Message

From: Vergeront, Julie [Vergeront.Julie@epa.gov]
Sent: 8/1/2018 7:56:06 PM
To: Kataoka, Mark [Kataoka.Mark@epa.gov]
CC: McAlpine, Jerrold [McAlpine.Jay@epa.gov]; Bray, Dave [Bray.Dave@epa.gov]; Hardesty, Doug [Hardesty.Doug@epa.gov]
Subject: RE: NSR/Title V Air Permitting Staff Conference Call
Attachments: 180720 PotlatchDeltic mNSR Permit Analysis App C - AQIA.docx

Oops! Forgot to attach. Here it is.

Julie A. Vergeront
Assistant Regional Counsel
EPA Region 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101
206-553-1497
vergeront.julie@epa.gov

Confidential communication for internal deliberations only; attorney-client privilege, attorney work product and/or enforcement privilege; do not distribute outside EPA or DOJ

From: Vergeront, Julie
Sent: Wednesday, August 01, 2018 12:53 PM
To: Kataoka, Mark <Kataoka.Mark@epa.gov>
Cc: McAlpine, Jerrold <McAlpine.Jay@epa.gov>; Bray, Dave <bray.dave@epa.gov>; Hardesty, Doug <Hardesty.Doug@epa.gov>
Subject: RE: NSR/Title V Air Permitting Staff Conference Call

Mark,

Thanks for speaking up on the call and following up.

Here is the draft of the AQIA for he Potlatch permit. Note that Jay, our modeler who was talking during the call, is currently revising the analysis to account for the company's recent agreement to limit VOC emissions to 50 tpy.

Let us know if you have concerns about on the SILs or the draft MERPS guidance—or anything else.

Thanks,

Julie A. Vergeront
Assistant Regional Counsel
EPA Region 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101
206-553-1497
vergeront.julie@epa.gov

Confidential communication for internal deliberations only; attorney-client privilege, attorney work product and/or enforcement privilege; do not distribute outside EPA or DOJ

From: Kataoka, Mark
Sent: Wednesday, August 01, 2018 12:10 PM
To: Hardesty, Doug <Hardesty.Doug@epa.gov>
Cc: Vergeront, Julie <Vergeront.Julie@epa.gov>
Subject: FW: NSR/Title V Air Permitting Staff Conference Call

Doug (ccing Julie V since I heard her on the call),

Sorry – I'm not sure if you were the person speaking but could you or a Regional attorney explain a little bit more about

Ex. 5 AC/DP

Mark M. Kataoka
Attorney
EPA OGC ARLO (2344A)
202-564-5584

From: Adams, Yolanda
Sent: July 31, 2018 3:16 PM
To: Ackerman, Charmagne <Ackerman.Charmagne@epa.gov>; Adams, Yolanda <Adams.Yolanda@epa.gov>; Akers, Brad <Akers.Brad@epa.gov>; Angelbeck, Richard <angelbeck.richard@epa.gov>; Aquitania, Manny <Aquitania.Manny@epa.gov>; Argentieri, Sabrina <argentieri.sabrina@epa.gov>; Baker, Sarah <baker.sarah@epa.gov>; Barrett, Richard <barrett.richard@epa.gov>; Barton, Kasey <Barton.Kasey@epa.gov>; BECKHAM, LISA <BECKHAM.LISA@EPA.GOV>; Bellizzi, Carol <Bellizzi.Carol@epa.gov>; Benjamin, Lynorae <benjamin.lynorae@epa.gov>; Bertram, Emily <Bertram.Emily@epa.gov>; Bertram, Gary <Bertram.Gary@epa.gov>; Bird, Patrick <Bird.Patrick@epa.gov>; Blathras, Constantine <blathras.constantine@epa.gov>; Boehmcke, Daniel <Boehmcke.Daniel@epa.gov>; Bradley, Twunjala <Bradley.Twunjala@epa.gov>; Braganza, Bonnie <Braganza.Bonnie@epa.gov>; Branning, Amy <Branning.Amy@epa.gov>; Bray, Dave <Bray.Dave@epa.gov>; Bridgers, George <Bridgers.George@epa.gov>; Buckler, Charles <Buckler.Charles@epa.gov>; Buenning, Hans <Buenning.Hans@epa.gov>; Burger, Riley <burger.riley@epa.gov>; Burns, Ward <Burns.Ward@epa.gov>; Campbell, Dave <campbell.dave@epa.gov>; Carrillo, Andrea <Carrillo.Andrea@epa.gov>; Castro, Grecia <Castro.Grecia@epa.gov>; Ceron, Heather <Ceron.Heather@epa.gov>; Chapman, Apple <Chapman.Apple@epa.gov>; Chatfield, Ethan <chatfield.ethan@epa.gov>; Cheever, Robert <cheever.robert@epa.gov>; Chen, Alexander <Chen.Alex@epa.gov>; Chen, Eugene <Chen.Eugene@epa.gov>; Christenson, Kara <Christenson.Kara@epa.gov>; Clark, Adam <Clark.Adam@epa.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>; Conrad, Daniel <conrad.daniel@epa.gov>; Cox, Kyndall <Cox.Kyndall@epa.gov>; Crum, Lynda <Crum.Lynda@epa.gov>; Culligan, Kevin <Culligan.Kevin@epa.gov>; Cunningham, Roylene <Cunningham.Roylene@epa.gov>; Dahl, Donald <dahl.donald@epa.gov>; Dain, Gregory <Dain.Greg@epa.gov>; Damico, Genevieve <damico.genevieve@epa.gov>; Danesh, Paymon <Danesh.Paymon@epa.gov>; Darrow, Jennifer <darrow.jennifer@epa.gov>; Daugavietis, Andre <daugavietis.andre@epa.gov>; Deroeck, Dan <Deroeck.Dan@epa.gov>; Dholakia, Umesh <Dholakia.Umesh@epa.gov>; Diaz, Stephanie <diaz.stephanie@epa.gov>; Diaz-Galarza, Gloria <diaz-galarza.gloria@epa.gov>; Doster, Brian <Doster.Brian@epa.gov>; Dressler, Jason <Dressler.Jason@epa.gov>; Dugan, Brett <Dugan.Brett@epa.gov>; duke, gerallyn <duke.gerallyn@epa.gov>; Duraski, Robert <Duraski.Robert@epa.gov>; Dykes, Teresa <Dykes.Teresa@epa.gov>; Fallon, Gail <fallon.gail@epa.gov>; Febres, Andres <febres-martinez.andres@epa.gov>; Foley, Patrick <Foley.Patrick@epa.gov>; Fortin, Kelly <Fortin.Kelly@epa.gov>; Froikin, Sara <Froikin.Sara@epa.gov>; Garwood, Ben <Garwood.Ben@epa.gov>; Gilbert, Alexas <Gilbert.Alexas@epa.gov>; Glass, Geoffrey <GLASS.GEOFFREY@EPA.GOV>; Gmyr, Joanna <Gmyr.Joanna@epa.gov>; Gordon, Michael <Gordon.Mike@epa.gov>; Gotto, Lisa <Gotto.Lisa@epa.gov>; Greaves, Natasha <Greaves.Natasha@epa.gov>; Gross, Louise C <gross.louise@epa.gov>; Hall, Kristin <Hall.Kristin@epa.gov>; Hardesty, Doug <Hardesty.Doug@epa.gov>; Harvey, Lornette <Harvey.Lornette@epa.gov>; Hazziez, Natasha <Hazziez.Natasha@epa.gov>; Hedgpeth, Zach <Hedgpeth.Zach@epa.gov>; HertzWu, Sara <HertzWu.Sara@epa.gov>; Hofmeister, Art <Hofmeister.Art@epa.gov>;

Hogan, Stephanie <Hogan.Stephanie@epa.gov>; Holtrop, Bryan <Holtrop.Bryan@epa.gov>; Hong, Jeanhee <Hong.Jeanhee@epa.gov>; Huey, Joel <Huey.Joel@epa.gov>; Hughes-Fairley, Rosalyn <Hughes-Fairley.Rosalyn@epa.gov>; Igoe, Sheila <Igoe.Sheila@epa.gov>; Ihlenburg, Erick <Ihlenburg.Erick@epa.gov>; Johansen, Amy <Johansen.Amy@epa.gov>; Johnson, Keith <johnson.keith@epa.gov>; Johnson, Terry <Johnson.Terry@epa.gov>; Jon, Frank <Jon.Frank@epa.gov>; Kanniganti, Radhica <kanniganti.radhica@epa.gov>; Kataoka, Mark <Kataoka.Mark@epa.gov>; Keenan, John <keenan.john@epa.gov>; Keller, Peter <keller.peter@epa.gov>; Kelly, Shaheerah <Kelly.Shaheerah@epa.gov>; Kenknight, Jeff <Kenknight.Jeff@epa.gov>; Kloeckner, Jane <Kloeckner.Jane@epa.gov>; Knodel, Jon <Knodel.Jon@epa.gov>; Kornylak, Vera S. <Kornylak.Vera@epa.gov>; Kraj, Susan <kraj.susan@epa.gov>; Krallman, John <krallman.john@epa.gov>; Krivo, Stan <Krivo.Stanley@epa.gov>; Lakeman, Sean <Lakeman.Sean@epa.gov>; Land, Eva <Land.Eva@epa.gov>; Langman, Michael <langman.michael@epa.gov>; Laumann, Sara <Laumann.Sara@epa.gov>; Law, Donald <Law.Donald@epa.gov>; LeDoux, Erica <LeDoux.Erica@epa.gov>; Lee, Anita <Lee.Anita@epa.gov>; Lee, Michael <lee.michaelg@epa.gov>; Leone, Kevin <Leone.Kevin@epa.gov>; Lieben, Ivan <Lieben.Ivan@epa.gov>; Lloyd, David <Lloyd.David@epa.gov>; Logan, Paul <Logan.Paul@epa.gov>; Lorang, Phil <Lorang.Phil@epa.gov>; Lueders, Jesse <Lueders.Jesse@epa.gov>; Lusky, Katy <Lusky.Kathleen@epa.gov>; MacKenzie, Lionel <MacKenzie.Lionel@epa.gov>; Magee, Melanie <Magee.Melanie@epa.gov>; Maier, Brent <Maier.Brent@epa.gov>; Mangino, Joseph <Mangino.Joseph@epa.gov>; Marcus, Danny <marcus.danny@epa.gov>; Mastro, Donna <Mastro.Donna@epa.gov>; Mataway-Novak, Dylan <Mataway-Novak.Dylan@epa.gov>; Matthews, Julie <Matthews.Juliane@epa.gov>; McAlpine, Jerrold <McAlpine.Jay@epa.gov>; McAuliffe, Mary <mcauliffe.mary@epa.gov>; McCahill, Brendan <Mccahill.Brendan@epa.gov>; McCullough, Hugh <McCullough.Hugh@epa.gov>; McFadden, Kelly <McFadden.Kelly@epa.gov>; McHale, Mary <McHale.Mary@epa.gov>; Meeks, Jeremy <meeks.jeremy@epa.gov>; Meyer, Dan <Meyer.Dan@epa.gov>; Meyer, Jonathan <Meyer.Jonathan@epa.gov>; Mohr, Ashley <Mohr.Ashley@epa.gov>; Montanez, Jessica <Montanez.Jessica@epa.gov>; Moskal, John <Moskal.John@epa.gov>; Murray, Julie <Murray.Julie@epa.gov>; Narvaez, Madonna <Narvaez.Madonna@epa.gov>; Nguyen, Thien Khoi <nguyen.thien@epa.gov>; Nizich, Greg <Nizich.Greg@epa.gov>; North, Alexis <North.Alexis@epa.gov>; Odendahl, Steve <Odendahl.Steve@epa.gov>; Ogulei, David <Ogulei.David@epa.gov>; Okubo, Noreen <Okubo.Noreen@epa.gov>; Olszewski, Joshua <olszewski.joshua@epa.gov>; Opila, MaryCate <Opila.MaryCate@epa.gov>; Oquendo, Ana <Oquendo.Ana@epa.gov>; Ortega, Kellie <Ortega.Kellie@epa.gov>; Palmer, Karen <Palmer.Karen@epa.gov>; Parrish, Robert <Parrish.Robert@epa.gov>; Peachey, Robert <peachey.robert@epa.gov>; Pepple, Karl <Pepple.Karl@epa.gov>; Perez, Idalia <Perez.Idalia@epa.gov>; Peter, David <peter.david@epa.gov>; Petriman, Viorica <Petriman.Viorica@epa.gov>; Portanova, Sam <portanova.sam@epa.gov>; Porter, Andrew <Porter.Andrew@epa.gov>; Purvis, James <Purvis.James@epa.gov>; Queiroz, Gustavo <queiroz.gustavo@epa.gov>; Rao, Raj <Rao.Raj@epa.gov>; Rineheart, Rachel <Rineheart.Rachel@epa.gov>; Rios, Gerardo <Rios.Gerardo@epa.gov>; Robinson, Jeffrey <Robinson.Jeffrey@epa.gov>; Root, Kathleen <Root.Kathleen@epa.gov>; Rouch, Ellen <Rouch.Ellen@epa.gov>; Ruddick, Randall <ruddick.randall@epa.gov>; Ruvo, Richard <Ruvo.Richard@epa.gov>; Sareen, Neha <sareen.neha@epa.gov>; Schoellkopf, Lynde <Schoellkopf.Lynde@epa.gov>; Schulingkamp, Joseph <Schulingkamp.Joseph@epa.gov>; Schwartz, Colin <Schwartz.Colin@epa.gov>; Scott, Patricia A. <Scott.PatriciaA@epa.gov>; Seidman, Emily <seidman.emily@epa.gov>; Senghani, Dinesh <senghani.dinesh@epa.gov>; Shepherd, Lorinda <Shepherd.Lorinda@epa.gov>; Siegel, Joseph <Siegel.Joseph@epa.gov>; Siffring, Stuart <Siffring.Stuart@epa.gov>; Sims, Mark <Sims.Mark@epa.gov>; Skelley, Dana <Skelley.Dana@epa.gov>; Skinner-Thompson, Jonathan <Skinner-Thompson.Jonathan@epa.gov>; Smith, Claudia <Smith.Claudia@epa.gov>; Smith, Mark A. <Smith.Marka@epa.gov>; Smith, Noah <SMITH.NOAH@EPA.GOV>; Snyder, Erik <snyder.erik@epa.gov>; Solomon, David <Solomon.David@epa.gov>; Spangler, Matthew <Spangler.Matthew@epa.gov>; Spiegelman, Nina <Spiegelman.Nina@epa.gov>; Stewart, Kathleen <Stewart.Kathleen@epa.gov>; Stone, William <stone.william@epa.gov>; Sutin, Elyana <Sutin.Elyana@epa.gov>; Suzuki, Debra <Suzuki.Debra@epa.gov>; Svendsgaard, Dave <Svendsgaard.Dave@epa.gov>; Table, Melba <Table.Melba@epa.gov>; Talley, David <Talley.David@epa.gov>; Tennenbaum, Susan <Tennenbaum.Susan@epa.gov>; Terriquez, Joe <terriquez.joe@epa.gov>; Terry, Randy <Terry.Randy@epa.gov>; Terry, Sara <Terry.Sara@epa.gov>; Todd, Robert <Todd.Robert@epa.gov>; Toups, Brad <Toups.Brad@epa.gov>; Triplett, Eric <Triplett.Eric@epa.gov>; TSAI, YA-TING <Tsai.Ya-Ting@epa.gov>; Valenziano, Beth <valenziano.beth@epa.gov>; Vergeront, Julie <Vergeront.Julie@epa.gov>; Versace, Paul <Versace.Paul@epa.gov>; Vetter, Cheryl <Vetter.Cheryl@epa.gov>; Villatora, Liliana <Villatora.Liliana@epa.gov>; Vyas, Himanshu <vyas.himanshu@epa.gov>; Wagner, William <wagner.william@epa.gov>; Walters, Julie <Walters.Julie@epa.gov>; WARD, LA WEEDA <WARD.LAWEEDA@EPA.GOV>; Watson, Lucinda <Watson.Lucinda@epa.gov>; Wauters, Patrick

<wauters.patrick@epa.gov>; Webber, Robert <Webber.Robert@epa.gov>; Weiler, Eaton <weiler.eaton@epa.gov>; Wheeler, Carrie <Wheeler.Carrie@epa.gov>; Wiley, Adina <Wiley.Adina@epa.gov>; Williams, Melina <Williams.Melina@epa.gov>; Williamson, Timothy <Williamson.Tim@epa.gov>; Wilson, Aimee <Wilson.Aimee@epa.gov>; Wilson, Holly <Wilson.Holly@epa.gov>; Wood, Anna <Wood.Anna@epa.gov>; Wortman, Eric <Wortman.Eric@epa.gov>; Yannayon, Laura <Yannayon.Laura@epa.gov>; Zenick, Elliott <Zenick.Elliott@epa.gov>; Zuniga, Mario <zuniga.mario@epa.gov>
Subject: NSR/Title V Air Permitting Staff Conference Call

Agenda for Monthly Air Permitting Staff Call
August 1, 2018
2:00 – 4:00 pm Eastern Time
Call-in Number: Ex. 6 Personal Privacy (PP) || Code: Ex. 6 Personal Privacy (PP)

Today's agenda:

2:00 pm Roll call and New Staff Introductions – Yolanda Adams (R4)

2:05 pm Regional Issues || PotlatchDeltic PSD Project || Doug Hardesty (R10) (attachment)

2:35 pm NSR Updates – OAQPS
- Source Aggregation (Greg Nizich)
- Project Aggregation (Dave Svendsgaard)
- CPP Replacement Rule (Dave Svendsgaard)
- PEA Rulemaking (Jessica Montanez)
- Ambient Air (Chuck Buckler)
- SILs Guidance (Chuck Buckler)

3:10 pm R9 Identified Issue || Definition of "Begin Actual Construction" in Minor NSR Programs || Shaheerah Kelly (R9) (attachments)

3:25 pm Recent Petition Responses
- Motiva Port Arthur Refinery – Dylan Mataway-Novak (OAQPS) / Kyndall Cox (R6)

3:40 pm Around the Regions, Call Wrap-up and Action Items – Yolanda Adams (R4)

Heads Up...
Region 1 will take the lead for Regional Issues on our September 5th call
Reminder: Please review your recent correspondence and e-mail for any significant or other precedent-setting documents to Jon Knodel or Ward Burns in Region 7 for inclusion in the NSR Policy and Guidance Database.
To join the Permit List Serve: Send a blank email, from the email address you want added to the list serve, to subscribe-permit@lists.epa.gov
Title V Petition Database: https://www.epa.gov/title-v-operating-permits/title-v-petition-database
NSR and Title V Air Permitting Sharepoint Site:
https://usepa.sharepoint.com/sites/OAR_Custom/NSRandTitleVAirPermitting/SitePages/Home.aspx

Yolanda Adams | Environmental Engineer | U.S. Environmental Protection Agency
Region 4 | Air, Pesticides & Toxics Management Division | Air Permits Section

61 Forsyth St. SW | Atlanta, GA 30303
404.562.9214 | adams.yolanda@epa.gov

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

APR 17 2018

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program

FROM: Peter Tsirigotis
Director

TO: Regional Air Division Directors, Regions 1-10

The purpose of the attached document is to provide guidance on compliance demonstration tools for use with ozone and fine particles ($PM_{2.5}$) in the Prevention of Significant Deterioration (PSD) permitting program. The Environmental Protection Agency (EPA) has developed a new analytical approach and has used it to identify a significant impact level (SIL) for each ozone and $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS) and for the $PM_{2.5}$ PSD increments. Permitting authorities may use these values to help determine whether a proposed PSD source causes or contributes to a violation of the corresponding NAAQS or PSD increments. Separately, we have developed a technical document that provides a detailed discussion of the technical analysis used in the development of these values and a legal memorandum that provides further detail on the legal basis that permitting authorities may choose to adopt to support using SILs to show that requirements for obtaining a PSD permit are satisfied.[1] This guidance provides a summary of the results of the technical analysis and information on the particular points in the PSD air quality analysis at which permitting authorities may decide to use these values on a case-by-case basis in the review of PSD permit applications. This guidance, and the technical and legal documents, are not final agency actions and do not create any binding requirements on permitting authorities, permit applicants or the public.

Please share this guidance with permitting authorities in your Region. If you have questions regarding the guidance, please contact Raj Rao at *rao.raj@epa.gov* or (919) 541-5344. For questions regarding the technical document, please contact Tyler Fox at *fox.tyler@epa.gov* or (919) 541-5562. For questions regarding the legal document, please contact Brian Doster at *doster.brian@epa.gov* or (202) 564-1932.

Attachment

[1] "Technical Basis for the EPA's Development of Significant Impact Thresholds for $PM_{2.5}$ and Ozone," EPA-454/R-18-001, April 2018; "Legal Memorandum: Application of Significant Impact Levels in the Air Quality Demonstration for Prevention of Significant Deterioration Permitting under the Clean Air Act," April 2018.

Attachment

Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program

I. INTRODUCTION

When a Prevention of Significant Deterioration (PSD) permit applicant has shown through air quality modeling that the projected air quality impact from a proposed source for a particular pollutant is not significant or meaningful, the EPA believes there is a valid analytical and legal basis in most cases for the permitting authority to conclude that the proposed source will not cause or contribute to a violation of a National Ambient Air Quality Standard (NAAQS) or PSD increment for that pollutant. To show that the proposed source will not have a significant or meaningful impact on air quality, permit applicants and permitting authorities may elect to use these Significant Impact Level (SIL) values (air quality concentration values) as a compliance demonstration tool. In this guidance and accompanying documents, the EPA has provided policy, technical and legal analyses that permitting authorities may choose to adopt in supporting the use of the SILs to make the required demonstration in particular PSD permitting actions. The use of SILs can help satisfy PSD requirements while expediting the permitting process and conserving resources for permit applicants and permitting authorities.

The EPA has previously issued guidance describing particular uses of SILs.[1,2,3,4] The EPA has also recognized that permitting authorities have the discretion to apply SILs on a case-by-case basis in the review of individual permit applications, provided such use is justified in the permitting record.[5] In an effort to reduce the need for case-by-case justification by permitting authorities, the EPA finalized a rule in 2010 to codify, among other things, particular $PM_{2.5}$ SIL values and specific

---

[1] Memorandum from Stephen D. Page, EPA OAQPS, to EPA Regional Air Division Directors, "Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program," August 23, 2010.

[2] Memorandum from Stephen D. Page, EPA OAQPS, to EPA Regional Air Division Directors, "Guidance Concerning the Implementation of the 1-hour NO_2 NAAQS for the Prevention of Significant Deterioration Program," June 29, 2010.

[3] Memorandum from Stephen D. Page, EPA OAQPS, to OAQPS Personnel and EPA Regional Modelers, "Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS," March 23, 2010.

[4] Memorandum from Gerald A. Emison, EPA OAQPS, to Thomas J. Maslany, EPA Air Management Division, EPA Region 3, "Air Quality Analysis for Prevention of Significant Deterioration (PSD)," July 5, 1988.

[5] Order Responding to Petitioner's Request that the Administrator Object to Issuance of a State Operating Permit, *In the Matter of CF&I Steel, L.P. dba EVRAZ Rocky Mountain Steel*, Petition Number VIII-2011-01, at 15-17 (May 31, 2012) (*"Rocky Mountain Steel Order"); In re: Mississippi Lime Company*, 15 E.A.D. 349, 375-379 (Environmental Appeals Board (EAB) 2011).

ED_013256A_00000443-00002

applications of those values ("2010 rulemaking").[6] However, in the course of subsequent litigation over this rule, the EPA conceded the regulation was flawed because it did not preserve the discretion of permitting authorities to require additional analysis in certain circumstances, and the court granted the EPA's request to vacate and remand the rule so that the EPA could address the flaw.[7]

Following the litigation, the EPA began developing a new rule to address the flaw identified in the 2010 rulemaking.[8] However, after further evaluation and the identification of a revised set of SIL values based on the technical and legal analyses described below, the EPA believes it should first obtain experience with the application of these values in the permitting program before establishing a generally applicable rule.[9] Thus, the EPA intends at this point to take a two-step approach.

First, the EPA is providing non-binding guidance so that we may gain valuable experience and information as permitting authorities use their discretion to apply and justify the application of the SIL values identified below on a case-by-case basis in the context of individual permitting decisions. We will be seeking to learn generally about permitting agencies' experiences in applying SILs in particular PSD permitting decisions. We will also be seeking more specific information, including how often and in what types of settings the application of a SIL at the single-source assessment and cumulative assessment stages of the PSD air quality analysis has made a critical difference in whether a conclusion was reached that the proposed source will not cause or contribute to a NAAQS or PSD increment violation. The EPA intends to obtain this information through its own PSD permitting activities in states that do not have SIP-approved PSD programs, regular discussions between our Regional offices and air agencies, regular conference calls with the permitting committees of national organizations of air agencies, and technical conferences of air quality modelers and others interested in permitting activities.

Second, the EPA will use this experience and information to assess, refine and, as appropriate, codify SIL values and specific applications of those values in a future, potentially binding rulemaking. During this second step, to assess whether it is appropriate to codify particular SIL

---

[6] 75 FR 64864 (October 20, 2010).

[7] *Sierra Club v. EPA*, 705 F.3d 458, 463-66 (D.C. Cir. 2013). In its litigation brief at n. 10, the EPA stated an intent to issue guidance in the near future concerning $PM_{2.5}$ values remaining in 40 CFR 51.165(b)(2). The EPA issued such guidance in May 2014. Memorandum from Stephen D. Page, EPA OAQPS, to EPA Regional Air Division Directors, "Guidance for $PM_{2.5}$ Permit Modeling," May 20, 2014.

[8] Fall 2015 Regulatory Agenda, USEPA, 80 FR 78024, December 15, 2015. Ozone and Fine Particulate Matter ($PM_{2.5}$) Significant Impact Levels (SILs) for Prevention of Significant Deterioration (PSD), RIN: 2060-AR28. *http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201510&RIN=2060-AR28.*

[9] *See SEC v. Chenery Corp.*, 332 U.S. 194, 199-203 (1947) (recognizing that some principles may warrant further development before they are ready to be codified in a rule of general applicability).

ED_013256A_00000443-00003

values for ozone and $PM_{2.5}$, the EPA will consider whether permitting experience has confirmed that the recommended SIL values are suitable in all circumstances to show that an increase in air quality concentration below the value does not cause or contribute to a violation of the NAAQS or PSD increments.

Permitting authorities retain discretion to use or not to use these EPA-derived SILs in particular PSD permitting actions. If a permitting authority chooses to use these SIL values to support a case-by-case permitting decision, it must justify the values and their use in the administrative record for the permitting action.[10] Permitting authorities also have discretion to develop their own SIL values, provided that such values are properly supported in the record for permitting actions or decisions in which the values are used to make the required showing. Detailed technical guidance on the development of alternative SIL values is beyond the scope of this document; however, we provide a limited discussion later in this document (*see*, e.g., page 12). This guidance (including the legal and technical documents) supporting the EPA's recommended SIL values may be viewed as a model for permitting authorities that seek to develop alternative SIL values. Permitting authorities may elect to utilize alternative "confidence intervals" as well as regional or local factors in developing their own SIL values.[11]

Since the 2010 rulemaking, the EPA has examined the legal basis for using SIL values in PSD air quality impact analyses. In addition, the EPA has sought to develop a stronger analytical foundation for the EPA recommended SIL values. This guidance and supporting documents are the products of this effort. They identify specific SIL values for ozone and $PM_{2.5}$ and provide a supporting justification that permitting authorities may choose to apply on a case-by-case basis. The values and supporting justification are designed so that permitting authorities can choose to apply the SIL values to demonstrate that a proposed source does not cause or contribute to a violation of NAAQS or PSD increments. In contrast to the 2010 rulemaking, we have developed separate SIL values for the $PM_{2.5}$ NAAQS and PSD increments, and we have developed SILs for the ozone NAAQS. Since there are no PSD increments for ozone, the EPA has not developed SILs for ozone.

The EPA believes that the application of these SILs in the manner described below would be sufficient in most situations for a permitting authority to conclude that a proposed source will not cause or contribute to a violation of an ozone or $PM_{2.5}$ NAAQS or $PM_{2.5}$ PSD increments. However, this guidance is not a final agency action and does not reflect a final determination by the EPA that any particular proposed source with a projected impact below the recommended SIL value does not cause or contribute to a violation. A determination that a proposed source does not cause or contribute to a violation can only be made by a permitting authority on a permit-specific basis after consideration of the permit record. This guidance is not legally binding and does not affect the rights or obligations of permit applicants, permitting authorities, or others. The SIL

[10] *Rocky Mountain Steel Order* at 16-18, supra footnote 5. Such a justification may incorporate the information compiled by the EPA to support the SILs recommended in this memorandum.

[11] A description of the "confidence interval" is provided at page 12 of this document and in the technical document at section 2.2 (Statistical Methods and Assessing Significance Using Confidence Intervals).

ED_013256A_00000443-00004

values identified by the EPA have no practical effect unless and until permitting authorities decide to use those values in particular permitting actions. The experience of permitting authorities using these SILs on a case-by-case basis, or in choosing to limit or forego their use in specific situations, will be valuable information for the EPA to consider in a future rulemaking. Permitting authorities retain the discretion to apply and justify different approaches and to require additional information from the permit applicant to make the required air quality impact demonstration, consistent with the relevant PSD permitting requirements.

II. BACKGROUND

A PSD permit applicant must demonstrate that "emissions from construction or operation of such facility will not cause, or contribute to, air pollution in excess of any" NAAQS or PSD increment.[12] The EPA has reflected this requirement in its PSD regulations.[13] The Clean Air Act (Act) does not specify how a permit applicant or permitting authority is to make this demonstration, but section 165(e) authorizes the EPA to determine how the analysis is to be conducted, including the use of air quality models. In accordance with this authority, the EPA has promulgated regulations that identify such models and the conditions under which they may be used in the PSD program to make the demonstration required under the Act.[14]

Using the models identified in the EPA's regulations, there are two basic ways that a PSD permit applicant can demonstrate that the proposed source's emissions will not cause or contribute to a violation of a NAAQS or PSD increment. One way is to demonstrate that no such violation is occurring or projected to occur in the area affected by the emissions from the proposed source.[15] A second way is to demonstrate that the emissions from the proposed source do not cause or contribute to any identified violation of the NAAQS or PSD increments.[16]

The Act does not define "cause" or "contribute." Reading these terms in context, the EPA has historically interpreted this provision in section 165(a)(3) of the Act and associated regulations to mean that a source must have a "significant impact" on ambient air quality in order to cause or contribute to a violation.[17] Thus, the EPA and other permitting authorities have concluded that a

---

[12] 42 U.S.C. 7475(a)(3) (section 165(a)(3) of the Act). The EPA interprets the phrase "in excess of" to mean a violation, not the exceedance described in 40 CFR 50.1(l).

[13] 40 CFR 51.166(k); 40 CFR 52.21(k).

[14] The PSD regulations at 40 CFR 51.166(l) and 52.21(l) require the use of "applicable models, data bases, and other requirements" specified in 40 CFR part 51, Appendix W, also known as the *Guideline on Air Quality Models (Guideline)*.

[15] 1990 Draft New Source Review (NSR) Workshop Manual at C.51.

[16] 40 CFR part 51, App. W, § 9.2.3; 1990 Draft NSR Workshop Manual at C.52.

[17] *In re: Prairie State Generating Co.*, 13 E.A.D. 1, 105 (EAB 2006). This EAB opinion includes a long discussion of the EPA's prior guidance with other examples.

ED_013256A_00000443-00005

proposed source may meet the requirements in section 165(a)(3) and the EPA's PSD regulations by showing that its projected impact on air quality at the site of a modeled violation is below a level of air quality impact considered to be significant.[18]

Historic Use of SILs

In the context of section 165(a)(3), the EPA has historically used pollutant-specific concentration levels known as "significant impact levels" to identify the degree of air quality impact that "causes, or contributes to" a violation of a NAAQS or PSD increment.[19] Consistent with the EPA guidance, proposed sources have met the requirement to demonstrate that they do not cause or contribute to a violation by showing that the ambient air quality impacts resulting from the proposed source's emissions would be below these concentration levels.[20] The SIL values have served as a compliance demonstration tool to make the required demonstration in the PSD program. They have helped to reduce the burden on permitting authorities and permit applicants to conduct often time-consuming and resource-intensive air dispersion modeling where such modeling was unnecessary to demonstrate that a permit applicant meets the requirements of section 165(a)(3), consistent with the procedures set forth originally in 1977 in the "Guidelines for Air Quality Maintenance Planning and Analysis, Volume 10 (Revised) and Procedures for Evaluating Air Quality Impact of New Stationary Sources."[21]

Recent Status of SILs for Ozone and $PM_{2.5}$

Since the inception of the PSD program, the EPA has faced technical challenges with providing compliance demonstration tools for those pollutants that are not directly emitted by sources (ozone and secondarily-formed $PM_{2.5}$) and which form through chemical reactions of precursor pollutants. In July 2010, the Sierra Club petitioned the EPA to initiate rulemaking regarding the establishment of air quality models for ozone and $PM_{2.5}$ for use by PSD permit applicants. In January 2012, the EPA granted the petition and committed to engage in rulemaking to evaluate whether updates to the *Guideline* are warranted and, as appropriate, incorporate new analytical techniques or models for ozone and secondarily-formed $PM_{2.5}$. In granting the petition, the EPA explained that the "complex chemistry of ozone and secondary formation of $PM_{2.5}$ are well-documented and have historically presented significant challenges to the designation of particular models for assessing

[18] 1990 Draft NSR Workshop Manual at C.52.
[19] 61 FR 38250, 38293 (July 23, 1996); 72 FR 54112, 54139 (September 21, 2007).
[20] 1990 Draft NSR Workshop Manual at C.51-C.52.
[21] October 1977, U.S. EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711. The 1977 document did not discuss SILs, but did identify procedures for air quality analyses pursuant to the PSD program.

ED_013256A_00000443-00006

the impacts of individual stationary sources on the formation of these air pollutants"[22] Because of these considerations, the EPA's past judgment had been that it was not technically sound to designate with particularity specific models that must be used to assess the impacts of a single source on ozone and secondarily-formed $PM_{2.5}$ concentrations. Instead, the EPA established a consultation process with permitting authorities for determining (on a permit-specific basis) the analytical techniques that should be used for single-source analyses for both ozone and secondarily-formed $PM_{2.5}$.

The EPA has responded to the Sierra Club petition by finalizing revisions to the EPA's *Guideline*.[23] As discussed in the preamble to the *Guideline*, recent technical advances have made it reasonable for the EPA to provide more specific guidelines that identify appropriate analytical techniques or models that may be used in compliance demonstrations for the ozone and $PM_{2.5}$ NAAQS and $PM_{2.5}$ PSD increments. The revisions to the *Guideline* include criteria and process steps for choosing single-source analytical techniques or models to estimate ozone impacts from precursor nitrogen oxide (NOx) and volatile organic compound (VOC) emissions and to assess concentrations of direct and secondarily-formed $PM_{2.5}$. The ozone and $PM_{2.5}$ SIL values recommended in this guidance are intended to complement the *Guideline* updates by providing thresholds that may be used to determine whether an increase in air pollutant concentration (impact) predicted by the chosen technique or model causes or contributes to a violation.

In the 2010 rulemaking, the EPA established SIL values for $PM_{2.5}$ in paragraph (k)(2) of the PSD regulations at 40 CFR 51.166 and 52.21. In January 2013, the U.S. Court of Appeals for the District of Columbia Circuit granted the EPA's request to vacate and remand the paragraph (k)(2) provision in both PSD regulations so the EPA could correct them.[24] Paragraph (k)(2) as promulgated in 2010 included numerical values of $PM_{2.5}$ SILs and statements about their role in completing an air quality impact analysis with regard to the $PM_{2.5}$ NAAQS and PSD increments. Specifically, the 52.21(k)(2) rule text stated that if the impact of a proposed source seeking a federal PSD permit was below the relevant SIL value(s), then the proposed source would be deemed to not cause or contribute to a violation. The 51.166(k)(2) rule text stated that a state's PSD rules could contain a similar provision. The EPA asked the court to vacate and remand the (k)(2) paragraphs of both PSD regulations so that the EPA could correct an inconsistency between (1) that rule text, which left no discretion for the permitting authority, and (2) our statements in the preamble to the 2010 rulemaking, which identified certain circumstances where it may not be

[22] Letter from Gina McCarthy, Assistant Administrator, EPA Office of Air and Radiation, to Robert Ukeiley, Sierra Club, January 4, 2012.
[23] 82 FR 5182 (January 17, 2017).
[24] *Sierra Club v. EPA*, 705 F.3d 458, 466 (D.C. Cir. 2013).

ED_013256A_00000443-00007

appropriate for a permitting authority to rely solely on the $PM_{2.5}$ SILs as a basis for concluding that a proposed source does not cause or contribute to a violation.[25]

The court left intact the $PM_{2.5}$ NAAQS significance levels separately promulgated at 40 CFR 51.165(b)(2), because the regulatory text in that section did not say that a proposed source that has an impact less than the significance level is always deemed to not cause or contribute to a violation. The regulatory text at 40 CFR 51.165(b)(2) says that a major source or major modification with a projected impact greater than the listed significance level at any location that does not or would not meet the applicable NAAQS will be considered to cause or contribute to a violation, but this provision does not compel the opposite conclusion for projected impacts equal to or below that level.[26]

III. RECOMMENDED SIL VALUES FOR USE IN AIR QUALITY IMPACT DEMONSTRATION REQUIRED TO OBTAIN A PSD PERMIT

As discussed above, the EPA has interpreted the phrase "cause, or contribute to" in section 165(a)(3) of the Act to mean that a proposed source will have a "significant impact" on air pollutant concentrations that violate the standards. In this context, the EPA believes permitting authorities may read the phrase "cause, or contribute to" in section 165(a)(3) to be inapplicable to an air quality impact that is insignificant. This interpretation is more fully explained in the legal memorandum. In the context of this section of the Act, the EPA believes an insignificant impact is an impact on air quality concentrations that is small and not meaningful (e.g., the EPA has often described such an impact as "trivial" or "*de minimis*").

As discussed in more detail in the legal memorandum, a permitting authority may conclude that a PSD permit applicant will "cause" a modeled violation of a NAAQS when the increased emissions from construction or modification of the proposed source are the reason for, responsible for, or the "but for" cause of the violation. However, a permitting authority must also consider whether emissions "contribute" to a violation in circumstances where a violation of the NAAQS is present before considering the proposed increase in emissions from a PSD construction project, or when

[25] These preamble statements were the following: "[N]otwithstanding the existence of a SIL, permitting authorities should determine when it may be appropriate to conclude that even a *de minimis* impact will 'cause or contribute to' an air quality problem and to seek remedial action from the proposed new source or modification." *See* 75 FR 64864, 64892. "[T]he use of a SIL may not be appropriate when a substantial portion of any NAAQS or increment is known to be consumed." *See* 75 FR 64864, 64894. "[W]e earlier provided an example of when it might be appropriate to require a modified source to mitigate its contribution to a violation of a NAAQS or increment even when the predicted ambient impact of the proposed emissions increase would result in what is normally considered to be *de minimis*." *See* 75 FR 64864, 64894.

[26] 40 CFR 51.165(b)(2) is phrased such that an impact equal to the listed value is treated the same as impacts below the listed value. This contrasts to the approach in former 40 CFR 51.166(k)(2) and 52.21(k)(2), and, in this guidance, that an impact equal to the SIL is treated the same as impacts above the SIL.

ED_013256A_00000443-00008

emissions from multiple sources may impact a particular area. In the absence of specific language in section 165(a)(3) regarding the degree of contribution that is required (such as the term "significantly"), a permitting authority has the discretion under this provision to exercise its judgment to determine the degree of impact that contributes to adverse air quality conditions based on the particular context in which the term contribute is used. A permitting authority may also identify criteria or factors that may be used to determine whether something contributes, including qualitative or quantitative criteria that are appropriate to the particular context.[27]

For purposes of implementing section 165(a)(3) of the Act, the EPA has found it more expedient and practical to use a quantitative threshold (expressed as a level of change in air quality concentration) to determine whether increased emissions from proposed construction or modification of a source will cause or contribute to air quality concentrations in violation of applicable standards. One of the goals of the development of SILs as a compliance demonstration tool is to ensure an appropriate balance between maintenance of air quality and PSD permit process streamlining. The EPA believes that the permitting process can be streamlined without compromising air quality if the EPA and permitting authorities are able to identify a quantitative threshold or dividing line between an insignificant and a significant impact on air pollutant concentrations. Using a quantitative threshold for this purpose is permissible as long as the EPA or the appropriate permitting authority provides a reasoned explanation for why impacts below that value do not cause or contribute to a violation in a particular context.

Historical Approach for Developing SILs

To determine what is (and is not) a significant impact in the context of section 165(a)(3) of the Act, the EPA has previously supported using the levels in 40 CFR 51.165(b)(2).[28] The EPA has

[27] *See Catawba County, N.C. v. EPA*, 571 F.3d 20, 39 (D.C. Cir. 2009). In this case interpreting the term "contributes" in section 107(d) of the Act, the court held that the EPA is not required to establish a quantitative or objective, bright-line test to define a contribution by sources to adverse air quality conditions in a nearby area in the context of designations with respect to attainment of a NAAQS. The court recognized that the EPA has the discretion to use a totality-of-the-circumstances test if the Agency defines and explains the criteria that it is applying. While this opinion said that a quantified threshold is not required to define "contribution" in the context of section 107(d), the court's reasoning does not preclude PSD permitting authorities from choosing to use a quantitative level of impact to represent a contribution to a violation of the NAAQS or PSD increment when implementing section 165(a)(3) of the Act.

[28] The Emison Memo, *supra* footnote 5, references 40 CFR 51.165(b)(2) for the purpose of defining "significant" in this context. The NSR Workshop Manual at C.26-C.28 lists values from 40 CFR 51.165(b)(2) for the purpose of defining the area of "significant ambient impact."

ED_013256A_00000443-00009

described these levels as "significance levels."[29] 40 CFR 51.165(b)(2) was originally promulgated by the EPA in 1987 as part of an offset provision permitting authorities could apply after it was determined that construction at a stationary source was predicted to cause or contribute to a violation of the NAAQS.[30] This regulation provides that a proposed source planning to locate in an attainment area will be considered to "cause or contribute to" a violation of the NAAQS if its impact would exceed specific values identified in the regulation. For example, 40 CFR 51.165(b)(2) states that a proposed source impact that is greater than 5 micrograms per cubic meter ($\mu g/m^3$) for the 24-hour sulfur dioxide (SO_2) NAAQS causes or contributes to a violation of that NAAQS. The section refers to these values as "significance levels." Values are not provided for every NAAQS, particularly ozone (and not for $PM_{2.5}$ until the 2010 rulemaking), but for those NAAQS covered in this regulation, the application is the same. Over time, these air quality concentration significance levels in 40 CFR 51.165(b)(2) have become known as "significant *impact* levels"[31] [emphasis added] in order to distinguish them from the significant *emissions rates* reflected in the definition of the term "significant," which serve a different function in the PSD program.[32] The EPA has also issued guidance memoranda that have provided recommended SIL values for the 1-hour nitrogen dioxide (NO_2) and SO_2 NAAQS, to be used for the purpose of determining what are (and are not) significant impacts for these pollutants in the context of the 1-hour standards.[33]

As referenced above, the EPA's values contained in 40 CFR 51.165(b)(2) originally were related to the level of protection afforded by the PSD increments that Congress established for Class I areas.[34] The EPA generally relied on that approach in 2010 by using the ratio of the $PM_{2.5}$ NAAQS

---

[29] The EPA initially promulgated these same concentration values in 1978 and described them as the "minimum amount of ambient impact that is significant." 43 FR 26380, 26398 (June 19, 1978). In the 1979 Emissions Offset Interpretative Ruling (Appendix S to 40 CFR part 51), the EPA used these values as the "significance levels" under which a source locating in the "clean" portion of a nonattainment area may be exempt from the preconstruction review requirements. 44 FR 3274, 3283 (January 16, 1979). Under Appendix S, as revised in 1980, the EPA considered a source to "cause or contribute to" a violation if the impact of the source or modification would exceed these significance levels at any locality that does not meet the NAAQS. 45 FR 31307, 31311 (May 13, 1980).

[30] 52 FR 24672, 24713 (July 1, 1987).

[31] The first reference to "significant impact levels" is in the 1980 NSR Workshop Manual, which the EPA subsequently updated in the 1990 draft. It is worth noting that the 1977 comments to the proposed Appendix W rule (45 FR 58543) addressed whether a single-source screening technique should be used to determine if a cumulative modeling analysis would be required in a preconstruction review; industry and state agency comments indicated both groups favored some use of a tool to alleviate resource burden.

[32] 40 CFR 52.21(b)(23) defines the term "significant" and applies discrete values for determining if the emissions increase from a proposed source will be significant. This regulation states that an increase in emissions of each ozone precursor (VOC and NOx) is significant if it equals or exceeds 40 tons per year (tpy) and, for direct emissions of $PM_{2.5}$ the significance level is 10 tpy. For $PM_{2.5}$ precursor emissions, the significance level is 40 tpy for SO_2 and 40 tpy for NOx.

[33] Page memoranda, *supra* footnotes 1 and 2 of this attachment.

[34] 43 FR 26380, 26398.

ED_013256A_00000443-00010

to the particulate matter 10 micrometers or less in diameter (PM_{10}) NAAQS as a multiplier to add $PM_{2.5}$ values to 40 CFR 51.165(b)(2) and to establish $PM_{2.5}$ SIL values in 40 CFR 51.166(k)(2) and 52.21(k)(2).[35] However, given limitations in the rationale supporting them, the EPA recognized in the preamble to the 2010 rulemaking that a permitting authority may not be able to apply the SIL values derived through this approach in every situation to show that proposed construction does not cause or contribute to a violation of standards. The EPA acknowledged that "the use of a SIL may not be appropriate when a substantial portion of any NAAQS or increment is known to be consumed." The EPA also said that "notwithstanding the existence of a SIL, permitting authorities should determine when it may be appropriate to conclude that even a *de minimis* impact will 'cause or contribute to' an air quality problem and to seek remedial action from the proposed new source or modification."[36] To guard against the improper use of the 2010 SILs for $PM_{2.5}$ in such circumstances, the EPA later recommended that permitting authorities use those SILs only where they could establish that the difference between background concentrations in a particular area and the NAAQS was greater than those SIL values.[37] This approach was intended to guard against misuse of the SILs in situations where the existing air quality was already close to the NAAQS.

Analytical Foundation for Recommended SILs

Since the May 2014 $PM_{2.5}$ modeling guidance was issued, the EPA has conducted a statistical analysis that provides an improved analytical foundation for the EPA's selection, based on the policy considerations described below, of a degree of change in concentration that permitting authorities may use to represent an insignificant impact on air pollutant concentrations for ozone and $PM_{2.5}$ in the context of PSD permitting. This technical method, referred to as the air quality variability approach, is described in the technical document. Given the improvements reflected in this method, the EPA does not see a need for permitting authorities to show that the difference between background concentrations and the relevant NAAQS is greater than the SIL value before applying one of the recommended $PM_{2.5}$ SIL values. The EPA's intention with this new method was to derive SIL values that are more universally applicable to a range of conditions, including those where a substantial portion of the NAAQS or PSD increment is known to be consumed. However, permitting authorities retain discretion whether to apply SILs as a general matter, or in particular permitting actions, based on information in the permit record.

In order for a specific change in air quality concentrations to be used to show that a proposed source does not cause or contribute to a violation of the NAAQS, the concentration change must

[35] 75 FR 64890.
[36] 75 FR 64864, 64892.
[37] Memorandum from Stephen D. Page, EPA OAQPS, to EPA Regional Air Division Directors, "Guidance for $PM_{2.5}$ Permit Modeling," May 20, 2014.

ED_013256A_00000443-00011

represent a level of impact on ambient air quality that is not significant or meaningful. The EPA's judgment is that values representing such a level can be selected from a statistical analysis of the variability of air quality, using data from the U.S. ambient monitoring network for ozone and $PM_{2.5}$. Due to fluctuating meteorological conditions and changes in day-to-day operations of all air pollution sources in an area, there is an inherent variability in the air quality in the area surrounding a monitoring site. This variability can be characterized through the application of a well-established statistical framework for quantifying uncertainty.[38,39] The analysis described in the technical document quantifies the inherent variability in pollutant concentrations (as measured by design values) and informs the EPA's choice of a value for a change in concentrations that the EPA does not consider significant or meaningful because changes of this magnitude are well within the inherent variability of observed design values.[40] Once the precautionary choices described below are built into the calculation, this degree of change in concentration is, thus, indistinguishable from the inherent variability in the measured atmosphere and may be observed even in the absence of the increased emissions from a new or modified source. Therefore, a permitting authority can reasonably conclude that emissions of a proposed source that have a projected impact below the SIL values provided in this memorandum are not the reason for, responsible for, or the "but for" cause of a NAAQS violation. Likewise, this indicates that changes in air quality within this range are not meaningful, and, thus, do not contribute to a violation of the NAAQS.

Before delving in detail into the technical and policy considerations that inform the EPA's choice of the SILs recommended in this document, it is important to point out that the discretion of the EPA and other permitting authorities is limited by the 2010 rulemaking. Specifically, since the EPA has established by regulation that a $PM_{2.5}$ impact greater than a certain value will be considered to cause or contribute to a violation of the relevant NAAQS, permitting authorities may not use a value higher than 1.2 $\mu g/m^3$ for the 24-hour $PM_{2.5}$ NAAQS or a value higher than 0.3 $\mu g/m^3$ for the annual $PM_{2.5}$ NAAQS. Because ozone is not addressed in 40 CFR 51.165(b)(2), permitting authorities are not precluded from developing a higher ozone NAAQS SIL value than recommended in this guidance. Likewise, 40 CFR 51.165(b)(2) does not address PSD increments and, thus, does not constrain the discretion of a permitting authority to develop a higher SIL value and use it for PSD increment purposes.

---

[38] Efron, B. (1979); "Bootstrap methods: Another look at the jackknife". The Annals of Statistics 7 (1): 1–26. doi:10.1214/aos/1176344552.

[39] Efron, B. (2003); Second Thoughts on the Bootstrap. Stat. Sci., 18, 135-140.

[40] The EPA conducted an external peer review of the technical document containing the statistical analysis used for developing the SILs for ozone and $PM_{2.5}$. The peer review comments were supportive of the air quality variability method as being appropriate for application for SILs. The comments also suggested several considerations for improvements to the technical document and analyses to better support the application of the analysis to determine specific SIL values. Therefore, the EPA made a number of revisions to the technical document, including conducting new analyses to investigate issues raised by the reviewers, edits to a number of sections for clarity and accuracy, and updating the analysis to include the most recent data. A peer review report that outlines the subsequent changes to the technical analysis is available from the U.S. EPA library, library number EPA 454/S-18-001.

ED_013256A_00000443-00012

Basis for Development of Recommended SILs for Ozone and $PM_{2.5}$

In developing the recommended SILs for ozone and $PM_{2.5}$, we assessed the variability in pollutant concentrations, as determined by the national monitoring network, from the design value at each monitor (i.e., baseline value). The technical analysis uses traditional statistical techniques based on statistical significance testing to characterize the variability in air quality. The conceptual underpinnings of the analysis are an application of the concept of "statistical significance" to inform a policy decision regarding what represents an insignificant impact and, therefore, may serve as the basis for developing a SIL for use in the air quality impact analyses required for PSD permitting. More specifically, traditional statistics is based on the concept of identifying what constitutes a statistically significant change from a baseline value where the "baseline" is the statistic of interest, such as the mean or, in this case, the design value. Rather than focusing on statistically significant changes, the purpose of the analysis was to calculate changes in the design values that, once precautionary choices are applied, may be considered not significant or meaningful. To identify recommended SILs for the desired application in the PSD program, the EPA determined that the findings of the statistical analysis can be used to identify a change in the design value (i.e., an air quality impact) below which a permitting authority may reasonably conclude that the impact does not cause or contribute to a violation of a NAAQS. The principles of statistical significance testing do not by themselves provide a single, unique threshold for determining the statistical significance of a change in the design value. Statistical significance testing provides a range of concentration values that can be considered to represent a statistically significant change in air quality or, in this application, a change in air quality that is not statistically significant. Therefore, it is necessary to consider the function and application of SIL values in the context of the PSD program and to select a change in air quality that is reasonably representative of the showing that a proposed source will not cause or contribute to a NAAQS violation, as required by the Act and PSD regulations.

In making a recommendation for an appropriate SIL value, the EPA balanced two considerations: 1) the usefulness of the SIL as a compliance demonstration tool in the PSD permitting program, and 2) the likelihood of a SIL value representing an impact that is not significant. In balancing these considerations, the EPA made policy decisions concerning the confidence interval (CI) to represent the inherent variability for purposes of the NAAQS compliance demonstration, the approach used to scale local variability to the level of the NAAQS, the geographic extent of each summary value, and the design value year or years from which to use the variability results. As described below, for each of these factors, the EPA chose options that are precautionary, leading to SILs designed to ensure the protection of air quality.

Through the statistical analysis, we calculated CIs, which represent different assessments of the level of change in air quality based on the inherent variability in the air quality of an area. We then selected the recommended SIL values as a function of the CIs, the baseline value, and policy considerations. The selection of a CI in defining a particular SIL value required an exercise of judgment based on the technical and policy considerations (as described below) such that the selected value represents a level of change in air quality concentration that can be considered not significant or meaningful in the context of evaluating the impact of emissions from a proposed

source. These policy considerations work in conjunction with the statistical analysis, to provide a rational basis to select values derived from the statistical analysis that can be applied as a tool for making the PSD compliance demonstration required by the Act and PSD regulations. For more information on the design and results of the technical analysis, please refer to the technical document.

The technical analysis relies upon data from the national ambient monitoring network for ozone and $PM_{2.5}$. Because these data generally are the basis for determining NAAQS attainment, they are an appropriate basis to characterize air quality, with the statistical analysis evaluating the variation in the design value at each monitoring site across the nation. This variability in air quality concentrations is described by the different CIs computed from the statistical analysis. The CIs identify a statistically significant deviation from the baseline value. As described in the technical document (Section 3.0), the EPA has calculated CIs at the 25 percent, 50 percent, 68 percent, 75 percent, and 95 percent intervals for consideration in defining SIL values for ozone and $PM_{2.5}$. The smallest CI that might be used to identify a statistically significant change would be a 68 percent CI, which corresponds to one standard deviation from the baseline value. Thus, any change in the design value larger than the variation represented by the 68 percent CI could be considered to be a statistically significant change. However, for purposes of the PSD program, we are seeking to identify a concentration value that constitutes an insignificant impact, meaning a change in the design value that does not reflect a meaningful difference in air quality based on the introduction of a new source. Thus, from a statistical perspective, the EPA believes that the CIs used in determining an appropriate SIL value should be below 68 percent, corresponding to a change of less than one standard deviation.

Very small SIL values would have limited use to permitting authorities (i.e., would lead to "false positives"), while larger values (closer to the air quality change represented by the 68 percent CI) would lead to "false negatives." In weighing these competing considerations to select an appropriate SIL value, the EPA believes that air quality change represented by a 50 percent CI represents a protective approach for a SIL value because it is sufficiently within the 68 percent CI, while still being sufficiently higher than zero such that it can be a useful compliance demonstration tool for the PSD permitting process. Of the available choices, the 50 percent CI has more utility as a screening tool under the permitting program, while providing a value that adequately reflects a change in air quality concentrations that is not significant or meaningful.

The EPA chose to use the relative variability rather than the absolute variability in calculating the SILs because the technical analysis (Section 4.0) showed that the relative variability is fairly consistent across the range of design values, suggesting a commonality in the relative variability across a wide range of geographic regions, chemical regimes, and baseline air quality levels in the development of the SILs.

In order to promote national consistency, the EPA has historically provided national SIL values rather than regional or local values. The EPA considered whether a SIL value should be informed by the statistical analysis at the particular site of the proposed source or the central tendency across all monitored sites in the U.S., regardless of the proposed source's planned location. The EPA

continues to recommend using a national SIL value based on the variability aggregated across the nation rather than developing regional or local values. Findings from the statistical analysis indicate that while there are local spatial correlations, there are few instances of large scale (e.g., region-to-region) trends in ambient air variability. Thus, national numbers are supported by the spatial analysis and suitable for use here. Because NAAQS and PSD increments are set on a national basis, the EPA and permitting authorities have historically used national SILs in the PSD program. National SIL values are designed to be used for any location subject to PSD requirements and eliminate the need to determine local or regional approaches for developing a SIL value, including addressing the status of local air quality monitoring (which would be needed if regional or local SILs were to be determined). However, as noted above, local permitting authorities have the discretion to develop alternate SILs.[41] Having a national SIL value promotes consistency in implementation and prevents possible confusion or arbitrary choices that may arise with highly localized SIL values (i.e., determining which monitors to use for computations and other possible deviations from national protocol). Given these considerations, the EPA recommends continuing the practice of using national SIL values. Furthermore, as shown in the technical analysis (Section 4.0), because the median statistic is less influenced by high variability areas, the median statistic is preferred for use in selecting a SIL. Therefore, using the median statistic of the relative variability from the 50 percent CIs from the entire U.S. ambient monitoring network satisfies the policy needs for a SIL and is congruent with the physical and chemical processes that result in this variability.

Next, the EPA chose to use the most recently available years of ambient monitoring data (2012-2016) in the technical analysis to derive the recommended SILs. The SILs should reflect the most recent and representative state of the nation's atmosphere. In assessing the historical trends in ozone and $PM_{2.5}$ air quality levels across the nation, there are observable downward trends in concentrations that indicate more recent data are most appropriate. To have more confidence that the resulting values would not be unduly influenced by temporary circumstances or episodic events, the EPA's recommended SILs are based on an average of the most recent three design value years as a basis for ozone and $PM_{2.5}$ SIL development (i.e., 2012-2014, 2013-2015, 2014-2016).

[41] In the cases where a permitting authority is considering an alternative SIL(s) due to the characteristics of regional variability (e.g., if, based on the analysis presented in the technical document, a specific area appears to have more localized variability than the national average), it is important to understand the factors driving that apparent variability to fully support the application of alternative SIL(s). For example, the results presented in section 4.3 of the technical document show some areas with regional variability for the 24-hour $PM_{2.5}$ standard, though no regional trends were apparent for the annual $PM_{2.5}$ standard and the ozone standard. Furthermore, these regional trends for the 24-hour $PM_{2.5}$ standard were not apparent in the other data years shown in the appendix of the technical document. Additionally, the discussion in the technical document highlights potential causes for some of the variability in these regions (e.g., lower sampling frequency, that can lead to apparently higher variability than would otherwise be shown with higher sampling frequency). Similar issues are discussed in the technical document and can have important consequences for the results and conclusions drawn from more localized analyses of the ambient data and should be thoroughly vetted when considering alternative SILs.

ED_013256A_00000443-00015

SILs for NAAQS

Using the method described above, the EPA developed SIL values for the 8-hour ozone NAAQS and the annual and 24-hour $PM_{2.5}$ NAAQS. Table 1 lists these SIL values for the NAAQS. Each of these SIL values is based on the level, averaging period and statistical form of its corresponding NAAQS. For the reasons discussed in this guidance and supporting documents, we recommend that PSD permitting authorities use the following values as SILs on a case-by-case basis in the manner described in the next section.

Table 1. Recommended SIL Values for Ozone and $PM_{2.5}$ NAAQS

Criteria Pollutant (NAAQS level)	NAAQS SIL concentration
Ozone 8-hour (70 ppb)	1.0 ppb
$PM_{2.5}$ 24-hour (35 $\mu g/m^3$)	1.2 $\mu g/m^3$*
$PM_{2.5}$ annual (12 $\mu g/m^3$ or 15 $\mu g/m^3$)	0.2 $\mu g/m^3$

* The table accounts for the significance level for the 24-hour $PM_{2.5}$ NAAQS in 40 CFR 51.165(b)(2). Refer to the guidance discussion for details.

For the 8-hour ozone NAAQS, the SIL value we recommend is 1.0 part per billion (ppb). Consistent with the form of the NAAQS, this value is based on the annual 4th highest daily maximum 8-hour concentration, averaged over 3 years. The recommended SIL value for ozone is the same as the derived value from the air quality variability analysis.

For the 24-hour $PM_{2.5}$ NAAQS, the SIL value we recommend is 1.2 $\mu g/m^3$. The derived value from the air quality variability analysis is 1.5 $\mu g/m^3$ and is based on an analysis of the 98th percentile 24-hour concentrations averaged over 3 years. However, 40 CFR 51.165(b)(2) still lists 1.2 $\mu g/m^3$ as the significance level for the 24-hour $PM_{2.5}$ NAAQS. In the 2010 rulemaking, the EPA determined that an impact above this value will be considered to cause or contribute to a violation of the 24-hour $PM_{2.5}$ NAAQS at any location that does not meet this standard. In the same rule, the EPA also sought to establish that an impact below this value would not cause or contribute to a violation of this NAAQS but acknowledged that there could be circumstances where this conclusion was not always valid. Even though the ambient air quality variability approach indicates that an impact below 1.5 $\mu g/m^3$ is not significant, significance levels for $PM_{2.5}$ remain in the EPA's regulations at 40 CFR 51.165(b)(2) and the EPA is presently bound by its prior conclusion (that an impact above 1.2 $\mu g/m^3$ is significant and will cause or contribute to a violation of the 24-hour $PM_{2.5}$ NAAQS). Thus, the EPA cannot conclude at this time that an impact between 1.2 $\mu g/m^3$ and 1.5 $\mu g/m^3$ is an insignificant impact or an impact that will not cause or contribute to a violation of the NAAQS. However, based on the ambient air quality variability

ED_013256A_00000443-00016

approach, the EPA can conclude that impacts below 1.2 $\mu g/m^3$ are insignificant at any location and will not cause or contribute to a violation of the NAAQS.[42]

For the annual $PM_{2.5}$ NAAQS, we recommend 0.2 $\mu g/m^3$ as the SIL value, which is the value based on a 3-year average of annual average concentrations. This value is lower than the value of 0.3 $\mu g/m^3$ listed in 40 CFR 51.165(b)(2). Since 40 CFR 51.165(b)(2) does not address whether an impact below 0.3 $\mu g/m^3$ causes or contributes to a violation of the NAAQS, the EPA and other permitting authorities retain the discretion under this provision to determine on a case-by-case basis whether an impact between 0.2 $\mu g/m^3$ and 0.3 $\mu g/m^3$ will cause or contribute to a violation of the annual $PM_{2.5}$ NAAQS. However, based on the ambient air quality variability approach, the EPA's judgment is that an impact below 0.2 $\mu g/m^3$ is not significant and should be considered to not cause or contribute to any violation of the annual $PM_{2.5}$ NAAQS that is identified.

We recommend that these SIL values apply to the NAAQS everywhere, regardless of the class of the airshed.[43] For $PM_{2.5}$, this recommendation is different than what was provided in the vacated (k)(2) paragraphs, where the SIL value that would be used for NAAQS purposes was different for Class I areas than for Class II and III areas. The EPA recognizes that, historically, Congress has provided special protections to Class I areas, as described below in the discussion of SILs for PSD increments. The EPA believes that because each ozone and $PM_{2.5}$ NAAQS is uniform throughout the class areas, no class-specific protection via SILs is necessary when assessing whether a source causes or contributes to a violation of the NAAQS.

SILs for PSD Increments

There are no PSD increments established for ozone and, thus, no ozone SIL values are needed for PSD increment compliance purposes. We used the air quality variability approach to develop PSD increment SILs for the $PM_{2.5}$ PSD increments (*see* Table 2), but in an indirect way. The SIL values

[42] 40 CFR 51.165(b)(2) provides that a source impact higher than one of the listed significance levels is to be considered significant. A source impact exactly equal to a significance level need not be considered significant. In contrast, in this guidance, consistent with past guidance, we are recommending that a value exactly equal to a recommended SIL be considered significant. Thus, these two approaches treat a value equal to the stated level differently. In practice, we do not expect this to be a practical difference because it will be very unusual for a source's impact to exactly equal one of the recommended SIL values.

[43] When Congress established the PSD program requirements under the 1977 Act Amendments, it included specific numerical PSD increment levels for SO_2 and particulate matter (expressed at that time as "total suspended particulate") for Class I, II and III areas. Congress designated Class I areas (including certain national parks and wilderness areas) as areas of special national concern, where the need to prevent deterioration of air quality is the greatest. Consequently, the PSD increments are the smallest in Class I areas. The PSD increments of Class II areas are larger than those of Class I areas and allow for a moderate degree of emissions growth. Class III areas have the largest PSD increments, but to date no Class III areas have been designated. The EPA subsequently defined Class I, II and III PSD increments for NO_2 and PM_{10}, and $PM_{2.5}$ in multiple rulemakings.

ED_013256A_00000443-00017

for the $PM_{2.5}$ PSD increments are derived from the recommended NAAQS SIL values and reflect that, under the PSD regulations, the allowable PSD increment values are different for Class I, II and III areas. For Class II areas (which comprise most of the U.S.) and Class III areas (of which there are currently none), we recommend that the values of the NAAQS SILs also be used for PSD increment SILs. For Class I areas, we are recommending annual and 24-hour PSD increment SIL values that are lower than the NAAQS SIL values. This is because the EPA recognizes that Congress intended to establish special protection for Class I areas, as observed by the more stringent statutory Class I PSD increments, as well as provisions for use of air quality related values (including protection against visibility impairment).[44] To help reflect this additional protection, we applied the ratios of the Class I and Class II allowable PSD increments to the NAAQS SIL values derived in our technical analysis.[45] The EPA believes these values for Class I areas will continue to reflect this higher level of protection through the PSD increment SILs.

Table 2. Recommended SIL Values for $PM_{2.5}$ PSD Increments

Criteria Pollutant (averaging period)	PSD increment SIL concentration		
	Class I	Class II	Class III
$PM_{2.5}$ (24-hour)	0.27 $\mu g/m^3$	1.2 $\mu g/m^3$	1.2 $\mu g/m^3$
$PM_{2.5}$ (annual)	0.05 $\mu g/m^3$	0.2 $\mu g/m^3$	0.2 $\mu g/m^3$

IV. APPLICATION OF SILS

The EPA recommends that permitting authorities consider using these SIL values for ozone and $PM_{2.5}$ on a case-by-case basis at the same points in the PSD air quality analysis as SIL values historically have been used in the PSD program, as described below, with one exception regarding defining the spatial extent for modeling.

First, permitting authorities may elect to use the SIL values reflected in this guidance in a preliminary (single-source) analysis that considers only the impact of the proposed source in the permit application on air quality to determine whether a full (or cumulative) impact analysis is necessary before reaching a conclusion as to whether the proposed source would (or would not) cause or contribute to a violation.[46] A modeled result predicting that a proposed source's maximum impact will be below the corresponding SIL value recommended above generally may be considered to be a sufficient demonstration that the proposed source will not cause or contribute to a violation of the applicable NAAQS or PSD increment. If the single-source analysis shows that a proposed source will not have a significant impact on air quality, permitting authorities may

[44] Section 165(d)(2) of the Act sets forth procedures affording special protection against adverse air quality impacts in Class I areas. Also, section 169A of the Act declares a national goal of preventing future and remedying any existing impairment of visibility in Class I areas. 42 U.S.C. 7475 and 7491.

[45] To derive the Class I PSD increment SIL values, we started with the corresponding NAAQS SIL value as the base number and adjusted it by the ratio of the associated Class I and II PSD increments. For the annual $PM_{2.5}$ increment, we reduced the NAAQS SIL value by the ratio of 1:4, because the Class I PSD increment is 1 $\mu g/m^3$ and the Class II PSD increment is 4 $\mu g/m^3$. We used the ratio of 2:9 for the 24-hour $PM_{2.5}$ increment. For the 24-hour increment, we used the 40 CFR 51.165(b)(2) value of 1.2 $\mu g/m^3$ as our base number.

[46] 1990 Draft NSR Workshop Manual at C.24-C.25, C.51.

ED_013256A_00000443-00018

generally conclude there is no need to conduct a cumulative impact analysis to assess whether there will be any violations of the NAAQS or PSD increment. However, upon considering the permit record in an individual case, if a permitting authority has a basis for concern that a demonstration that a proposed source's impact is below the relevant SIL value at all locations is not sufficient to demonstrate that the proposed source will not cause or contribute to a violation, then the permitting authority should require additional information from the permit applicant to make the required air quality impact demonstration.

Second, where the preliminary analysis described in the prior paragraph shows a significant impact, permitting authorities may choose to use the recommended SIL values in a cumulative impact analysis for a NAAQS, which, in addition to the proposed new major stationary source or major modification, includes the impact of existing sources (onsite with the proposed major modification, as well as other existing sources), and the appropriate background concentration. The EPA has described this application of a SIL as a "culpability analysis."[47] Where a cumulative impact analysis predicts a NAAQS violation, the permitting authority may further evaluate whether the proposed source will cause or contribute to the violation by comparing the proposed source's modeled contribution to that violation to the corresponding SIL value. If the modeled impact is below the recommended SIL value at the violating receptor during the violation, the EPA believes this will be sufficient in most cases for a permitting authority to conclude that the source does not cause or contribute to (is not culpable for) the predicted violation. This demonstration would, thus, allow the permit to be issued if all other PSD requirements are satisfied. If the proposed source's modeled impact is higher than or equal to the recommended SIL value at the violating receptor during a violation, then a permit should not be issued unless (1) further modifications are made to the proposed source to reduce the proposed source's impact to a not significant level at the affected receptor during the violation, or (2) the proposed source obtains sufficient emissions reductions from other sources to compensate for its contribution to the violation.[48]

Third, permitting authorities may decide to use the SIL values recommended above in a cumulative impact analysis for a PSD increment. According to 40 CFR 51.166(c)(1) and 52.21(c), an allowable PSD increment based on an annual average may not be exceeded, and the allowable PSD increment for any other time period may be exceeded once per year at any one location. In either case, the PSD increment SILs recommended above may be used to determine if the proposed source will cause or contribute to that exceedance. If the cumulative impact analysis shows an annual average $PM_{2.5}$ PSD increment exceedance or a 24-hour PSD increment exceedance at a location, then the comparison of the proposed source's impact at that location during the exceedance to the corresponding SIL value may be used to determine whether the proposed source will cause or contribute to the exceedance(s) at that receptor. If the modeled impact is below the SIL for the relevant pollutant, then the permitting authority may conclude that the source does not cause or contribute to a violation of the PSD increment for that pollutant.

---

[47] *Prairie State*, 13 E.A.D. at 100; Mississippi Lime, 15 E.A.D. at 374.

[48] 1990 Draft NSR Workshop Manual at C.52-C.53; this latter alternative is referred to as a PSD offset, and state implementation plans may include an offset program based on federal regulations at 40 CFR 51.165(b).

In the past, SILs have been used in defining the spatial extent of the modeling domain for a cumulative impact analysis. Because an impact from a proposed source below a SIL value is considered not to cause or contribute to a violation, the EPA has previously recognized that there was no informational value in placing modeling receptors farther from the proposed source than the most distant point at which the proposed source's impact is equal to or greater than the applicable SIL value. Streamlining the modeling demonstration to reduce the number of receptors to those of value in determining if the proposed source will cause or contribute to a violation of the applicable NAAQS or PSD increment has enabled permit applicants to complete the required modeling with a reasonable effort. As discussed earlier, the EPA recently updated its *Guideline*. The revisions include providing an appropriate, revised basis for determining the modeling domain for NAAQS and PSD increment assessments. Thus, the revised *Guideline* should be used when considering the extent of the modeling domain.

The SILs identified in this guidance should not influence Air Quality Related Values analyses in Class I areas, which are independent reviews by the Federal Land Managers during the application review process.

Subject to limitations described in this guidance, permitting authorities may use the values in the above tables on a case-by-case basis to support air quality analyses and demonstrations required for issuance of PSD permits. Since this guidance is neither a final determination nor a binding regulation, permitting authorities retain the discretion not to use SILs as described here, either in specific cases or programmatically.

The case-by-case use of SIL values should be justified in the record for each permit. To ensure an adequate record, any PSD permitting decision that is based on this guidance (including the technical and legal documents) should incorporate the information contained in them. The permitting authority should also consider any additional information in the record that is relevant to making the required demonstration.

Permitting authorities also retain the discretion to use other values that may be justified separately from this guidance as levels of insignificant impact, subject to one limitation for the $PM_{2.5}$ NAAQS. Since the EPA has established by regulation that a $PM_{2.5}$ impact greater than certain values will cause or contribute to a violation of the relevant NAAQS, permitting authorities may not use a value higher than 1.2 $\mu g/m^3$ for the 24-hour $PM_{2.5}$ NAAQS or a value higher than 0.3 $\mu g/m^3$ for the annual $PM_{2.5}$ NAAQS. Because the 2010 rulemaking constrains the discretion of state and local permitting authorities, the EPA is committed to reassessing 40 CFR 51.165(b)(2) through a future rulemaking process that will begin within 18 months.

Because ozone is not addressed in 40 CFR 51.165(b)(2), permitting authorities are not precluded from developing a higher ozone NAAQS SIL value than recommended in this guidance. Likewise, 40 CFR 51.165(b)(2) does not address PSD increments and, thus, does not constrain the discretion of a permitting authority to use a higher SIL value that a permitting authority may develop for PSD increment purposes. Permitting authorities are also not precluded from developing and using lower SIL values than recommended in this guidance. Permitting authorities may elect to utilize

alternative CIs, based on regional or local factors, in developing their own SIL values. The case-by-case use of a SIL value should be supported by a comparable record in each instance that shows that the value represents a level below which a proposed source does not cause or contribute to a violation of the NAAQS or PSD increment.

Message

From: Hardesty, Doug [Hardesty.Doug@epa.gov]
Sent: 7/24/2018 8:31:59 PM
To: Bray, Dave [Bray.Dave@epa.gov]; Vergeront, Julie [Vergeront.Julie@epa.gov]
Subject: FW: Boise/Wallula early preliminary PSD permit and technical support document
Attachments: PrelimBoiseTSDforPSD18-01 .pdf; BoisePSD18-01.pdf

Julie and Dave,

Recall that we have an application for the GHG gas portion of this PSD project. I just talked to Ecology's public notice person regarding trying to coordinate permit the public process, which makes sense if we can do it. Ecology is pushing to issue this by Oct 1, holding a public comment period from Aug 13 to Sept 14. They also are planning on a hearing on Sept 12.

I've been waiting to see Ecology's draft before creating ours. Now I need to get moving. Ex. 5 Deliberative Process (DP) Ex. 5 Deliberative Process (DP) That said, I'd like to crank for a week to see how close we can come to that deadline.

I will send you a rough draft and a plan later this week, so we can talk through the logistics and details.

Regarding Ecology's draft, I plan on reviewing it during the comment period. Prior to that, the key thing to think about is

Ex. 5 Deliberative Process (DP)

Ex. 5 Deliberative Process (DP)

Thoughts/reactions?

Doug Hardesty
208.378.5759
Air Permit Program Lead
Stationary Source Unit, Office of Air and Waste, U.S. EPA, Region 10
950 W Bannock St, Suite 900, Boise, Idaho 83702

From: Inloes, Scott (ECY) [mailto:SINL461@ECY.WA.GOV]
Sent: Tuesday, July 24, 2018 1:54 PM
To: Butkus, Paul <PaulButkus@BoisePaper.com>; Garber, Rich D <RichGarber@packagingcorp.com>; McFadden, Kelly <McFadden.Kelly@epa.gov>; Hardesty, Doug <Hardesty.Doug@epa.gov>; Ogle, Stephanie (ECY) <stog461@ECY.WA.GOV>; jade461@ECY.WA.GOV; Tonnie Cummings <tonnie_cummings@nps.gov>; Shepherd, Don <don_shepherd@nps.gov>; Miller, James - FS <jamesmiller2@fs.fed.us>; robin.priddy@bentoncleanair.org
Cc: Inloes, Scott (ECY) <SINL461@ECY.WA.GOV>; Crooks, Marc (ECY) <mcro461@ECY.WA.GOV>
Subject: Boise/Wallula early preliminary PSD permit and technical support document

All,

This email is for Boise to review the attached documents for errors before we issue the documents for public comment. Ecology's PSD team will issue the PSD permit for NOx and CO. EPA will issue the GHG PSD permit and Ecology's Industrial Section will issue all other pollutants. Once any issues have been resolved we will process the permits for public comment in August. The PSD team is working will EPA and the Industrial Section to coordinate the public comment period.

Ecology is reviewing the 2017-2018 EPA guidance and is applying the guidance on a case by case bases. Ecology is allowing Boise the use of the March EPA 2018 guidance regarding applicability based on: PSD still applies, Boise perform

NOx and increment modeling, the potential additional modeling would be for PM10 and PM2.5 (NAAQA and increment), and the site has had projects over the years to reduce PM emissions, Class I would be unchanged with minimal impacts.

If you have questions please call me.

Scott Inloes, PE.
Air Quality Program
WA Department of Ecology
Phone: 360-407-6896

DEPARTMENT OF
ECOLOGY
State of Washington

Technical Support Document for Boise White Paper, LLC

Wallula Pulp and Paper Mill No. 3 Paper Machine Modification

July 2018

Publication and Contact Information

For more information contact:

Air Quality Program
P.O. Box 47600
Olympia, WA 98504-7600
Phone: 360-407-6800

Washington State Department of Ecology — www.ecology.wa.gov

- Headquarters, Olympia 360-407-6000
- Northwest Regional Office, Bellevue 425-649-7000
- Southwest Regional Office, Olympia 360-407-6300
- Central Regional Office, Union Gap 509-575-2490
- Eastern Regional Office, Spokane 509-329-3400

To request ADA accommodation including materials in a format for the visually impaired, call Ecology at 360-407-6800 or visit https://ecology.wa.gov/accessibility. People with impaired hearing may call Washington Relay Service at 711. People with speech disability may call TTY at 877-833-6341.

ED_013256A_00000447-00002

Technical Support Document for Boise White Paper, LLC

Wallula Pulp and Paper Mill No. 3 Paper Machine Modification

Air Quality Program

Washington State Department of Ecology

Olympia, Washington

This page is purposely left blank

ED_013256A_00000447-00004

Table of Contents

Page

List of Figures and Tables vi
Figures vi
Tables vi
1. Executive Summary 1
1.1. Physical modifications 1
2. Introduction 5
2.1. The permitting process 5
2.2. Site and project description 7
3. PSD Applicability Review 17
3.1. Overview and permitting history 17
3.2. Significant emissions increases calculation 19
3.3. Significant net emissions increase calculations 33
4. BACT Review 36
4.1. Definitions and policy concerning BACT 36
4.2. BACT analysis for #3 paper machine and #2 M&D digester (NCG) 37
4.3. Toxic air pollutants 38
5. Ambient Air Quality Impacts Analysis 39
5.1. Regulatory requirements 39
5.2. Maximum criteria pollutant concentrations predicted by AERMOD 40
5.3. Ozone impacts 44
5.4. Impacts on Class I areas 46
6. Additional Impacts Analysis 48
6.1. Construction and growth impacts 48
6.2. Visibility 48
6.3. Soils and vegetation analysis 49
7. Environmental Justice 50
8. State Environmental Policy Act 52
9. Public Involvement 53
10. Agency Contact 54
References 55
Acronyms and Abbreviations 56

ED_013256A_00000447-00005

List of Figures and Tables

Page

Figures

Figure 1: Process PWR-6 (power and recovery) 11
Figure 2: Process PULP-4 (pulp and washing) 12
Figure 3: Environmental Justice Screening Map 51

Tables

Table 1: Summary of Emission Units Affected by the #3 PM 9
Table 2: Boise's Chosen Dates for Baseline Actual Emissions 20
Table 3: Emissions Increases of Regulated NSR Pollutants for No. 3 Paper Machine (tpy) 21
Table 4: Emissions Increases of Regulated NSR Pollutants for Brown Stock Washers (tpy) 23
Table 5: Emissions Increases of Regulated NSR Pollutants for Deckers (tpy) 23
Table 6: Emissions Increases of Regulated NSR Pollutants for Knot Tank (tpy) 24
Table 7: Emissions Increases of Regulated NSR Pollutants for No. 3 Recovery Boiler (tpy) 24
Table 8: Emissions Increases of Regulated NSR Pollutants for No. 2 Recovery Boiler (tpy) 25
Table 9: Emissions Increases of Regulated NSR Pollutants for No. 3 Smelt Dissolving Tank (tpy) 26
Table 10: Emissions Increases of Regulated NSR Pollutants for No. 2 Smelt Dissolving Tank . 26
Table 11: Emissions Increases of Regulated NSR Pollutants for Lime Kiln (tpy) 27
Table 12: Emissions Increases of Regulated NSR Pollutants for Slaker (tpy) 27
Table 13: Emissions Increases of Regulated NSR Pollutants for 14%-Weak Black Liquor Tank28
Table 14: Emissions Increases of Regulated NSR Pollutants for 44%-Intermediate Black Liquor Tank (tpy) 28
Table 15: Emissions Increases of Regulated NSR Pollutants for 63%-Heavy Black Liquor Tank 29
Table 16: Emissions Increases of Regulated NSR Pollutants for Makedown Tank (tpy) 29
Table 17: Emissions Increases of Regulated NSR Pollutants for NCG Auto Vent (tpy) 29
Table 18: Emissions Increases of Regulated NSR Pollutants for Fugitive (tpy) 30
Table 19: Emissions Increases of Regulated NSR Pollutants for Storage Piles (tpy) 30
Table 20: Total Estimated Project Emissions, Net Emissions, and SERs 32
Table 21: Netting Analysis Changes in Emissions (tpy) 34

ED_013256A_00000447-00006

Table 22: Total Estimated Project Net Emissions and SERs 34
Table 23: Technical Feasibility Assessment 37
Table 24: NO_X SIL Modeling Input Files 40
Table 25: Maximum Criteria Pollutant Concentrations Predicted by AERMOD for Class II 41
Table 26: NAAQS Input Files from Boise 42
Table 27: NAAQS and Increment Input Files from Nearby Sources 43
Table 28: NO_X Increment Input Files from Boise 43
Table 29: Maximum Criteria Pollutant Concentrations Predicted by AERMOD for Class II 44
Table 30: Maximum Criteria Pollutant Concentrations Predicted by AERMOD for Class I..... 46
Table 31: Class I Areas within 200 km of the Boise Facility 47
Table 32: Level 1 VISCREEN Results – Whitman Mission National Historic Site (Class II Area – Request of the National Parks Service) 49

ED_013256A_00000447-00007

1. Executive Summary

Boise White Paper, LLC (Boise) operates a pulp and paper mill in Wallula, Washington, referred to as the Wallula Mill. The Wallula Mill currently produces Kraft and NSSC paper products at the pulp and paper mill. In addition, a container plant is also co-located in Wallula.

The Prevention of Significant Deterioration (PSD) project referred to as the #3 Paper Machine Modification Project (#3 PM modification or project) will make the following changes to the mill:

1.1. Physical modifications

1.1.1. #3 PM

- The #3 PM is being modified to produce unbleached Kraft linerboard. Pulp and large amounts of water are fed to the #3 PM headbox where it forms a slurry, which is applied to a wire, where it forms a wet sheet. The wet sheet travels to the press section and dryer section to remove water. The #3 PM wire speed will increase from 3,800 feet per minute to 4,000 feet per minute with the same width. The forming section of the paper machine will be modified to increase dewatering capability. The press section will be modified with a modern shoe press. The current natural gas dryers will be converted to new steam dryers. In the future, minor VOC containing additives will be used by the #3 PM.
- The maximum daily capacity of the current #3 PM is about 800 machine dried tons per day (MDT/day) with a direct natural gas dryer. The #3 PM direct fire heaters and coating operations will be removed. The modified #3 PM will be converted to unbleached linerboard at 1,400 MDT/day capacity (annual average). The maximum daily paper production capacity will be 1,680 MDT/day (#3 PM only).

1.1.2. #2 M&D digester

- The #2 M&D digester is being modified by replacing Bauer feed valve and a larger sawdust blower. The #2 M&D digester feed valve will increase daily throughput from 210 oven dry tons/day (ODT/day) to 300 ODT/day. The total M&D yearly production will stay at 365 ODT/day.
- Emissions from the Kraft digesters are routed to the noncondensible gas (NCG) system. Boise is proposing to add a white liquor scrubber to the NCG system to reduce TRS emissions. The annual TRS emissions will be reduced but while during periods were the white liquor scrubber is down short term emissions will increase. The treated NCG system has three control options (control options are part of the digester/NCS emission unit) as follows that will see any increase in VOC:
    - Lime kiln – full year operations with SO_2 scrubber.

ED_013256A_00000447-00008

  - NCG auto vent – MACT venting limited to 87 hours per year (excluding startup, shutdown, and malfunctions).
  - Hog fuel boiler – NCG control limited to 1,200 hours per year and 102 tpy SO_2 per minor permit limits.
- Boise stated that the increase in VOC would offset fuel usage for the lime kiln and hog fuel boiler. Ecology calculated an increase in project VOC emissions from the NCG system at about 250 tpy or 7,600 MMBtu/yr. The lime kiln and hog fuel boiler will therefore have an increase in CO and NO_X of less than one tpy each pollutant per emission unit.
- The Kraft pulp mill (will experience an increase in short-term and long-term pulp throughput but will not increase in black liquor solids (BLS) throughput on a short-term basis. The change from a low kappa pulp cook to a less intensive high kappa cook to unbleached liner board will reduce BLS generation per ton of pulp produced.
- Boise states that no other equipment is being modified.

The following equipment will have an increase in emissions a result of an increase in utilization:

- No. 2 recovery furnace
- No. 3 recovery furnace
- No. 2 smelt dissolving tank
- No. 3 smelt dissolving tank (the stack will increase from 51.3 meters to 61.51 meters
- Lime kiln (minor increase from No. 2 M&D digester/NCG)
- Black liquor tanks
- Slaker
- Makedown tank
- Kymar digester
- #1 M&D digester
- Brownstock washers
- Knot tank
- Deckers
- No. 2 paper machine
- Softwood storage pile
- Sawdust storage pile
- Softwood/sawdust handling
- Softwood/sawdust blowers (other than sawdust blower to No. 2 M&D digester)
- Vehicle travel
- Wastewater treatment
- NCG auto vent (minor increase from the No. 2 M&D digester)

ED_013256A_00000447-00009

The following equipment was formally shutdown in Department of Ecology Order, No. DE-18AQIS-15757.

- The #1 paper machine was shut down on December 2016.
- The bleach plant was permanently shut down in May of 2018.
    - Bleach plant seal tank
    - Bleach plant scrubber
    - E2 hood exhaust
    - E2 tower
    - E1 tower
    - R8 scrubber
    - Bleach plant (general)

Equipment unaffected by the project:

- Neutral Sulfite Semi chemical (NSSC) pulping process
- NSSC DKP presses
- NSSC filtrate tank
- Box clipping cyclone – container plant
- Starch silo – container plant
- Corrugator – container plant
- No. 1 & No. 2 power boilers
- Hog fuel boiler (minor increase from No. 2 M&D digester/NCG)
- The increase in recovery boilers steam generation is estimated at 229,000 lb/hr (annual average) and site wide steam demand of 226,000 lb/hr.

Construction on this project is expected to begin sometime in 2018, and the modified #3 paper machine and #2 M&D digester equipment is expected to start operating sometime in 2018.

A PSD analysis for this project determined that it would have physical or operational changes that qualify as a major modification. Estimated project emissions are above the PSD significant emission rate (SER) thresholds both before and after considering significant net emission increases and/or decreases associated with this project for each of the following pollutants: nitrogen oxides (NO_X) and carbon monoxide (CO). Ecology issues this permit to cover the emissions of NO_X and CO.

Greenhouse gas (GHG) emissions are regulated in the state of Washington as biogenic and non-biogenic (11,130 tpy of CO_2e non-biogenic, 99,473 biogenic CO_2 and total 110,603 tpy CO_2e). Ecology has determined based on the following facts. Boise #2 and #3 recovery boilers emit carbon dioxide from industrial combustion of biomass in the form of fuel wood, wood waste, wood by-products, and wood residuals shall not be considered a GHG (state of Washington) as long as the region's silvicultural sequestration capacity is maintained or increased (RCW 70.235.020(3)). Washington State's SIP contained in 40 CFR 52.2497 allows EPA Region 10 to issue biogenic GHG PSD permits in the state of Washington.

ED_013256A_00000447-00010

A full technical review of the project for these pollutants, including a Best Available Control Technology (BACT) analysis, and the project's effect on national ambient air quality standards (NAAQS), PSD increments, visibility, soils, and vegetation, is required and included in this technical support document (TSD).

The emissions of other non-GHG air pollutants not subjected to PSD review are covered in the Ecology's Industrial Section Notice of Construction (NOC) approval for this project. EPA Region 10 will issue the GHG PSD permit for this project.

All of these modifications will meet air quality regulations as part of this PSD permit.

The Washington State Department of Ecology (Ecology) received the initial PSD application on January 9, 2018, and the application fee on December 21, 2017. Boise provided a revised application on June 1, 2018. Boise submitted supplemental material to Ecology on June 22, 2018, and Ecology determined Boise's application to be complete on June 25, 2018.

ED_013256A_00000447-00011

2. Introduction

2.1. The permitting process

2.1.1. The PSD process

PSD permitting requirements in Washington State are established in Washington Administrative Code (WAC) 173-400-700 through 750 (Title 40, Code of Federal Regulations (CFR) 52.21).

Washington State implements its PSD program as a State Implementation Plan (SIP)-approved program. This SIP-approved program became effective May 29, 2015.[1]

State and federal rules require PSD review of all new or modified air pollution sources that meet certain criteria in an attainment or unclassifiable area with the NAAQS. The objective of the PSD program is to prevent significant adverse environmental impact from emissions into the atmosphere by a proposed new major source, or major modification to an existing major source. The program limits degradation of air quality to that which is not considered "significant."

Under WAC 173-400-720 through 750, a project proposed at an existing major stationary source is subject to PSD review if the project either is a "major modification" to an existing "major stationary source," or is a major stationary source unto itself. The Boise Wallula site is currently a major stationary source.

To be considered a major modification, the following three project aspects are considered: physical or operational changes resulting from the project, project emissions compared with significant emission rates (SER), and significant net emission increases (and/or decreases).

Unless a physical change or change in the method of operation of a major stationary source is exempted by applicable regulation 40 CFR 52.21(b)(2)(iii)(a through k), it is a major modification if the change results in both a significant emissions increase and a significant net emissions increase at the source. "Significant emissions increase" means that the emissions increase for any regulated PSD pollutant is greater than the PSD SER threshold for that regulated pollutant.

This project will have physical or operational change consistent with the definition of "major modification" in 40 CFR 52.21(b)(2)(i). In addition, estimated project emissions are above the PSD SER thresholds both before and after considering significant net emission increases and/or decreases associated with the project for each of the following pollutants: nitrogen oxides (NO_X), carbon monoxide (CO), and biogenic greenhouse gases (CO_2e).

PSD rules are designed to keep an area with "good" air in compliance with the National Ambient Air Quality Standards (NAAQS). The distinctive requirements of PSD are Best Available Control Technology (BACT), air quality analysis (allowable increments and comparison with the NAAQS), and analysis of impacts of the project on visibility, vegetation, and soils.

---

[1] 80 FR 23721, April 29, 2015.

ED_013256A_00000447-00012

PSD rules require the utilization of BACT for certain new or modified emission units, which is the most effective air pollution control equipment and procedures that are determined to be available after considering environmental, economic, and energy factors.

A full technical review of the project for these pollutants, including a (BACT) analysis, and the project's effect on NAAQS, PSD increments, visibility, soils and vegetation, is required and included in this technical support document (TSD). Greenhouse gas (GHG) emissions are regulated in the state of Washington as biogenic and non-biogenic (11,130 tpy of CO_2e non-biogenic and 99,473 tpy CO_2 biogenic). Ecology has determined based on the following facts. Boise #2 and #3 recovery boilers emit carbon dioxide from industrial combustion of biomass in the form of fuel wood, wood waste, wood by-products, and wood residuals shall not be considered a GHG (state of Washington) as long as the region's silvicultural sequestration capacity is maintained or increased (RCW 70.235.020(3)). Washington State's SIP contained in 40 CFR 52.2497 allows EPA Region 10 to issue biogenic GHG PSD permits in the state of Washington.

The emissions of other non-biogenic air pollutants not subjected to Washington State PSD review are covered in the Ecology Industrial Section's Notice of Construction (NOC) approval for this project.

A summary of project component descriptions is provided in Section 2.2.2., with a more detailed PSD review process description for this project provided in Section 3. BACT information for this project is included in Section 4. An ambient impact analysis is presented in Section 5 and an additional growth impact analysis is presented in Section 6. These sections form the basis of the permit approval conditions.

2.1.2. The NOC process

This project is subject to NOC permitting requirements under state of Washington regulations Chapters 173-400 and 173-460 (and/or local air regulations where applicable). Ecology's Industrial Section is the permitting authority for air pollutants not included in PSD permitting. This includes the New Source Review (NSR) permitting of criteria pollutants that are not PSD-applicable, air toxics issues under federal maximum achievable control technology (MACT) and state 173-460 WAC, and Title V permitting requirements. The procedure for issuing an NOC permit was established in Chapter 70.94 RCW.

WAC 173-400-110 outlines the NSR procedures for permitting criteria pollutants. These procedures are further refined in WAC 173-400-113 (requirements for new sources located in attainment or unclassifiable areas) and/or local air requirements where applicable. WAC 173-460-040 NSR supplements the requirements contained in Chapter 173-400 WAC (and/or local air requirements where applicable) by adding additional requirements for sources of toxic air pollutants (TAPs).

ED_013256A_00000447-00013

2.2. Site and project description

2.2.1. Site description

The Boise facility is located in a Class II area that is designated as "attainment or unclassifiable" for the purpose of PSD permitting for all pollutants. $PM_{2.5}$ has been monitored in Kennewick since 2007 while ozone monitoring started in 2015. Ozone designation was based on 2015 and 2016 data only.

2.2.2. Project description

The proposed project will not increase the current footprint acreage of the site. The mill produces paper products.

2.2.2.1. Physical modifications

2.2.2.1.1. #3 PM

- The #3 PM is being modified to produce unbleached Kraft linerboard. Pulp and large amounts of water are fed to the #3 PM headbox where it forms a slurry, which is applied to a wire, where it forms a wet sheet. The wet sheet travels to the press section and dryer section to remove water. The #3 PM wire speed will increase from 3,800 feet per minute to 4,000 feet per minute with the same width. The forming section of the paper machine will be modified to increase dewatering capability. The press section will be modified with a modern shoe press. The current natural gas dryers will be converted to new steam dryers. In the future, minor VOC containing additives will be used by the #3 PM.
- The maximum daily capacity of the current #3 PM is about 800 machine dried tons per day (MDT/day) with a direct natural gas dryer. The #3 PM direct fire heaters and coating operations will be removed. The modified #3 PM will be converted to unbleached linerboard at 1,400 MDT/day capacity (annual average). The maximum daily paper production capacity will be 1,680 MDT/day (#3 PM only).

2.2.2.1.2. #2 M&D Digester

- The #2 M&D digester is being modified by replacing Bauer feed valve and a larger sawdust blower. The #2 M&D digester feed valve will increase daily throughput from 210 oven dry tons/day (ODT/day) to 300 ODT/day. The total M&D yearly production will stay at 365 ODT/day.
- Emissions from the Kraft digesters are routed to the noncondensible gas (NCG) system. Boise is proposing to add a white liquor scrubber to the NCG system to reduce TRS emissions. The annual TRS emissions will be reduced but while during periods were the white liquor scrubber is down short term emissions will increase. The treated NCG system has three control options (control options are part of the digester/NCS emission unit) as follows that will see any increase in VOC:
    - Lime kiln – full year operations with SO_2 scrubber

ED_013256A_00000447-00014

  - NCG auto vent – MACT venting limited to 87 hours per year (excluding start-up, shutdown, and malfunctions)
  - Hog fuel boiler – NCG control limited to 1,200 hours per year and 102 tpy SO_2 per minor permit limits
- Boise stated that the increase in VOC would offset fuel usage for the lime kiln and hog fuel boiler. Ecology calculated an increase in project VOC emissions from the NCG system at about 250 tpy or 7,600 MMBtu/yr. The lime kiln and hog fuel boiler will therefore have an increase in CO and NO_X of less than 1 tpy each pollutant per emission unit.
- The Kraft pulp mill (will experience an increase in short-term and long-term pulp throughput but will not increase in black liquor solids (BLS) throughput on a short-term basis. The change from a low kappa pulp cook to a less intensive high kappa cook to unbleached liner board will reduce BLS generation per ton of pulp produced.
- Boise states that no other equipment is being modified.

The following equipment will have an increase in emissions a result of an increase in utilization:

- No. 2 recovery furnace
- No. 3 recovery furnace
- No. 2 smelt dissolving tank
- No. 3 smelt dissolving tank (the stack will increase from 51.3 meters to 61.51 meters
- Lime kiln (minor increase from No. 2 M&D digester/NCG)
- Black liquor tanks
- Slaker
- Makedown tank
- Kymar digester
- #1 M&D digester
- Brownstock washers
- Knot tank
- Deckers
- No. 2 paper machine
- Softwood storage pile
- Sawdust storage pile
- Softwood/sawdust handling
- Softwood/sawdust blowers (other than sawdust blower to No. 2 M&D digester)
- Vehicle travel
- Wastewater treatment
- NCG auto vent (minor increase from the No. 2 M&D digester)

ED_013256A_00000447-00015

The following equipment was formally shutdown in Department of Ecology Order, No. DE-18AQIS-15757.

- The #1 paper machine was shut down on December 2016
- The bleach plant was permanently shut down in May of 2018.
    - Bleach plant seal tank
    - Bleach plant scrubber
    - E2 hood exhaust
    - E2 tower
    - E1 tower
    - R8 scrubber
    - Bleach plant (general)

Equipment unaffected by the project:

- Neutral sulfite semi chemical (NSSC) pulping process
- NSSC DKP presses
- NSSC filtrate tank
- Box clipping cyclone – container plant
- Starch silo – container plant
- Corrugator – container plant
- No. 1 & No. 2 power boilers
- Hog fuel boiler (minor increase from No. 2 M&D digester/NCG)
- The increase in recovery boilers steam generation is estimated at 229,000 lb/hr (annual average) and site-wide steam demand of 226,000 lb/hr.

A summary of all emission units affected by the project are listed in Table 1.

Table 1: Summary of Emission Units Affected by the #3 PM

Equipment Unit	New/Existing Unit (Change in Utilization)
#3 paper machine	Modification
#2 M&D digester and sawdust blower	Modification
NCG auto vent	Part of #2 M&D digester emission unit
Lime kiln	Part of #2 M&D digester emission unit
Hog fuel boiler	Part of #2 M&D digester emission unit
No. 2 recovery furnace	Existing unit (change in utilization)
No. 3 recovery furnace	Existing unit (change in utilization)
No. 2 smelt dissolving tank	Existing unit (change in utilization)

ED_013256A_00000447-00016

Equipment Unit	New/Existing Unit (Change in Utilization)
No. 3 Smelt dissolving tank (the stack will increase from 51.3 meters to 61.51 meters	Existing unit (change in utilization)
Black liquor tanks	Existing unit (change in utilization)
Slaker	Existing unit (change in utilization)
Makedown tank	Existing unit (change in utilization)
Kymar digester	Existing unit (change in utilization)
#1 M&D digester	Existing unit (change in utilization)
Brownstock washers	Existing unit (change in utilization)
Knot tank	Existing unit (change in utilization)
Deckers	Existing unit (change in utilization)
No. 2 paper machine	Existing unit (change in utilization)
Softwood storage pile	Existing unit (change in utilization)
Sawdust storage Pile	Existing unit (change in utilization)
Softwood/sawdust handling	Existing unit (change in utilization)
Softwood/sawdust blowers (other than sawdust blower to No. 2 M&D digester)	Existing unit (change in utilization)
Vehicle travel	Existing unit (change in utilization)
Wastewater treatment	Existing unit (change in utilization)

The following figures from the application show a high-level process flow diagram of the power/recovery and pulp/washing systems. A more detailed description of the project major components is provided in the following subsections.

ED_013256A_00000447-00017

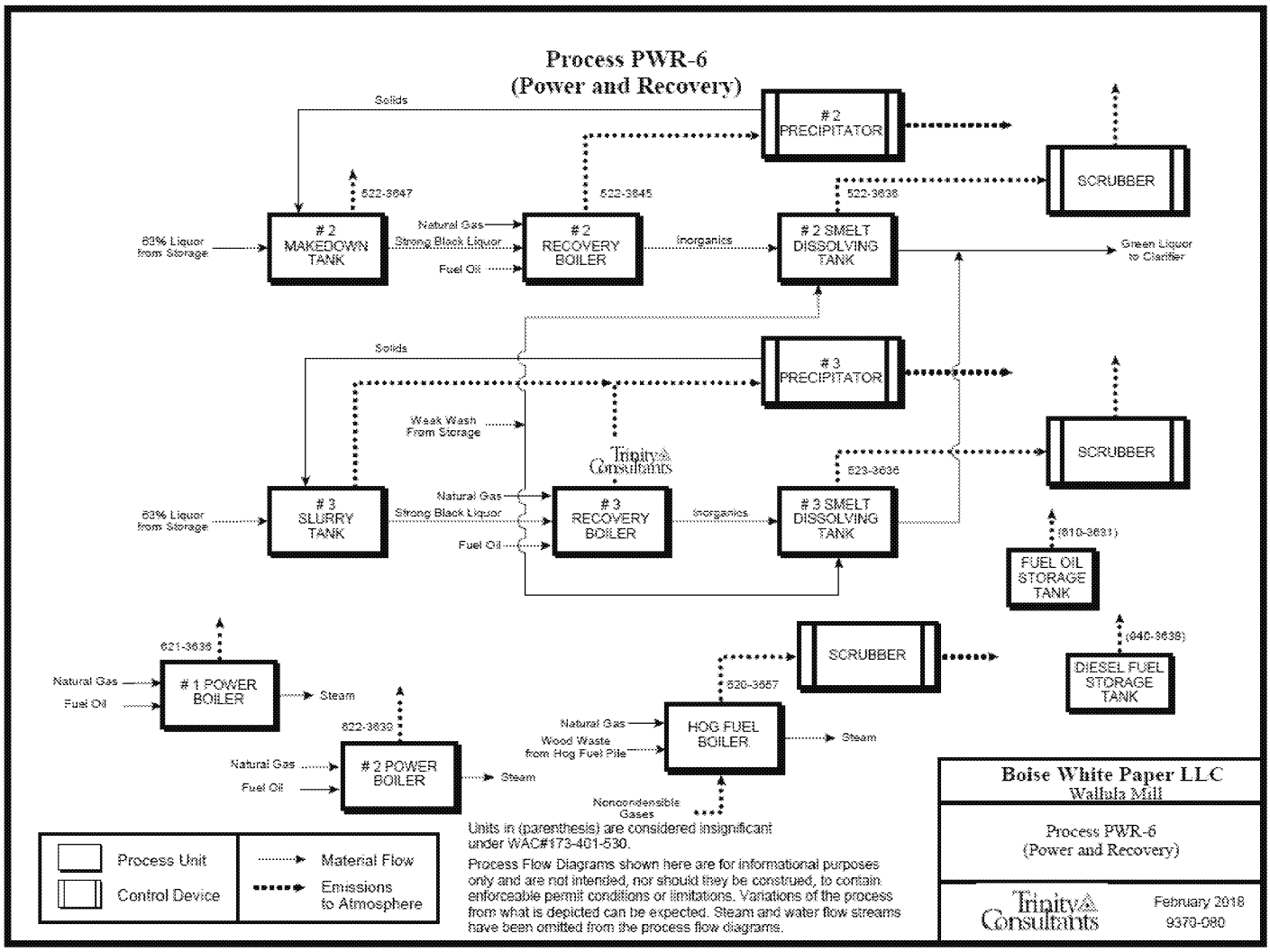


Figure 1: Process PWR-6 (power and recovery)

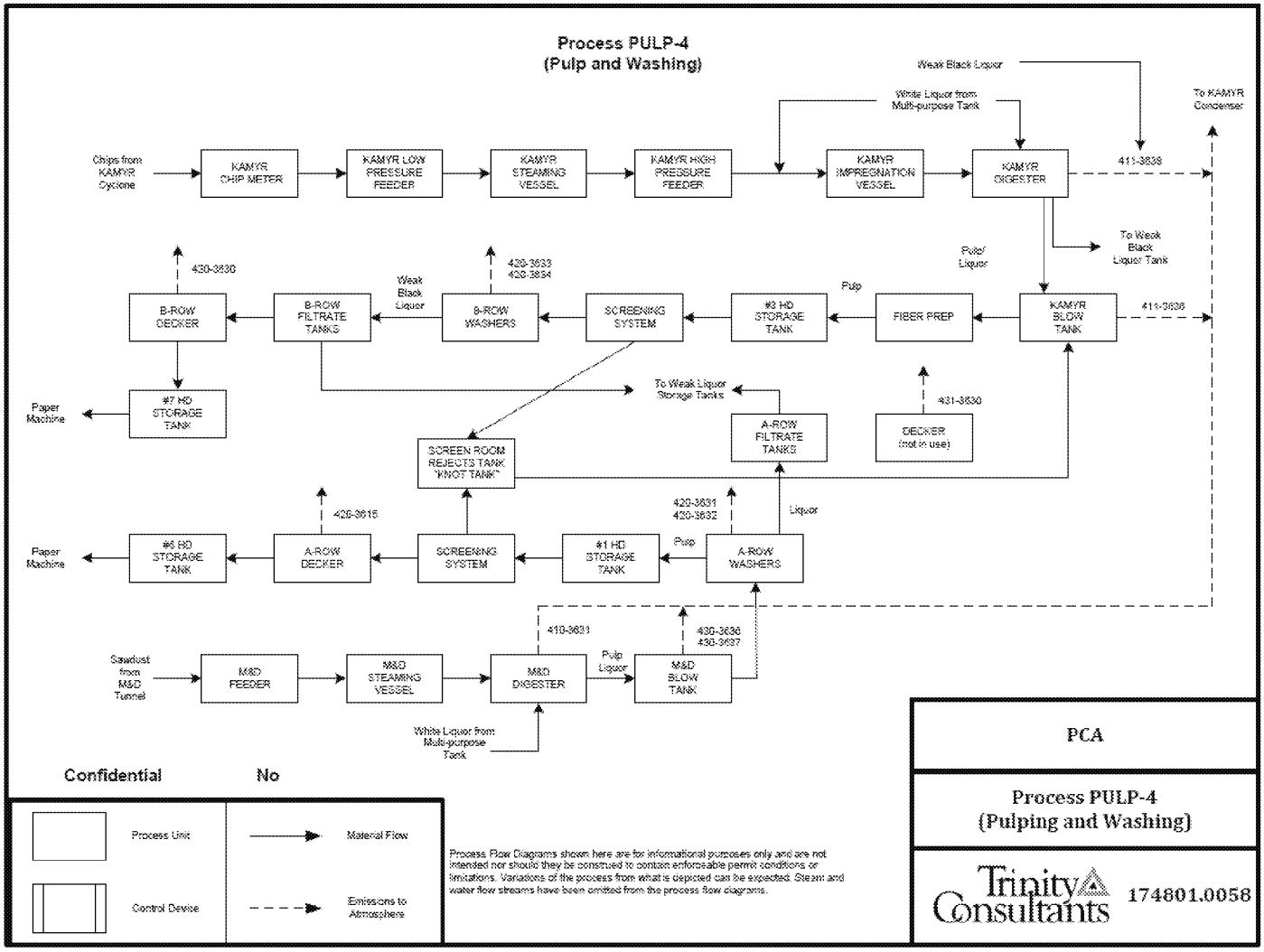


Figure 2: Process PULP-4 (pulp and washing)

2.2.2.2. The modification of the #3 PM

The #3 PM is being modified to produce unbleached Kraft linerboard. Pulp and large amounts of water are fed to the #3 PM headbox where it forms a slurry, which is applied to a wire, where it forms a wet sheet. The wet sheet travels to the press section and dryer section to remove water. The #3 PM wire speed will increase from 3,800 feet per minute to 4,000 feet per minute with the same width. The forming section of the paper machine will be modified to increase dewatering capability. The press section will be modified with a modern shoe press. The current natural gas dryers will be converted to new steam dryers. In the future, minor VOC containing additives will be used by the #3 PM.

The maximum daily capacity of the current #3 PM is about 800 machine dried tons per day (MDT/day) with a direct natural gas dryer. The #3 PM direct fire heaters and coating operations will be removed. The modified #3 PM will be converted to unbleached linerboard at 1,400 MDT/day capacity (annual average). The maximum daily paper production capacity will be 1,680 MDT/day (#3 PM only).

2.2.2.3. #2 M&D digester (controls NCG vent)

The #2 M&D digester is being modified by replacing Bauer feed valve and a larger sawdust blower. The #2 M&D digester feed valve will increase daily throughput from 210 oven dry tons/day (ODT/day) to 300 ODTP/day. The total M&D yearly production will stay at 365 ODT/day.

Emissions from the Kraft digesters are routed to the NCG system. Boise is proposing to add a white liquor scrubber to the NCG system to reduce TRS emissions. The annual TRS emissions will be reduced but while during periods were the white liquor scrubber is down short-term emissions will increase. The treated NCG system has three control options (control options are part of the digester/NCS emission unit) as follows that will see any increase in VOC:

- Lime kiln – full year operations with SO_2 scrubber.
- NCG auto vent – MACT venting limited to 87 hours per year (excluding start-up, shutdown, and malfunctions).
- Hog fuel boiler – NCG control limited to 1,200 hours per year and 102 tpy SO_2 per minor permit limits.

Boise stated that the increase in VOC emissions (26.3 lb/hr Section 4-4 of the application) would offset fuel usage for the lime kiln and hog fuel boiler. Ecology calculated an increase in project VOC emissions from the NCG system at about 250 tpy or 7,600 MMBtu/yr. The lime kiln and hog fuel boiler will therefore have an increase in CO and NO_X of less than 1 tpy each pollutant per emission unit.

The Kraft pulp mill (will experience an increase in short-term and long-term pulp throughput but will not increase in black liquor solids (BLS) throughput on a short-term basis. The change from a low kappa pulp cook to a less intensive high kappa cook to unbleached liner board will reduce BLS generation per ton of pulp produced.

ED_013256A_00000447-00020

2.2.2.4. Kamyr Kraft digester (controls NCG)

The project will increase the utilization of the Kamyr Kraft digester/pulp mill.

The application states the maximum pulp production (annual average) will increase to 980 ODT/day from the Kamyr pulp mill and unchanged from the M&D plant at 365 ODT/day (total 1345 ODT/day) (annual average). The Kamyr cooking operation will change by using less chemical and shorter cooking time.

2.2.2.5. Low-volume, high concentration – NCG system

The low-volume, high concentration NCG is being changed to add a white liquor scrubber to increase sulfur recovery (TRS and SO_2). The NCGs is collected from applicable equipment includes the #1 and #2 M&D digesters, the NSSC digester, the Kamyr digester, the #1 evaporator seal tank, #2 evaporator seal tank, #3 evaporator seal tank, foul condensate tank, lime kiln condensate collection tank, hog fuel boiler condensate collection tank, and the LVHC condensate collection system. Emissions can be routed to the lime kiln (SO_2 controls), hog fuel boiler (no SO_2 controls), or the auto valve. The auto valve is the only uncontrolled emission point. Emissions are expected to increase due to more utilization and due to the modification of #2 M&D digester.

2.2.2.6. NCG white liquor scrubber

The facility will be installing a white liquor scrubber to enhance chemical recovery of sulfur compounds from the mill's NCG stream. There will no increase in TRS or SO_2 on an annual basis. Emissions reductions have not been accounted for in the applications. Boise stated that NCG represents a tiny fraction of the lime kiln and hog fuel boiler heat input. Boise indicated that an increase in VOC/fuels will be offset by a corresponding decrease in traditional fuel and will have no measurable impact on emissions of NO_X or CO.

2.2.2.7. Brown stock washers and deckers (emission inventory – pulping and washing)

The brown stock washers are used to recover chemical to be reused in the mill. The deckers are used to remove water to allow for more storage volume. Historically, the pulping and washing emissions have been a single source in the emission inventory. In the application, Boise has separated the mill into the two emission points brown stock washer and deckers. Emissions are expected to increase due to increased utilization. In April of 2018, NACSI wrote to Boise supporting the use of emissions factors for historical bleach Kraft pulp and unbleached Kraft that resulted in a reduction in VOC and TRS emissions in the application.

2.2.2.8. Knot tank (part of other in the emission inventory)

The existing Knot tank takes M&D washed pulp and Kamyr feed prior to washing rejects and recycles the material back to the Kamyr blow tank for additional fiber prep.

2.2.2.9. Three pulp mill liquor tanks (part of other in the emissions inventory)

The existing three tanks from the application are identified as 14 percent weak black liquor tanks, 44 percent intermediate black liquor tank, and 63 percent heavy black liquor tank. Emissions are based on tank size thus not increase in project emissions.

ED_013256A_00000447-00021

2.2.2.10. Makedown (part of other in the emissions inventory)

The existing makedown tank is used prior to the recovery boilers to reintroduce solids from ESP into the recovery boilers.

2.2.2.11. #2 recovery boiler (same as the emissions inventory)

The existing #2 recovery boiler has not fired black liquor since 2012. The mill has records that the unit has made steam after 2012. The mill has minimally fired the unit on natural gas. The unit has been maintained to produce steam as needed during other unit maintenance periods. The mill has identified two sets of activities, inspection, and repair as needed. And, update of equipment to current controls and safety standards. These activities will not increase design capacity or actual performance of the furnace (steaming rate, rated heat input capacity, or BLS firing rate). Boise has indicated that these activities qualify as routine maintenance and repair. Ecology's review was not based on these activities meeting this definition.

2.2.2.12. #3 recovery boiler (same as the emissions inventory)

The existing #3 recovery boiler has been the only unit firing black liquor since 2012.

2.2.2.13. #2 smelt tank (same as the emissions inventory)

The existing #2 smelt tank has been idle since the #2 recovery boiler has not been firing black liquor for six years.

2.2.2.14. #3 smelt tank (same as the emissions inventory)

The existing #3 smelt tank has been operated continuously. Boise proposes to increase the height of the #3 smelt dissolving tank stack to at least 61.51 meters. The higher stack was not relied on for modeling.

2.2.2.15. Lime kiln (same as the emissions inventory)

The existing lime kiln has been operating at it lower operating range. In the future, the lime kiln will be operating at near capacity with lower NO_X emission factors. The lime kiln is the normal control for the NCG system.

2.2.2.16. Slaker (part of other in the emissions inventory)

The existing slaker should have minor increase in emissions.

2.2.2.17. Storage piles (not in the emissions inventory)

The storage piles will increase in size to accommodate the increase in pulping rate.

2.2.2.18. Other (not in the emission inventory)

The existing other sources.

ED_013256A_00000447-00022

2.2.2.19. Steam demand

The steam demand historically has been 565,000 lb/hr (annual average) and will increase to 791,000 lb/hr (annual average). The demand will increase by 226,000 lb/hr (annual average) with the recovery boilers generating an additional 229,000 lb/hr (annual average).

2.2.2.20. Historic and projected annual throughputs

The project will result in a daily increase in pulp throughput due to the #2 M&D digester modification but no increase in short-term BLS throughput at the recovery furnaces.

ED_013256A_00000447-00023

3. PSD Applicability Review

3.1. Overview and permitting history

As noted in Section 2.1.1, the proposed project will require a PSD permit because both the project's emissions (increase/decreases) and the net contemporaneous emissions increase/decreases caused by the project exceed PSD SERs for NSR pollutants, including greenhouse gases (GHGs). This section describes how the PSD applicability determination was performed.

The proposed project at Boise requires PSD review. In accordance with the requirements of 40 CFR 52.21(a)(2), these emission increases associated with the modified and existing units can be based on their potential to emit (PTE) or modified units is projected actual emissions and baseline actual emissions (BAE). BAE is defined in 40 CFR 52.21(b)(48) as "means the rate of emissions, in tons per year, of a regulated NSR pollutant, as determined in accordance with paragraphs (b)(48)(i) through (iv) of this section.

(i) For any existing electric utility steam generating unit, baseline actual emissions means the average rate, in tons per year, at which the unit actually emitted the pollutant during any consecutive 24-month period selected by the owner or operator within the 5-year period immediately preceding when the owner or operator begins actual construction of the project. The Administrator shall allow the use of a different time period upon a determination that it is more representative of normal source operation.

(a) The average rate shall include fugitive emissions to the extent quantifiable, and emissions associated with startups, shutdowns, and malfunctions.

(b) The average rate shall be adjusted downward to exclude any non-compliant emissions that occurred while the source was operating above any emission limitation that was legally enforceable during the consecutive 24-month period.

(c) For a regulated NSR pollutant, when a project involves multiple emissions units, only one consecutive 24-month period must be used to determine the baseline actual emissions for the emissions units being changed. A different consecutive 24-month period can be used for each regulated NSR pollutant.

(d) The average rate shall not be based on any consecutive 24-month period for which there is inadequate information for determining annual emissions, in tons per year, and for adjusting this amount if required by paragraph (b)(48)(i)(b) of this section.

(ii) For an existing emissions unit (other than an electric utility steam generating unit), baseline actual emissions means the average rate, in tons per year, at which the emissions unit actually emitted the pollutant during any consecutive 24-month period selected by the owner or operator within the 10-year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received by the Administrator for a permit required under this section or by the reviewing authority for a permit required by a plan, whichever is earlier, except that the 10-year period shall not include any period earlier than November 15, 1990.

ED_013256A_00000447-00024

(a) The average rate shall include fugitive emissions to the extent quantifiable, and emissions associated with startups, shutdowns, and malfunctions.

(b) The average rate shall be adjusted downward to exclude any non-compliant emissions that occurred while the source was operating above an emission limitation that was legally enforceable during the consecutive 24-month period.

(c) The average rate shall be adjusted downward to exclude any emissions that would have exceeded an emission limitation with which the major stationary source must currently comply, had such major stationary source been required to comply with such limitations during the consecutive 24-month period. However, if an emission limitation is part of a maximum achievable control technology standard that the Administrator proposed or promulgated under part 63 of this chapter, the baseline actual emissions need only be adjusted if the State has taken credit for such emissions reductions in an attainment demonstration or maintenance plan consistent with the requirements of § 51.165(a)(3)(ii)(G) of this chapter.

(d) For a regulated NSR pollutant, when a project involves multiple emissions units, only one consecutive 24-month period must be used to determine the baseline actual emissions for all the emissions units being changed. A different consecutive 24-month period can be used for each regulated NSR pollutant.

(e) The average rate shall not be based on any consecutive 24-month period for which there is inadequate information for determining annual emissions, in tons per year, and for adjusting this amount if required by paragraphs (b)(48)(ii)(b) and (c) of this section.

(iii) For a new emissions unit, the baseline actual emissions for purposes of determining the emissions increase that will result from the initial construction and operation of such unit shall equal zero; and thereafter, for all other purposes, shall equal the unit's potential to emit.

Boise is using EPA's Memorandum: "Project Emissions Accounting Under the New Source Review Preconstruction Permitting Program" which was published on March 30, 2018 (83 FR 13745) to determine if the project is having a significant emissions increase. Ecology is reviewing this guidance and will implement the guidance on a case-by-case basis. The use of the guidance did not exclude Boise from being subject to PSD (NO_X and CO). Boise did perform NO_X annual NAAQS and increment modeling within regulatory limits.

Ecology has determined that the additional review of VOC, PM_{10}, and $PM_{2.5}$ is not warranted. Since 1992, Boise has had projects to reduce emissions of PM_{10} and $PM_{2.5}$ thus expanding the increment. The non-PSD pollutants will be required to demonstrate BACT in the minor air permit.

After determining in Section 2.1.1. that there are no physical and operational changes of this project exempted by 40 CFR 52.21(b)(2)(iii)(a through k), (Step 1), the significant emissions increase/decrease analysis looks only at the emissions from the proposed project and is referred to here as Step 2. The significant net emissions increase analysis looks at additional increases and decreases from "contemporaneous" projects at the source and is referred to here as Step 3.

For the significant emissions increase/decrease analysis, the review involves both new emissions units and modification of existing units. The PSD regulations require use of the hybrid test for projects that involve both the addition of new emissions units and the modification of existing emissions units (40 CFR 52.21(a)(2)(iv)(f)). Under the hybrid test, a significant emissions increase/decrease of a regulated NSR pollutant is projected to occur if the sum of the emissions increases/decreases for each emissions unit, using the actual (BAE)-to-projected-actual applicability test (40 CFR 52.21(a)(2)(iv)(c) for modified units and the actual(BAE)-to-potential applicability test (40 CFR 52.21(a)(2)(iv)(d)) for new units, equals or exceeds the significance threshold for that pollutant as defined in paragraph 40 CFR 52.21(b)(23).

The actual (BAE)-to-projected-actual applicability test involves adding the projected actual emissions from existing emissions units that are modified as part of the project or that are otherwise expected to experience an emission increase as a result of the project, and then subtracting the past actual emissions (called the "baseline actual emissions") from those units.

In lieu of projecting future actual emissions for a particular existing emissions unit, an applicant can choose instead to use the unit's PTE as the unit's post project emissions (40 CFR 52.21(b)(41)(ii)(d)). The actual(BAE)-to-potential test, which is required for all new units being constructed as part of the project, involves totaling the potential emissions of the proposed new emissions units, then subtracting baseline actual emissions of those units. A new unit that is being constructed as part of the project has a baseline actual emission rate of zero (40 CFR 52.21(b)(48)(iii)).

If the project would result in a significant emissions increase, then a significant net emissions increase analysis is often conducted. However, EPA has clearly stated that calculating a net emissions increase is at the source's option (see, for example, 67, Federal Register 80186, at 80197 [December 31, 2002]). Therefore, a source may seek a PSD permit based on a calculated significant emission increase/decrease alone. The mill is an existing major source for PSD, Boise found that emissions for three (3) regulated NSR pollutants were considered to have significant emissions increases. Boise also performed a netting analysis with no pollutant netting out of PSD (see Sections 3.3.1 and 3.3.2). Because of the netting analysis, three pollutants had significant net emissions increases.

The modification of the #3 paper machine and #2 M&D digester, therefore, triggers PSD review for the three regulated NSR pollutants.

3.2. Significant emissions increases calculation

The project will involve modifying existing emission units. Therefore, the hybrid test, described in the previous section, is required. Test results for modified units are presented in this section followed by a summary hybrid test table.

3.2.1. Actual-to-potential test for new project units

No new emissions units.

ED_013256A_00000447-00026

3.2.2. Actual (BAE)-to-projected-actual applicability test for modified, debottlenecked, or other affected emissions units

Debottlenecking is the term used for situations when emission units upstream or downstream from the unit(s) undergoing a physical change or change in the method of operation will experience an emission increase as result of the project.

Other affected emissions units could experience increased utilization due to the project. Boise has determined that certain emission units upstream or downstream from the unit(s) undergoing a physical change or change in the method of operation will experience increased utilization as result of the project. Additional emissions from units with increased utilization are calculated using an actual (BAE)-to-projected-actual applicability test.

As described in Section 3.1, the actual (BAE)-to-projected-actual applicability test involves adding the projected actual emissions from existing emissions that are expected to experience an emission increase/decrease as a result of the project, and then subtracting the past actual emissions (called the "baseline actual emissions") from those units.

When calculating projected actual emissions, 40 CFR 52.21(b)(41)(ii)(c) requires that Boise: "Shall exclude, in calculating any increase in emissions that results from the particular project, that portion of the unit's emissions following the project that an existing unit could have accommodated during the consecutive 24-month period used to establish the baseline actual emissions under paragraph (b)(48) of this section and that are also unrelated to the particular project, including any increased utilization due to product demand growth…" These emissions are referred to in this TSD as "Excludables." Boise did not use demand growth exclusion because the majority of the emissions were a result of the project.

For existing emission units that are being modified, debottlenecked, or other affected units experiencing increased utilization as part of the project, the PSD baseline actual emissions are emissions averaged over a 24 consecutive month period. According to 40 CFR 52.21(b)(48)(ii), the 24-month period must occur "within the 10-year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received."

For a regulated NSR pollutant, when a project involves more than one emission unit, only one 24 consecutive month period may be used to determine the baseline actual emissions for all emission units being changed. However, a different 24 consecutive month period can be used for each regulated NSR pollutant (40 CFR 52.21(b)(48)(ii)(d)).

For baseline emissions, Boise chose the following 24-month periods for the pollutant:

Table 2: Boise's Chosen Dates for Baseline Actual Emissions

24-month Period	Pollutant(s)
January 2008–December 2009	PM, PM_{10}, $PM_{2.5}$, Lead
January 2010–December 2011	NO_X, CO_2e, SO_2, H_2SO_4, VOC, TRS
January 2013–December 2014	CO

3.2.2.1. Start-up and shutdown, and malfunction (SSM) emissions

This project does not have any elevated emissions from startup and shutdown that need to be accommodated. In addition, no alternative operating modes that needs to be considered.

3.2.3. Changes from historical emission inventory

The PSD emissions followed historical methodologies with the following exceptions:

- VOC emissions were calculated on as-compound basis rather than an as-carbon basis.
- Condensable PM emissions were added.
- VOC emissions from the NCG auto vent were added.
- The historical emissions did not include emissions from the paper machines except for the VOC from coating.
- Previously inventories included NO_X emissions from smelt dissolving tanks. NCASI believes this was a faults reading due to ammonia.
- The decker and the decker filtrate tank emissions were historically over reported.

The following equipment has been updated based on the newest NCASI emission factors.

- Knot tank
- Decker filtrate tank
- 63% - heavy black liquor tank
- 44% - intermediate black liquor tank
- 14% - week black liquor tank
- Makedown tank
- Slaker
- NCG auto vent

3.2.3.1. No. 3 paper machine actual (BAE)-to-projected-actual applicability test

Table 3 presents Boise's estimated emissions for the No. 3 PM.

Table 3: Emissions Increases of Regulated NSR Pollutants for No. 3 Paper Machine (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	1.21	0.54	4.38	4.38	3.29	0.0	0.0	4.88	0.0	*	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*	*
Projected emissions	0.0	0.0	5.15	5.15	2.58	0.0	0.0	33.14	0.0	*	*
Change in emissions	-1.21	-0.54	0.77	0.77	-0.71	0.0	0.0	28.26	0.0	*	*

* Zero, negligible, or not applicable.

Boise had not reported these emissions in the past annual emissions inventory. The past emission factors were based on bleached Kraft coated paper while the projected emissions are based on unbleached Kraft paper. The PM and VOC emissions factors were taken from NCASI Technical Bulletin No. 1020 and 973. One PM test for projected emissions and median of three PM test for BAE. The NCASI articles identified various sources of VOC, chemicals added at the paper machine, VOC contained in the pulp (bleached or unbleached). The VOC contained in the pulp is a function of the water used to recover chemicals and clean the pulp (Clean Condensate Alternative - CCA). In 2003, Ecology approved Boise's CCA plan to reduce HAP's from the Kraft mill. The projected emission factor for VOCs from paper machines is derived from the value presented in Table 4.33, NCASI Technical Bulletin No. 973, Compilation of 'Air Toxic' and Total Hydrocarbon Emissions Data for Pulp and Paper Mill Sources – A Second Update, February 2010. The VOC emission factor of 0.51 lb/ADTFP represents non-CCA mills, and therefore it cannot be used as is for a CCA mill such as the Wallula mill. The factor is adjusted to be representative of CCA Mills by multiplying by an adjustment ratio. This adjustment ratio is determined by dividing the acetaldehyde, methanol, and formaldehyde emission factors in Table 4.33, (converted to a lb C basis) for CCA mills by non-CCA mills, given that these are the only factors that provide a direct comparison between both types of mills. The VOC emission factor (as C) is converted to a lb VOC basis based on the carbon content of the VOC constituents in the Non-Clean Condensate mills which were tested for VOC. The adjustment ratio was determined as 6.88. The modified VOC (as C) emission factor is calculated as 7.41E-02 lb/ADTP. It is converted on a lb VOC basis using a lb VOC/lb VOCs (as C) ratio of 1.74, determined from the speciated HAP data for Non-Clean Condensate Mills in Table 4.33, NCASI Technical Bulletin No. 973. The resulting VOC emission factor of 0.129 lb/ADTP is used. The VOC emissions were adjusted due to emissions from coating operations.

3.2.3.2. Pulping and washing

This equipment Kamyr and M&D digesters are changing the Kappa number (coking time, chemical addition, and steam rate). The maximum historic daily Kamyr pulp rate will increase from 770 ODT/day to 980 ODT/day (annual average). The #3 PM also is projected to use up to 365 ODT/day from the M&D digesters for a total of 1,345 MDT/day. The #2 M&D digester will be modified to increase short-term capacity from 210 to 300 ODT/day. MDT includes the paper moisture while ODT is only the pulp weight.

Boise reported emissions inventory for the pulping and washing operations as following for the baseline years; VOC of 39 tpy (2009) and 46 tpy (2010) and TRS was not reported for the baseline years of 2010 2011. Boise has updated the emissions into the following areas but has not included emissions form the Neutral Sulfite Semi Chemical (NSSC) Pulping Process, which is unchanged by the project.

ED_013256A_00000447-00029

3.2.3.3. Brown stock washers (Kamyr and M&D digesters) actual (BAE)-to-projected-actual applicability test

Table 4 presents Boise's estimated emissions for brown stock washers.

Table 4: Emissions Increases of Regulated NSR Pollutants for Brown Stock Washers (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	163.53	0.0	55.11	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	122.85	0.0	11.03	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-40.68	0.0	-44.07	*

* Zero, negligible, or not applicable.

Note: Separate VOC emission factors are used for bleached paper production (during the baseline period) and unbleached paper production (for projected emissions). The emission factors used are based on an analysis conducted by NCASI to distinguish between brownstock washer emissions from bleached vs. unbleached pulp production. The analysis was conducted using data from NCASI Technical Bulletin Number 973, Table A-4a (updated October 2015) for methanol emissions. The methanol emission factors are used, because they are higher than VOC emission factors determined by NCASI in the same analysis using data from Technical Bulletin Number 1020, Table A-6. The emissions rates used were develop by Zach Emerson, NACSI in a letter dated April 16, 2018.

Separate TRS emission factors are used for bleached paper production (during the baseline period) and unbleached paper production (for projected emissions). The emission factors used are based on an analysis conducted by NCASI to distinguish between brownstock washer emissions from bleached vs. unbleached pulp production. The analysis was conducted using data from NCASI Technical Bulletin Number 973, Table A-4b (updated October 2015). The emissions rates used were develop by Zach Emerson, NACSI in a letter dated April 16, 2018.

3.2.3.4. Deckers (Kamyr and M&D digesters) actual-to-projected-actual applicability test

Table 5 presents Boise's estimated emissions for Deckers.

Table 5: Emissions Increases of Regulated NSR Pollutants for Deckers (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.55	0.0	11.03	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.57	0.0	17.94	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.03	0.0	6.91	*

* Zero, negligible, or not applicable.

The VOC emissions factors were taken from NCASI Technical Bulletin No. 1020 and assumed that the emissions were all methanol.

3.2.3.5. Knot tank (Kamyr and M&D digesters) actual (BAE)-to-projected-actual applicability test

Table 6 presents Boise's estimated emissions for Knot Tank.

Table 6: Emissions Increases of Regulated NSR Pollutants for Knot Tank (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.79	0.0	0.03	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.29	0.0	0.04	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.50	0.0	0.01	*

* Zero, negligible, or not applicable.

The VOC emissions factors were taken from NCASI Technical Bulletin No. 678.

3.2.3.6. Chemical Recovery

The shutting down of the bleach plant and changes to the Kraft mill will not increase the short-term amount of black liquor generated compared to past years. The annual utilization will increase.

3.2.3.7. No. 3 recovery boiler actual (BAE)-to-projected-actual applicability test

Table 7 presents Boise's estimated emissions for No. 3 recovery boiler.

Table 7: Emissions Increases of Regulated NSR Pollutants for No. 3 Recovery Boiler (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e Total	CO2e Non-Biogenic	TRS	Pb
BAE	669.30	299.17	11.82	25.95	24.09	430.62	1.77	47.21	636,492	5,336	3.13	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*	*
Projected emissions	980.04	331.46	17.44	32.30	29.56	465.79	1.99	53.18	734,087	8,065	3.99	*
Change in emissions	310.75	32.30	5.61	6.35	5.47	35.17	0.22	5.98	97,596	2,730	0.86	*

* Zero, negligible, or not applicable.

The above emissions are based on CEMS or emission test data: CO, NO_X, PM, PM_{10}, $PM_{2.5}$ (condensable added based on NCASI data), SO_2, and TRS. Projected CO emissions based on expected emissions based on 300 ppm CO concentration. Condensable PM was added to non-condensable PM test based on NCASI TB 1010.

The VOC emissions factors were taken from NCASI Technical Bulletin No. 1010 and are assumed all methanol. Lead emissions factor was taken from NCASI Database Air Toxics Master Summary Table for Pulp and Paper Mills. Sulfur acid emissions factor was from NCASI TB No. 973. GHG emissions factors were from 40 CFR 98, Subpart A, AA, and C.

Boise #2 and #3 recovery boilers emit carbon dioxide from industrial combustion of biomass in the form of fuel wood, wood waste, wood by-products, and wood residuals shall not be considered a GHG (state of Washington) as long as the region's silvicultural sequestration capacity is maintained or increased (RCW 70.235.020(3)).

3.2.3.8. No. 2 recovery boiler actual (BAE)-to-projected-actual applicability test

Table 8 presents Boise's estimated emissions for No. 2 recovery boiler.

Table 8: Emissions Increases of Regulated NSR Pollutants for No. 2 Recovery Boiler (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e Total	CO2e Non-Biogenic	TRS	Pb
BAE	5.34	72.74	8.36	7.65	6.34	341.70	0.33	8.75	121,628	12,242	0.37	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*	*
Projected emissions	43.48	70.81	7.53	7.63	6.45	321.55	0.33	8.78	129,272	14,164	0.63	*
Change in emissions	38.14	-1.93	-0.83	-0.02	0.11	-20.15	0.0	0.3	7,644	1,922	0.26	*

* Zero, negligible, or not applicable.

The above emissions are based on CEMS or emission test data: CO, NO_X, PM, PM_{10}, $PM_{2.5}$ (condensable added based on NCASI data), SO_2, and TRS. Projected CO emissions based on expected emissions based on 300 ppm CO concentration. Condensable PM was added to non-condensable PM test based on NCASI TB 1010.

The VOC emissions factors were taken from NCASI Technical Bulletin No. 1010 and are assumed all methanol. Lead emissions factor was taken from NCASI Database Air Toxics Master Summary Table for Pulp and Paper Mills. Sulfur acid emissions factor was from NCASI TB No. 973. GHG emissions factors were from 40 CFR 98, Subpart A, AA, and C.

Boise #2 and #3 recovery boilers emit carbon dioxide from industrial combustion of biomass in the form of fuel wood, wood waste, wood by-products, and wood residuals shall not be considered a greenhouse gas (state of Washington) as long as the region's silvicultural sequestration capacity is maintained or increased (RCW 70.235.020(3)).

Boise supplied information supporting that the unit had generated minimal amount of steam over the years of no black liquor burning. Over the last six years, the site has done maintenance to unit to maintain its viability. The expected 2018 maintenance was reviewed and no projects were identified to increase capacity or reliability. Varies activities include inspection followed by unidentified replacement activities therefore Ecology cannot determine if these repairs will be routine maintenance or not.

3.2.3.9. No. 3 smelt dissolving tank actual (BAE)-to-projected-actual applicability test

Table 9 presents Boise's estimated emissions for No. 3 smelt dissolving tank.

Table 9: Emissions Increases of Regulated NSR Pollutants for No. 3 Smelt Dissolving Tank (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	28.43	30.60	22.85	1.52	0.0	6.74	0.0	3.07	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	39.23	41.79	31.09	1.71	0.0	7.6	0.0	3.45	*
Change in emissions	0.0	0.0	10.80	11.19	8.24	0.19	0.0	0.85	0.0	0.39	*

* Zero, negligible, or not applicable.

Filterable PM is based on site emission test results. NCASI memo dated August 18, 2017, on salt dissolving tank is used to estimate condensable PM material and the $PM/PM_{2.5}$ ratio. VOC and SO_2 emissions are from NCASI Technical Bulletin No. 1020. TRS and Lead emissions factors were from NCASI Air Toxics Master Summary Table for Pulp and Paper Mills. The #3 smelt dissolving tank stack will increase from 51.3 meters to 61.51 meters.

3.2.3.10. No. 2 smelt dissolving tank actual (BAE)-to-projected-actual applicability test

Table 10 presents Boise's estimated emissions for the No. 2 smelt dissolving tank.

Table 10: Emissions Increases of Regulated NSR Pollutants for No. 2 Smelt Dissolving Tank

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	2.66	3.04	2.32	0.28	0.0	1.25	0.0	0.57	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	3.91	4.33	3.26	0.28	0.0	1.25	0.0	0.57	*
Change in emissions	0.0	0.0	1.24	1.29	0.95	0.0	0.0	0.0	0.0	0.0	*

* Zero, negligible, or not applicable.

Filterable PM is based on site emission test results. NCASI memo dated August 18, 2017, on salt dissolving tank is used to estimate condensable PM material and the $PM/PM_{2.5}$ ratio. VOC and SO_2 emissions are from NCASI Technical Bulletin No. 1020. TRS and lead emissions factors were from NCASI Air Toxics Master Summary Table for Pulp and Paper Mills. Only data from 2008-2012 was used to develop project emission factors because black liquor was not recovered in 2013-2016.

3.2.3.11. Lime kiln actual (BAE)-to-projected-actual applicability test

Table 11 presents Boise's estimated emissions for the lime kiln.

Table 11: Emissions Increases of Regulated NSR Pollutants for Lime Kiln (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	6.79	52.18	45.25	49.19	49.19	1.82	0.82	4.78	29,775	4.48	0.01
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Projected emissions	10.84	66.11	37.16	41.15	41.15	1.52	0.88	5.14	35,138	4.47	0.01
Change in emissions	4.05	13.93	-8.09	-8.04	-8.04	-0.30	0.06	0.36	5,362	-0.01	0.0

∗ Zero, negligible, or not applicable.

Site-specific emissions factors were developed and used for Projected Actual Emissions for CO, NO_X, SO_2, TRS, non-condensable PM, PM_{10}, and $PM_{2.5}$.

NCASI Technical Bulletin No. 1020 was used VOC and add condensable PM10/PM2.5. Lead emissions factor was taken from NCASI Database Air Toxics Master Summary Table for Pulp and Paper Mills. Sulfuric acid emission factor is from NCASI Technical Bulletin No. 973. GHG emissions factors were from 40 CFR 98, Subpart C, AA, and A.

Fuel oil was only used in 2008-2010, and Boise is still capable of burning fuel oil.

3.2.3.12. Slaker actual (BAE)-to-projected-actual applicability test

Table 12 presents Boise's estimated emissions for the slaker.

Table 12: Emissions Increases of Regulated NSR Pollutants for Slaker (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.26	0.0	0.02	0.0
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.59	0.0	0.3	0.0
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.33	0.0	0.01	0.0

∗ Zero, negligible, or not applicable.

NCASI Technical Bulletin No. 1020 and 973 contains the emissions factors for VOC (methanol) and TRS emissions.

3.2.3.13. Fourteen percent weak black liquor tank actual (BAE)-to-projected-actual applicability test

Table 13 presents Boise's estimated emissions for the 14%-weak black liquor tank.

Table 13: Emissions Increases of Regulated NSR Pollutants for 14%-Weak Black Liquor Tank

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.10	0.0	0.88	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.10	0.0	0.88	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*

∗ Zero, negligible, or not applicable.

NCASI Technical Bulletin No. 1020 was used for and VOC and adjusted from carbon to methanol. TRS emissions factor was taken from NCASI Database Air Toxics Master Summary Table for Pulp and Paper Mills.

3.2.3.14. Forty-four percent intermediate black liquor tank actual (BAE)-to-projected-actual applicability test

Table 14 presents Boise's estimated emissions for the 44%-intermediate black liquor tank.

Table 14: Emissions Increases of Regulated NSR Pollutants for 44%-Intermediate Black Liquor Tank (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.29	0.0	1.15	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.29	0.0	1.15	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*

∗ Zero, negligible, or not applicable.

NCASI Technical Bulletin No. 1020 was used and VOC adjusted from carbon to methanol. TRS emissions factor was taken from NCASI Database Air Toxics Master Summary Table for Pulp and Paper Mills.

3.2.3.15. Sixty-three percent heavy black liquor tank actual (BAE)-to-projected-actual applicability test

Table 15 presents Boise's estimated emissions for the 63%-heavy black liquor tank.

Table 15: Emissions Increases of Regulated NSR Pollutants for 63%-Heavy Black Liquor Tank

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.29	0.0	1.15	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.29	0.0	1.15	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*

* Zero, negligible, or not applicable.

NCASI Technical Bulletin No. 1020 was used and VOC adjusted from carbon to methanol. TRS emissions factor was taken from NCASI Database Air Toxics Master Summary Table for Pulp and Paper Mills.

3.2.3.16. Makedown tank actual (BAE)-to-projected actual applicability test

Table 16 presents Boise's estimated emissions for the makedown tank.

Table 16: Emissions Increases of Regulated NSR Pollutants for Makedown Tank (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.04	0.0	0.05	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.15	0.0	0.05	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.0	0.0	*

* Zero, negligible, or not applicable.

NCASI Technical Bulletin No. 1020 and 849 was used to for VOC and TRS emissions factors.

3.2.3.17. NCG auto vent actual (BAE)-to-projected-actual applicability test

Table 17 presents Boise's estimated emissions for the NCG auto vent, which does not include the controlled emissions from the lime kiln or hog fuel boiler.

Table 17: Emissions Increases of Regulated NSR Pollutants for NCG Auto Vent (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.29	0.0	0.28	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
Projected emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.91	0.0	0.88	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.62	0.0	0.60	*

∗ Zero, negligible, or not applicable.

NCASI Technical Bulletin No. 973 was used and VOC adjusted from carbon to methanol. TRS emissions factor was taken from NCASI Database Air Toxics Master Summary Table for Pulp and Paper Mills. The emissions were adjusted based on the actual and projected hours the bypass valve was open.

3.2.3.18. Fugitive (other than storage piles) actual (BAE)-to-projected-actual applicability test

Table 18 presents Boise's estimated emissions for other.

Table 18: Emissions Increases of Regulated NSR Pollutants for Fugitive (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	0.60	0.21	0.04	0.0	0.0	2.86	0.0	*	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*	*
Projected emissions	0.0	0.0	1.14	0.39	0.07	0.0	0.0	4.72	0.0	*	*
Change in emissions	0.0	0.0	0.54	0.18	0.03	0.0	0.0	1.86	0.0	*	*

∗ Zero, negligible, or not applicable.

Emissions include wastewater treatment, drop points, blowers & unloading, vehicle travel. The Surface Impoundment Modeling System was used to estimate VOC emissions. Drop points/blowers/unloading emissions are based on Chapter 13.2.4 of AP-42. Vehicle travel emissions are based on Chapter 13.2.1-5 of AP-42.

3.2.3.19. Storage piles actual (BAE)-to-projected-actual applicability test

Table 19 presents Boise's estimated emissions for storage piles.

Table 19: Emissions Increases of Regulated NSR Pollutants for Storage Piles (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	TRS	Pb
BAE	0.0	0.0	2.00	1.00	0.40	0.0	0.0	16.66	0.0	*	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*	*
Projected emissions	0.0	0.0	2.32	1.16	0.46	0.0	0.0	19.33	0.0	*	*
Change in emissions	0.0	0.0	0.32	0.16	0.06	0.0	0.0	2.67	0.0	*	*

∗ Zero, negligible, or not applicable.

Emission factors are calculated following the methodology provided in Control of Open Fugitive Dust Sources dated 1988.

3.2.4. Hybrid test – significant emissions increase analysis summary

The total emission increases relating to the project is the sum of the increases and decreases from the existing units (projected actual minus baseline actual emissions) and the PTE from the proposed newly constructed units and is presented in Table 26. The federal rule defines a SER to be equal to or exceeding any of the SERs listed in Table 26 (40 CFR 52.21(b)(23)).

Boise is using EPA's Memorandum: "Project Emissions Accounting Under the New Source Review Preconstruction Permitting Program" which was published on March 30, 2018, (83 FR 13745) to determine if the project is having a significant emissions increase. Ecology is reviewing this guidance and will implement the guidance on a case by case basis. The use of the guidance did not exclude Boise from being subject to PSD (NO_X and CO). Boise did perform NO_X annual NAAQS and increment modeling within regulatory limits.

Ecology has determined that the additional review of VOC, PM_{10}, and $PM_{2.5}$ is not warranted. Since 1992, Boise has had projects to reduce emissions of PM_{10} and $PM_{2.5}$ thus expanding the increment. The non-PSD pollutants will be required to demonstrate BACT in the minor air permit.

In addition to regulated NSR pollutants, GHGs are subject to regulation as of January 2, 2011. EPA's PSD rule under 40 CFR 52.21(b)(49)(iv) states that "beginning January 2, 2011, the pollutant GHGs is subject to regulation if:

a. The stationary source is a new major stationary source for a regulated NSR pollutant that is not GHGs, and also will emit or will have the potential to emit 75,000 tpy CO_2e or more; or

b. The stationary source is an existing major stationary source for a regulated NSR pollutant that is not GHGs, and also will have an emissions increase of a regulated NSR pollutant, and an emissions increase of 75,000 tpy CO_2e or more."

Boise is an existing major stationary source for at least one regulated NSR pollutant that is not GHGs. Based on Table 26, the proposed project is expected to result in a significant increase of two (2) other NSR regulated pollutants. Therefore, because the project will result in an emissions increase of 75,000 tpy of CO_2e, the GHG emissions from the project are also subject to PSD review and are included in Table 26.

Boise triggers PSD for NOx, CO, and GHG based on increased utilization of two recovery boilers and a lime kiln. The project emissions are estimated at 110,602 tpy of CO_2e (11,130 tpy CO_2 non-biogenic). This determination is based on the following facts. Boise #2 and #3 recovery boilers emit carbon dioxide from industrial combustion of biomass in the form of fuel wood, wood waste, wood by-products, and wood residuals shall not be considered a GHG (state of Washington) as long as the region's silvicultural sequestration capacity is maintained or increased (RCW 70.235.020(3)). Ecology will issue the PSD permit for NO_X and CO emissions.

Only three sources have increase in project emission of total CO_2e. The project emissions increase are result of increase in utilization are as follows:

- #2 recovery boiler – 7,644 tpy of CO_2 biogenic
- #3 recovery boiler – 97,596 tpy of CO_2 biogenic
- Lime kiln – 5,364 tpy of CO_2 non-biogenic

The following is the citation from the SIP addressing biogenic GHG PSD permits in the state of Washington: § 52.2497(b) significant deterioration of air quality states the following:

> § 52.2497 (b) Regulations for preventing significant deterioration of air quality. The provisions of § 52.21, except paragraph (a)(1), are hereby incorporated and made a part of the applicable plan for Washington for the facilities, emission sources, geographic areas, and permits listed in paragraph (a) of this section. For situations addressed in paragraph (a)(~~2~~1)(i) of this section, the EPA will issue a Federal PSD permit under § 52.21 to the new major stationary source or major modification addressing PSD requirements applicable to GHGs for all subject emission units at the source, regardless of whether CO_2 emissions resulted from the industrial combustion of biomass or from other sources of GHGs at the facility. EPA will be issuing a GHG only PSD permit to cover the emissions of biogenic CO_2 emissions that are not regulated by the state of Washington.

Based on Table 20, three (3) pollutants have significant emission increases.

Table 20: Total Estimated Project Emissions, Net Emissions, and SERs

Pollutant	Project Estimated Emissions	SER (tpy)	Emissions Greater than SERs (Yes/No)
NO_X	43.76	40	Yes
CO	351.72	100	Yes
SO_2	14.91	40	No
PM	10.37	25	No
PM_{10}	11.88	15	No (50%)
$PM_{2.5}$	6.12	10	No (50%)
VOCs	21.12	40	No (50%)
Lead (Pb)	<0.01	0.6	No
Sulfuric acid (H_2SO_4)	0.29	7	No
Hydrogen sulfide (H_2S)	Negligible	10	No
CO_2e (GHGs) non-biogenic	11,130	75,000	No (WA State permit for non-biogenic)
CO_2e (GHGs) biogenic	99,473	75,000	Yes (EPA permit for all GHG emissions)
Fluorides	Negligible	3	No

Pollutant	Project Estimated Emissions	SER (tpy)	Emissions Greater than SERs (Yes/No)
Total reduced sulfur (TRS)	0.0	10	No
Reduced sulfur compounds	0.0	10	No
Municipal waste combustor/landfill emissions	*	†	No

* The project does not involve municipal waste.
† See 40 CFR 52.21(b)(23).

3.3. Significant net emissions increase calculations

The steps necessary to calculate the net emission increase are outlined in 40 CFR 52.21(b)(3)(i).

When a netting analysis is performed, only the pollutants that have significant emission increases need to go through the analysis.

3.3.1. Netting rules

According to 40 CFR 52.21(b)(3)(i), a net emissions increase means, with respect to any regulated NSR pollutant emitted by a major stationary source, the amount by which the sum of the following exceeds zero: the increase in emissions from a particular physical change or change in the method of operation at a stationary source; and any other increases and decreases in actual emissions at the major stationary source that are contemporaneous with the particular change and are otherwise creditable.

An increase or decrease in actual emissions is contemporaneous with the increase from the particular change only if it occurs between the date five years before construction on the particular change commences; and the date that the increase from the particular change occurs.

An increase or decrease in actual emissions is creditable only if: the reviewing authority has not relied on it in issuing a permit, which is in effect when the increase in actual emissions from the particular change occurs; and the increase or decrease in emissions did not occur at a Clean Unit (with some exceptions). It also includes increase or decrease in fugitive emissions (to the extent quantifiable), for an emissions unit that is part of one of the major source categories.

An increase or decrease in actual emissions of CO, NO_X, and GHG emissions CO_2e that occurs before the applicable minor source baseline date is creditable only if it is required to be considered in calculating the amount of maximum allowable increases remaining available.

An increase in actual emissions is creditable only to the extent that the new level of actual emissions exceeds the old level.

A decrease in actual emissions is creditable only to the extent that the old level of actual emissions or the old level of allowable emissions, whichever is lower, exceeds the new level of actual emissions. It must also be enforceable as a practical matter at and after the time that actual construction on the particular change begins. It must also have approximately the same qualitative significance for public health and welfare as that attributed to the increase from the particular change.

ED_013256A_00000447-00040

An increase that results from a physical change at a source occurs when the emissions unit on which construction occurred becomes operational and begins to emit a particular pollutant. Any replacement unit that requires shakedown becomes operational only after a reasonable shakedown period, not to exceed 180 days.

3.3.2. Netting analysis

Boise has shut down the Bleach plant in May of 2018 and the #1 paper machine in December of 2016. The #3 paper machine coater and IR dryer will be shut down prior to modification of the paper machine.

Boise's construction is expected to occur in late 2018 and be completed in 2018. Therefore, the contemporaneous period for the #3 PM project extends from 2013 through the time in 2018 when the change in project emissions occurs. Table 21 presents the Boise's estimated netting analysis changes in emissions, with specific project notes from the application included for each applicable project.

Table 21: Netting Analysis Changes in Emissions (tpy)

Project	Project Start Date	CO	NO_X	PM_{10}	$PM_{2.5}$	VOC	CO_2e	TRS
BP seal tank	2018	0.0	0.0	N/A	N/A	N/A	0.0	N/A
BP scrubber	2018	0.0	0.0	N/A	N/A	N/A	0.0	N/A
E2 hood exhaust	2018	0.0	0.0	N/A	N/A	N/A	0.0	N/A
E2 tower	2018	0.0	0.0	N/A	N/A	N/A	0.0	N/A
E1 tower	2018	0.0	0.0	N/A	N/A	N/A	0.0	N/A
R8 scrubber	2018	0.0	0.0	N/A	N/A	N/A	0.0	N/A
BP general	2018	-82.94	0.0	N/A	N/A	N/A	0.0	N/A
No. 1 paper machine	2016	0.0	0.0	N/A	N/A	N/A	0.0	N/A
Net emission changes	---	-82.94	0.0	N/A	N/A	N/A	0.0	N/A

3.3.3. Significant net emissions increase analysis summary

Estimated project net emissions and SERs for each of these pollutant are shown in Table 22.

Table 22: Total Estimated Project Net Emissions and SERs

Pollutant	Net Emissions (tpy)	SER (tpy)	Net Emissions Greater than SERs (Yes/No)
NO_X	43.76	40	Yes
CO	268.78	100	Yes
CO_2e (GHGs)	110,603	75,000	Yes

Before and after netting, Boise's # 3PM product triggers PSD for the three (3) pollutants listed in Table 22.

ED_013256A_00000447-00042

4. BACT Review

4.1. Definitions and policy concerning BACT

All new major sources or major modifications are required to utilize BACT for those new and modified emission units that will experience an increase in emissions because of the project. BACT is defined as an emissions limitation based on the maximum degree of reduction for each pollutant subject to regulation, emitted from any proposed major stationary source or major modification, on a case-by-case basis, taking into account cost-effectiveness, economic, energy, environmental, and other impacts (40 CFR §52.21(b)(12)).

Federal guidance requires each PSD permit applicant to implement a "top-down" BACT analysis process for each new or physically or operationally changed emissions unit. Ecology has adopted the top-down BACT process for its BACT determinations. This top-down BACT analysis process consists of five basic steps described below:[2]

Step 1. Identify all available control technologies with practical potential for application to the specific emission unit for the regulated pollutant under evaluation.

Step 2. Eliminate all technically infeasible control technologies.

Step 3. Rank remaining control technologies by control effectiveness and tabulate a control hierarchy.

Step 4. Evaluate most effective controls and document results.

Step 5. Select BACT, which will be the most effective practical option not rejected, based on economic, environmental, and/or energy impacts.

If the applicant proposes to implement the most effective or "top" available control strategy, Step 4 is not necessary.

As shown above, the "top-down" BACT process starts by considering all available emission control technologies, and ranks them for further evaluation from most effective to least effective technically available control technology. The most effective emission reduction technology is then evaluated for economic feasibility. If the technology is proven infeasible based on economics, energy, or other environmental considerations, then the next most stringent level of reduction is considered. The most stringent level of emissions control that is not determined to be technically and economically infeasible is selected as BACT. While the permitting agency makes the final BACT decision, the burden is on the applicant to prove why the most stringent level of control should not be used.

Boise did not provide a 5-step top-down BACT analysis for the project, because the #3 paper machine does not directly emit NOx and CO. Boise considered the #2 M&D digester to only have direct emissions of VOC and TRS. Boise did not consider the emissions from the control

---

[2] See EPA's *Draft New Source Review Workshop Manual*, 1990; and PSD and Title V Permitting Guidance for Greenhouse Gases <http://www.epa.gov/nsr/ghgdocs/ghgpermittingguidance.pdf>.

device. Ecology considered the NO_X and CO emissions from the kiln and hog fuel boiler to be subject to BACT.

4.2. BACT analysis for #3 paper machine and #2 M&D digester (NCG)

This section presents a BACT analysis for the applicable emission units and their pollutants for #3 paper machine.

4.2.1. Available control technologies NO_X and CO controls

Boise currently uses direct drying of the wet paper sheet. The elimination of direct drying will eliminate emissions of NO_X and CO from the #3 paper machine is determined to be BACT.

The #2 M&D digester is controlled by the NCG system. The NCG system has three control options, lime kiln (primary control), hog fuel boiler, and auto vent (uncontrolled). The kiln and hog fuel boiler will combust VOC/fuel to form NO_X and CO. The increase in emissions is estimated to be less than 1.0 tpy of each pollutant per emission point.

4.2.2. BACT feasibility review

Table 23 addresses the technical feasibility of implementing each control technology from Section 4.2.1. for the project.

Table 23: Technical Feasibility Assessment

Emission Unit(s)	Control	Technical Feasibility Assessment	Applicable Pollutants
#3 paper machine	Direct drying	Technically feasible	NO_X, CO and GHG
#3 paper machine	Steam drying	Technically feasible	Increase utilization of #2 and #3 recovery boilers
#2 M&D digester (NCG)	NO_X & CO controls	Technically feasible	NO_X and CO (minor emissions)
#2 M&D digester – lime kiln controls	Lime kiln with a minimum temperature of 1200°F (650°C) for at least 0.5 second, consistent with 40 CFR 283a(1)	Technically feasible	CO

Emission Unit(s)	Control	Technical Feasibility Assessment	Applicable Pollutants
#2 M&D digester – hog fuel boiler	Hog fuel boiler with a minimum temperature of 1200°F (650°C) for at least 0.5 second, consistent with 40 CFR 283a(1). Limited to 1,200 hours per year.	Technically feasible	CO

BACT (NO_X and CO) for the #3 paper machine is the use of steam drying and the shutdown of direct drying.

BACT (NO_X) for lime kiln and hog fuel boiler is limiting the increase in emissions to less than 1 tpy.

BACT (CO) for lime kiln and hog fuel boiler is maintaining a combustion temperature of at least 1200°F (650°C) consistent with 40 CFR 283a(1).

4.2.3. #2 D&M digester modification

This section addresses NO_X and CO control including: ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for NO_X and CO. Emissions from the #2 M&D digester are vented to the non-condensable gas vent (NCG) system. The NCG is a combination of various high concentrations of TRS compounds and VOCs, which can be controlled by the lime kiln, hog fuel boiler, or auto vent. The primary control is the lime kiln, which is subject to the following requirements for:

The No. 1 and No. 2 M&D digesters TRS – Treat all collectible NCG to reduce VOC emissions equal to reduction achieved by thermal oxidation in a lime kiln or other combustion unit. This results in emissions of NO_X and CO. The Mill is currently subject to 40 CFR 63.450 (40 CFR 63.443) and 40 CFR 60.283a(1)(1)(iii) which requires the combustion in a lime kiln or other combustion device (hog fuel boiler) subject to the minimum temperature of 1200°F (see 4.3.2 of Boise's application).

4.3. Toxic air pollutants

PSD rules require the applicant to consider emissions of TAPs during the course of a BACT analysis, but specifically exempt all pollutants subject to regulation under Section 112 of the federal Clean Air Act from regulation under the PSD program.

The emissions of TAPs will be covered in the Ecology's industrial air permit NOC approval for this project.

5. Ambient Air Quality Impacts Analysis

5.1. Regulatory requirements

For PSD, an ambient Air Quality Impacts Analysis (AQIA) is required for all pollutants that are emitted in significant quantities to determine the ambient impacts associated with the construction and operation of the proposed modifications. The main purpose of the air quality analysis is to demonstrate that new emissions emitted from the proposed major stationary source or major modification will not cause or contribute to a violation of any applicable NAAQS or PSD increment.

The input to the models can be broken down into long term and short-term impact analysis. The long-term impact are determine based on the difference between the projected actual emissions and actual emissions defined in 40 CFR 52.21(b)(21).

(i) Actual emissions means the actual rate of emissions of a regulated NSR pollutant from an emissions unit, as determined in accordance with paragraphs (b)(21)(ii) through (iv) of this section, except that this definition shall not apply for calculating whether a significant emissions increase has occurred, or for establishing a PAL under paragraph (aa) of this section. Instead, paragraphs (b)(41) and (b)(48) of this section shall apply for those purposes.

(ii) In general, actual emissions as of a particular date shall equal the average rate, in tons per year, at which the unit actually emitted the pollutant during a consecutive 24-month period which precedes the particular date and which is representative of normal source operation. The Administrator shall allow the use of a different time period upon a determination that it is more representative of normal source operation. Actual emissions shall be calculated using the unit's actual operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period.

(iii) The Administrator may presume that source-specific allowable emissions for the unit are equivalent to the actual emissions of the unit.

(iv) For any emissions unit that has not begun normal operations on the particular date, actual emissions shall equal the potential to emit of the unit on that date.

Federal and Washington State PSD regulations require a demonstration that the project does not cause or contribute to a violation of the NAAQS (WAC 173-720(4)(a)(vi) and 40 CFR 52.21(k).

ED_013256A_00000447-00046

The following is a summary of the long-term inputs used for the modeling files (NO_X SIL):

Table 24: NO_X SIL Modeling Input Files

Source/Emissions	Actual Emissions (2015-2016) Grams/Second	Project Actual Emissions Grams/Second	Increase in Emissions Grams/Second
#3 Paper Machine	None	None	None
#2 Recovery boiler	0.4155	2.037	1.6215
#3 Recovery Boiler	7.35	9.535	2.185
Lime Kiln	1.848	1.902	0.0540
Hog Fuel Boiler	6.912	6.912	None
Power Boiler 1	1.374	1.374	None
Power Boiler 2	1.528	1.1528	None

Note: Emission rate is based on 8760 hours.

The AQIA starts with preliminary modeling for each pollutant to determine whether an applicant can forego detailed analysis and preconstruction monitoring. If the projected ambient concentration increase for a given pollutant is below the PSD Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMCs) for each averaging period, no further analysis of the ambient impact is required for that pollutant. While secondary emissions are not included when determining PSD applicability, they are included when considering air quality impacts. The impacts to Class I and Class II areas (see Tables 31 and 36, respectively).

For those pollutants with averaging periods that have impacts greater than the SIL, a full impact analysis (taking into account other increment consuming sources) is used to demonstrate compliance with NAAQS and PSD increments.

Typically, the AQIA includes an analysis of impacts to local areas that are within 50 kilometers (km) of the project, and a regional air quality impact assessment for impacts beyond 50 km. For projects in Washington State, this latter analysis usually includes impacts on Class I areas.

The AERMOD dispersion model was used for predicting local impact concentrations. The background NO_2 concentration was from NW AirQuest Consortium (2009-2011 design values). Community Multi-Scale Air Quality (CMAQ) model was used to develop the background concentrations.

5.2. Maximum criteria pollutant concentrations predicted by AERMOD

Using project emissions only, AERMOD predicted impacts for criteria pollutants compared to SILs and Monitoring de minimis levels or SMCs are presented in Table 25.

Table 25: Maximum Criteria Pollutant Concentrations Predicted by AERMOD for Class II

Criteria Pollutant	Avg. Period	Max AERMOD Concentration in Class II Areas (μg/m³)	SIL (μg/m3)	SMC (μg/m3)	Is AERMOD Concentration Greater than Applicable SIL or SMC?
NO_X	Annual	1.28	1	14	SIL Yes

Because the project impacts are greater than the SILs, a full impact analysis (taking into account other increment consuming sources) is required to demonstrate compliance with NAAQS and Class II PSD increments. NAAQS compliance is assumed and compliance with WAAQS is assumed by compliance with NAAQS.

In addition to considering NAAQS, Ecology also considered the general vicinity around this project about general environmental justice concerns. In Ecology's analysis, it is noted that Section 6 of this TSD considered construction and area growth affects (temporary and minimal) due to this project as well as visibility (stack plumes dissipate short distances from the facility due to dispersion and evaporation, of which this project is only a small contributor). Based on this information, along with consideration of the general population of the area, Ecology concludes that minority or low-income populations will not experience disproportionately high and adverse human health or environmental effects due to exposure to relevant criteria pollutants because of this project.

The modelled impact was less than the SMC (14μg/m³ annual average) therefore pre-construction monitoring may be avoided, per 40 CFR 52.21(i)(5)(i).

Cumulative (Full) Impact Analysis

Full impact analysis is required to the pollutant that exceeded the SIL level in the screening analysis. Boise exceeded the Class II SIL for the annual NO_X therefore increment and NAAQS analysis is required. The annual emissions that were modelled is contained in Table 26.

Boise – Modified Units/Annual Emissions

1. #3 paper machine – no increase in NO_X emissions
2. #2 M&D digester – no direct increase in NO_X emissions
    a. Increase in VOC control by the lime kiln or hog fuel boiler (see below).

Boise – Increased Utilization

1. No. 2 recovery furnace
2. No. 3 recovery furnace
3. Lime kiln

Boise – Unaffected Units

1. Two power boilers
2. Hog fuel boiler (minor increase in VOC/fuel from the NCG due to #2 M&D modification).

Facilities in the Area

The major PSD baseline for annual NO_X was established on February 8, 1988, and the minor baseline was established on February 11, 1992.

Boise exceeded the Class II SIL for the annual NO_X therefore increment and NAAQS analysis is required and minor baseline on Feb 11, 1992, can be used to offset the increases from the baseline year. The following companies' emissions for 2015-2016 were used for the NAAQS and increment evaluations in Tables 26 and 27.

The following is a summary of the Boise long-term inputs for the modeling files (NO_X NAAQS).

Table 26: NAAQS Input Files from Boise

Source/Emissions	NO_X Emissions Grams/Second	Basis
#3 paper machine	None	None
#2 recovery boiler	3.203	Emission factor and potential daily throughput
#3 recovery boiler	23.73	Allowable NO_X emission limit
Lime kiln	4.174	Emission factor and potential daily throughput
Hog fuel boiler	9.862	Allowable NO_X emission limit and 24-month average production rate
Power boiler 1	1.374	Emission factor and 24-month average throughput
Power boiler 2	1.528	Emission factor and 24-month average throughput

Boise adjusted the 1992 emissions data based on actual data or improved emission factors with more current emission inventory. No project as Boise's facility expanded the increment. The 1992 baseline data was not used for nearby sources, which is more conservative.

The following is a summary of the nearby sources long-term inputs used for the modeling files (NO_X NAAQS and increment):

Table 27: NAAQS and Increment Input Files from Nearby Sources

Source/Emissions	NO_X Emissions Grams/Second
Sandvik Special Metals LLC – Etching 1	0.187
Sandvik Special Metals LLC – Etching 2	0.187
Sandvik Special Metals LLC – Etching 3	0.187
Greenbriar Rail Services	0.01942
Gas Transmission Northwest Station 8 – Unit 8B	0.4667
Gas Transmission Northwest Station 8 – Unit 8C	2.945
Gas Transmission Northwest Station 8 – Unit 8A	0.6829
Gas Transmission Northwest Station 8 – Auxl	0.004315
Agrium US Inc – Plant 9	1.256
Agrium US Inc – Boiler	0.0489
Agrium US Inc – Nitric acid concentrator	0.03596
Agrium US Inc – Plant 8	0.09205
Agrium US Inc – NG flare	0.00374
Agrium US Inc – Finley flare	0.002301
LAMPSON INTERNATIONAL LTD	0.1968
TIDEWATER TERMINAL COMPANY - SNAKE RIVER	1.153
ANDEAVOR LOGISTICS OPERATIONS LLC - PASCO TERMINAL	0.7899
TYSON FRESH MEATS INC	0.1102

Note: Emissions are based on average of 2015-2016 emission inventory.

The following is a summary of the Boise long-term inputs used for the modeling files (NO_X increment):

Table 28: NO_X Increment Input Files from Boise

Source/Emissions	Modeling Rates NO_X Emissions Grams/Second	1992 Baseline Modeling Rates NO_X Emissions Grams/Second	Basis
#3 paper machine	None	None	None
#2 recovery boiler	3.203	---	Emission factor and potential daily throughput
#3 recovery boiler	23.73	-8.285	Allowable NO_X emission limit
Lime kiln	4.174	-2.877	Emission factor and potential daily throughput

Source/Emissions	Modeling Rates NO_X Emissions Grams/Second	1992 Baseline Modeling Rates NO_X Emissions Grams/Second	Basis
Hog fuel boiler	6.912	-6.703	2015-2016 average emission rate
Power boiler 1	1.374	-0.2385	2015-2016 average emission rate
Power boiler 2	1.528	-1.461	2015-2016 average emission rate

The Class II NO_X annual SIL was exceeded therefore the NAAQS (100 $\mu g/m^3$) and Class II increment (25 $\mu g/m^3$) were evaluated and are summarized in Table 35.

Federal and Washington State PSD regulations require a demonstration that the project does not cause or contribute to a violation of the NAAQS or increment (WAC 173-113(3) and WAC 173-720(4)(a)(vi) and 40 CFR 52.21(k). Only receptors exceeding the SIL in the significance models will be included in the NAAQS and increment evaluation. Emission sources affected by the project are modeled at their allowable emission rate. Emission sources unaffected by the project are treated like nearby sources, and their emissions rates are calculated using the maximum allowable emission limit and average throughput of the two most recent years (2015-2016), per Table 8-2 of Appendix W.

Table 29: Maximum Criteria Pollutant Concentrations Predicted by AERMOD for Class II

Criteria Pollutant	Avg. Period	Max AERMOD Concentration in Class II Areas and Background ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Increment ($\mu g/m3$)	Is AERMOD Concentration Greater than Applicable NAAQS or Increment?
NO_X	Annual	31.48	100	---	No
NO_X	Annual	7.24	---	25	No

The design value for Wallula NO_X is 4.4 ppb (8.28ug/m3) and modeled NAAQS concentration of 23.31 $\mu g/m^3$.

5.3. Ozone impacts

NO_X and VOCs are precursors to ozone. Because the proposed emission increases in VOCs and NO_X from the #3 paper machine will not exceed 100 tpy for either pollutant, a demonstration that the project would not cause or significantly contribute to a violation of the ozone NAAQS was not required.

5.3.1. Ozone background information

EPA has set primary and secondary ozone standards to protect human health and welfare. On March 12, 2008, EPA revised the primary and secondary ozone standards to 0.075 ppm for an 8-hr average. And, EPA lowered it again in December 2015 to 0.070 ppm for an 8-hr average.

Ozone is formed in the troposphere when sunlight causes complex photochemical reactions involving NO_X, VOCs, and CO that originate chiefly from gasoline engines and burning of other fossil fuels. Woody vegetation is another major source of VOC emissions to NO_X emissions within the surrounding airshed, and the relative reactivities of the VOC species. NO_X and VOCs can be transported long distances by regional weather patterns before they react to create ozone in the atmosphere, where it can persist for several weeks. Because ozone is a regional pollutant, precursor sources both near and far can contribute to ozone formation.

Breathing ozone can trigger a variety of health problems for humans, including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Elevated levels of ozone can also reduce lung function by inflaming the linings of the lungs. Repeated exposure to elevated concentrations of ozone may permanently scar lung tissue. Ozone is also phytotoxic, causing damage to a variety of vegetation (Ashmore et al., 2004). Ozone pollution has been shown to reduce plant growth, alter species composition, and predispose trees to insect and disease attack. Ozone also causes direct foliar injury to some plant species. Ozone affected leaves are marked with discoloration and lesions, and they age more rapidly than normal leaves (EPA, 2007).

Ozone enters plants through leaf stomata, causing changes in biochemical and physiological process. The mesophyll cells under the upper epidermis of leaves are the most sensitive to ozone, and those are the first cells to die. The adjacent epidermal cells then die, forming a small black or brown interveinal necrotic lesion that becomes visible on the upper surface of the leaf. These lesions, termed oxidant stipple, are quite specific indicators that the plant has been exposed to ozone. Other plant symptoms can result from exposure to ozone. However, these symptoms are non-specific for ozone since other stressors can also cause them to occur. In general, the most reliable indicator that ozone has impacted vegetation is oxidant stipple.

In addition to effecting individual plants, ozone can also affect entire ecosystems. Plants growing in areas with high exposure to ambient ozone may undergo natural selection for ozone tolerance (EPA, 2007). The result could be the elimination of the most ozone sensitive genotypes from the area (National Park Service, 2010).

While VOCs and NO_X are recognized as precursors to the formation of ground level ozone, which is regulated as a criteria pollutant, the FLAG guidance states that "current information indicates most FLM areas are NO_X limited" with respect to the formation of ground level ozone. A NO_X limited region is one where the concentration of ozone depends on the amount of NO_X in the atmosphere. This occurs when there is a lack of nitrogen dioxides, thus inhibiting ozone titration when oxygen mixes with VOCs. In these regions, controlling NO_X would reduce ozone concentrations. A VOC's limited region is one where concentration of ozone depends on the amount of VOCs in the atmosphere. In these regions, controlling VOCs would reduce ozone concentrations. The FLAG guidance further states that "until there is enough information available for FLAG to determine whether ozone formation in each FLM area is primarily limited by NO_X or VOC emissions, we will assume all FLM areas are NO_X limited and will focus on control of NO_X emissions" (FLAG Executive Summary and Section 3.4.5).

ED_013256A_00000447-00052

5.4. Impacts on Class I areas

As shown in Table 36, project impacts in Class I areas are not greater than the SILs. Therefore, an impact analysis (taking into account other increment consuming sources) is not required to demonstrate compliance with NAAQS and PSD increments.

Table 30: Maximum Criteria Pollutant Concentrations Predicted by AERMOD for Class I

Criteria Pollutant	Avg. Period	Max AERMOD Concentration in Class I Areas (µg/m^3)	SIL (µg/m^3)	Is AERMOD Concentration Greater than Applicable SIL?
NO_X	Annual	0.00719	0.1	No

However, in addition to addressing NAAQS and PSD increments, PSD rules require an analysis of air quality related values (AQRVs) on federally mandated Class I areas. Class I areas are defined in the Clean Air Act as having special national or regional value from a natural, scenic, recreational, or historic perspective. Class I areas include national parks over 6,000 acres and wilderness areas and memorial parks over 5,000 acres as of 1977. The impacts to these areas are stringently regulated because they have remained relatively untouched by development.

5.4.1. AQRV background information

PSD regulations and guidance require additional impact analyses to evaluate the effects of the project's emissions on visibility, local soils, and vegetation in Class I and in Class II areas (see Section 6), and the effect of increased air pollutant concentrations on flora and fauna in the Class I areas. The additional impact analyses are also used to evaluate the effect of the project on growth in the area surrounding the project in Class II areas (see Section 6).

The analyses assess increment consumption and impacts on AQRVs in Class I areas. AQRVs include regional visibility or haze, the effects of primary and secondary pollutants on sensitive plants, the effects of pollutant deposition on soils and receiving water bodies, and other effects associated with secondary aerosol formation. The FLMs for the National Park Service, U.S. Fish and Wildlife Service, and U.S. Forest Service have the responsibility of ensuring AQRVs in the Class I areas are not adversely affected. The Federal Land Managers' (FLMs) guidance on evaluating impacts of major projects on Class I areas is the *Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – revised* (2010) (National Park Service, 2010).

In FLAG, the FLMs have developed a tool to screen out projects that would not have a significant impact on AQRVs based on annual emissions and distance from a Class I area. This screening tool is called the Q/D Method, which is to divide the amount of emission increases in tons per year (Q) by the distance to a federal Class I area in km (D). FLAG states that "The FLM role within the regulatory context consists of considering whether emissions from a new source, or emission increases from a modified source, may have an adverse impact on AQRVs and providing comments to permitting authorities. Therefore, the agencies will consider a source locating greater than 50 km from a Class I area to have negligible impacts with respect to Class I

AQRVs if its total SO_2, NO_x, PM_{10}, and H_2SO_4 (sulfuric acid) annual emissions (in tons per year, based on 24-hour maximum allowable emissions), divided by the distance (in km) from the Class I area (Q/D) is 10 or less. The agencies would not request any further Class I AQRV impact analyses from such sources." Boise calculated Q at 6.16 tpy based on emissions increases from the modification of the #3 Paper Machine and #2 M&D digester vented to the NCG vent. The NCG vent has three emissions options, direct vent, Lime Kiln, and Hog fuel boiler.

5.4.2. Boise AQRV analysis

For the Boise's #3 PM project, the only pollutants that would have a significant net increase are NO_X, CO, and GHG. Q (tpy) is defined on page 24 of the Flag guidance as the tpy of the PM10, SO_2, NO_X, and H_2SO_4 that have a net increase in the 24-hour allowable rate. The Q/D values for each Class I area in Washington is presented in Table 37. Q was determined to be 6.16 tpy (PM_{10} – 4.55 and SO_2 – 1.61).

Table 31: Class I Areas within 200 km of the Boise Facility

Area	Distance (D) from Boise to Class I Area (km)	Quantity (Q) of Max 24-hr Emission Increase (tpy)	Q Divided by D (Q/D) (tons/km)	Is Q/D Less than 10? (Yes/No)
Eagle Cap Wilderness Area	113	6.16	0.06	Yes
Hells Canyon Wilderness Area	195	6.16	0.03	Yes

Because Q/D is less than 10 for all areas in Table 37, additional Class I AQRV impact analyses are not required. Also as explained in Section 5.2, because project impacts are greater than the SILs, a full impact analysis (taking into account other increment consuming sources) is required to demonstrate compliance with NAAQS and Class II PSD increments. NAAQS compliance is assumed and compliance with WAAQS is assumed by compliance with NAAQS.

5.4.2.1. Soils and receiving water bodies (deposition)

Ecology did not require Boise to perform a deposition analysis because the project emission rates for SO_2 are below the SERs and the Q/D is less than 10. In addition, the other pollutants emitted by the project are not expected to contribute to impacts on soil and vegetation in the area surrounding the Wallula Mill.

5.4.2.2. Visibility (Class I areas)

Because Q/D is less than 10 for all areas in Table 37, a visibility analysis in Class I areas is not required.

ED_013256A_00000447-00054

6. Additional Impacts Analysis

6.1. Construction and growth impacts

The project will increase traffic. No new area homes or industry is anticipated during construction or after construction because of the project. Impacts from new commercial development are assumed minimal, as the project will occur within the existing fenceline of Boise property.

The number of employees at Boise is expected to remain the same because of this project. During construction of this project, there will be approximately 700 additional employees on-site. The existing traffic on the main highway to the facility (Washington State Route 12) will increased traffic due to construction and once operational, are both expected to be negligible by comparison.

During this time, there will be increased traffic congestion, increased vehicle emissions, and increased demand for local skilled workers. However, because construction is expected to last only 3 weeks, these increases are expected to be temporary and insignificant. Therefore, the proposed project is not expected to cause adverse construction and growth related impacts.

6.2. Visibility

As noted in the application, the 1990 draft NSR Workshop Manual provides the following description of a Class II visibility analysis in Chapter D, Section II.D:

"In the visibility impairment analysis, the applicant is especially concerned with impacts that occur within the area affected by applicable emissions. Note that the visibility analysis required here is distinct from the Class I area visibility analysis requirement. The suggested components of a good visibility impairment analysis are:" (addressed for each below the listed components in italics font):

- *"a determination of the visual quality of the area,"*

Regarding area regional haze, pre-existing visible water vapor (steam) plumes can be seen from the mill which dissipate short distances from the facility due to dispersion and evaporation.

- *"an initial screening of emission sources to assess the possibility of visibility impairment, and"*

The project emissions are located within the existing Paper Machine buildings and stacks so that after the project is completed, the project emission sources are likely to increase water vapor impair local visibility.

- *"if warranted, a more in-depth analysis involving computer models."*

As noted in the application: "The Q/D screening values for the Project indicate that emissions from the Project will not significantly impact visibility in either Class I or sensitive Class II

ED_013256A_00000447-00055

areas." Normally for other Class II areas, the analysis provided for regional haze appears to be sufficient. The National Park Service requested that the Whitman Mission National Historic Site be evaluated for visibility impacts (Not a Class I area). Boise used Level 1 VISCREEN to evaluate visibility impacts. The inputs to the model were NO_X - 0.0 lb/hr and PM_{10} - 1.45 lb/hr. The model used a distance is 35.2–36.3 km.

Table 32: Level 1 VISCREEN Results – Whitman Mission National Historic Site (Class II Area – Request of the National Parks Service)

	Highest Value	Casual Observer Perceptibility	Best-Estimate Observer Perceptibility	Lower-Bound Observer Perceptibility
Delta E	0.072	2	0.8	0.2
Contrast	0.001	0.05	0.02	0.005

Note: For information only. No regulatory levels of concern.

6.3. Soils and vegetation analysis

Regarding economic impacts of the project on vegetation and soils, or agriculture and forestry, the project emissions comply with primary and secondary NAAQS, which were intended to address factors such as soils and vegetation.

The following excerpt from the application, which further addresses project impacts on soils and vegetation, is pasted below:

"For most types of soils and vegetation, ambient concentrations of criteria pollutants below the secondary NAAQS will not result in harmful effect. Comparison to these standards is used as the primary criteria for determining whether or not the No. 3 Paper Machine rebuild project will result in significant impacts on soil and vegetation in the area. Since the modeling analysis demonstrated compliance with the primary and secondary NO2 NAAQS, the No. 3 Paper Machine rebuild project will not cause any significant air quality imparts on the soil and vegetation in the area."

Based on these impacts in the application, Ecology believes Boise has satisfactorily addressed project impacts on Class II soils and vegetation.

7. Environmental Justice

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Ecology conducts EJ review to ensure no group of people bears a disproportionate share of the negative environmental consequences as the result of the permitting action.

The initial step in this review is to identify any affected populations or communities of concern. Ecology used EPA's environmental justice screening and mapping tool EJSCREEN. The area of the map shown below, which includes a total of 121 square miles was selected for the analysis.

ED_013256A_00000447-00057

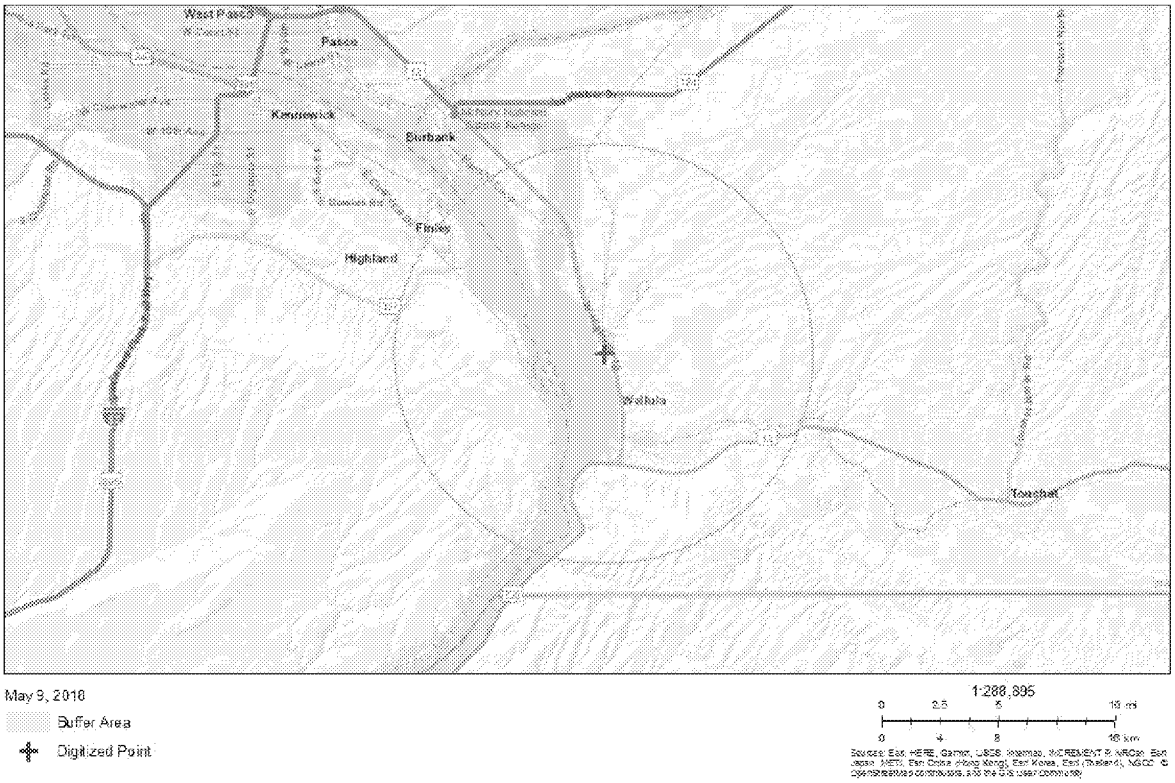


Figure 3: Environmental Justice Screening Map

The EJSCREEN American Community Survey (ACS) report estimates that approximately 29 percent of the population (1,582) in the area consists of minorities, with approximately one percent of the total population speaking English "less than well." A copy of the ACS report with more detailed information will be filed as part of the supporting documentation for the project.

The NAAQS analysis indicates that the project is protective of the community as a whole and no other review is needed. It also appears that a majority of the population in the selected area can understand and speak English proficiently. Ecology is not expecting any communication barrier to posting notice on the legal page of the predominant newspaper in the Wallula area in both English and Spanish. Ecology also determines that an enhanced outreach effort is not needed due to the nature and scope of this project.

8. State Environmental Policy Act

Under Washington State rules, a final PSD permit shall not be issued for a project until the applicant has demonstrated that State Environmental Policy Act (SEPA) review has been completed for the project. Ecology's Industrial Section is the lead agency for SEPA.

On xxxxxxx, Ecology's Industrial Section issued the Final Determination xxxxx. In accordance with the SEPA process. As noted in the Final SEPA xxx: "no new significant impacts have been identified" and "seven days following publication of the Final XXX, permits for the Proposed Action may be issued based on the regulatory requirements for each permit process."

Ecology concludes that the applicant has adequately demonstrated compliance with SEPA requirements.

ED_013256A_00000447-00059

9. Public Involvement

This PSD permitting action is subject to a minimum 30-day public comment period under WAC 173-400-740. A newspaper public notice announcing the public comment period was published in the Tri-City Herald on XXX. In accordance with WAC 173-400-740(2)(a), application materials and was made available for public inspection at:

Burbank Library Burbank Library
875 S. Lake Road
Burbank, WA 99323
509-545-6549

Washington State Department of Ecology
Air Quality Program
300 Desmond Drive SE
Lacey, WA 98503
360-407-6800

- A public hearing on the proposed PSD was held on August 27, 2018, at the Burbank Library Burbank Library - Walla Walla County Rural Library District, in Burbank, WA.

ED_013256A_00000447-00060

10. Agency Contact

Scott Inloes, P.E.
Washington State Department of Ecology
Air Quality Program
P.O. Box 47600
Olympia, WA 98504-7600
360-407-6314
Scott.inloes@ecy.wa.gov

ED_013256A_00000447-00061

References

Ashmore, M., Karlsson, P.E., and H. Pleije, New directions: a new generation of ozone critical levels for the protection of vegetation in Europe (correspondence), *Atmospheric Environment*, 38: 2213-2214, 2004.

Brace, S., Peterson, D. L., and D. Horner, Diagnosing Ozone Injury in Vascular Plants of the Pacific Northwest, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 1998.

California Air Resources Board, Statewide BACT Clearinghouse, <http://www.arb.ca.gov/bact/bact.htm>, California Environmental Protection Agency, Sacramento, California, 2014.

EPA, *Draft EPA New Source Review Workshop Manual*, 1990. Available at:

<http://www.epa.gov./ttn/nsr/gen/wkshpman.pdf>

-----, *EPA Air Pollution Control Cost Manual*, Sixth Edition (EPA 452/B-02-001), January 2002. Available at: <http://www.epa.gov/oaqps001/lead/pdfs/2002_01_cost_control_%20manual.pdf>

-----, Review of the National Ambient Air Quality Standards for Ozone: Policy Assessment of Scientific and Technical Information, EPA-452/R-07-007, 2007.

-----, RACT/BACT/LAER Clearinghouse, RBLC Database, Technology Transfer Network Clean Air Technology Center, 2014. Available at: <http://cfpub.epa.gov/RBLC/index.cfm?action=Home.Home&lang=en>

National Park Service, *Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I report – revised 2010)*, 2010. Available at: <http://www.nature.nps.gov/air/pubs/pdf/flag/Flag_2010.pdf>

South Coast Air Quality Management District, SCAQMD Clearinghouse, Diamond Bar, California, 2014. Available at: <http://www.aqmd.gov/bact/287160.htm>

ED_013256A_00000447-00062

Acronyms and Abbreviations

°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
ALW	Alpine Wilderness
AQIA	Air Quality Impacts Analysis
AQRV	Air Quality Related Values
BACT	Best Available Control Technology
CARB	California Air Resources Board
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FLAG	Federal Land Managers' Air Quality Relative Values Workgroup
FLM	Federal Land Manager
FR	Federal Register
GHG	greenhouse gas
H_2SO_4	sulfuric acid mist
HAPs	hazardous air pollutants
hr/yr	hours per year
kW	Kilowatt
MACT	maximum achievable control technology
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOC	Notice of Construction
NO_X	nitrogen oxides
NPS	National Park Service
NSR	New Source Review
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
PTE	potential to emit

ED_013256A_00000447-00063

Q/d	emissions to distance
RBLC	RACT/BACT/LAER Clearinghouse
SCR	selective catalytic reduction
SEPA	State Environmental Policy Act
SER	significant emission rate
SIL	significant impact level
SO_2	sulfur dioxide
SO_X	sulfur oxides
TAP	toxic air pollutant
tpy	tons per year
VOC	volatile organic compound
WAC	Washington Administrative Code

ED_013256A_00000447-00064

Message

From: McAlpine, Jerrold [McAlpine.Jay@epa.gov]
Sent: 7/31/2018 5:10:40 PM
To: Ken Merrill [kmerrill@kalispeltribe.com]
CC: Dhammapala, Ranil (ECY) [rdha461@ecy.wa.gov]; Bray, Dave [Bray.Dave@epa.gov]
Subject: RE: Hi Test Silicon Smelter update
Attachments: PacWest_Newport_PSD_Modeling_Protocol.pdf

Ken,

The applicant sent the protocol and WRF model performance report PDFs yesterday to Ecology, EPA, and the USFS. I had a brief conversation with Ecology and they agreed EPA could distribute to the Tribe. The protocol is attached. I will send a followup email with the performance study attached (16.4 MB) – please let me know if these bounce and if so I can transfer via dropbox or another option.

Jay

Jay McAlpine, PhD
Atmospheric Scientist, Regional Modeling Contact
Office of Air and Waste
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 155, OAW-150
Seattle, WA 98101
206.553.0094
McAlpine.Jay@epa.gov

From: Ken Merrill [mailto:kmerrill@kalispeltribe.com]
Sent: Tuesday, July 31, 2018 9:46 AM
To: McAlpine, Jerrold <McAlpine.Jay@epa.gov>
Subject: RE: Hi Test Silicon Smelter update

Thanks Jay. We have not seen it from Ecology yet and we would appreciate seeing the draft protocol as soon as possible. --Ken

Ken Merrill
Water Resources Program
(509) 447-7276 (office)
(509) 209-0069 (cell)

From: McAlpine, Jerrold <McAlpine.Jay@epa.gov>
Sent: Monday, July 30, 2018 3:40 PM
To: Ken Merrill <kmerrill@kalispeltribe.com>
Subject: RE: Hi Test Silicon Smelter update

Ken,

A quick heads up: today we received the next draft of the (now PacWest) silicon smelter air modeling protocol (we had received no recent prior notice the draft was on its way!). I am awaiting approval from my management before I send it out – likely will be able to send you the draft tomorrow.

Jay

Jay McAlpine, PhD
Atmospheric Scientist, Regional Modeling Contact
Office of Air and Waste
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 155, OAW-150
Seattle, WA 98101
206.553.0094
McAlpine.Jay@epa.gov

From: Ken Merrill [mailto:kmerrill@kalispeltribe.com]
Sent: Monday, April 09, 2018 10:55 AM
To: McAlpine, Jerrold <McAlpine.Jay@epa.gov>
Subject: Hi Test Silicon Smelter update

Hi Jay- Have you heard anything lately about the PSD modeling protocol or anything else pertaining to Hi Test?
--Ken

Kenneth R. Merrill
Manager - Water Resources Program
Kalispel Tribe Natural Resources
PO Box 39, Usk, WA, 99180
(509) 447-7276 (office)
(509) 209-0069 (cell)

Prepared for:

PacWest Silicon
Edmonton, Alberta

Prepared by:

Ramboll US Corporation
Lynnwood, Washington

July 2018

Project Number:
1690002828

PACWEST SILICON NEWPORT

REVISED PSD MODELING PROTOCOL

RAMBOLL

CONTENTS

Acronyms and Abbreviations iii

1. Introduction 1
1.1 Project Emissions and Regulatory Analysis 2
1.1.1 Criteria Pollutant Emissions 3
1.1.2 Toxic Pollutant Emissions 3

2. Class II Modeling Methodology 6
2.1 Dispersion Model Selection 6
2.2 Modeling Methodology 7
2.2.1 Model Setup 7
2.2.2 Meteorology 7
2.2.3 Receptor Network and Terrain 8
2.2.4 Emission Unit Parameters 8
2.2.5 Good Engineering Practice Analysis 9
2.2.6 NO to NO_2 Chemical Transformations 11
2.3 Criteria Pollutant Significant Impact Level Assessment 11
2.4 Significant Impact Area Determination 14
2.5 Preconstruction Monitoring Analysis 14
2.6 PSD Class II Increment Consumption 14
2.7 Criteria Pollutant Ambient Air Quality Standards Assessment 15
2.8 Toxic Air Pollutant Small Quantity Emission Rate Assessment 16
2.9 Ozone and Secondary $PM_{2.5}$ Assessment 17

3. CLASS I Modeling Methodology 24
3.1 Class I PSD Increment Assessment Methodology 24
3.2 Class I Air Quality Related Values Methodology 26
3.2.1 Dispersion Model Selection 31
3.2.2 Modeling Methodology Summary 31
3.2.3 Characterization of Emissions 32
3.2.4 Chemical Transformations 33
3.2.5 Meteorological Data 33
3.2.6 Receptors and Terrain 34
3.2.7 Post-Processing Procedures 34

4. References 38

ED_013256A_00000450-00002

TABLES

Table 1. Preliminary Project Emissions Increases 5
Table 2. Applicable Class II PSD Air Quality Standards 13
Table 3. Background Concentrations 17
Table 4. Most Conservative Illustrative MERP Values (TPY) 18
Table 5. MERP analysis results for $PM_{2.5}$ and ozone. 19
Table 6. Ozone Design Values at Green Bluff, WA 22
Table 7. Class I Area Significant Levels and Increments 26
Table 8. Mandatory Class I Areas Within 300 km, with initial Q/D 29

FIGURES

Figure 1. PacWest Facility Location and Property Boundary 4
Figure 2. 20 km by 20 km Receptor Grid 10
Figure 3. Location of Green Bluff AQS Monitoring Site 21
Figure 4. Class I Areas within 300 km of the proposed facility 28
Figure 5. Proposed CALPUFF Modeling Domain 30
Figure 6. Proposed Domain with 4 km Resolution Terrain 30

ED_013256A_00000450-00003

ACRONYMS AND ABBREVIATIONS

AERMOD ..... Air quality dispersion modeling system used in this analysis. The AERMOD modeling system consists of two pre-processors and a dispersion model. The meteorological preprocessor (AERMET) provides meteorological information, and a terrain pre-processor (AERMAP) characterizes terrain, and generates receptor grids for the dispersion model (AERMOD)

Ambient air quality standard... Health-based standard representing a pollutant concentration in the ambient air usually over some averaging period like 1-hour, intended to protect the health and welfare of people with a margin of safety

Ambient air ..... The air in outdoor locations to which the public has access, e.g., outside the property boundary of the emissions source

Attainment/Nonattainment..... A determination and classification made by EPA indicating whether ambient air quality in an area complies with (i.e., attains) or fails to meet (i.e., nonattainment) the requirements of one or more NAAQS

Averaging time ..... A specific length of time (e.g., 1 hour, 24-hours, 1 year) over which measured or model-calculated concentrations of an air pollutant are averaged for comparison with the NAAQS based on the same averaging period. Note that some NAAQSs are also based on multi-year averages of certain percentiles of measured or calculated concentrations.

AQIA ..... Air quality impact assessment

AQRV..... Air quality related values: acid deposition flux and visibility impairment

ARM/ARM2 ..... Ambient Ratio Method/Ambient Ratio Method 2; Tier 2 NO-to-NO_2 chemical transformation methods

ASIL ..... Acceptable Source Impact Level

BACT ..... Best available control technology

BART ..... Best available retrofit technology

BPIP PRIME ..... EPA's Prime version of the Building Profile Input Program

CALPUFF ..... Air quality dispersion modeling system typically used for long-range (greater than 50 km) transport assessments. The meteorological preprocessor (CALMET) provides meteorological information for the dispersion model (CALPUFF). The CALPOST post-processor can be used in conjunction with the CALPUFF utility POSTUTIL to summarize modeling results

CO ..... Carbon monoxide, a criteria air pollutant

ED_013256A_00000450-00004

CO_2 ..... Carbon dioxide

Criteria air pollutant ..... An air pollutant specifically governed by the Federal Clean Air Act for which ambient air quality standards have been set. Criteria air pollutants include carbon monoxide, particulate matter, sulfur dioxide, nitrogen dioxide, ozone, and lead

DAT..... Deposition Analysis Threshold, typically in units of kilograms per hectare per year

Dispersion model ..... A computerized calculation tool used to estimate pollutant concentrations in the ambient air based on numeric simulations that consider the locations and rates of pollutant emissions and the effects of meteorological conditions, usually over specific averaging times (e.g., 8-hours)

Ecology..... Washington State Department of Ecology

EPA ..... U.S. Environmental Protection Agency

FLAG ..... Federal Land Managers' Air Quality Related Workgroup

FLMs..... Federal Land Managers

Fugitive dust..... Potential air pollutant in the form of dust (or other pollutant) emitted from a non-point or non-mobile source such as dust from a road or from a storage pile caused by wind

GEP stack height..... Good engineering practice stack height; the height at which a stack must be to avoid building wake effects on emissions during dispersion analysis

H1H, H2H..... Highest first-high, highest second-high. The first "highest" is over time, the second over space

IDAPA..... Idaho Administrative Code

IWAQM ..... Interagency Workgroup on Air Quality Modeling

MERP..... Modeled emission rates for precursors

Meteorological data set..... A compilation of meteorological data representing conditions over some period of time and including such things as wind speed and wind direction, and formatted as required by the dispersion model being used. This analysis used a meteorological data set covering 5 years

Micrometer/Micron ..... One millionth of a meter; typically used to distinguish particle size; a typical human hair is 100 about microns in diameter

MMIF ..... Mesoscale model interface program, which converts meteorological model outputs to dispersion model inputs

Modeling domain..... The area included in the dispersion-modeling analysis

Modeling receptor ..... A theoretical (i.e., often non-specific) location used in computer modeling at which air pollutant concentrations are

ED_013256A_00000450-00005

	calculated. Modeling may also use site-specific receptors representing individual locations
MPE	Model Performance Evaluation
NAAQS	National Ambient Air Quality Standard
NED	National Elevation Dataset
NO_2	nitrogen dioxide, a criteria air pollutant
Nonattainment area	An area delineated by regulatory agencies including US EPA and the Washington Department of Ecology in which an ambient air quality standard has been violated and where there is a program in place designed to reduce air pollution so that the standard can be attained
NOx	Oxides of nitrogen, a general class of air pollutant without a specific air quality standard but used in monitoring air quality
NPDES	National Pollutant Discharge Elimination System
NPS/FS	National Park Service/Forest Service
NWS	National Weather Service
O_3	ozone
OLM	Ozone Limiting Method; Tier 3 NO-to-NO_2 chemical transformation method
Particulate matter (PM)	Air pollutant comprised of solid or liquid particles; PM is usually characterized based on the particle size. See also PM_{10} and $PM_{2.5}$
PM_{10}	"Coarse" inhalable particulate matter with an aerodynamic size less than or equal to 10 micrometers (microns)
$PM_{2.5}$	"Fine" inhalable particulate matter with an aerodynamic size less than or equal to 2.5 micrometers (microns)
ppb	Parts per billion
PSD	Prevention of Significant Deterioration
PVMRM	Plume Volume Molar Ratio Method; Tier 3 NO-to-NO_2 chemical transformation method
RAWS	Remote Automated Weather Stations
SCC	Source Classification Code
SCR	Selective Catalytic Reduction
SER	Significant Emission Rate
SIA	Significant Impact Area
SIC	Standard Industrial Classification
SIL	Significant Impact Level

ED_013256A_00000450-00006

SMC ..... Significant Monitoring Concentration

SO_2 ..... Sulfur dioxide, a criteria air pollutant

SPECIATE..... A database giving fractions of particulate matter sub-species

SQER..... Small Quantity Emission Rate

TAP ..... Toxic Air Pollutant

T-BACT ..... Best available control technology for toxic air pollutants

tpy ..... Tons per year, an estimate of annual emissions

$\mu g/m^3$ ..... Micrograms per cubic meter (a metric used in quantifying concentrations of air pollutants)

USFS ..... U.S. Forest Service

USFWS ..... U.S. Fish and Wildlife Service

USGS..... U.S. Geological Survey

VOC..... Volatile organic compound

Volume source..... An emission source type defined in AERMOD. Volume sources emit diffuse air pollutants from a three-dimensional area. Line sources, such as emissions from transiting trains, can be simulated using multiple, adjacent volume sources

WAAQS..... Washington Ambient Air Quality Standards

WAC..... Washington Administrative Code

WRF ..... The Weather Research and Forecast model, a meteorological model

ED_013256A_00000450-00007

1. INTRODUCTION

PacWest Silicon, Inc. (PacWest, formerly called HiTest Silicon) proposes to construct a facility near Newport, Washington to produce very high-quality silicon. The proposed facility boundary would be adjacent to the Washington-Idaho border, as shown in Figure 1. Primary access for both employees and truck deliveries would be via a road to be constructed under or near the electric lines that run east-to-west along the north boundary of the property, out to Washington Highway 2 west of the property. A rail loop would also be constructed to the west of the main facility, to facilitate the delivery of certain raw materials. The details of the road and rail lines are not final at this time, but will be presented in the Prevention of Significant Deterioration (PSD) application.

PacWest owns and operates a mine east of Golden, British Columbia (BC) Canada, but can only process about one third of the annual permitted production rate. The deposit being mined contains very high purity quartz (silicon dioxide) in the form of sand, with nearly no other minerals or organic matter mixed in.

The sand/quartz would be brought by rail from the mine in BC to the rail loop adjacent to the proposed facility, as would low-sulfur coal, and would be unloaded and moved via conveyor belt to storage on-site. Local wood chips and charcoal would be brought to the facility by truck and stored on-site. All raw materials would be stored in enclosed sheds, not open piles, to reduce fugitive emissions.

An electric submerged arc furnace process would then be used to reduce the silica in the quartz, essentially removing the O_2 from each SiO_2 atom to create CO_2, leaving solid Si as the main product. SiO gas formed in the process sublimates to produce SiO_2 in the form of amorphous silica fume, releasing oxygen-free radicals which, given the high temperatures, react with atmospheric nitrogen to form NOx. The sulfur in the coal reacts to form SO_2, and particulate matter (PM) is also produced as a by-product.

A large baghouse would be used to reduce PM from the furnaces and from the refining/casting room. Because most of this PM is actually high-grade silica fume, the main baghouse filtrate would be bagged and sold as a product. Smaller bag houses would control PM from the crushing/screening operation, and from material handling (moving materials from the storage sheds to the furnaces). All conveyance

ED_013256A_00000450-00008

systems would be covered, as would the rail and truck offload stations. PM emissions would be controlled by misting.

Other emission units planned for the facility include an emergency generator, and an emergency water pump.

The common methods to control NOx and SO_2 have never been implemented in the silicon smelting industry. Traditional wet scrubber systems to control SO_2 would produce more wastewater than the Newport wastewater treatment plant National Pollutant Discharge Elimination System (NPDES) permit allows and would require more water be input than is available. Traditional selective catalytic reduction (SCR) can control NOx but produces ammonium nitrate as a byproduct which must be filtered via a baghouse. Because PacWest does not want ammonium nitrate mixed with their silicon dust product, SCR would have to be introduced into the flue gas stream after the main baghouse, where the temperature of the flue gas makes SCR much less efficient. A Best Available Control Technology (BACT) analysis will be presented that details each of these possible control methods.

Current plans call for construction of two furnaces, but the proposed facility layout would leave room for two additional furnaces to potentially be constructed in the future. Future market forces and availability of capital will control whether the two additional furnace lines will ever be built.

PacWest intends to submit a permit application to obtain an Order of Approval to Construct, and a PSD permit from the Washington Department of Ecology (Ecology).

1.1 Project Emissions and Regulatory Analysis

The facility will fall under Standard Industrial Classification (SIC) code 3339, "Primary Smelting and Refining of Nonferrous Metals, Except Copper and Aluminum."[1] As such, it will not be one of the 28 named sources found at 40 CFR 51.166(b)(1).

The proposed project area is either in attainment or unclassifiable for all National Ambient Air Quality Standards (NAAQS).

[1] https://www.osha.gov/pls/imis/sic_manual.display?id=304&tab=description

ED_013256A_00000450-00009

Emission calculations for the proposed facility will be based on BACT, engineering calculations, fuel usage, and operating hours. Potential emission calculations for the two furnaces are based on continuous operation (24 hours per day, 365 days per year). PacWest has invested considerable effort in a refined design of the furnaces and hoods, using detailed computational fluid dynamics modeling. The results indicate a considerable reduction in the emission factor for NOx (lb. per ton Si produced) compared to the most recent similar facility constructed in the United States. By blending the use of charcoal with coal as the source of carbon, the SO_2 emission factor can also be reduced – as well as reducing the CO_2 from fossil fuels (as opposed to carbon already in the biosphere).

Emission calculations for the emergency generators are based on weekly test runs of no more than one hour per run (up to 100 hours per year of operation). PacWest plans to use water misting technology for dust containment at all partially enclosed discharge and drop points, and to keep the wood chips saturated with moisture. Covered storage will be used for quartz, coal, and charcoal. Baghouses would control fugitive dust from material handling.

1.1.1 Criteria Pollutant Emissions

Preliminary calculations of the PSD pollutant emissions attributable to the proposed project are presented in Table 1, and compared to the applicable Significant Emission Rates (SERs). These preliminary calculations indicate the project's NO_X, CO, SO_2, PM_{10}, $PM_{2.5}$, and greenhouse gas emission increases are expected to be greater than the applicable SERs. Because NO_X and SO_2 emission increases are above the SERs, an analysis of the proposed source contribution to secondary $PM_{2.5}$ and ozone increases will be required.

1.1.2 Toxic Pollutant Emissions

Washington Administrative Code (WAC) 173-460 requires the evaluation Toxic Air Pollutant (TAP) emission increases from new and modified sources. Preliminary estimates indicate that the new furnaces will emit small quantities of TAPs. Emissions of TAPs will be estimated based on the BACT for Toxics (T-BACT) analysis, emission factors from the U.S. Environmental Protection Agency's (EPA's) AP-42 reference guide, and publicly available source tests from other similar silicon smelters.

ED_013256A_00000450-00010

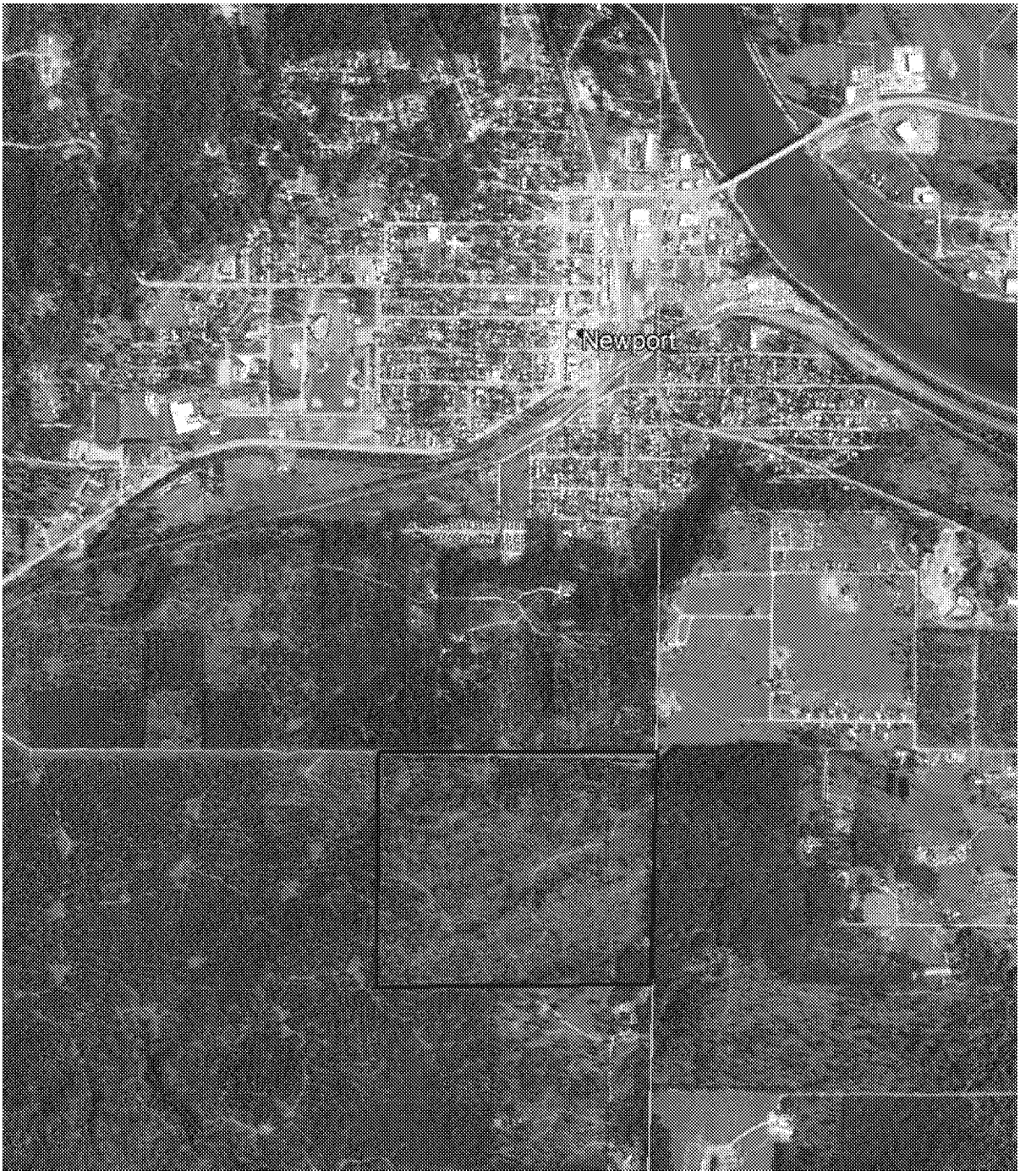


Figure 1. PacWest Facility Location and Property Boundary

Table 1. Preliminary Project Emissions Increases

PSD Pollutant	Preliminary Project Emission Increases (tpy)	PSD Significant Emission Rate (tpy)	Triggers PSD?
NOx	935	40	Yes
CO	307	100	Yes
SO_2	649	40	Yes
PM	45	25	Yes
PM_{10}	36	15	Yes
$PM_{2.5}$	34	10	Yes
VOC	90	40	Yes
Pb	0.1	0.6	No
Fluorides	1	3	No
H_2SO_4	1	7	No
Greenhouse Gases	766,131	75,000	Yes
Total HAPs	23	25	No
Max of any HAP	8	10	No

ED_013256A_00000450-00012

2. CLASS II MODELING METHODOLOGY

Air quality impact assessments (AQIAs) are performed using dispersion modeling techniques in accordance with the EPA's Guideline on Air Quality Models (codified as Appendix W to 40 CFR Part 51, hereafter referred to as the Guideline). The results of a modeling analysis can exempt the applicant from ambient air monitoring or cumulative source modeling.

The local AQIA will include emissions attributable to the proposed emission units. The purpose of the AQIA is to assess potential impacts of the proposed project on air quality in the area surrounding the proposed site. Computer-based dispersion modeling techniques will be applied to simulate criteria and toxic air pollutant releases from the facility to assess compliance with PSD Increments, the NAAQS the Washington Ambient Air Quality Standards (WAAQS), and Ecology's Acceptable Source Impact Levels (ASILs) for toxic air pollutants. This section describes the techniques for the AQIA. This analysis will focus on the prediction of concentrations of pollutants directly emitted by the proposed and affected emission units, but also addresses near-field secondary pollutants.

Dispersion modeling techniques are also used to assess potential impacts to Class I areas, including degradation of visibility and other air-quality-related values (AQRVs). The "regional" AQRV analysis is described in Section 3 of this modeling protocol.

2.1 Dispersion Model Selection

The rationale for the dispersion modeling approach is based on the Guideline, considerations of the local terrain, and the emission units' characteristics. AERMOD is currently the preferred dispersion model recommended by the Guideline for complex source configurations, emission units subject to exhaust plume downwash, and situations where there is the potential for exhaust plumes to interact with complex terrain.

AERMOD is proposed for the modeling analysis primarily because it is the most up-to-date near-field dispersion model currently available. Additionally, the modeling domain and source configuration suggests the potential for exhaust plume downwash and plume impacts on intermediate and complex terrain.

ED_013256A_00000450-00013

2.2 Modeling Methodology

AERMOD will be applied to calculated emissions using regulatory defaults, in addition to the options and data discussed in this section.

2.2.1 Model Setup

The most recent version of AERMOD (currently version 18081) will be applied with the default options for dispersion that depend on representative meteorological data, regional upper air data, and the local physical characteristics of land-use. AERMOD contains several options for urban dispersion that were not selected for these analyses due to the rural characteristics of the area in which the facility is proposed.

2.2.2 Meteorology

A 10-meter meteorological (MET) tower operated by the Idaho Department of Transportation (ID41, mesowest ITDA8, Old Town[2]) is located just east of the site. However, the Idaho Department of Transportation does not perform any audits or other quality control on their meteorological towers. This precludes its use in a PSD permit. Additionally, there appear to be significant obstructions within 10 times the mast height (100 m).

A Remote Automated Weather Station (RAWS) station is located approximately 24 km southeast of the site (HOOI1, Blanchard - Hoodoo[3]). The site is located in a small circular clearing within a stand of trees, with a radius of approximately 35 m. Many RAWS meteorological sites use a 3 m mast, so the nearest obstruction (a tree) is not within 10 times the height of the mast. Furthermore, RAWS sites are typically audited/calibrated only every few years.

The closest National Weather Service (NWS) meteorological station is at Deer Park (KDEW), approximately 36 km southwest of the proposed site. The Deer Park airport is known as a haven for glider plane enthusiasts, due to the relatively higher wind speeds in the region. This region of high wind speeds does not extend to the Newport area, such that KDEW would not be a "representative" site in the terms discussed in Appendix W, Section 8.3.

---

[2] http://lb.511.idaho.gov/idlb/cameras/camera.jsf?id=122&view=state&text=m&textOnly=false
[3] http://mesowest.utah.edu/cgi-bin/droman/station_total.cgi?stn=HOOI1&unit=0

PacWest did not install its own meteorological tower in anticipation, so no on-site data exists. With no nearby representative meteorology of suitable quality for a PSD permit available, we propose to follow Appendix W and rely on meteorological data produced by a prognostic weather model.

A three-year meteorological database will be constructed using the Weather Research and Forecasting (WRF) model. WRF outputs will be processed using the Mesoscale Model Interface (MMIF) processor to create an ONSITE datafile and a file that mimics the output of AERSURFACE. The AERMOD meteorological preprocessor, AERMET (version 18081) will be used to process these files.

A WRF Model Performance Evaluation (MPE) and justification of the use of WRF data for the situation was submitted with this Protocol.

2.2.3 Receptor Network and Terrain

The 20 km by 20 km modeling domain proposed for the AQIA is shown in Figure 2. Terrain elevations for receptors and emission units will be prepared using available 1/3 arc-second (~10m) data from the National Elevation Dataset (NED) developed by the United States Geological Survey (USGS).

An initial receptor set has been developed to be used for the AQIA. The initial receptor set includes receptors spaced 500 m apart covering the outermost portion of the simulation domain. Nested grids of 50-m and 250-m spaced receptors will cover 2-km and 6-km square areas centered on the facility. Maximum AERMOD-predicted concentrations located in coarse receptor areas (i.e., receptor spacing greater than 50 m) will be further investigated using a localized fine receptor grid. Receptors will also be located at 10 m intervals along the facility property boundaries. The initial receptor locations are shown in Figure 2. The base elevation and hill height scale for each receptor will be determined using AERMAP (version 18081).

2.2.4 Emission Unit Parameters

The AQIA requires estimates of the stack heights and other stack exit parameters to characterize the exhaust flow from the emission units. Stack parameters for the proposed facility will be obtained from vendors and included in the permit application.

ED_013256A_00000450-00015

In addition, the stack locations and building locations with dimensions will be provided to AERMOD to assess potential downwash effects. Wind direction-specific building profiles will be prepared by using the EPA's Prime version of the Building Profile Input Program (BPIP PRIME). The base elevation of each emission unit will be estimated using AERMAP.

2.2.5 Good Engineering Practice Analysis

A good engineering practice (GEP) stack height design analysis will be conducted based on the specifications of the buildings according to EPA procedures (EPA 1985a). Releases below the GEP stack height are potentially subject to building wake effects that can result in relatively high ground level predictions from the EPA's regulatory models. For the purposes of PSD review, the EPA does not allow credit for the added dispersion associated with releases above the GEP stack height and restricts the simulated heights in the modeling to the GEP stack height.

ED_013256A_00000450-00016

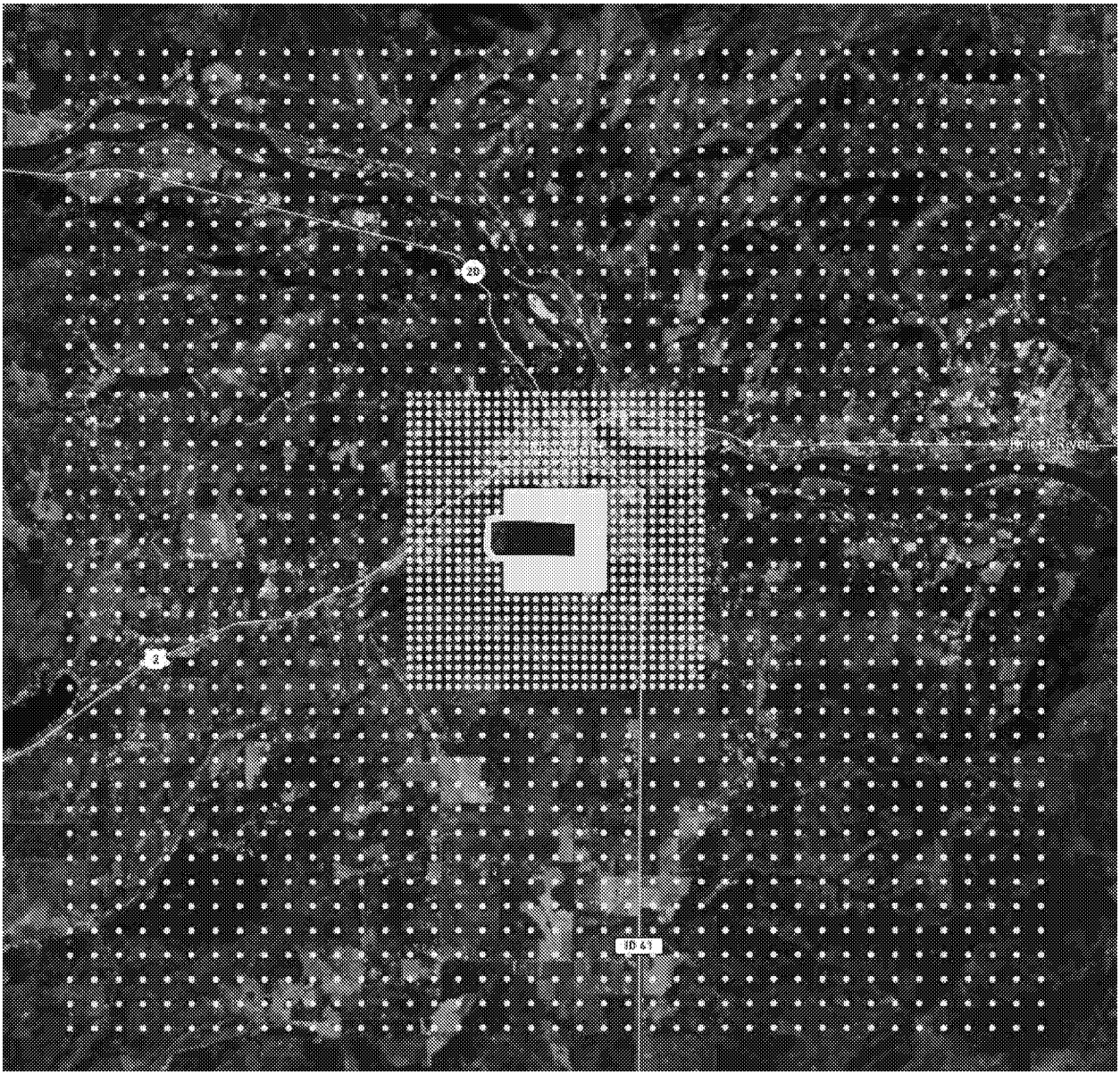


Figure 2. 20 km by 20 km Receptor Grid

A GEP stack height determination will be made for the proposed exhaust stacks for each new emission unit. GEP stack height is equal to the height of the building which has the dominant wake effect ("zone of influence") on the stack plume plus 1.5 times the lesser of (1) that building's maximum projected width, or (2) the building height. This GEP stack height is expressed in the following equation:

$$Hg = H + 1.5\ L \qquad \text{(Equation 1)}$$

ED_013256A_00000450-00017

Hg is the GEP stack height, H is the building height, and L is the lesser of the maximum projected building width or height.

Use of a stack with the GEP stack height removes the plume completely from the building wake zone.

The cavity height is the stack height required to prevent the stack plume from entering the cavity region of the building. Pollutant plumes which are entrained into the cavity region of a building often produce extremely high concentrations. EPA defines cavity height by the following equation:

$$Hc = H + 0.5\ L \qquad \text{(Equation 2)}$$

Hc is the Cavity height, H is the building height, and L is the lesser of the maximum projected building width or height.

EPA's BPIP PRIME program will be used for the GEP analysis once the final building and stack locations for the new facility are available.

2.2.6 NO to NO_2 Chemical Transformations

We will follow EPA Guidance[4] for NO-to-NO_2 transformations. Initially, the Tier 1 approach of full conversion will be assumed. If the predicted NO_2 concentrations exceed the Significant Impact Level (SIL) or NAAQS, the Tier 2 Ambient Ratio Method 2 (ARM2) will be applied to predict the percentage of NOx that is NO_2 (equivalently, the percentage of NO converted to NO_2). At this time, we do not anticipate needing to use a Tier 3 method (Plume Volume Molar Ratio [PVMRM] or Ozone Limiting Method [OLM]).

2.3 Criteria Pollutant Significant Impact Level Assessment

Ambient concentrations of criteria pollutants due to emission releases from the proposed project will be predicted using AERMOD. Maximum short-term concentrations and annual average concentrations will be obtained for comparison with SILs.

---

[4] Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard, EPA/OAQPS, September 30, 2014. https://www3.epa.gov/scram001/guidance/clarification/NO2_Clarification_Memo-20140930.pdf

ED_013256A_00000450-00018

SILs have been established for various criteria pollutants, and are listed in Table 2. If pollutant concentrations exceed the SILs, then further evaluation is required to compare the project's concentrations to the Class II PSD Increments, the NAAQS, and the WAAQS. However, if all modeled ambient impact concentrations modeled for facility operations are less than the SILs then no further analysis will be required. Additionally, under PSD regulations, only facilities with impacts in excess of SILs are required to include the impacts of other facilities or consider collecting background ambient air quality information.

For 1-hour NO_2 and 1-hour SO_2 EPA's interim SIL (4 percent of the NAAQS) has been assumed to apply.[5] On January 22, 2013, the $PM_{2.5}$ SILs and Significant Monitoring Concentration (SMC) were vacated by the United States Court of Appeals for the District of Columbia Circuit. On August 1, 2016, EPA issued for public comment some draft guidance for $PM_{2.5}$, justifying suggested replacement SILs and SMC. That guidance was finalized on April 17, 2018, and we propose to use the SILs it suggests.

On December 2, 2016, EPA issued draft guidance on the use of Model Emission Rates for Precursors (MERPs) to estimate near-field secondary PM, and updated the guidance on February 23, 2017. Using the same reference source as will be used for the ozone analysis discussed in Section 2.9, we will calculate the contribution to near-field total $PM_{2.5}$ from primary NO_X (converted to ammonium nitrate) and primary SO_2 (converted to ammonium sulfate). This MERP contribution will be applied to all Class II receptors, but not to the Class I receptors discussed in Section 3.1. This methodology follows the 2017 updates to the Guideline, which we believe is more relevant than the guidance on air quality impact assessments issued on May 20, 2014.[6]

---

[5] General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO_2 Significant Impact Level. June 28, 2010 EPA Memorandum.
General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level. August 23, 2010 EPA Memorandum
[6] Available at
https://www3.epa.gov/scram001/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf

Table 2. Applicable Class II PSD Air Quality Standards

Pollutant	Significant Impact Levels (µg/m³)	Monitoring De Minimus Conc. (µg/m³)	PSD Class II Increment (µg/m³)	NAAQS / WAAQS [a] (µg/m³)
CO 8-hour	500	575	None	10,000
CO 1-hour	2,000	None	None	40,000
NO_2 annual	1	14	25	100
NO_2 1-hour [b]	7.5	None	None	188
SO_2 Annual	1	None	20	52
SO_2 24-hour	5	13	91	365
SO_2 3-hour	25	None	512	1300
SO_2 1-hour [c]	7.8	None	None	196
$PM_{2.5}$ annual [d]	0.2	None	4	12
$PM_{2.5}$ 24-hour [d]	1.2	4	9	35
PM_{10} 24-hour	5	10	30	150
O_3 8-hour [e]	2 (1 ppb)	None	None	137 (70 ppb)

Notes:

a The ambient air quality standards shown are the most stringent of the WAAQS and NAAQS. EPA has revoked the annual PM_{10}, annual SO_2, and 24-hour SO_2 standards.

b For the 1-hour NO_2 standard (188 µg/m^3, or 100 ppb), EPA provided an interim SIL of 7.5 µg/m³ (1-hr)

c For the 1-hour SO_2 standard (196 µg/m^3, or 75 ppb), EPA provided an interim SIL of 7.8 µg/m³ (1-hr)

d The $PM_{2.5}$ significance and monitoring de minimus levels were vacated on January 22, 2013 from the Federal PSD regulations. Draft SILs were released on August 1, 2016

e For the 8-hour O_3 standard (137 µg/m^3, or 70 ppb), EPA proposed a draft SIL of 1 ppb (1.96 µg/m^3) on August 1, 2016

ED_013256A_00000450-00020

2.4 Significant Impact Area Determination

If modeling results exceed the significance levels, the Significant Impact Area (SIA) will be determined for that pollutant and averaging period. The SIA is a circular area around the source with a radius equal to the distance to the farthest receptor with a concentration exceeding the significance level. It should be noted that the SIA will not exceed 50 km due to constraints of the dispersion model. The SIA is utilized to define the inventory for the full impact analysis. If required, inventory data will be gathered for all sources within up to 50 km of the SIA.

Only those receptors within the SIA where significance results are predicted to exceed the relevant SIL will be used in any full impact analysis. Only at those receptors could the facility potentially significantly contribute to a modeled NAAQS exceedance.

2.5 Preconstruction Monitoring Analysis

Pre-construction ambient monitoring may be required for any regulated pollutant that triggers PSD review. If the AERMOD-predicted maximum concentration for the project exceeds a monitoring de minimus concentration, ambient monitoring may be required unless existing ambient monitoring data are deemed representative of local conditions. The applicable monitoring de minimus concentration values are presented in Table 2.

2.6 PSD Class II Increment Consumption

For any pollutant/averaging time with a significant impact analysis concentration above the SIL, a Class II increment consumption analysis will be performed if an increment has been established for that pollutant/averaging time. The modeling assessment would normally include other sources with the potential to significantly consume increment within the SIA plus up to 50 km. Should such an analysis be required, Ramboll proposes to use data from Washington State University's Northwest International Air Quality Environmental Science and Technology Consortium's NW-AIRQUEST online tool (see Table 3) as a surrogate. The emissions inventory in the NW-AIRQUEST tool includes all increment-consuming and non-increment-consuming sources, and summing it with PacWest's predicted impacts would be a conservative demonstration of compliance with the Class II PSD increments.

ED_013256A_00000450-00021

Should such an analysis prove to be too conservative for some species, Ramboll will obtain off-property emission sources from Ecology and Idaho Department of Environmental Quality. The appropriate baseline date for the pollutant will be established and actual emissions changes from the baseline date will be estimated for offsite sources. The proposed facility will be modeled using potential emissions as they will be new emission units.

According to data available on Ecology's website[7] for Pend Oreille county, the minor source baseline dates are:

- SO_2 June 28, 1981
- TSP/PM_{10} March 20, 1979
- $PM_{2.5}$ None (not yet triggered)
- NOx None (not yet triggered)

This PSD permit will likely establish the minor source baseline dates for $PM_{2.5}$ and NOx. Any PSD increment consumption analysis should consider emissions increases from all major and minor new or modified sources permitted after the major and minor source baseline dates, respectively.

For increments with an annual averaging period, the highest model prediction will be compared to the applicable PSD increment. For shorter averaging periods, the highest second-high model-prediction will be compared to the applicable PSD increment.

2.7 Criteria Pollutant Ambient Air Quality Standards Assessment

NAAQS have been established by EPA and are presented in Table 2. Some of the criteria pollutants are subject to both "primary" and "secondary" federal standards. Primary standards are designed to protect human health with a margin of safety. Secondary standards are established to protect the public welfare from any known or anticipated adverse effects associated with these pollutants, such as soiling, corrosion, or damage to vegetation.

A NAAQS assessment will be based on AERMOD simulations of PacWest emissions and other industrial sources with the potential to significantly impact the same

[7] https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Air-emissions-inventory

receptors as the proposed facility. As with the Class II increment analysis, Ramboll will obtain emission inventory data from Ecology for other industrial sources. Emissions from all sources may be based on allowable emissions or maximum potential to emit estimates, or may be based on 2-year average actual/representative emissions. Data will be verified as necessary with other public records and any refinements will be documented in the modeling report. Only those receptors inside the SIA that exceed the SILs will be used in the NAAQS analysis, and only those averaging periods whose concentrations exceed the SILs will be considered.

If a NAAQS compliance demonstration is required, we will include applicable background pollutant concentrations from the nearest monitoring stations or from Washington State University's Northwest International Air Quality Environmental Science and Technology Consortium's NW-AIRQUEST online tool[8]. Table 3 contains preliminary background concentrations, obtained from the NW-AIRQUEST site. This online application provides spatially interpolated design values of criteria pollutants for the years of 2009-2011 for Idaho, Washington and Oregon. Ramboll may also develop seasonal or hour-of-day background values for the NAAQS assessment.

2.8 Toxic Air Pollutant Small Quantity Emission Rate Assessment

New and modified sources of TAPs are regulated on the state level by WAC 173-460. Under these regulations, emissions of TAPs from new emission units must be evaluated to ensure compliance with WAC 173-460-070. Additionally, new emission units must use T-BACT. T-BACT applies to each TAP or a mixture of TAPs that is discharged, taking into account the potency, quantity, and toxicity of each TAP.

Under these air toxic regulations, an initial evaluation is conducted and the results are compared to the Small Quantity Emission Rates. TAP emissions exceeding the corresponding Small Quantity Emission Rates (SQER) are then required to undergo air dispersion modeling for an ASIL analysis following WAC 173-460.

---

[8] Washington State University. NW AIRQUEST Design Value Lookup Tool. Available at http://www.lar.wsu.edu/nw-airquest/lookup.html

ED_013256A_00000450-00023

Because the facility borders the State of Idaho, an analysis using Idaho Administrative Code (IDAPA) 58.01.01.585 and 58.01.01.586 will also be performed, to insure compliance with both State's toxics programs.

The full TAPs assessment will be included in the PSD Application.

Table 3. Background Concentrations

Pollutant	Averaging Time	Averaging Method	NW-AIRQUEST Background Value
NO_2	1-hour	3-year avg. of 98th percentile of daily maxes.	10 µg/m^3
	Annual	Annual mean	1.7 µg/m^3
$PM_{2.5}$	24-hour	3-year average of the 98th percentile 24-hr averages.	14 µg/m^3
	Annual	3-year avg. of annual mean	4.6 µg/m^3
PM_{10}	24-hour	3-year avg. of 2nd highs	100 µg/m^3
SO_2	1-hour	3-year avg. of 99th percentile of daily max. 1-hour averages.	1.2 µg/m^3
	3-hour	2nd high	1.2 µg/m^3
	24-hour	2nd high	0.83 µg/m^3
	Annual	Annual mean	0.3 µg/m^3

2.9 Ozone and Secondary $PM_{2.5}$ Assessment

Initial proposed NO_X and SO_2 emission increases from the facility are above the SERs, triggering an analysis of the facility's potential contribution to ozone (O_3) and secondary $PM_{2.5}$ formation. Although proposed VOC emission increases are not above the SER, VOC emissions are incorporated into ozone MERP calculations as a conservative approach.

Following the draft Guidance on the use of MERPs for PSD permitting, Tier I methodologies were used to calculate the contributions to ozone and $PM_{2.5}$ associated with preliminary facility emission increases. Table 4 presents the most conservative MERP values for highest maximum daily 8-hour ozone, daily maximum

$PM_{2.5}$, and annual average $PM_{2.5}$ in the eastern, central, and western United States (adapted from Table 7-1 in the draft MERP guidance). If proposed emission increases are below the most conservative MERP values, no additional calculations are required to demonstrate that proposed emissions will result in ozone and $PM_{2.5}$ increases below the critical air quality threshold (SILs). For $PM_{2.5}$, NOx and SO_2 emissions must be considered together, along with NOx and VOC emissions for ozone.

The conservative Western US NOx and SO_2 MERP values for 8-hr ozone and daily $PM_{2.5}$, respectively, are lower than proposed NOx and SO_2 emissions so further analysis is required to estimate the impact of proposed emissions on 8-hr O_3 and daily $PM_{2.5}$. When proposed NOx and SO_2 emissions are considered together, the combined emissions are well below (58%) the combination of conservative NOx and SO_2 MERP values for annual average $PM_{2.5}$ in the Western US. Therefore, no further analysis is required to demonstrate that the proposed emissions will not increase annual average $PM_{2.5}$ concentrations by more than the SIL (0.2 μg/m^3).

Table 4. Most Conservative Illustrative MERP Values (TPY)

Precursor	Area	8-hr O_3	Daily $PM_{2.5}$	Annual $PM_{2.5}$
NO_X	CUS	126	1693	5496
	EUS	170	2295	10144
	WUS	184	1075	3184
SO_2	CUS	-	238	839
	EUS	-	628	4013
	WUS	-	210	2289
VOC	CUS	948	-	-
	EUS	1159	-	-
	WUS	1049	-	-

Notes:
"CUS" = Central United States, "EUS" = Eastern United States, "WUS" = Western United States
Source: Adapted from Table 7-1 in the draft MERP guidance

For 8-hr ozone and daily $PM_{2.5}$, the relationship between precursor emissions and secondary chemistry formation from a modeled hypothetical source in Morrow, OR

ED_013256A_00000450-00025

(source 18) with a high stack height (90 m) and 500 tpy emission rates was used in Tier I calculations. Figure A-3 in the draft Guidance shows the locations of modeled hypothetical sources. Modeled hypothetical sources in Yellowstone County, MT (source 11) and Klickitat County, WA (source 23) were also considered and source 18 was chosen to be conservative, as it resulted in the highest estimated ozone and $PM_{2.5}$ increases.

Table 5 shows the ozone and $PM_{2.5}$ increases associated with the hypothetical source in Morrow, OR.

The daily maximum $PM_{2.5}$ increases from NO_X and SO_2 emissions associated with source 18 are used to calculate the daily maximum secondary $PM_{2.5}$ increase from the proposed facility in the following equation:

$$\frac{935\ TPY\ NOx\ from\ proposed\ facility}{500\ TPY\ NOx\ from\ source\ 18} \cdot 0.15\,\frac{\mu g}{m^3} + \frac{649\ TPY\ SO_2\ from\ proposed\ facility}{500\ TPY\ SO_2\ from\ source\ 18} \cdot 0.19\,\frac{\mu g}{m^3} = 0.53\ \frac{\mu g}{m^3}$$

Table 5. MERP analysis results for $PM_{2.5}$ and ozone.

Precursor	Daily $PM_{2.5}$ ($\mu g/m^3$)	8-hr O_3 (ppb)
NO_X	0.15	1.94
SO_2	0.19	-
VOC	-	0.46
Sum	0.34	2.40

It is estimated that the NO_X and SO_2 emissions from the proposed facility will lead to a 0.53 $\mu g/m^3$ increase in daily maximum secondary $PM_{2.5}$. Although not described in detail here, a similar approach was used to estimate an annual average secondary $PM_{2.5}$ increase of 0.02 $\mu g/m^3$ from the proposed facility. Estimated total (primary + secondary) $PM_{2.5}$ increases associated with the facility will be compared to the SIL.

The daily maximum 8-hour ozone increases from NO_X and VOC emissions associated with source 18 are used to calculate the daily maximum 8-hour ozone increase from the proposed facility in the equation below:

$$\frac{935\ TPY\ NOx\ from\ proposed\ facility}{500\ TPY\ NOx\ from\ source\ 18} \cdot 1.94\ ppb + \frac{90\ TPY\ VOC\ from\ proposed\ facility}{500\ TPY\ VOC\ from\ source\ 18} \cdot 0.46\ ppb = 3.7\ ppb$$

This calculation suggests that the proposed facility will increase daily maximum 8-hour ozone by 3.7 parts per billion (ppb), which is above the proposed SIL (1 ppb). This increase is largely driven by proposed NOx emissions, which are over an order of magnitude higher than proposed VOC emissions.

Because the Tier 1 methodology of using the MERP guidance did not predict an ozone concentration below the proposed SIL, further analysis is needed to ensure that facility ozone increases do not lead to ozone NAAQS exceedances. Estimated ozone contributions associated with the proposed facility (3.7 ppb) are roughly 4 times the proposed ozone SIL (1 ppb). In accordance with recent EPA guidance[9], the estimated ozone contribution is close enough to the proposed ozone SIL to allow for a qualitative assessment of the cumulative impacts of ozone in the region surrounding the proposed facility.

In this assessment, the estimated ozone contribution from the proposed facility is added to representative regional background ozone concentrations and compared to the difference between the ozone NAAQS and SIL (i.e., 75 ppb – 1 ppb = 74 ppb).

The closest EPA Air Quality System (AQS) monitoring site to the proposed PacWest facility is located in Green Bluff, Washington, roughly 40 kilometers southwest of Newport. Figure 3 shows the location of the Green Bluff AQS monitoring site.

[9] Presentation by Tyler Fox at AWMA Specialty Modeling Conference (November 14, 2017, Research Triangle Park, NC).

ED_013256A_00000450-00027

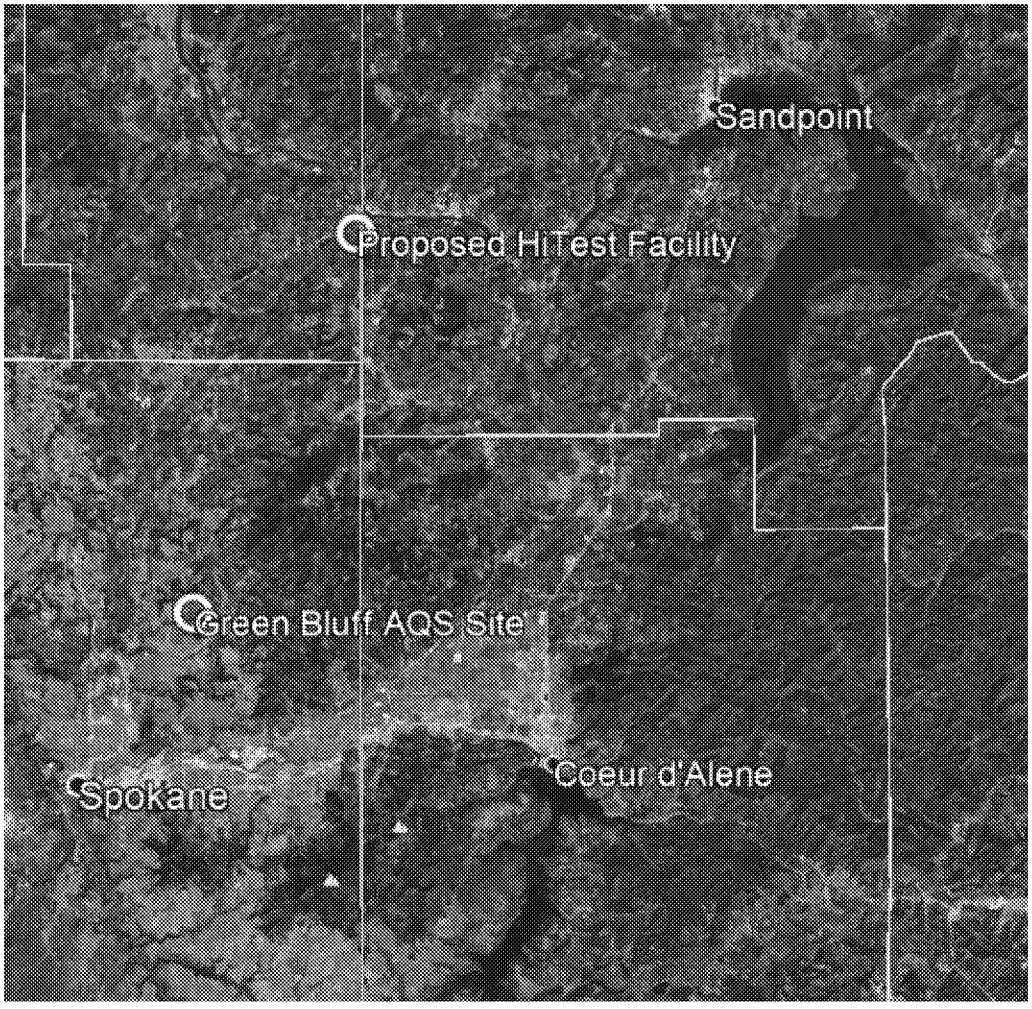


Figure 3. Location of Green Bluff AQS Monitoring Site

The ozone design values (3-year average of 4th highest daily 8-hour maximum ozone concentrations) from 2009 to 2016 range from 57 to 62 ppb, as shown in Table 6.

Table 6. Ozone Design Values at Green Bluff, WA

Years	Ozone Design Value (ppb)
2007-2009	60
2008-2010	58
2009-2011	57
2010-2012	59
2011-2013	60
2012-2014	62
2013-2015	62
2014-2016	60

The AQS ozone design values at Green Bluff, WA are generally consistent with the 2009-2011 ozone design values (55 ppb) from the NW-AIRQUEST[10] website for the coordinates of the proposed Facility (48.162584°, -117.046194°).

If the maximum ozone design value (62 ppb) from Table 6 is used to represent recent background ozone concentrations in the region, the combination of background ozone and predicted Facility ozone increases (65.7 ppb) is still well below the difference between the current ozone NAAQS and proposed SIL (74 ppb).

2.10 Additional Impact Analysis

40 CFR 51.21(o) requires an analysis of the impairment to visibility, soils and vegetation that would occur as a result of the project, as well as other residential/industrial growth that the project may trigger.

A qualitative analysis will be presented in the PSD application to address most of these topics, with the exception of visibility in the Kalispel Reservation (which has been explicitly requested). For the latter, a model such as VISCREEN, PLUVUE II, or CALPUFF will be used. Class I settings will taken from those of the Cabinet

[10] NW-AIRQUEST daily 8-hr maximum ozone Design Values from 2009-2011 at coordinates 48.162584°, -117.046194° were obtained from: http://lar.wsu.edu/nw-airquest/lookup.html

Mountains, the closest and probably climatically most similar mandatory Class I area.

ED_013256A_00000450-00030

3. CLASS I MODELING METHODOLOGY

PSD regulations require an analysis to address both Class I PSD increments, and Class I AQRVs. Ecology is responsible for reviewing the former, while the Federal Land Managers (FLMs) are responsible for reviewing the latter.

3.1 Class I PSD Increment Assessment Methodology

The Spokane Indian Reservation has been redesignated a Class I area under the PSD program but has not requested AQRV protections, only the added protection of the Class I PSD increments. Similarly, the Kalispel Tribe of Indians sent a letter to EPA (on May 11, 2017) proposing to redesignate the Kalispel Indian Reservation a Class I area under the PSD program. Like the Spokane Tribe, the Kalispel Tribe has not requested AQRV protections, only the added protection of the Class I PSD increments. We assume that EPA will act to redesignate the Kalispel Indian Reservation before this PSD permit is granted, and will treat it as a Class I area.

The Kalispel Indian Reservation is approximately 22 km from the proposed site, while the distance to the Spokane Indian Reservation is approximately 53 km (Figure 4). Additionally, as shown in Section 3.2, there is one federally mandated Class I area within 100 km of the facility (the Cabinet Mountain Wilderness Area at approximately 94 km) and ten federally mandated Class I areas within 300 km of the facility. See Section 3.2 for a "Q/D" screening methodology following the Federal Land Managers' (FLMs) Air Quality Related Workgroup (FLAG) 2010 guidance to select which Class I areas must be included in the assessment.

Table 7 summarizes the applicable Class I PSD increments and proposed Class I SILs. At this point, there are two sets of Class I SILs, those proposed by EPA and those recommended by the FLMs. These proposed and recommended SILs were obtained from the Federal Register, Vol. 61, No. 143, p. 38292, July 23, 1996, and from the draft guidance of August 1, 2016 (revised August 18, 2016), respectively.

Because the distance is less than 50 km, we will perform the Class I PSD increment analysis for the Kalispel Indian Reservation using AERMOD. We will follow the modeling methodology detailed in Section 2, and include the MERP-predicted contributions for $PM_{2.5}$. Modeling receptors will be placed at 200 m intervals within the boundaries of the Kalispel Indian Reservation with additional receptors placed along the perimeter at 100 m spacing, resulting in 1363 receptors. If initial

ED_013256A_00000450-00031

modeling results show a steep gradient, then a nest of finer receptors will be added and the model re-run to insure the model is not "missing" the highest value.

Initially, an AERMOD technique will be applied to assess Class I PSD increments at the Spokane Indian Reservation (SPOK) and the Cabinet Mountains WA (CAMO). A series of arcs of receptors will be placed at 50 km radius from the proposed facility, using the minimum and maximum angles between the facility and the Class I receptors, plus 20°. The receptor arc will use elevations and hill heights set at ten (10) equal intervals between the minimum and maximum elevations within the Class I area. Each Class I area will have its own set of receptors, specific to the range of elevations found within it.

Should the respective AERMOD analyses for the Kalispel and Spokane Indian Reservations predict highest second high (H2H) values that exceed the Class I SILs, then we propose adding model predictions to the design values from the NW-AIRQUEST design value Lookup Tool[11] to address the Class I PSD increment.

The NW-AIRQUEST tool uses a 2009 emissions inventory. We will use EPA State-wide inventories of SO_2 to show the decrease in SO_2 emissions since 2009, indicating that using the Lookup Tool without scaling is conservative. The 2009 emissions inventory contains all other nearby sources of SO_2, both increment-consuming sources and those built before the baseline trigger date. Therefore, adding the concentrations from the Lookup Tool to the predicted concentrations will be a conservative over-estimate of the Class I PSD increment consumption. If the sum is below the increment, that will indicate compliance.

Should the AERMOD-with-arcs technique for CAMO predict H2H values that exceed the Class I SILs, CALPUFF will be used in screening mode. The CALPUFF modeling will mostly follow the modeling methodology detailed in Section 3.2, with the exception of turning "off" the chemistry and deposition schemes which have never been officially accepted by EPA. The FLM-specified receptors will be used for CAMO for the CALPUFF screening run.

[11] Available at http://lar.wsu.edu/nw-airquest/lookup.html

ED_013256A_00000450-00032

Table 7. Class I Area Significant Levels and Increments

Pollutant	Averaging Period	PSD Class I Increment	EPA SIL [a]	FLM SIL [a]
PM_{10}	Annual	4	0.2	0.08
	24-hour	8	0.3	0.27
$PM_{2.5}$	Annual	1	0.05 [b]	--
	24-hour	2	0.27 [b]	--
SO_2	Annual	2	0.1	0.03
	24-hour	5	0.2	0.07
	3-hour	25	1	0.48
NO_2	Annual	2.5	0.1	0.03

Notes:

a – SIL = Significant Impact Level; EPA proposed and FLM recommended from the Federal Register, Vol. 61, No. 142, p. 38292, July 23, 1996.

b – The Class I $PM_{2.5}$ SILs were vacated on January 22, 2013. New SILs have been circulated for public comment, which we propose to use.

3.2 Class I Air Quality Related Values Methodology

PSD guidance requires an analysis of potential impacts to AQRVs in Federal Class I areas within 100 km of the project. However, the FLMs have in the past requested analyses of AQRV impacts for additional Class I areas within 300 km of the site. Starting with FLAG (2010), there is no maximum distance when considering which Class I areas to include – inclusion is triggered by having a "Q/D" screening value that exceeds 10. There are ten federally mandated Class I areas with 300 km of the proposed facility. Figure 4 displays the location of the site with a 300-km ring encircling it, and shows the closest Class I areas along with the two relevant Reservations.

The "Q/D" screening method is used to choose which Class I areas should be included in the modeling. Because neither the Kalispel Tribe nor the Spokane Tribe of Indians has requested AQRV protections, their reservations will not be included in the AQRV analysis, regardless of their Q/D values. Note however visibility in the

Kalispel Indian Reservation will be address in the Additional Impact Analysis, see Section 2.10.

Table 8 lists the approximate distance between the site and the Class I areas, as well as the initial Q/D values (total emissions in tons per year, divided by the distance in km). The preliminary net emission increase (Q) is based on the sum of the maximum 24-hour NO_X, SO_2, PM_{10}, and H_2SO_4 emissions from the proposed facility, expressed in tons per year. Note that a Q/D screening value of 10 is the screening threshold currently under consideration by the FLMs. With such a low potential for Class I impacts, we believe an AQRV analyses other than for the Cabinet Mountains WA may not be required. In the event that FLMs still require an AQRV assessment, we are providing this protocol to define our assessment methodology.

At the request of the National Park Service, we will include Glacier NP in the analysis.

ED_013256A_00000450-00034

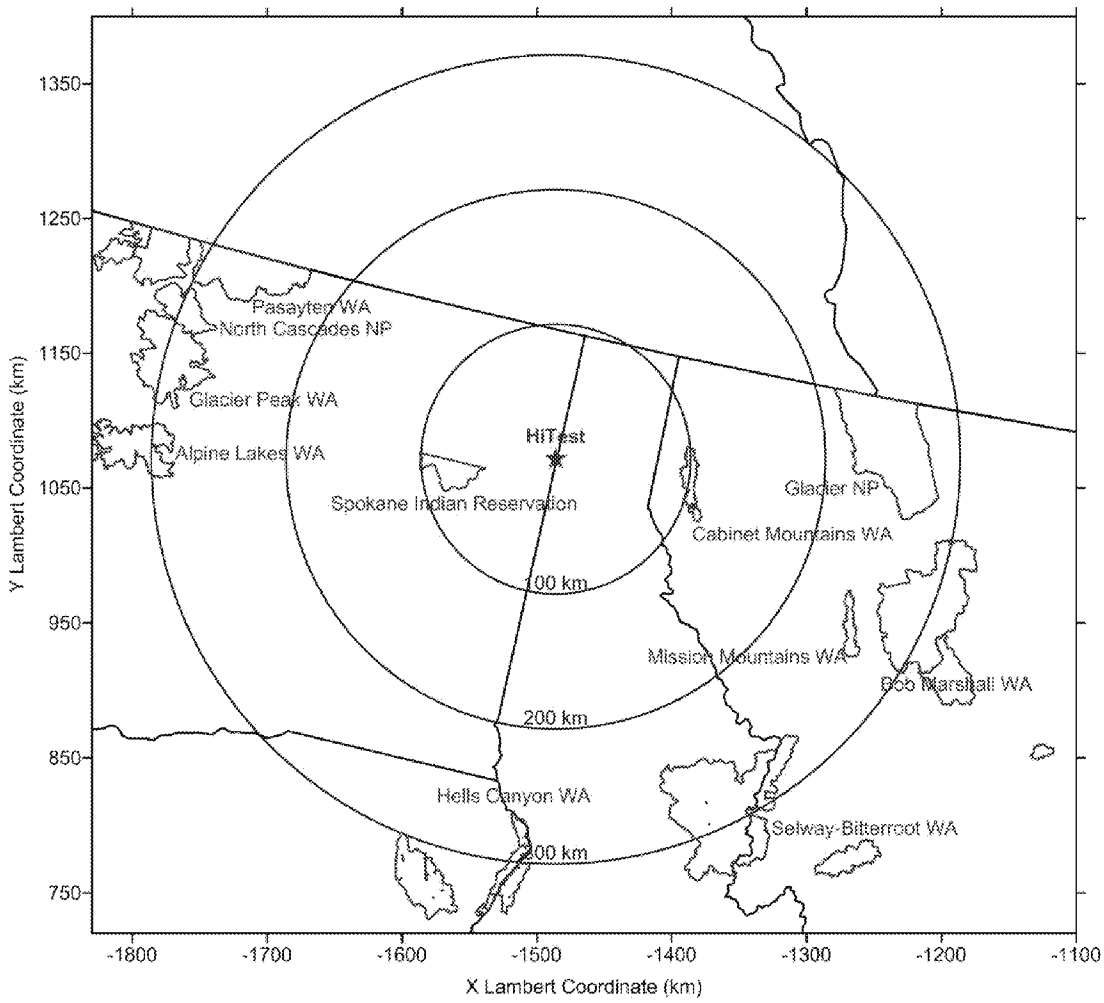


Figure 4. Class I Areas within 300 km of the proposed facility

The proposed modeling domain shown in Figure 5 includes a buffer of at least 50 km around the Glacier NP boundary and a buffer of at least 100 km around the proposed facility. If any FLM requests that another Class I area be included in the analysis, the modeling domain will be expanded using the same 50 km buffer criteria.

The proposed modeling domain also includes the Spokane Indian Reservation, to allow for the possibility of using CALPUFF as a screening model to address Class I PSD increments there.

Table 8. Mandatory Class I Areas Within 300 km, with initial Q/D

ID	Name	Approximate distance to closest part of Class I area (km)	Preliminary Q/D Value (tpy/km)
CAMO	**Cabinet Mountains WA**	**90**	**17.22**
GLAC	Glacier NP	205	7.56
PASA	Pasayten WA	217	7.14
MIMO	Mission Mountains WA	229	6.77
SELW	Selway-Bitterroot WA	235	6.59
BOMA	Bob Marshall WA	248	6.25
GLPE	Glacier Peak WA	251	6.17
HECA	Hells Canyon WA	255	6.08
NOCA	North Cascades NP	259	5.98
ALLA	Alpine Lakes WA	272	5.70
EACA	Eagle Cap WA	289	5.36

Note:
Bolded areas indicate required AQRV analysis based on Q/D value

ED_013256A_00000450-00036

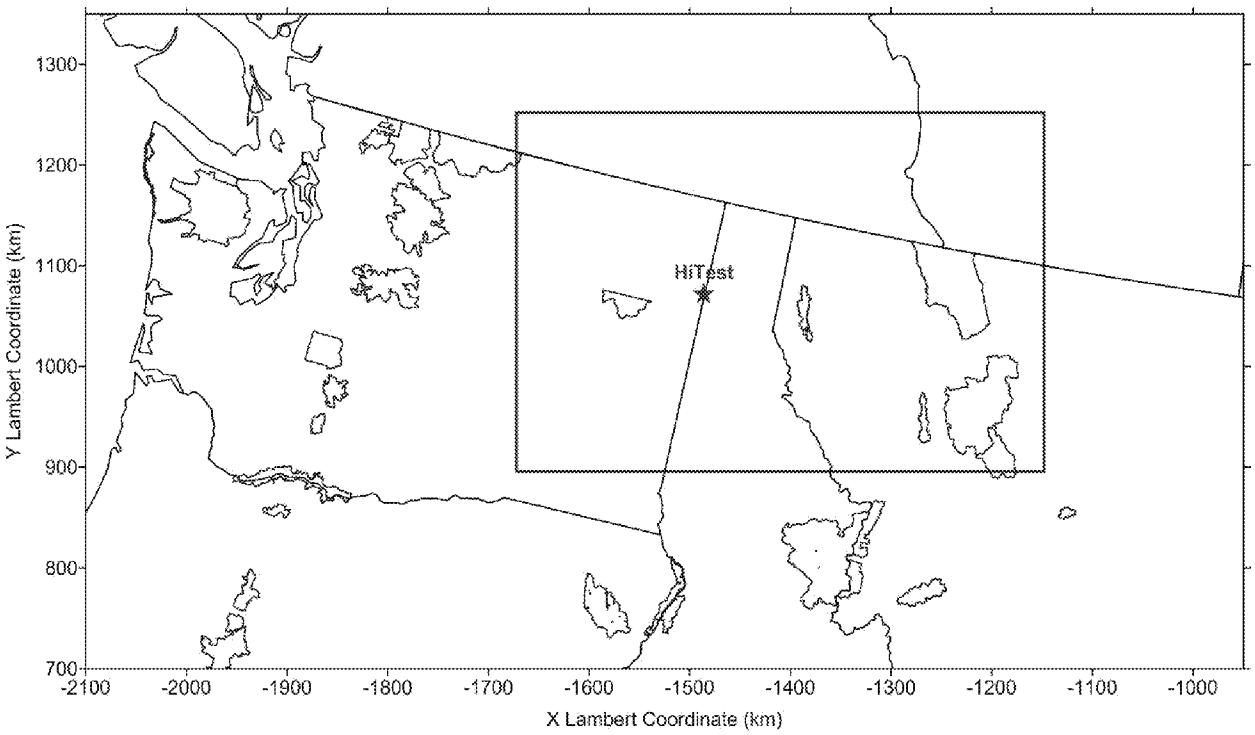


Figure 5. Proposed CALPUFF Modeling Domain

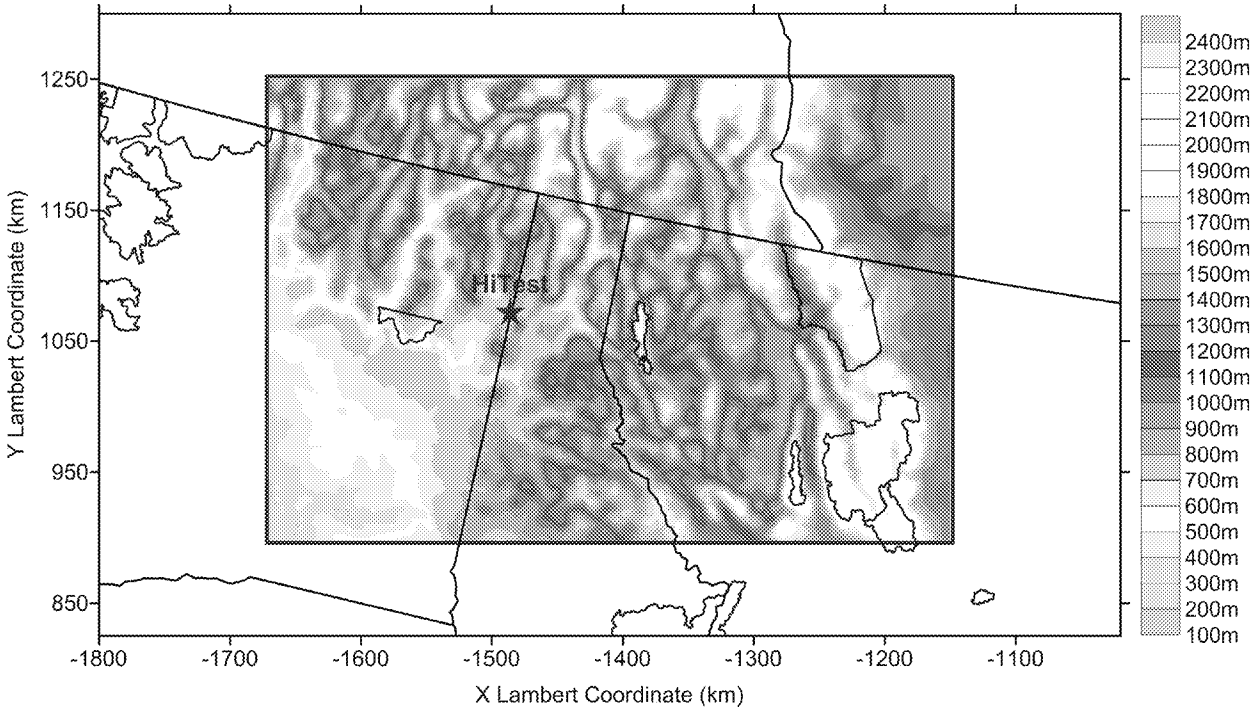


Figure 6. Proposed Domain with 4 km Resolution Terrain

3.2.1 Dispersion Model Selection

On April 15, 2003, EPA adopted the CALPUFF modeling system as the EPA's preferred model for long-range transport assessments and for evaluating potential impacts to Class I areas by including CALPUFF in Appendix A of the EPA's Guideline on Air Quality Models (codified as Appendix W to 40 CFR Part 51). Features of the CALPUFF modeling system include the ability to consider secondary aerosol formation, gaseous and particle deposition, wet and dry deposition processes, and complex three-dimensional wind regimes.

On May 22, 2017, revisions to the Guideline became effective that (among other changes) removed CALPUFF from Appendix A. However, as detailed in the preamble of the proposed rulemaking, this action does not affect the use of CALPUFF under the FLM's guidance regarding AQRV assessments (FLAG 2010).

Ramboll will use CALPUFF version 5.8.5, dated December 14, 2015. This is the most recent "official" EPA version of CALPUFF, and corrects several errors present in the previous versions of CALPUFF, as detailed in Model Change Bulletins E, F, G, and H. CALPOST version 6.221, level 080724 will be used for post processing. As detailed in Section 3.2.5, we will use the latest version of Mesoscale Model Interface program (MMIF) in place of CALMET.

3.2.2 Modeling Methodology Summary

The modeling procedures will follow FLAG and Interagency Workgroup on Air Quality Modeling (IWAQM) recommendations, in particular, FLAG (2000, revised October 2010)[12] and IWAQM (1998) guidance documents. FLAG (2010) revises some procedures in the FLAG (2000) report, the most significant revisions are related to visibility impact calculations. The general CALPUFF modeling approach is summarized here:

- Regulatory Options: CALPUFF will be run in the regulatory mode (MREG =1).
- Modeling Period: Three years will be modeled (2014, 2015, and 2016) using 4 km resolution output from the WRF meteorological model, processed by MMIF.

[12] The FLAG 2000 and 2010 documents are available at http://www.nature.nps.gov/air/Permits/flag/.

ED_013256A_00000450-00038

- Modeling Domain: The modeling domain will include each of the Class I areas for which Q/D exceeds 10, in their entireties, and extend 50 km beyond the far edge of each Class I area.
- Background Ammonia: Past AQRV studies of other regional sources have used a conservative 17 ppb ammonia concentration.
- Background Ozone: Hourly surface ozone will be extracted from the USEPA's AQS database, using all stations within 50km of the modeling domain. A conservative value of 60 ppb will be used when none of the supplied ozone stations have valid data.
- Receptors: High spatial density National Park Service/Forest Service (NPS/FS) receptors[13] in the Class I areas will be used. High spatial density receptors will also be placed inside the Spokane Indian Reservation.
- Visibility Impact Assessment: Visibility impacts will be calculated using the FLAG (2010) recommended Method 8, sub-mode 5 included as the default option in CALPOST. We propose to use the annual average natural conditions tables in FLAG (2010) for monthly species background concentrations and relative humidity adjustment factors.

3.2.3 Characterization of Emissions

The Class I AQRV modeling analysis includes incremental increases in NOx, PM_{10}, $PM_{2.5}$, and SO_2 emissions. There are no Class I area deposition flux thresholds associated with CO or VOCs, and neither CO nor VOCs contribute to visibility impairment in CALPUFF. Therefore, CO and VOCs are not included in any of the AQRV analyses.

Data characterizing the chemical composition and size distribution of the PM_{10} and $PM_{2.5}$ emissions are needed for the AQRV analysis using the CALPUFF modeling system. Particulate emissions must be divided into these six species:

- Soot or elemental carbon (EC)
- Organic carbon (OC)
- Fine soil particles (PMF)
- Coarse particles (PMC)
- Sulfate (SO_4)
- Nitrate (NO_3)

[13] Class I receptors are available at http://www.nature.nps.gov/air/maps/Receptors/index.cfm.

ED_013256A_00000450-00039

At the request of USFS' Bret Anderson, rather than using the SPECIATE database to speciate PM into the above components, Ramboll will speciate PM into only PMC and PMF, where PMF = $PM_{2.5}$ and PMC = PM_{10} – $PM_{2.5}$.

3.2.4 Chemical Transformations

The NOx chemistry in CALPUFF depends on the ambient ammonia concentration to establish the equilibrium between gaseous nitric acid and ammonium nitrate. However, ambient ammonia concentrations are not explicitly simulated by CALPUFF and the user must select an appropriate background concentration. The IWAQM Phase II Recommendations suggest typical ammonia concentrations are: 10 ppb for grasslands, 0.5 ppb for forests, and 1 ppb for arid lands during warmer weather.

For the current analysis, we propose to use 17 ppb for the background ammonia concentration. This conservative concentration was recommended for Pacific Northwest BART simulations and is based on measurements in southern British Columbia. It has been used for most, if not all, PSD modeling in the region since then. This relatively high background ensures the conversion of NOx to ammonium nitrate is not limited by a lack of ammonia for the range of NOx concentrations predicted in this study.

Reaction rates in the CALPUFF chemistry algorithms are also influenced by background ozone concentrations. Hourly ozone monitoring data will be extracted from the USEPA's AQS database and formatted for use in this analysis. A background of 60 ppb will be used during periods of missing data.

3.2.5 Meteorological Data

The AQRV analysis will use three years of hourly 4 km horizontal mesh size prognostic WRF model output data from January 2014 through December 2016. This is the 4 km domain from the same WRF simulation whose 1.33 km domain will supply the meteorology for the Class II modeling analysis presented in Section 2.2.2.

A Model Performance Evaluation justifying its use for the AQRV analysis has been submitted simultaneously with this Modeling Protocol.

Based on recent communication with Tim Allen (USFWS), we propose to use the most recent version of the EPA's MMIF version 3.4 in place of the meteorological pre-processor CALMET. In addition to specifying the three-dimensional wind field,

ED_013256A_00000450-00040

MMIF also estimates the boundary layer parameters used to characterize diffusion and deposition by the dispersion model. The proposed MMIF application setup and input data preparation are as follows:

- The proposed model domain is shown in Figure 5. The horizontal mesh size will be 4 km and the domain will cover an area of 524 km by 356 km.
- There will be ten vertical levels, ranging geometrically from the surface to 4,000 m, using the FLM default layers (MMIF default).
- A Lambert Conformal Conic (LCC) coordinate system will be used with an origin of 40°N, 97°W and standard latitudes of 33°N and 45°N (the so-called Regional Planning Organization or "RPO" projection).
- Land use and terrain data will be inherited (passed through by MMIF) from the USGS-based datasets included in the WRF distribution. Figure 6 shows the 4-km mesh size terrain to be used in the simulations.
- The MMIF-default Golder method for calculating Pasquill-Gifford stability class will be used.
- The MMIF-default WRF-supplied mixing layer heights will be used.

MMIF will be run in monthly segments using the WRF prognostic data.

3.2.6 Receptors and Terrain

The CALPUFF dispersion model simulations will assess AQRVs within each Class I area at discrete receptors obtained from the NPS. In addition to the discrete receptors, a receptor grid with 4-km spacing may also be used throughout the CALPUFF modeling domain to construct plots showing the spatial variation of the calculated parameters. These plots can be used for diagnostic purposes, as well as to develop figures that may be presented in the permit application. Comparisons with AQRV criteria will be based on the discrete receptor locations and elevations rather than the domain-wide gridded receptors.

3.2.7 Post-Processing Procedures

The CALPUFF modeling system will be used to predict criteria pollutant concentrations (if CALPUFF is used in screening mode to address Class I PSD increments), concentrations of PM_{10} species that contribute to regional haze, total deposition fluxes (wet and dry) for nitrogen-containing pollutant species, and total deposition fluxes for sulfur species. For each emission case considered, three annual simulations will be performed in parallel for each of the three modeling years. A sample CALPUFF input file is included with this submittal.

ED_013256A_00000450-00041

The CALPUFF utility POSTUTIL will be used to manipulate the large CALPUFF output files and calculate a number of the parameters needed to assess AQRVs in the areas of interest. Specifically, POSTUTIL will be used to sum the sulfur and nitrogen portions of the deposited gaseous and particle compounds to estimate the total sulfur and nitrogen deposition fluxes. The nitrogen in the ammonium nitrate and ammonium sulfate, including the portion that might be from the background ammonia, will be incorporated in the total.

Following the application of POSTUTIL, the CALPOST post-processor will be used to summarize the modeling results.

Predicted annual sulfur and nitrogen deposition fluxes will be used as a measure to assess potential impacts to soils and vegetation in regional Class I areas. The FLMs have established Deposition Analysis Thresholds (DATs) for nitrogen and sulfur of 0.005 kilograms per hectare per year (kg/ha/yr).[14] These "thresholds" are based on natural background deposition estimates culled from various research efforts, a variability factor, and a safety factor that accounts for cumulative effects. The nitrogen and sulfur DATs are not adverse impact thresholds, but are intended as conservative screening criteria that allow the FLMs to identify potential deposition fluxes that require their consideration on a case-by-case basis.

The FLAG workgroup recommends procedures for estimating the visibility impacts due to proposed new sources at Class I areas using CALPUFF modeling (FLAG, 2010). The FLAG visibility metric is the estimated maximum 24-hour change in extinction (Δb_{ext}) over clean natural visibility conditions (Natural Conditions) at the Class I area. The interpretation of the FLAG thresholds for extinction change over natural background is as follows:

- If the source's visibility impact is < 5% on all days, the FLM will likely not object to the permit.
- If there are days with the source's visibility impact > 10%, the FLM may object to the permit.

[14] *Guidance on Nitrogen and Sulfur Deposition Analysis Thresholds*, available on the FLAG internet site at http://www2.nature.nps.gov/ard/flagfree/NSDATGuidance.htm

ED_013256A_00000450-00042

- If there are days in which the source's visibility impact is above 5%, the frequency, magnitude and duration of the visibility impacts are used to make a significance determination.

If a source exceeds a specific threshold at a Class I area, then the frequency, magnitude and duration of the impacts and the reliability and accuracy of the modeling are examined to interpret the modeling results.

The FLAG (2010) procedures employ the IMPROVE extinction equation to calculate b_{ext} (Method 8, sub-mode 5, invoked with MVISCHECK=1 in CALPOST). This equation for extinction uses monthly relative humidity adjustment factors with relative humidity capped at 95%. It uses annual background aerosol concentrations recommended by the FLMs for the Class I area of concern, and assesses the visibility using the 98th percentile modeled values at each receptor. In order to use Method 8, sub-mode 5, CALPOST version 6.221 (level 080724) will be used to post-process the CALPUFF output files.

For FLAG 2010, a project's extinction is calculated using the revised IMPROVE reconstructed mass extinction equation as follows:

$$
\begin{aligned}
b_{project} = {} & 2.2 \times f_S(RH) \times [\text{Small Sulfate}] + 4.8 \times f_L(RH) \times [\text{Large Sulfate}] \\
& + 2.4 \times f_S(RH) \times [\text{Small Nitrate}] + 5.1 \times f_L(RH) \times [\text{Large Nitrate}] \\
& + 2.8 \times [\text{Small Organic Mass}] + 6.1 \times [\text{Large Organic Mass}] \\
& + 10 \times [\text{Elemental Carbon}] \\
& + 1 \times [\text{Fine Soil}] \\
& + 0.6 \times [\text{Coarse Mass}] \\
& + 1.7 \times f_{SS}(RH) \times [\text{Sea Salt}] \\
& + \text{Rayleigh Scattering (Site Specific)} \\
& + 0.33 \times [NO_2\,(\text{ppb})]\ \{\text{or as: } 0.1755 \times [NO_2\,(\mu g/m^3)]\}
\end{aligned}
$$

Where:

[ ] indicates concentrations in $\mu g/m^3$
$f_S(RH)$ = Relative humidity adjustment factor for small sulfate and nitrate
$f_L(RH)$ = Relative humidity adjustment factor for large sulfate and nitrate
$f_{SS}(RH)$ = Relative humidity adjustment factor for sea salt
For Total Sulfate < 20 $\mu g/m^3$:
[Large Sulfate] = ([Total Sulfate] / 20 $\mu g/m^3$) × [Total Sulfate]
For Total Sulfate ≥ 20 $\mu g/m^3$:
[Large Sulfate] = [Total Sulfate]

ED_013256A_00000450-00043

And:

[Small Sulfate] = [Total Sulfate] – [Large Sulfate]

To calculate large and small nitrate and organic mass, substitute ({Large, Small, Total} {Nitrate, Organic Mass}) for Sulfate.

The visibility related AQRVs will be summarized for each area of interest in a series of tables showing the number of days the 5 percent change to extinction was exceeded and showing the extinction budgets for the top 8 days in each year of the simulation and any day with a change to extinction greater than 5 percent. Time series plots will be used to display the seasonality of the modeling results and contour plots of the predicted maximum 24-hour extinction coefficients will be used to examine spatial variability.

ED_013256A_00000450-00044

4. REFERENCES

Federal Land Manager Advisory Group (FLAG). 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report - Revised (2010). Available at: http://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf.

ED_013256A_00000450-00045

Message

From: Hardesty, Doug [Hardesty.Doug@epa.gov]
Sent: 5/3/2018 7:14:51 PM
To: Bray, Dave [Bray.Dave@epa.gov]
Subject: FW: Boise Wallula - Incompleteness Letter
Attachments: PCAIncompletenessLtr012518.pdf; BP_Blaine_TSD.pdf; BP_final_PSD.pdf; Tesoro_Anacortes_final_PSD.pdf; Tesoro_Anacortes_TSD.pdf

Doug Hardesty
208.378.5759
Air Permit Program Lead
Stationary Source Unit, Office of Air and Waste, U.S. EPA, Region 10
950 W Bannock St, Suite 900, Boise, Idaho 83702

From: Inloes, Scott (ECY) [mailto:SINL461@ECY.WA.GOV]
Sent: Thursday, January 25, 2018 5:17 PM
To: Butkus, Paul <PaulButkus@BoisePaper.com>; Piotrowski, John <JPiotrowski@packagingcorp.com>; Ramos, Charleston <CharlestonRamos@boisepaper.com>
Cc: Aaron Day <ADay@trinityconsultants.com>; Carruthers, Robert (ECY) <roca461@ECY.WA.GOV>; Crooks, Marc (ECY) <mcro461@ECY.WA.GOV>; Anna Henolson <AHenolson@trinityconsultants.com>; Ghidey, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>; Hardesty, Doug <Hardesty.Doug@epa.gov>; jamesmiller2@fs.fed.us; Ogle, Stephanie (ECY) <stog461@ECY.WA.GOV>; Shepherd, Don <don_shepherd@nps.gov>; Notar, John <john_notar@nps.gov>; Tonnie_Cummings@nps.gov
Subject: Boise Wallula - Incompleteness Letter

All,

Attached you will find a PDF of the incompleteness letter which was mailed to Bert Brown today. Also attached is copies of the most resent PSD permits and support documents.

The next step will be for Boise to complete and mail the requested information to me for review. The information will be reviewed, if the information is complete, I will determine the application complete and send a letter/email to the group. Ecology will continue to work on the preliminary PSD permit and technical support document with the information that has been received. I would offer to meet with your team if any of the request is unclear.

Scott Inloes, PE.
Air Quality Program
WA Department of Ecology
Phone: 360-407-6896

DEPARTMENT OF
ECOLOGY
State of Washington

FINAL TECHNICAL SUPPORT DOCUMENT FOR:

BP WEST COAST PRODUCTS LLC
BP CHERRY POINT REFINERY
TWO COKER HEATERS - REPLACEMENT PROJECT

Prepared by

Air Quality Program
Olympia, Washington

May 23, 2017

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 1
2. INTRODUCTION 1
   2.1. The Permitting Process 1
      2.1.1. The PSD process 1
      2.1.2. The NOC process 3
   2.2. Site and Project Description 3
      2.2.1. Site description 3
      2.2.2. Project description 5
      2.2.3. Aggregation discussion 9
3. PSD APPLICABILITY REVIEW 9
   3.1. Overview and Permitting History 9
   3.2. Significant Emissions Increases Calculations 10
      3.2.1. Actual-to-potential test for new coker heaters and components 10
      3.2.2. Actual-to-projected-actual applicability test for modified and debottlenecked emissions units 11
      3.2.3. Hybrid test - significant emissions increase analysis summary 25
   3.3 Significant Net Emissions Increase Calculations 26
      3.3.1. Netting rules 26
      3.3.2. Netting analysis 27
4. BACT 29
   4.1. Definitions and Policy Concerning BACT 29
   4.2. BACT Analysis for Coker Heaters 30
      4.2.1. BACT analysis for coker heaters 31
      4.2.2. BACT feasibility review 36
      4.2.3. Modes of Operation 40
      4.2.4. NO_X BACT for coker heater direct emissions 40
      4.2.5. CO and VOC BACT for coker heater direct emissions 42
      4.2.6. PM, PM_{10}, $PM_{2.5}$ BACT for coker heater direct emissions 43
      4.2.7. SO_2 and H_2SO_4 BACT for coker heater direct emissions 44
      4.2.8. GHG BACT for coker heater direct emissions 46
      4.2.9. BACT for coker heater fugitive component leaks 47
5. AMBIENT AIR QUALITY IMPACTS ANALYSIS 48

ED_013256A_00000453-00002

5.1. Regulatory Requirements 48
5.2. Maximum Criteria Pollutant Concentrations Predicted by AERMOD 49
5.2.1. Secondary $PM_{2.5}$ formation 51
5.3. Ozone Impacts 51
5.3.1. Ozone background information 51
5.3.2. BP ozone study results 52
5.4. Impacts on Class I Areas 53
5.4.1. AQRVs background information 56
5.4.2. BP AQRV analysis 57
6. ADDITIONAL IMPACTS ANALYSIS 60
6.1. Growth Analysis 60
6.1.1. Construction and growth impacts 60
6.2. Visibility (Class II Areas) 60
6.3. Soils and Vegetation Analysis 61
7. STATE ENVIRONMENTAL POLICY ACT 61
8. PUBLIC INVOLVEMENT 61
9. AGENCY CONTACT 62
REFERENCES 63
ACRONYMS AND ABBREVIATIONS 64
APPENDIX A. ECOLOGY RESPONSE TO COMMENTS 66
APPENDIX B. BP RESPONSE TO COMMENTS 67
APPENDIX C. COMMENTS RECEIVED 68

ED_013256A_00000453-00003

LIST OF FIGURES

Figure 1. The BP Cherry Point Refinery facility location map 4
Figure 2. The BP Cherry Point Refinery aerial photograph 5
Figure 3. Simplified coker diagram 6
Figure 4. Source and building locations with heights 49

LIST OF TABLES

Table 1. Emissions Increases of Regulated NSR Pollutants for New Coker Heaters (tpy)* 11
Table 2. BP's Chosen Dates for Baseline Actual Emissions 12
Table 3. Documentation of BP's Defense of Adjustments to BAE 13
Table 4. Emissions Increases of Regulated NSR Pollutants for Coke Drum Venting (tpy) 20
Table 5. Emissions Increases of Regulated NSR Pollutants for Green Coke Handling (tpy) 20
Table 6. Emissions Increases of Regulated NSR Pollutants for Calciners (tpy) 20
Table 7. Emissions Increases of Regulated NSR Pollutants for Hydrocracker (tpy) 21
Table 8. Emissions Increases of Regulated NSR Pollutants for the Sulfur Plant (tpy) 22
Table 9. Emissions Increases of Regulated NSR Pollutants for the Crude Heater (tpy) 22
Table 10. Emissions Increases of Regulated NSR Pollutants for the Crude Heater (tpy) 22
Table 11. Emissions Increases of Regulated NSR Pollutants for the South Vacuum Heater (tpy) 23
Table 12. Emissions Increases of Regulated NSR Pollutants for the #1 and #2 Reformer Heaters (tpy) 23
Table 13. Emissions Increases of Regulated NSR Pollutants for Naphtha Heaters (tpy) 23
Table 14. Emissions Increases of Regulated NSR Pollutants for the Hydrogen Plant (tpy) 24
Table 15. Emissions Increases of Regulated NSR Pollutants for the #1 DHDS Reboiler (tpy) .. 24
Table 16. Emissions Increases of Regulated NSR Pollutants for the ISOM (tpy) 24
Table 17. Emissions Increases of Regulated for Additional Affected Units* (tpy) 25
Table 18. Total Estimated Project Emissions, Net Emissions, and SERs 26
Table 19. Netting Analysis Changes in Emissions (tpy) 27
Table 20. Total Estimated Project Net Emissions and SERs 29
Table 21. Initial Technical Feasibility Assessment 36
Table 22. Ranking of Control Technologies for Coker Heaters (NO_X BACT) 40
Table 23. Ranking of Control Technologies for Coker Heaters (CO and VOC BACT) 42

ED_013256A_00000453-00004

Table 24. Ranking of Control Technologies for Coker Heaters (Particulate BACT) 43
Table 25. Ranking of Control Technologies for Coker Heaters (SO_2 and H_2SO_4 BACT) 44
Table 26. Ranking of Control Technologies for Coker Heaters (GHG BACT) 46
Table 27. Ranking of Control Technologies for Components (VOC and GHG BACT) 47
Table 28. Maximum Criteria Pollutant Concentrations Predicted by AERMOD 49
Table 29. Maximum TAP Concentrations Predicted by AERMOD 50
Table 30. PSD Modeling Review Checklist 54
Table 31. Class I Areas within 300 KM of the BP Facility 57
Table 32. Maximum Criteria Pollutant Concentrations Predicted by CALPUFF 58
Table 33. Predicted Class I Area Deposition Fluxes Compared to NPS DAT 59
Table 34. Predicted Class I Area Visibility Results 59

ED_013256A_00000453-00005

1. EXECUTIVE SUMMARY

BP West Coast Products LLC operates a refinery in Blaine, Washington, referred to as the BP Cherry Point Refinery. The BP Cherry Point Refinery (refinery) produces petroleum based fuels.

This Prevention of Significant Deterioration (PSD) project referred to as the BP Two Coker Heaters – Replacement project (or project), which allows BP to install two new coker heaters and related equipment at their Blaine, Washington, facility. Coker heaters are used in the production of petroleum products such as fuel for vehicles. The original coker heaters were installed as part of the original facility in 1970, and are not as efficient as the new two new coker heaters.

The coker heater replacement project will make the following changes to the refinery:

- Install two coker heaters with improvied process cleaning capability.
- Change the equipment used to separate various portions of the coker products.
- Install a compressor and pump to upgrade the coker from its 1970 design.

All of these changes meet air quality regulations as part of this PSD permit.

The Washington State Department of Ecology (Ecology) received the PSD application fee on August 27, 2014, and the initial application on September 30, 2014. Ecology determined the application to be incomplete on October 22, 2014. BP submitted a revised PSD permit application in March 2016, with supplementary materials after that date. The application was determined to be complete on April 28, 2016. BP provided a consolidated application (including supplementary materials) on June 23, 2016, and provided other supplemental information on November 4, 2016.

2. INTRODUCTION

2.1. The Permitting Process

2.1.1. The PSD process

PSD permitting requirements in Washington State are established in Title 40, Code of Federal Regulations (CFR) 52.21; Washington Administrative Code (WAC) 173-400-700 through 750. Washington State implements its PSD program as a State Implementation Plan (SIP) approved program. This SIP approved program became effective May 29, 2015.[1]

Federal and state rules require PSD review of all new or modified air pollution sources that meet certain criteria in an attainment or unclassifiable area with the National Ambient Air Quality Standards (NAAQS). The objective of the PSD program is to prevent significant adverse

[1] 80 FR 23721, April 29, 2015.

environmental impact from emissions into the atmosphere by a proposed new major source, or major modification to an existing major source. The program limits degradation of air quality to that which is not considered "significant."

Under WAC 173-400-720 through 750, a project proposed at an existing major stationary source is subject to PSD review if the project either is a "major modification" to an existing "major stationary source," or is a major stationary source unto itself.

To be considered a major modification, the following three project aspects are considered: physical or operational changes resulting from the project, project emissions compared with significant emission rates (SER), and significant net emission increases (and/or decreases).

Unless a physical change or change in the method of operation of a major stationary source is exempted by applicable regulation 40 CFR 52.21(b)(2)(iii)(a through k), it is a major modification if the change results in both a significant emissions increase and a significant net emissions increase at the source. "Significant emissions increase" means that the emissions increase for any regulated PSD pollutant is greater than the PSD SER threshold for that regulated pollutant.

This project will have physical or operational change consistent with the definition of "major modification" in 40 CFR 52.21(b)(2)(i). In addition, estimated project emissions are above the PSD SER thresholds both before and after considering significant net emission increases and/or decreases associated with the project for each of the following pollutants: combined emissions of nitrogen oxide and nitrogen dioxide (NO_X), carbon monoxide (CO), sulfur dioxide (SO_2), sulfuric acid mist (H_2SO_4), particulate matter (PM), PM less than 10 microns (PM_{10}), PM less than 2.5 microns ($PM_{2.5}$), volatile organic compounds (VOCs), and greenhouse gases (CO_{2e}).

PSD rules are designed to keep an area with "good" air in compliance with the NAAQS. The distinctive requirements of PSD are Best Available Control Technology (BACT), air quality analysis (allowable increments and comparison with the NAAQS), and analysis of impacts of the project on visibility, vegetation, and soils.

PSD rules require the utilization of BACT for certain new or modified emission units, which is the most effective air pollution control equipment and procedures that are determined to be available after considering environmental, economic, and energy factors.

A full technical review of the project for these pollutants, including a (BACT) analysis, and the project's effect on the NAAQS, PSD increments, visibility, soils and vegetation, is required and included in this Technical Support Document (TSD).

The emissions of other air pollutants not subjected to PSD review are covered in the Northwest Clean Air Agency's (NWCAA) Notice of Construction (NOC) approval for this project

A summary of project component descriptions is provided in Section 2.2.2., with a more detailed PSD review process description for this project provided in Section 3. BACT information for this project is included in Section 4. An ambient impact anlysis is presented in Section 5 and an additional growth impact analysis is presented in Section 6. These sections form the basis of the permit approval conditions.

2.1.2. The NOC process

This project is subject to NOC permitting requirements under state of Washington regulations Chapters 173-400 and 173-460 (and/or local air regulations where applicable). NWCAA is the permitting authority for air pollutants not included in PSD permitting. This includes the New Source Review (NSR) permitting of criteria pollutants that are not PSD-applicable, air toxics issues under federal maximum achievable control technology (MACT) and state 173-460 WAC, and Title V permitting requirements. The procedure for issuing an NOC permit was established in Chapter 70.94 RCW.

WAC 173-400-110 outlines the NSR procedures for permitting criteria pollutants. These procedures are further refined in WAC 173-400-113 (requirements for new sources located in attainment or unclassifiable areas) and/or local air requirmeents where applicable). WAC 173-460-040 NSR supplements the requirements contained in Chapter 173-400 WAC (and/or local air requirmeents where applicable) by adding additional requirements for sources of toxic air pollutants (TAPs).

2.2. Site and Project Description

2.2.1. Site description

The BP Cherry Point Refinery is located in the city of Blaine in Whatcom County, Washington (see Figure 1). BP is situated in Sections 7 and 8, Township 39N, Range 1E Willamette Meridian. An aerial photograph is included as Figure 2. The proposed project will not increase the current footprint acreage of the site.

The BP facility is located in a Class II area that is designated as "attainment or unclassifiable" for the purpose of PSD permitting for all pollutants.

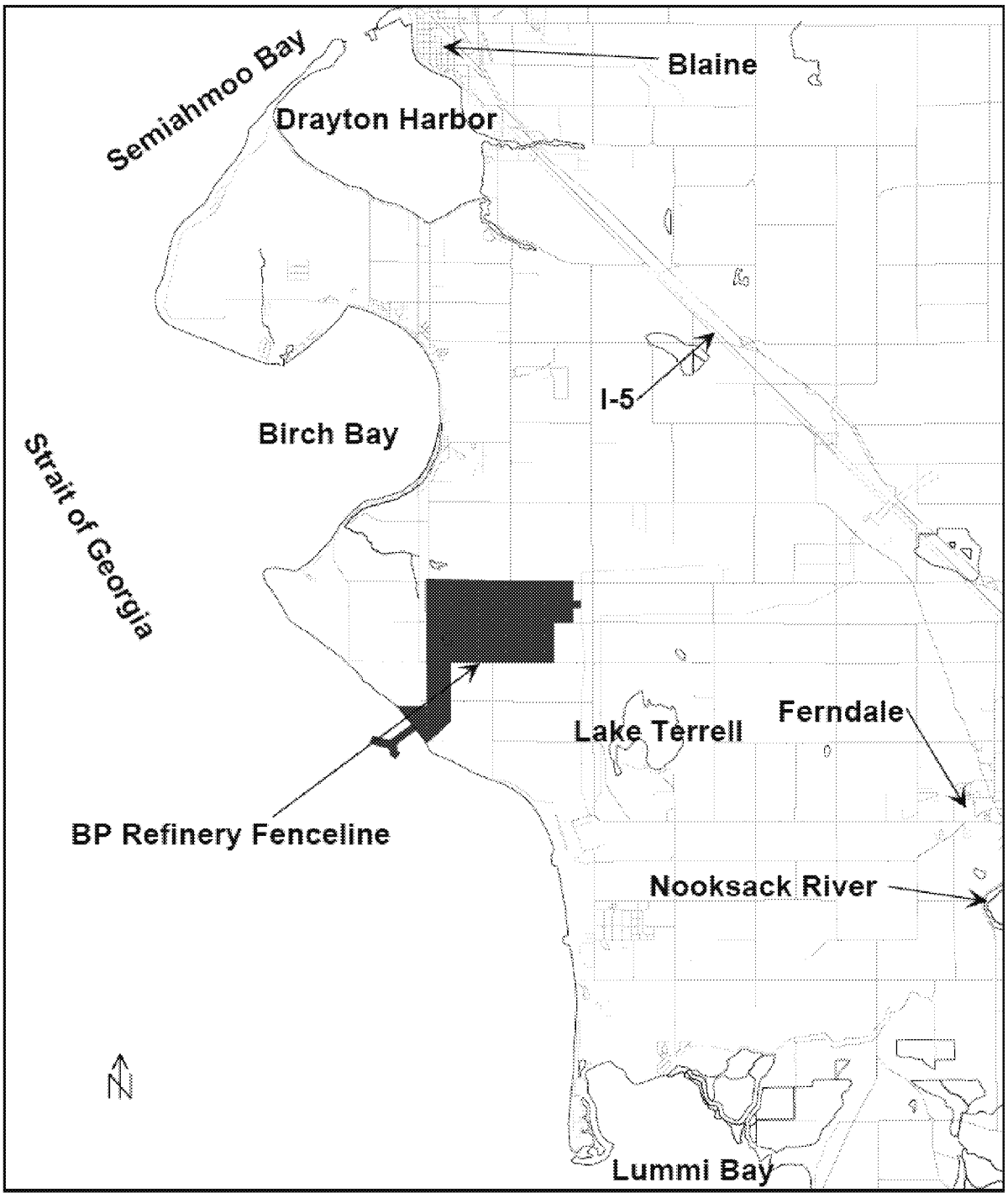


Figure 1. The BP Cherry Point Refinery facility location map

(Source: BP Cherry Point Refinery Coker Heater Replacement Project application, prepared by Ramboll Environ, received 3/28/2016)

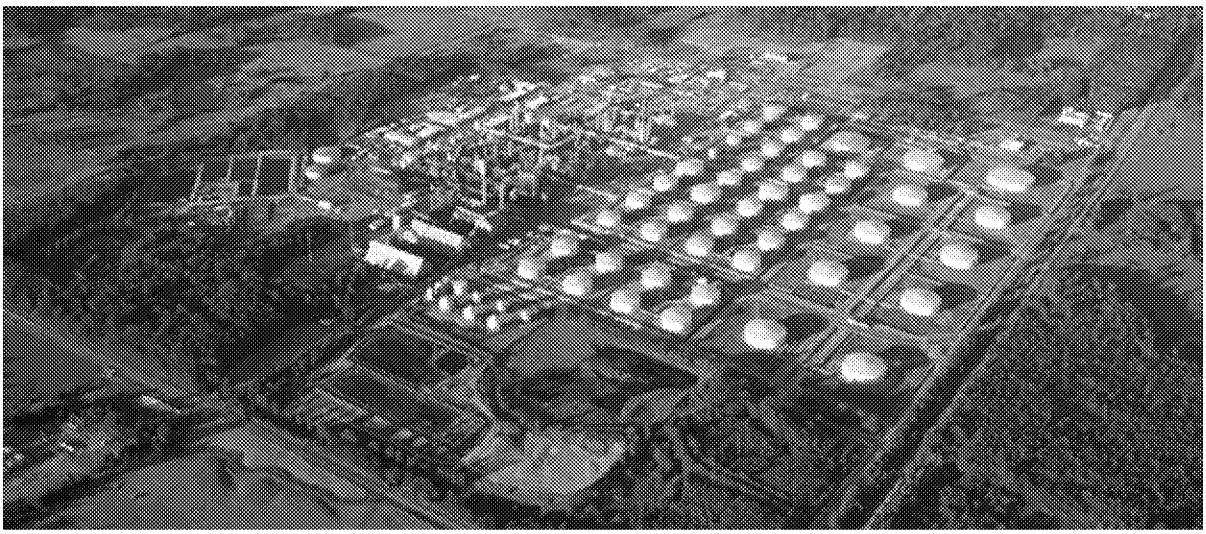


Figure 2. The BP Cherry Point Refinery aerial photograph

(Source: BP Cherry Point Refinery Coker Heater Replacement Project application, prepared by Ramboll Environ, received 3/28/2016)

2.2.2. Project description

BP West Coast Products LLC owns and operates the BP Cherry Point Refinery. The refinery produces petroleum based fuels. This PSD project referred to as the BP Coker Heaters – Replacement project (or project), will make the following changes to the refinery:

- Replace the two existing coker heaters, installed as part of the original facility in 1970, with two new coker heaters equipped with spalling (online cleaning capability).
- Install a lean oil absorption system in the coker off gas system.
- Install a compressor as part of the new lean oil absorption system.
- Install bypasses of existing heat exchangers in crude preheat system.

Changes not triggering NSR include:

- Replace the boiler feedwater circulation pump for the coker heaters.
- Change the main fractionator accumulator for additional sour water generation associated with online spalling capability.

Construction on this project is expected to begin sometime in 2017, and the new units are expected to start operating during the third quarter of 2019.

According to BP's application for this project, the project will result in a 22 percent increase in annual coker unit utilization. Collectively, the online coker heater cleaning capability and new heat exhangers bypasses in the cude prehat sytem could conservatively increase annual crude

utilization by four percent. This project is expected to cause increased annual utilization for the following units and processes at the refinery:

- Cooling towers
- Coke drum venting, cutting and draining emissions
- Green coke handling activities
- Calciners
- All facility unit heaters
- Catalyst replacement
- Flaring

The following figure from the application shows a simplified coker process. A more detailed description of the project components is provided in the following subsections.

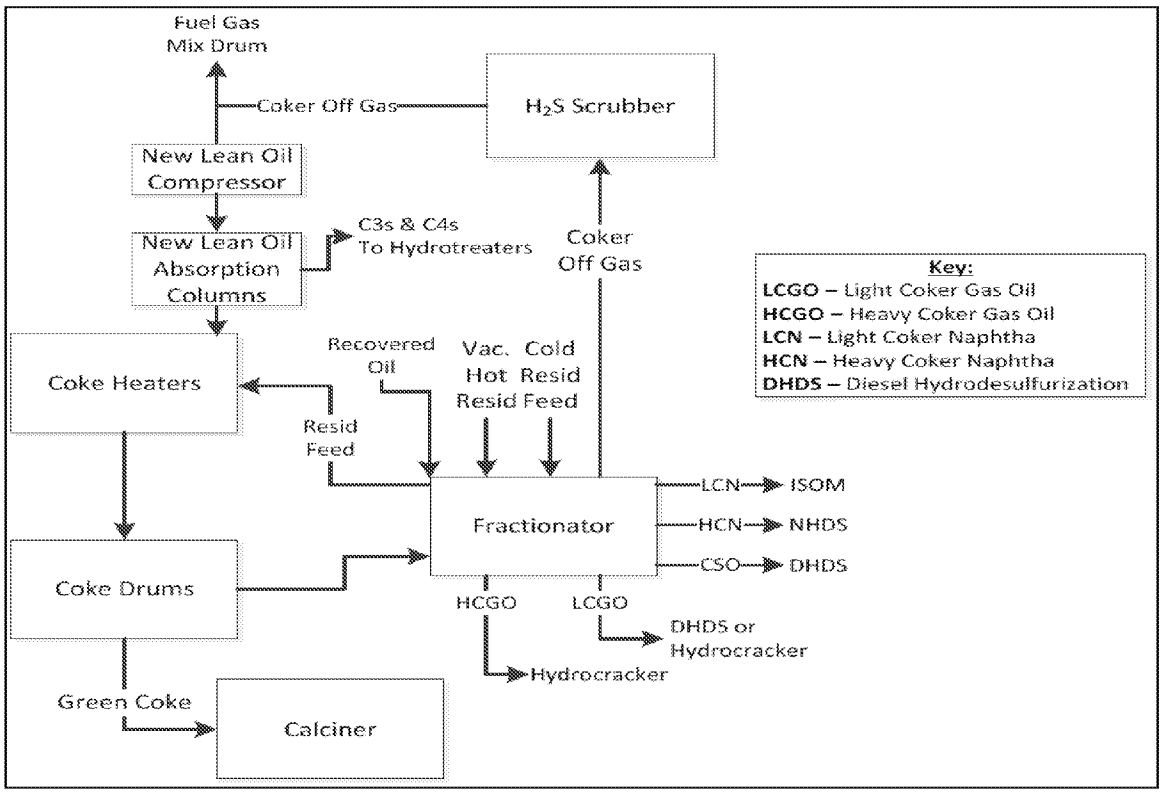


Figure 3. Simplified coker diagram

(Source: BP Cherry Point Refinery Coker Heater Replacement Project application, prepared by Ramboll Environ, received 3/28/2016)

2.2.2.1. Coker heaters

The following excerpts from the BP PSD application prepared by Ramboll Environ describe the new coker heaters:
"The new coker heaters will each have burners rated at 303 MMBtu/hr heat release higher heating value (HHV). The increase in heat availability at the coker heaters will allow the residual oil to be transferred from the crude unit to the coker unit at lower temperatures (less than 700F°). There are no modifications to the crude unit heater. To achieve the lower temps, BP plans to use an existing cooling box to transfer heat from the residual oil to the refinery cooling towers. Piping changes and a new pump will be made to the existing cooling box as part of the Project. BP does not expect any increase in short-term crude processing rate as a result of the Project.

"The new heaters will be a balanced draft design with overall heat efficiency (absorbed duty divided by fired duty) near 90 percent. The heater efficiency will be obtained through use of a heat recovery system to preheat combustion air and generate 25,000 pounds of steam per hour from each heater. Steam generated by the heat recovery system will be added to the refinery 140 pound steam header.

"The new heaters will primarily operate in balanced draft mode (forced draft and induced draft fans); however, they will have the option to operate in natural draft mode (i.e. without the air preheater) under certain operating conditions. Operating in natural draft mode lowers the heater efficiency and constrains coker unit throughput. BP does not plan to operate the heaters in natural draft mode during normal operations, but BP also recognizes the need for operational flexibility if an air preheater (balanced draft) needs to be taken offline. BP will typically operate in balanced draft mode in order to utilize the air preheater and maximize the heater efficiency.

"Each new coker heater will also have online cleaning capability (spalling) to reduce the time for periodic offline heater cleaning (decoking). During spalling two of the six passes of the coker heater tubes will be taken out of service (one cell at a time) and approximately 8,500 pounds of steam per hour will be introduced into each of the out of service passes. By adjusting the temperature of the tubes and flowing high rates of steam through the tubes coke deposits are dislodged from the tubes and transported to the active coke drum by the steam.

"The existing coker heaters require offline cleaning 2 to 3 times per year. Shutting down one of the heaters for a decoke event results in flare emissions and historically has required BP to reduce the Crude Unit processing rate until the coker heater decoke is complete. The coker heaters online cleaning capability will reduce flaring emissions and allow BP to conservatively process up to 1.4 percent more crude oil per year (2.9 thousand barrels per day [kbpd], annual average) compared to past actual throughput. BP estimates that a current coker heater decoke lasts approximately 10 days and crude rate is decreased by approximately 35 kbpd during a decoke (350 kb per decoke). BP has based the increase in annual crude throughput on the assumption of going from three decokes per year (current actual) down to zero decokes per year (projected actual), which results in 2.9 kbpd increase in crude utilization for future years regardless of the crude slate.

"Each new coker heater will be designed with a Safety Instrumented System (SIS) consisting of sensors, control valves, and software that takes the heaters to a safe state in the event of unsafe conditions. These additional components are included in the fugitive emission calculations for the new heaters."

2.2.2.2. Lean oil absorption system with compressor

The following excerpts from the BP PSD application prepared by Ramboll Environ describe the new lean oil absorption system and compressor:

"BP proposes to install a new compressor with a lean oil absorption system to recover C3 (i.e. propanes) and C4 (i.e. butanes) hydrocarbons. These hydrocarbons will be processed by the light ends unit to become a saleable product. The lean oil absorption system is designed to process approximately 44 percent of the coker off gas generated. A benefit of the lean oil absorption system is additional sulfur removal (39 percent annual average) from the coker off gas that will be used as fuel in the new coker heaters.

"The lean oil absorption system included with this Project reduces SO_2 emissions from the coker heaters during normal operations by recovering hydrocarbons (including mercaptans) from the coker off gas for additional downstream processing into products. BP as a company only has one operational lean oil absorption system recovering products from coker off gas.

"Lean oil absorption technology is based on recovering liquids from the off gas. Higher molecular weight sulfur compounds (i.e. mercaptans) will be recovered with liquids in the coker off gas. Low molecular weight sulfur compounds will not be recovered in the lean oil system and will be burned as coker off gas in the coker heaters. The residual feed to the coker unit is the primary source of low molecular weight sulfur compounds, and the coking process will also generate some additional low molecular weight compounds."

2.2.2.3. Main fractionator overhead accumulator

The following excerpts from the BP PSD application prepared by Ramboll Environ describe the changes to the main fractionator overhead accumulator:

"The overhead accumulator separates overhead vapor, distillate, and sour water from the main fractionator tower in the coker unit. Online coker heater cleaning will result in additional water vapor directed to the overhead accumulator, which requires BP to increase the size of the overhead accumulator.

There are no atmospheric emissions from the overhead accumulator during normal operation. Increasing the overhead accumulator size to accommodate additional steam from coker heater cleaning will not increase the likelihood of an upset or a malfunction event occurring within the delayed coker at the refinery."

According to BP, the only direct emissions from the main fractionator overhead accumulator are accounted for with BP's leak detection and repair program (LDAR).

2.2.2.4. Boiler feed water circulation pump

The following excerpts from the BP PSD application prepared by Ramboll Environ describe the replacement boiler feed water circulation pump:

"BP proposes to replace the boiler feed water circulation pump to recover heat from the coker unit. The circulation pump has no effect on coker unit emissions."

2.2.3. Aggregation discussion

Ecology reviewed other BP projects to see if they should be aggregated with this coker heater replacement project. No other projects were deemed to be aggregated with the Coker Project. Specifically, the sulfur plant modificaiont project was reviewed as part of a PSD applicability determination. Ecology prepared a PSD applicability determination for the sulfur plant modification project (SPMP) and determined that it is not subject to aggregation with the PSD Coker Project. The 7-page determination outlines the reasons Ecology made that determination which was based on multiple criteria. After reviewing the criteria documented in the determination, Ecology concluded that the projects should not be aggregated together based on the key conclusion of the applicability determination, stated as follows: "*While Ecology was initially concerned that the two projects may be linked by necessity of each other, Ecology is now satisfied, as explained in the previous criterions, that both projects can be successfully and viably implemented independent from each other and without the need for the other project.*" Appendix A (response to comment 5), includes the full SPMP PSD applicability determination). Response to EPA comment 116 in Appendix B also includes a detailed discussion on aggregation.

3. PSD APPLICABILITY REVIEW

3.1. Overview and Permitting History

As noted in Section 2.2.1, the proposed project will require a PSD permit because both the project's emissions increase and the net contemporaneous emissions increase caused by the project exceed PSD SERs for NSR pollutants, including greenhouse gases (GHGs). This section describes how that determination was performed.

The proposed project at BP require a PSD review. In accordance with the requirements of 40 CFR 52.21(a)(2), these emission increases associated with the new and existing units is based on their potential to emit (PTE) and baseline actual emissions.

After determininting in Section 2.1.1. that there are no physical and operational changes of this project exempted by 40 CFR 52.21(b)(2)(iii)(a through k), (Step 1), the significant emissions

increase analysis looks only at the emissions from the proposed project and is referred to here as Step 2. The significant net emissions increase analysis looks at additional increases and decreases from "contemporaneous" projects at the source and is referred to here as Step 3.

For the significant emissions increase analysis, the review involves both new emissions units and modification of existing units. The PSD regulations require use of the hybrid test for projects that involve both the addition of new emissions units and the modification of existing emissions units (40 CFR 52.21(a)(2)(iv)(f)). Under the hybrid test, a significant emissions increase of a regulated NSR pollutant is projected to occur if the sum of the emissions increases for each emissions unit, using the actual-to-projected-actual applicability test (40 CFR 52.21(a)(2)(iv)(c) for modified units and the actual-to-potential applicability test (40 CFR 52.21(a)(2)(iv)(d)) for new units, equals or exceeds the significance threshold for that pollutant as defined in paragraph 40 CFR 52.21(b)(23).

The actual-to-projected-actual applicability test involves adding the projected actual emissions from existing emissions units that are modified as part of the project or that are otherwise expected to experience an emission increase as a result of the project, and then subtracting the past actual emissions (called the "baseline actual emissions") from those units.
In lieu of projecting future actual emissions for a particular existing emissions unit, an applicant can choose instead to use the unit's PTE as the unit's post project emissions (40 CFR 52.21(b)(41)(ii)(d)). The actual-to-potential test, which is required for all new units being constructed as part of the project, involves totaling the potential emissions of the proposed new emissions units, then subtracting past actual emissions of those units. A new unit that is being constructed as part of the project has a baseline of zero (40 CFR 52.21(b)(48)(iii)).

If the project would result in a significant emissions increase, then a significant net emissions increase analysis is often conducted. However, EPA has clearly stated that calculating a net emissions increase is at the source's option (see, for example, 67, Federal Register 80186, at 80197 [December 31, 2002]). Therefore, a source may seek a PSD permit based on a calculated significant emission increase alone. For the Coker project, which is an existing major source for PSD, BP found that emissions for nine (9) regulated NSR pollutants were considered to have significant emissions increases. BP also performed a netting analysis (see sections 3.3.1 and 3.3.2) and found that the same nine pollutants had significant net emissions increases also.

The BP Coker project therefore triggers PSD review for the nine regulated NSR pollutants.

3.2. Significant Emissions Increases Calculations

The project will involve both modifying existing emission units and constructing new emission units. Therefore, the hybrid test, described in the previous section, is required. Test results for both new and modified units are presented in this section followed by a summary hybrid test table.

3.2.1. Actual-to-potential test for new coker heaters and components

The calculations for new coker heater emissions were based on the BACT limit emission rates listed in Section 4.2.3.3, and the following parameters:

- Maximum heater burner capacity: 303.00 MMBtu/hr
- Hours of operation: 8760 hr/yr
- Hours of startup/shutdown/standby: 504 hr/yr
- F Factor for refinery fuel gas: 8,381 dscf/MMBtu
- Exhaust gas volume flow: 43,323 dscfm at zero percent O_2

The results of the new cokers heater and component emissions are listed in Table 1.

Table 1. Emissions Increases of Regulated NSR Pollutants for New Coker Heaters (tpy)*

Emission Unit	CO	NO_X	PM†	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
Coker heaters	90.9	159.3	6.6	26.5	26.5	131.9	10.6	14.3	320,883	0.03	0.0013
Coker heater component fugitives‡	§	§	§	§	§	§	§	1.1	5.5	0.1	§

* Amounts of other PSD regulated pollutants (TRS, reduced sulfur compounds, and municipal waste-related pollutants) are estimated to be zero or negligible.
† Filterable.
‡ Includes crude pre-heat components emission estimates.
§ Zero, negligible, or not applicable.

3.2.2. Actual-to-projected-actual applicability test for modified and debottlenecked emissions units

Debottlenecking is the term used for situations when emission units upstream or downstream from the unit(s) undergoing a physical change or change in the method of operation will experience an emission increase as result of the project. Additional emissions from units with increased utilization are calculated using an actual-to-projected-actual applicability test.

As described in Section 3.1, the actual-to-projected-actual applicability test involves adding the projected actual emissions from existing emissions that are expected to experience an emission increase as a result of the project, and then subtracting the past actual emissions (called the "baseline actual emissions") from those units.

When calculating projected actual emissions, 40 CFR 52.21(b)(41)(ii)(c) requires that BP "Shall exclude, in calculating any increase in emissions that results from the particular project, that portion of the unit's emissions following the project that an existing unit could have accommodated during the consecutive 24-month period used to establish the baseline actual emissions under paragraph (b)(48) of this section and that are also unrelated to the particular

project, including any increased utilization due to product demand growth…" These emissions are referred to in this TSD as "excludables."

For existing emission units that are being modified or debottlenecked as part of the project, the PSD baseline emissions are emissions averaged over a 24 consecutive month period. According to 40 CFR 52.21(b)(48)(ii), the 24-month period must occur "within the 10-year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received."

For a regulated NSR pollutant, when a project involves more than one emission unit, only one 24 consecutive month period may be used to determine the baseline actual emissions for all emission units being changed. However, a different 24 consecutive month period can be used for each regulated NSR pollutant (40 CFR 52.21(b)(48)(ii)(d)).

For baseline emissions, BP chose the following 24-month periods for the pollutant.

Table 2. BP's Chosen Dates for Baseline Actual Emissions

24-Month Period	Pollutant(s)
2008-2009	SO_2
2010-2011	CO, PM, PM_{10}, $PM_{2.5}$, CO_{2e}, and lead
2011-2012	NOx
2012-2013	VOC and H_2S
2013-2014	H_2SO_4

Because BP's application was considered complete on April 28, 2016, BP's chosen 24-month periods are all within the required 10-year window. Ecology performed a thorough review of BP's chosen baseline actual emission (BAE) dates for comparison to Ecology emission inventory data. Ecology found discrepancies and asked BP to provide reasons from PSD guidance to justify the discrepancies. According to 40 CFR 52.21(b)(21)(ii), "The Administrator shall allow the use of a different time period upon a determination that it is more representative of normal source operation." In Table 3, BP provided the following justifications for adjustments to baseline emissions.

Table 3. Documentation of BP's Defense of Adjustments to BAE				
Pollutant (24-mo period chosen for baseline)	**Emission Unit**	**Actual Emissions Inventory Values: (Years: emissions)**	**Emissions Used in Application (Years: emissions)**	**Justification for not using emission inventory values and/or the chosen emission inventory years**
SO_2 (2008/2009)	Crude Shipping Unloading	Not Applicable	2011: 264 tpy 2012: 254 tpy	See Section 2.5.13 (Crude Unloading), page 19 of the air permit application. Emissions from the vessel are considered secondary because they occur when a vessel is docked at the refinery. Secondary emissions are not accounted for in PSD applicability calculations (40 CFR 52.21(b)(4)), but they must be evaluated as part of the air quality impacts analysis (40 CFR 52.21(k)).
NOx (2011/2012)	1st Frac Reboiler	2011: 137 tpy 2012: 125 tpy	2011: 21 tpy 2012: 19 tpy	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." And subsection (c) "requires the baseline actual emissions to be adjusted downward to account for an emission limit that the source must currently comply." Based on the reasons below, BP has adjusted the "actual" 2011/12 emissions from the 1st Frac Reboiler. According to the application footnote b on page C-13, NOx baseline actual emissions are now based on past actual fuel use, projected actual heat input requirements, and emission limit from permit OAC #1067a. Section 3.2.5 of the application states that "BP adjusted the baseline actual emissions for this heater as if the emission unit was required to comply with the current 0.04 lb/MMBtu NOx emission limit." This is the limit referred to in the cited PSD regulation section (c), and which was implemented during the 2011-2012 timeframe as explained in section 3.2.5.

Table 3. Documentation of BP's Defense of Adjustments to BAE				
Pollutant (24-mo period chosen for baseline)	**Emission Unit**	**Actual Emissions Inventory Values: (Years: emissions)**	**Emissions Used in Application (Years: emissions)**	**Justification for not using emission inventory values and/or the chosen emission inventory years**
	Hydrocracker R4 Heater	2011: 20 tpy 2012: 16 tpy	2011: 29 tpy 2012: 24 tpy	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." Based on the reasons below BP has learned that the listed emissions more accurately reflected the "actual" 2012/12 emissions from the R4 heater compared to the values BP reported in the 2011/12 inventory According to the application footnote on page C-13 for the R4 Heater, NO_X baseline actual emissions are now based on past actual fuel use and engineering estimate emission factor. Section 3.2.5 states that "engineering test data for the heater are more accurate." BP has used handheld analyzers in the past to estimate emission concentrations which are better emissions estimation compared to a general AP-42 emission factor.
	North Vacuum Heater	2011: 41 tpy 2012: 36 tpy	2011: 37.6 tpy (41.0 tpy) 2012: 33.8 tpy (36.1 tpy)	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." The 2011 and 2012 emissions inventories were based on calendar year emission testing. In the application, 2013 source test data was inadvertently used to re-calculate 2011 and 2012 actual emissions. The application under-estimated baseline NO_X emissions by 2.8 tpy. The project is PSD major for NO_X and re-adjusting the baseline NO_X emissions does not change the determination. In addition, adjusting the baseline NO_X emissions in the application would result in the project emission increase changing from 4.8 tpy to 2.0 tpy. Therefore, the emissions impacts evaluated

Table 3. Documentation of BP's Defense of Adjustments to BAE				
Pollutant (24-mo period chosen for baseline)	**Emission Unit**	**Actual Emissions Inventory Values: (Years: emissions)**	**Emissions Used in Application (Years: emissions)**	**Justification for not using emission inventory values and/or the chosen emission inventory years**
				in the application are overestimated and no change will be made to the application.
$PM_{10}/PM_{2.5}$ (2010/2011)	Crude Heater	2010: 16 tpy 2011: 13 tpy	2010: 22 tpy 2011: 28 tpy	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." Based on the reasons below, BP has learned that the listed emissions data more accurately reflected the "actual" 2010/11 emissions from the crude heater compared to the values BP reported in the 2010/11 inventory. Past actual emission inventory $PM_{10}/PM_{2.5}$ emissions were based on AP-42 Section 1.4 (natural gas combustion) emission factors. BP recently conducted PM source testing for two refinery fuel gas-fired heaters (#2 DHDS Charge Heater & #3 DHDS Charge Heater). Emission factors derived from the refinery source tests are more representative of refinery fuel gas composition than the AP-42 emission factors for natural gas combustion. The $PM_{10}/PM_{2.5}$ emission factors in the application were updated to reflect the average of the two BP source tests (0.0085 lb/MMBtu), representing refinery fuel gas composition instead of natural gas composition.

Table 3. Documentation of BP's Defense of Adjustments to BAE				
Pollutant (24-mo period chosen for baseline)	**Emission Unit**	**Actual Emissions Inventory Values: (Years: emissions)**	**Emissions Used in Application (Years: emissions)**	**Justification for not using emission inventory values and/or the chosen emission inventory years**
	No. 1 Reformer	2010: 8 tpy 2011: 7 tpy	2010: 22 tpy 2011: 18 tpy	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." Based on the reasons below, BP has learned that the listed emissions data more accurately reflected the "actual" 2010/11 emissions from the No.1 reformer compared to the values BP reported in the 2010/11 inventory. Past actual emission inventory $PM_{10}/PM_{2.5}$ emissions were based on AP-42 Section 1.4 (natural gas combustion) emission factors. BP recently conducted PM source testing for two refinery fuel gas-fired heaters (#2 DHDS Charge Heater & #3 DHDS Charge Heater). Emission factors derived from the refinery source tests are more representative of refinery fuel gas composition than the AP-42 emission factors for natural gas combustion. The $PM_{10}/PM_{2.5}$ emission factors in the application were updated to reflect the average of the two BP source tests (0.0085 lb/MMBtu), representing refinery fuel gas composition instead of natural gas composition.

Table 3. Documentation of BP's Defense of Adjustments to BAE				
Pollutant (24-mo period chosen for baseline)	**Emission Unit**	**Actual Emissions Inventory Values: (Years: emissions)**	**Emissions Used in Application (Years: emissions)**	**Justification for not using emission inventory values and/or the chosen emission inventory years**
	No. 1 H2 Plant (north/ south)	2010: 8/8 tpy 2011: 7/8 tpy	2010: 22 tpy 2011: 21 tpy	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." Based on the reasons below, BP has learned that the listed emissions data more accurately reflected the "actual" 2010/11 emissions from the No.1 H2 plant compared to the values BP reported in the 2010/11 inventory. Past actual emission inventory $PM_{10}/PM_{2.5}$ emissions were based on AP-42 Section 1.4 (natural gas combustion) emission factors. BP recently conducted PM source testing for two refinery fuel gas-fired heaters (#2 DHDS Charge Heater & #3 DHDS Charge Heater). Emission factors derived from the refinery source tests are more representative of refinery fuel gas composition than the AP-42 emission factors for natural gas combustion. The $PM_{10}/PM_{2.5}$ emission factors in the application were updated to reflect the average of the two BP source tests (0.0085 lb/MMBtu), representing refinery fuel gas composition instead of natural gas composition.
H_2SO_4 (2013/2014)	Calciners 1&2	2013: 7.1 tpy 2014: 14.5 tpy	2013: 4.2 tpy 2014: 23.2 tpy	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." Based on the reasons below, BP has calculated annual "actual" 2013/14 emissions from the calciners slightly different from than the values BP reported in the 2013/14 inventory.
	Calciners 3	2013: 8.6 tpy 2014: 18.6 tpy	2013: 13.5 tpy 2014: 22.8 tpy	
	Calciners Total	2013: 21.6 tpy 2014: 33.1 tpy	2013: 17.7 tpy 2014: 46.0 tpy	

Table 3. Documentation of BP's Defense of Adjustments to BAE				
Pollutant (24-mo period chosen for baseline)	**Emission Unit**	**Actual Emissions Inventory Values: (Years: emissions)**	**Emissions Used in Application (Years: emissions)**	**Justification for not using emission inventory values and/or the chosen emission inventory years**
	Calciners 2013/2014 Avg	27.5 tpy	31.8 tpy	From Section 3.2.3 of the application, baseline emissions "are based on annual calciner utilization and emission factors developed from source tests." BP tested the two calciner stacks for H_2SO_4 emissions in July 2013 and July 2014. The same source test data were used to develop the reported emissions inventories and baseline emissions presented in the application. The reported emissions inventories were based on monthly emissions with the most current emission factor from an emission test (i.e. calciner operations before the July 2014 source test were based on the July 2013 emission data). The application was based on yearly throughput and the emission test during from the calendar year. The difference between the two calculation methodologies is approximately 4.3 tpy. The project triggers PSD review for H_2SO_4 regardless of the baseline calculation method for the calciners, and the application contains a BACT analysis for H2SO4 emissions. Washington's air toxic rule requires an evaluation of daily H_2SO_4 emission increases from the project; however, the project will not increase daily H_2SO_4 emissions from the calciners. No change to the application will be made.
H_2S (2012/2013)	Coke Drum venting	2012: 3 tpy	2012: 9 tpy	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." Based on the latest coke drum venting emission information as explained in detail in section 3.2.1* of the application, BP has learned that the listed emissions data more accurately reflected the "actual" 2012/13 emissions from coke drum venting compared to the values BP reported in the 2012/13 inventory.

Table 3. Documentation of BP's Defense of Adjustments to BAE				
Pollutant (24-mo period chosen for baseline)	**Emission Unit**	**Actual Emissions Inventory Values: (Years: emissions)**	**Emissions Used in Application (Years: emissions)**	**Justification for not using emission inventory values and/or the chosen emission inventory years**
				*According to section 3.2.1 of the application, "Data used to develop the emission calculations were obtained from EPA-requested source tests conducted at multiple refineries, including the BP-Husky refinery in Toledo….Emissions for 2005 – 2008 were estimated from 2013 actual emissions based on the annual average coker throughput in these years compared to throughput during 2013."
VOC (2012/2013)	Crude Heater	2012: 8 tpy 2013: 11 tpy	2012: 10 tpy 2013: 13 tpy	PSD regulations 40 CFR 52.21(b)(48)(ii) defines baseline actual emissions as "the average rate, in tons per year, at which the emissions unit actually emitted the pollutant." Based on the reasons below, BP has learned that the listed emissions data more accurately reflected the "actual" 2010/11 emissions from the crude heater compared to the values BP reported in the 2010/11 inventory. As described in section 3.2.7 of the application, "BP updated the baseline actual VOC emissions using the normalized AP-42 natural gas emission factor of 0.0054 lb/MMBtu and annual refinery fuel gas and vacuum tail gas heat inputs to the crude heater. Normalizing the AP-42 natural gas emission factors to an energy input basis is an improved emission calculation approach and is recommended in the AP-42 documentation."

3.2.2.1. Coke drum venting actual-to-projected-actual applicability test

Table 4 presents BP's estimated emissions for coke drum venting.

Table 4. Emissions Increases of Regulated NSR Pollutants for Coke Drum Venting (tpy)											
Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	1.0	*	3.2	3.2	3.2	*	*	14.1	1724	7.8	*
Excludables	0.0	*	2.6	2.6	2.6	*	*	0.9	46.4	2.6	*
Projected emissions	2.1	*	10.6	10.6	10.6	*	*	29.1	3664	14.4	*
Change in emissions	1.1	*	4.9	4.9	4.9	*	*	14.2	1893	4.0	*
* Zero, negligible, or not applicable.											

3.2.2.2. Green coke handling actual-to-projected-actual applicability test venting

Table 5 presents BP's estimated emissions for green coke handling.

Table 5. Emissions Increases of Regulated NSR Pollutants for Green Coke Handling (tpy)											
Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	*	*	18.0	17.9	17.9	*	*	*	*	*	*
Excludables	*	*	*	*	*	*	*	*	*	*	*
Projected emissions	*	*	21.5	19.2	18.1	*	*	*	*	*	*
Change in emissions	*	*	3.5	1.2	0.2	*	*	*	*	*	*
* Zero, negligible, or not applicable.											

3.2.2.3. Calciners actual-to-projected-actual applicability test

Table 6 presents BP's estimated emissions for calciners.

Table 6. Emissions Increases of Regulated NSR Pollutants for Calciners (tpy)											
Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	11.4	533.4	15.3	15.3	15.3	198.4	31.8	1.1	1,084,051	*	0.04
Excludables	3.4	280	6.7	6.7	6.7	41.3	12.4	0.5	318,563	*	0.01
Projected emissions	17.5	956.1	25.9	25.9	25.9	359.1	75.9	1.9	1,586,480	*	0.05
Change in emissions	2.7	142.7	3.9	3.9	3.9	119.3	31.8	0.2	183,866	*	0.01
* Zero, negligible, or not applicable.											

3.2.2.4. Hydrocracker actual-to-projected-actual applicability test

Table 7 presents BP's estimated emissions for the hydrocracker.

Table 7. Emissions Increases of Regulated NSR Pollutants for Hydrocracker (tpy)

Emission Unit	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
R10 Heater											
BAE	11.3	6.1	0.6	2.4	2.4	11.9	0.4	1.1	34,174	*	*
Excludables	3.1	4.5	0.2	0.7	0.7	2.9	0.1	0.8	9,319	*	*
Projected emissions	23.7	21.5	1.1	4.5	4.5	16.8	0.7	2.9	63,904	*	*
Change in emissions	9.2	10.8	0.4	1.4	1.4	2.0	0.2	0.9	20,411	*	*
1st Stage Fractionator Reboiler											
BAE	20.9	21.4	1.1	4.4	4.4	15.4	0.7	2.9	62,920	*	*
Excludables	-3.4	5.4	0.2	0.8	0.8	8.8	0.1	0.3	10,662	*	*
Projected emissions	34.7	34.7	1.8	7.4	7.4	27.4	1.1	4.7	104,550	*	*
Change in emissions	17.2	7.8	0.5	2.2	2.2	3.3	0.3	1.4	30,969	*	*
R4 Heater											
BAE	8.2	26.2	0.4	1.7	1.7	6.8	0.3	1.1	24,617	*	*
Excludables	1.8	8.6	0.1	0.4	0.4	3.2	0.0	0.2	5,363	*	*
Projected emissions	10.5	36.8	0.6	2.2	2.2	8.3	0.3	1.4	31,714	*	*
Change in emissions	0.6	2.0	0.0	10.1	0.1	0.0	0.0	0.1	1,734	*	*
2nd Stage Fractionator Reboiler											
BAE	29.2	36.6	1.6	6.2	6.2	24.3	0.9	3.3	88,099	*	*
Excludables	1.4	9.2	0.1	0.3	0.3	6.4	0.1	0.8	4,258	*	*
Projected emissions	32.1	56.2	1.7	6.8	6.8	25.4	1.1	4.3	96,939	*	*
Change in emissions	1.5	10.5	0.1	0.3	0.3	0.0	0.1	0.2	4,582	*	*
Hydrocracker Totals											
Change in emissions	28.5	31.1	1.0	4.1	4.1	5.3	0.9	2.6	87,296	*	*

* Zero, negligible, or not applicable.

3.2.2.5. Sulfur plant actual-to-projected-actual applicability test

Table 8 presents BP's estimated emissions for the sulfur plant.

Table 8. Emissions Increases of Regulated NSR Pollutants for the Sulfur Plant (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	152.5	15.9	0.5	2.1	2.1	67.0	2.7	1.2	71,883	0.5	*
Excludables	*	*	*	*	*	*	*	*	*	*	*
Projected emissions	204.0	25.0	0.7	2.7	2.7	99.0	4.0	1.5	95,103	0.6	*
Change in emissions	51.4	9.0	0.2	0.7	0.7	32.0	1.3	0.3	23,220	0.1	*

* Zero, negligible, or not applicable.

3.2.2.6. Crude heater actual-to-projected-actual applicability test

Table 9 presents BP's estimated emissions for the crude heater.

Table 9. Emissions Increases of Regulated NSR Pollutants for the Crude Heater (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	33.7	365.2	4.9	19.7	19.7	172.5	2.9	11.5	280,415	*	*
Excludables	3.2	104.9	0.5	1.9	1.9	12.8	0.2	2.2	26,993	*	*
Projected emissions	38.3	487.8	5.6	22.5	22.5	192.3	3.2	14.2	318,994	*	*
Change in emissions	1.4	17.7	0.2	0.8	0.8	7.0	0.1	0.5	11,587	*	*

* Zero, negligible, or not applicable.

3.2.2.7. North vacuum heater actual-to-projected-actual applicability test

Table 10 presents BP's estimated emissions for the north vacuum heater.

Table 10. Emissions Increases of Regulated NSR Pollutants for the Crude Heater (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	22.8	35.7	0.6	2.4	2.4	11.3	0.3	1.3	33,382	*	*
Excludables	3.1	13.9	0.1	0.3	0.3	1.1	0.1	0.4	4,601	*	*
Projected emissions	26.9	54.4	0.7	2.8	2.8	10.3	0.4	1.8	39,414	*	*
Change in emissions	1.0	4.8	0.0	0.1	0.1	0.0	0.0	0.1	1,432	*	*

* Zero, negligible, or not applicable.

3.2.2.8. South vacuum heater actual-to-projected-actual applicability test

Table 11 presents BP's estimated emissions for the south vacuum heater.

Table 11. Emissions Increases of Regulated NSR Pollutants for the South Vacuum Heater (tpy)

Emissions	CO	NO_X	PM*	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	0.9	29.3	1.5	6.1	6.1	28.4	0.8	3.4	86,001	†	†
Excludables	0.1	4.4	0.2	0.6	0.6	2.4	0.1	0.9	9,047	†	†
Projected emissions	1.0	44.3	1.7	6.9	6.9	25.9	1.0	4.4	98,630	†	†
Change in emissions	0.0	10.6	0.1	0.3	0.3	0.0	0.0	0.2	3,583	†	†

∗ Slight variations in emissons changes are due to roundoff error.
† Zero, negligible, or not applicable.

3.2.2.9. #1 and #2 reformer heaters actual-to-projected-actual applicability test

Table 12 presents the BPs estimated emissions for the #1 and #2 reformer heaters.

Table 12. Emissions Increases of Regulated NSR Pollutants for the #1 and #2 Reformer Heaters (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	0.9	287	5.9	23.5	3.5	111	3.0	4.8	333,920	∗	∗
Excludables	0.2	67.8	0.6	2.5	2.5	7.3	0.6	1.0	35,695	∗	∗
Projected emissions	1.1	369	6.8	7.0	7.0	101	3.8	6.0	83,547	∗	∗
Change in emissions	0.0	13.4	0.2	1.0	1.0	0.0	0.1	0.2	3,932	∗	∗

∗ Zero, negligible, or not applicable.

3.2.2.10. Naphtha heaters actual-to-projected-actual applicability test

Table 13 presents BP's estimated emissions for the naphtha heaters.

Table 13. Emissions Increases of Regulated NSR Pollutants for Naphtha Heaters (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	29.6	31.3	0.8	3.1	3.1	13.9	0.5	2.0	43,341	∗	∗
Excludables	8.8	14.3	0.2	0.9	0.9	4.1	0.0	0.5	12,842	∗	∗
Projected emissions	46.9	55.8	1.2	4.8	4.8	18.0	0.7	3.1	68,730	∗	∗
Change in emissions	8.6	10.2	0.2	0.9	0.9	0.0	0.1	0.6	12,547	∗	∗

∗ Zero, negligible, or not applicable.

3.2.2.11. #1 hydrogen plan actual-to-projected-actual applicability test

Table 14 presents BP's estimated emissions for the #1 hydrogen plant.

Table 14. Emissions Increases of Regulated NSR Pollutants for the Hydrogen Plant (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	207.1	223.0	5.3	21.4	21.4	93.3	1.3	8.3	716,428	*	*
Excludables	3.4	27.6	0.1	0.4	0.4	8.5	1.8	5.5	11,712	*	*
Projected emissions	218.5	260.1	5.6	22.6	22.6	84.0	3.2	14.3	745,571	*	*
Change in emissions	7.9	9.4	0.2	0.8	0.8	0.0	0.1	0.5	17,432	*	*

* Zero, negligible, or not applicable.

3.2.2.12. #1 DHDS reboiler actual-to-projected-actual applicability test

Table 15 presents BP's estimated emissions for the #1 DHDS reboiler.

Table 15. Emissions Increases of Regulated NSR Pollutants for the #1 DHDS Reboiler (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	0.3	4.4	0.4	1.5	1.5	6.6	0.2	0.8	21,090	*	*
Excludables	0.0	0.7	0.0	0.1	0.1	0.7	0.0	0.1	776	*	*
Projected emissions	0.4	6.1	0.5	1.9	1.9	7.0	0.3	1.2	26,749	*	*
Change in emissions	0.1	1.1	0.1	0.3	0.3	0.0	0.1	0.2	4,883	*	*

* Zero, negligible, or not applicable.

3.2.2.13. ISOM actual-to-projected-actual applicability test

Table 16 presents BP's estimated emissions for the ISOM.

Table 16. Emissions Increases of Regulated NSR Pollutants for the ISOM (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	0.1	0.2	*	0.1	0.1	0.4	*	0.1	1,222	*	*
Excludables	0.1	0.2	*	0.1	0.1	0.2	*	0.0	653	*	*
Projected emissions	0.2	0.6	*	0.2	0.2	0.6	*	0.1	2,294	*	*
Change in emissions	0.0	0.3	*	0.0	0.0	0.0	*	0.0	419	*	*

* Zero, negligible, or not applicable.

3.2.2.14. Additional affected units actual-to-projected-actual applicability test

Table 17 presents BP's estimated emissions for additional affected units.

Table 17. Emissions Increases of Regulated for Additional Affected Units* (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	3.2	34.5	13.3	2.9	0.8	0.0	†	204.1	5290	2.5	†
Excludables	7.5	15.5	0.6	0.6	0.6	0.0	†	79.6	4900	0.0	†
Projected emissions	12.2	52.2	33.8	6.8	1.5	0.2	†	297.0	10578	2.7	†
Change in emissions	1.5	2.1	19.9	3.3	0.1	0.2	†	13.3	388	0.2	†

* Additional units include emission increases (projected actual emissions minus BAE) for HP Flare, #1 & #2 cooling towers, wastewater treatment, storage tanks, and product loadout (truck, rail, and marine).

† Zero, negligible, or not applicable.

3.2.3. Hybrid test - significant emissions increase analysis summary

The total emission increases relating to the project is the sum of the increases from the existing units (projected actual minus BAE) and the PTE from the newly constructed units and is presented in Table 18. The federal rule defines an SER to be equal to or exceeding any of the SERs listed in Table 17 (40 CFR 52.21(b)(23)).

In addition to regulated NSR pollutants, GHGs are subject to regulation as of January 2, 2011. EPA's PSD rule under 40 CFR 52.21(b)(49)(iv) states that "beginning January 2, 2011, the pollutant GHGs is subject to regulation if:

(a) The stationary source is a new major stationary source for a regulated NSR pollutant that is not GHGs, and also will emit or will have the potential to emit 75,000 tpy CO_{2e} or more; or

(b) The stationary source is an existing major stationary source for a regulated NSR pollutant that is not GHGs, and also will have an emissions increase of a regulated NSR pollutant, and an emissions increase of 75,000 tpy CO_{2e} or more."

BP is an existing major stationary source for at least one regulated NSR pollutant that is not GHGs. In fact the proposed project is expected to result in a significant increase of eight (8) other NSR regulated pollutants. Therefore, because the project will result in an emissions increase of 75,000 tpy of CO_2e, the GHG emissions from the project are also subject to PSD review and are included in Table 18.

Table 18. Total Estimated Project Emissions, Emissions, and SERs			
Pollutant	Project Estimated Emissions	SER (tpy)	Emissions Greater Than SERs (Yes/No)
NO_X	412	40	Yes
CO	195	100	Yes
SO_2	296	40	Yes
PM	41	25	Yes
PM_{10}	49	15	Yes
$PM_{2.5}$	45	10	Yes
VOCs	48	40	Yes
Lead (Pb)	0.008	0.6	No
H_2SO_4	45	7	Yes
Hydrogen Sulfide (H_2S)	4.4	10	No
CO_2e (GHGs)	683,367	75,000	Yes
Fluorides	Negligible	3	No
Total reduced sulfur (TRS)	Negligible	10	No
Reduced sulfur compounds	Negligible	10	No
Municipal waste combustor/ landfill emissions	*	†	No
Reduced sulfur compounds	Negligible	10	No
* The project does not involve municipal waste. † See 40 CFR 52.21(b)(23).			

3.3 Significant Net Emissions Increase Calculations

The steps necessary to calculate the net emission increase are outlined in 40 CFR 52.21(b)(3)(i). When a netting analysis is performed, only the pollutants that have significant emission increases need to go through the analysis.

3.3.1. Netting rules

According to 40 CFR 52.21(b)(3)(i), a net emissions increase means, with respect to any regulated NSR pollutant emitted by a major stationary source, the amount by which the sum of the following exceeds zero: the increase in emissions from a particular physical change or change in the method of operation at a stationary source; and any other increases and decreases in actual emissions at the major stationary source that are contemporaneous with the particular change and are otherwise creditable.

An increase or decrease in actual emissions is contemporaneous with the increase from the particular change only if it occurs between the date five years before construction on the particular change commences; and the date that the increase from the particular change occurs.

For the BP project, construction and operation of the new coker heaters is expected to occur between 2017 and 1st quarter 2019 with a commissioning period through the 3rd quarter 2019. Therefore, the contemporaneous period for the BP project extends from 2012 through the 3rd quarter 2019.

An increase or decrease in actual emissions is creditable only if: the reviewing authority has not relied on it in issuing a permit, which is in effect when the increase in actual emissions from the particular change occurs; and the increase or decrease in emissions did not occur at a Clean Unit (with some exceptions).

It also includes increase or decrease in fugitive emissions (to the extent quantifiable), for an emissions unit that is part of one of the major source categories.

An increase or decrease in actual emissions of sulfur dioxide, particulate matter, or nitrogen oxides that occurs before the applicable minor source baseline date is creditable only if it is required to be considered in calculating the amount of maximum allowable increases remaining available.

An increase in actual emissions is creditable only to the extent that the new level of actual emissions exceeds the old level.

A decrease in actual emissions is creditable only to the extent that the old level of actual emissions or the old level of allowable emissions, whichever is lower, exceeds the new level of actual emissions. It must also be enforceable as a practical matter at and after the time that actual construction on the particular change begins. It must also have approximately the same qualitative significance for public health and welfare as that attributed to the increase from the particular change.

An increase that results from a physical change at a source occurs when the emissions unit on which construction occurred becomes operational and begins to emit a particular pollutant. Any replacement unit that requires shakedown becomes operational only after a reasonable shakedown period, not to exceed 180 days.

3.3.2. Netting analysis

Table 19 presents BP's estimated netting analysis changes in emissions, with specific project notes from the application included for each applicable project.

Table 19. Netting Analysis Changes in Emissions (tpy)

Change in Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e
Removal of existing coker heaters	-10.7	-88.4	-6.5	-6.5	-6.5	-85.4	-6.9	-4.7	-123,222
Rail logistics project[(a)]	(b)	(b)	(b)	(b)	(b)	(b)	(b)	4.5	(b)

Table 19. Netting Analysis Changes in Emissions (tpy)									
Change in Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e
Naphtha Reliability Project[c]	(b)	(b)	(b)	(b)	(b)	(b)	(b)	0.1	(b)
#3 Calciner Convection Section[d]	0.3	7.8	0.2	0.2	0.2	0.4	0.4	0.0	2,851
Hydrocracker ARV Project[e]	(b)	(b)	(b)	(b)	(b)	(b)	(b)	0.1	(b)
Clean Fuels Project[f]	31.3	22.4	6.5	(f)	23.4	10.0	0.4	30.3	534,796
1st Stage Fract. Reboiler Retrofit[g]	(b)	-87.7	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Net Emission Changes	20.9	-145.9	0.2	-6.3	17.1	-75	-6.1	30.3	414,425

(a) NWCAA issued OAC #1142 for the Rail Logistics Project on January 22, 2013. BP started operation of the equipment in December 2013.
(b) Zero, negligible, or not applicable.
(c) NWCAA issued OAC #1141 for the Naphtha Reliability Project on April 22, 2013. BP has not started operation of the proposed modification.
(d) BP received a PSD exemption letter for the #3 Calciner Heat Section Repair Project on September 18, 2013.
(e) NWCAA issued OAC #1122 for the Hydrocracker ARV Project on Aril 9, 2012. BP installed the new components in May 2012.
(f) NWCAA issued OAC #1064 for the Clean Fuels Project on November 29, 2010. Ecology issued PSD-10-01 for PM_{10} emissions from the project on December 13, 2010. BP started operation of the new equipment (#2 Hydrogen Plant and Flare and #3 DHDS Unit) in March 2013. Sulfur Plant and Hydrocracker heater emission increases projected in the Clean Fuels project are excluded from the contemporaneous netting because the same projected increases are already included in the emission calculations for the Project.
(g) NWCAA issued OAC #1067 for the burner retrofit on the Hydrocracker 1st Stage Fractionator Reboiler on November 29, 2010 (Rev. A on July 29, 2011). Startup of the new burner occurred in May 2012.

3.3.3. Significant net emissions increase analysis summary

Estimated project net emissions, and SERs for each of these pollutant are shown in Table 20.

Table 20. Total Estimated Project Net Emissions and SERs

Pollutant	Net Emissions (tpy)	SER (tpy)	Net Emissions Greater than SERs (Yes/No)
NO_X	266	40	Yes
CO	216	100	Yes
SO_2	221	40	Yes
PM	41	25	Yes
PM_{10}	43	15	Yes
$PM_{2.5}$	62	10	Yes
VOCs	79	40	Yes
H_2SO_4	39	7	Yes
CO_2e (GHGs)	1,097,792	75,000	Yes

After netting, BP's Coker Replacement Project triggers PSD for the nine (9) pollutants listed in Table 20. It should also be noted that BP included another project (the Sulfur Plant Modification Project or SPMP) in its air quality impact assessment for the Coker Project. BP determined that both the coker heater replacement project and the SPMP assume full annual utilization of the sulfur plant and, therefore, did not include SPMP contemporaneous emission increases/decreases as part of this project. Ecology performed a PSD applicability determination for the SPMP on February 12, 2015, and determined that it was not subject to PSD review.

4. BACT

4.1. Definitions and Policy Concerning BACT

All new major sources or major modifications are required to utilize BACT for those new and modified emission units that will experience an increase in emissions as a result of the project. BACT is defined as an emissions limitation based on the maximum degree of reduction for each pollutant subject to regulation, emitted from any proposed major stationary source or major modification, on a case-by-case basis, taking into account cost-effectiveness, economic, energy, environmental, and other impacts (40 CFR 52.21(b)(12)).

Federal guidance requires each PSD permit applicant to implement a "top-down" BACT analysis process for each new or physically or operationally changed emissions unit. Ecology has

adopted the top-down BACT process for its BACT determinations. This top-down BACT analysis process consists of five basic steps described below:[2]

Step 1. Identify all available control technologies with practical potential for application to the specific emission unit for the regulated pollutant under evaluation.

Step 2. Eliminate all technically infeasible control technologies.

Step 3. Rank remaining control technologies by control effectiveness and tabulate a control hierarchy.

Step 4. Evaluate most effective controls and document results.

Step 5. Select BACT, which will be the most effective practical option not rejected, based on economic, environmental, and/or energy impacts.

If the applicant proposes to implement the most effective or "top" available control strategy, Step 4 is not necessary.

As shown above, the "top-down" BACT process starts by considering all available emission control technologies, and ranks them for further evaluation from most effective to least effective technically available control technology. The most effective emission reduction technology is then evaluated for economic feasibility. If the technology is proven infeasible based on economics, energy, or other environmental considerations, then the next most stringent level of reduction is considered. The most stringent level of emissions control that is not determined to be technically and economically infeasible is selected as BACT. While the permitting agency makes the final BACT decision, the burden is on the applicant to prove why the most stringent level of control should not be used.

BP provided a 5-step top-down BACT analysis for the project, which was fully evaluated by Ecology and presented in the following subsections.

4.2. BACT Analysis for Coker Heaters

The permit provides limits for the new coker heaters to operate in either natural draft mode (no preheaters) or balanced draft mode (forced draft and induced draft fans). However, to maximize heater efficiency, the heaters will operate primarily in balanced draft mode. Startup/shutdown and standby modes are addressed in this section also.

[2] See EPA's *Draft New Source Review Workshop Manual*, 1990; and PSD and Title V Permitting Guidance for Greenhouse Gases <http://www.epa.gov/nsr/ghgdocs/ghgpermittingguidance.pdf>.

4.2.1. BACT analysis for coker heaters

The EPA RACT/BACT/LAER Clearinghouse (RBLC), recent petroleum refinery BACT determinations, BP BART information, and other emission reduction information sources were reviewed to provide the following list of available control options. While these options have been identified as available, they are not necessarily feasible (technically, economically, or otherwise). The available technologies as reviewed in the application and by Ecology are:

4.2.1.1. Dry electrostatic precipitator

An electrostatic precipitator (ESP) removes particles from an air stream by electrically charging the particles, then passing them through a force field that causes them to migrate to an oppositely charged collector plate. An ESP generally refers to a dry ESP unless specifically noted otherwise. The dust from the collector plates falls into a collection hopper at the bottom of the ESP. The collection efficiency of an ESP depends on particle diameter, electrical field strength, gas flowrate, and plate dimensions. A dry ESP is used for dry pollutants and uses a dry collecting surface.

4.2.1.2. Wet electrostatic precipitator

Wet electrostatic precipitator (WESP) control technology is identical to a dry ESP except that a wet ESP has a wet collecting surface and can be used for both wet and dry pollutants. The water addition can perform a number of tasks. It can change the electrical properties of the fly ash and can improve (or reduce) removal efficiency. The water is also used to remove sticky ashes from the ESP collector plants or to condense and remove semi-volatile compounds like some high molecular weight organic compounds. Unlike a dry ESP which removes only dry pollutants, a wet ESP can potentially remove solid, liquid, and soluble gas pollutants.

4.2.1.3. Good combustion practices

The formation of NOx can be minimized by proper operation and design practices. Operators can control the combustion stoichiometry to minimize NO_X formation while achieving efficient fuel combustion. This is the most basic combustion modification technique available.

4.2.1.4. Low excess air

Low excess air (LEA) is a technique where combustion is optimized by reducing the excess air introduced to the unit to the minimum amount necessary for stable, efficient combustion. Excess air is the air supplied in addition to the quantity required for stoichiometric combustion.

4.2.1.5. Staged combustion[3]

Staged combustion technologies such as over-fire air (OFA) reduce NO_X emissions by creating a fuel-rich zone via air staging (diverting a portion of the total amount of air required through separate ports). The highest temperatures are reached in the primary zone, generating thermal NO_X. "The general concept is to burn the fuel with an insufficient amount of air in a primary combustion zone. With insufficient oxygen available for complete combustion, most of the O_2 is consumed by carbon and hydrogen, leaving less available to form NO_X. As a result the fuel nitrogen combines to form N_2 ($N+N=N_2$). During the few hundredths of a second it takes for combustion to occur, the flame cools slightly. Once this cooling has occurred, the rest of the air is added to complete combustion. Since the fuel nitrogen radicals have disappeared, and the flame is too cool to generate a lot of thermal NO_X, relatively little NO_X will be formed in the secondary combustion zone." To determine which ports to divert air to, can be a trial and error process unique to each boiler. A successful setup will be accompanied by a smoky unclean looking fire, not a clear blue flame which operators sometimes misguidedly try to obtain.

4.2.1.6. Flue gas recirculation

Flue gas recirculation (FGR) reduces peak flame temperature by recirculating a portion of the flue gas back into the combustion zone as a replacement for combustion air. The recirculated gasses have a lower oxygen content that reduces the peak flame temperature in the combustion zone.

4.2.1.7. Fuel staging/combustion

Fuel Staging is also known as "reburning" or "off-stoichiometric combustion." Fuel staging is a technique where 10 to 20 percent of the total fuel input is diverted to a second combustion zone downstream of the primary zone. Again, this is a technique to reduce the peak flame temperature during combustion

4.2.1.8. Water/steam injection

Water/steam injection into the main flame can reduce the flame temperature and the generation of NO_X. It is an older technique most often used on older burner designs in natural gas and oil-fired boilers and gas turbines. If the flame temperature is sufficiently quenched, the generation of CO can increase and the process efficiency will decrease.

4.2.1.9. Selective catalytic reduction

Selective catalytic reduction (SCR) is an exhaust gas treatment process in which a NH_3 or urea reagent is injected into the exhaust gas upstream of a catalyst bed for exhaust temperatures between 450° and 750°F. In the SCR process, the urea or NH_3 injected into the exhaust is first

[3] Source: *NOx Emissions Control From Stationary Sources. APTI Course 418,* Reorganized 2012 by Brian W. Doyle, PhD, PE, presented February 26-28, 2013, Boise, ID, Department of Environmental Quality.

stored in a liquid storage tank and vaporized before injection. The exhaust/ammonia mixture then passes over the catalyst. The function of the catalyst is to lower the activation energy of the NO decomposition reaction, therefore, lowering the temperature necessary to carry out the reaction. On the catalyst surface, NH_3 and nitric oxide (NO) or nitrogen dioxide (NO_2) reacts to form diatomic nitrogen (N_2) and water. When operated within the optimum temperature range, the reaction can result in removal efficiencies between 70 and 90 percent. The rate of NO_X removal increases with temperature up to a maximum removal rate at a temperature between 700° and 750°F. As the temperature increases above the optimum temperature, or decreases below the optimum range for a conventional vanadium pentoxide catalyst, the NO_X removal efficiency begins to decrease. Depending on the temperatures involved, low temperature and higher temperature catalyst formulations are available. The effectiveness of an SCR system depends upon the same factors as the SNCR system and the condition of the catalyst. The catalyst can degrade over time due to poisoning, fouling, thermal stress, and erosion by particulates, reducing NO_X removal efficiency.

4.2.1.10. Selective non-catalytic reduction

Selective non-catalytic reduction (SNCR) is an exhaust gas treatment process in which urea or ammonia is injected into the exhaust gas. High temperatures, normally between 1,600° and 1,900°F (or up to 2,200 according to BP), promote the reaction between urea or ammonia (NH_3) and NO_X to form N_2 and water. The effectiveness of SNCR systems depends upon inlet NO_X concentration, temperature, mixing, residence time, reagent-to-NO_X ratio, and fuel sulfur content.

4.2.1.11. Non-selective catalytic reduction[4]

This technology uses a catalyst without a reagent and requires zero excess air. The catalyst causes NO_X to give up its oxygen to products of incomplete combustion (PICs), CO, and hydrocarbons, causing the pollutants to destroy each other. However, if oxygen is present, the PICs will burn up without destroying the NO_X.

4.2.1.12. Oxidation/reduction scrubbing

Several proprietary oxidation/reduction (O/R) scrubbing NO_X removal processes are commercially available. The basic elements of a typical process include cooling of the combustion gas stream below its dew point to condense water, treat with ozone or sodium chlorite to oxidize NO_X and SO_2 to their highest oxidized forms, then absorb these oxides as acids in a scrubber. It has been reported that O/R scrubbing has a theoretical NO_X removal efficiency of 95 percent.

[4] Source: *NOx Emissions Control From Stationary Sources, APTI Course 418,* Reorganized 2012 by Brian W. Doyle, PhD, PE, presented February 26-28, 2013, Boise, ID, Department of Environmental Quality.

4.2.1.13. Oxidation catalyst

Catalytic oxidation does not rely on the introduction of additional chemical reagents to promote the desired reactions. The activation energy required for the oxidation reaction between O_2, CO, and VOCs to proceed is reduced in the presence of a catalyst. Products of combustion are introduced into a catalytic bed, with the optimum temperature range for these systems being between 700°F and 1,100°F. The catalyst oxidizes CO to CO_2, and VOCs to CO_2 and H_2O, but it also can promote other, less desirable, oxidation reactions such as NH_3 to NO_X and SO_2 to SO_3. Consequently, the presence of an oxidation catalyst can cause emissions of other pollutants to increase, and therefore its design needs to be carefully considered.

4.2.1.14. LNBs

LNBs modify the initial combustion conditions to reduce the peak flame temperature, and thereby reduce NO_X formation. They are often used in conjunction with modifications to overfire air systems, where a portion of combustion occurs through ports above or "over" the burners to complete combustion of other gases such as CO. They are most useful when using fuels like natural gas or distillate oil. A pilot flame is used to maintain combustion stability in this fuel-lean environment. LNBs that feature an FGR system integrated into the burner design, which further minimizes flame temperatures and oxygen availability, are often referred to as ultra-low NO_X burners (ULNBs).

4.2.1.15. Flue gas desulfurization

In flue gas desulfurization (FGD) with a wet scrubber, a solution of sodium or calcium hydroxide absorbs SO_2 from the flue gas forming sodium or calcium sulfite. The collected sulfite can be further oxidized to sulfate or left as the sulfite. Typical systems using sodium regenerate the sodium or re-use, while calcium based systems dispose of the calcium sulfate/sulfite.

4.2.1.16. Wet scrubber

Wet scrubbers intercept dust particles using droplets of liquid (usually water). The larger, particle-enclosing water droplets are separated from the remaining droplets by gravity. The solid particulates are then separated from the water.

4.2.1.17. NO_X adsorbers

NO_X adsorbing technologies (some of which are known as SCONOx or EMx^{GT}) use a catalytic reactor method similar to SCR. SNONOx uses a regenerated catalytic bed with two materials, a precious metal oxidizing catalyst (such as platinum) and potassium carbonate. The platinum oxidizes the NO into NO_2, which can be adsorbed onto the potassium carbonate. It may require a catalyst wash every 90 days. The GT on EMx^{GT} indicates gas turbine application.

4.2.1.18. Fabric filter (baghouse)

A fabric filter (baghouse) consists of several fabric filters, typically configured in long, vertically suspended sock-like configurations. Dirty gas enters from one side, often from the outside of the bag, passing through the filter media and forming a particulate cake. The cake is removed by shaking or pulsing the fabric, which loosens the cake from the filter, allowing it to fall into a bin at the bottom of the baghouse. A variety of fabrics is available to cover fuel gas temperatures up to about 650°F. Baghouses are unsuitable for use on water saturated gas streams.

4.2.1.19. Cyclone separator

Cyclone separators remove solids from the air stream by application of centrifugal force. In solid fuel combustion devices like hog fuel boilers, they are commonly used to remove large particles prior to the flue gas entering smaller particle control devices such as baghouses or ESPs. Multi-cyclones are capable of effectively removing particles down to approximately three micrometers.[5]

4.2.1.20. Settling chambers

Similar to cyclone separators, settling chambers are used to remove large particles prior to the flue gas entering smaller particle control devices. However, whereas cyclone separators use centrifugal force, settling chambers use gravitational force and are limited to removal of particles larger than about 40-60 micrometers.[5]

4.2.1.21. Low-sulfur fuel/fuel gas conditioning

This technique seeks to limit the quantity of sulfur introduced to the combustion system. Unlike the formation of NO_X, which can be mitigated through combustion controls, the potential for SO_2 emissions is entirely dependent upon the quantity of sulfur present in the fuel. Sulfur compounds in fuel readily oxidize at combustion temperatures to form SO_2 (as well as some SO_3). Minimizing the sulfur content of the fuel combusted, either by selecting a fuel that naturally contains little sulfur, or one that has been processed to remove sulfur, is a popular method for reducing SO_2 emissions. In addition, sulfur in fuel has been shown to contribute to fine particulate emissions. Therefore, controlling or minimizing the sulfur content of the fuel will also minimize PM emissions.

4.2.1.22. Low-carbon fuel

According to the application: this includes combusting low-carbon fuels such as natural gas, RFG, and coker off gas. The lean oil absorption system will remove C3 and C4 hydrocarbons from the coker off gas prior to combustion in the coker heaters. RFG which is a mixture of light (C1 to C4) hydrocarbons. Other gases that are not condensed in the various distillation processes at the refinery, among them the cokers, which produce coker off gas. Carbon content of RFG

[5] EPA APTI Course 413, 5th Ed, Version 2: *Control of Particulate Matter Emissions Student Manual.*, Crowder., J.W., Smith., T., pp. 5-1, 6-24.

and coker off gas varies with the type of crude processed at the refinery; combustion of refinery process gases typically results in greater CO_2 emissions per unit of heat input than natural gas (composed of primarily methane). Nevertheless, as referenced in the application, "RFG and coker off gas are considered low carbon fuels when compared to other common fuels."[6]

4.2.1.23. Energy-efficient design and good combustion practices

These include: preheating combustion air with flue gases; heat recovery to produce 25,000 lb of 140 pound-per-square-inch (psi) steam per hour per heater; using burners with the most efficient design available, excess air monitoring and control (balanced-draft design), maintaining and operating burners as recommended by the manufacturer

4.2.1.24. Carbon capture and storage

Carbon Capture and Storage or Sequestration (CCS) technology includes three stages: removing or segregating CO_2 from the gas stream; compressing and transporting the CO_2; and permanently storing the CO_2.

4.2.2. BACT feasibility review

Table 21 addresses the technical feasibility of implementing each control technology from Section 4.2.1. for the project.

Table 21. Initial Technical Feasibility Assessment

Emission Unit(s)	Control	Technical Feasibility Assessment	Applicable Pollutants
Coker heaters	GCPs	Technically Feasible GCPs are considered a baseline control alternative.	CO, VOC, PM
Coker heaters	Wet scrubber (for SO_2)	Technically Feasible	SO_2
Coker heaters	Oxidation catalysts	Technically Feasible	CO, VOC
Coker heaters	LNBs	Technically Feasible	NO_X
Coker heaters	SCR	Technically Feasible	NO_X
Coker heaters	Low-sulfur fuel [caustic treatment with regeneration (i.e., gas-phase Merox)]	Technically Feasible	SO_2
Coker heaters	Low-sulfur fuel (cryogenic recovery of liquids)	Technically Feasible	SO_2

[6] From 40 CFR Part 98, Subpart C, Table C-1 (all expressed in kg CO_2/MMBtu): Natural Gas – 53.06, Fuel Gas – 59.00, Propane Gas – 61.46, No. 2 Fuel Oil – 73.96, Bituminous Coal – 93.28.

Table 21. Initial Technical Feasibility Assessment			
Emission Unit(s)	**Control**	**Technical Feasibility Assessment**	**Applicable Pollutants**
Coker heaters	Low-carbon fuel	Technically Feasible	GHG
Coker heaters	Energy-efficient design and GCPs for GHG	Technically Feasible	GHG
Coker heaters	CCS	Technically Feasible	GHG
Coker heaters	Low-sulfur fuel (caustic treatment without regeneration)	Technically Infeasible: Caustic treatment without regeneration is not technically feasible because it would require significant upgrades to the wastewater treatment plant in order to treat the new caustic treatment stream that would be generated by this type of treatment.	SO_2
Coker heaters	Low-sulfur fuel (PraxAir catalytic conversion)	Technically Infeasible: PraxAir catalytic conversion technology is only available at the laboratory scale and has not been proven on a full scale setup.	SO_2
Coker heaters	SNCR	Technically Infeasible: As noted in the application, use of an SNCR could potentially cause NO_X emissions to increase if exhaust temperatures drop below the required SNCR temperature requirements.	NO_X
Coker heaters	NSCR	Technically Infeasible: Exhaust from the proposed replacement coker heaters will not be the low-oxygen, fuel-rich exhaust stream that an NSCR system requires. In addition, there is no evidence that such a system has ever been employed to reduce emissions from an external gaseous combustion device. At one time, the technology was used to reduce process (not combustion) NO_X emissions from adipic and nitric acid plants, but it has fallen out of favor for economic reasons. NSCR is currently used in some cases to reduce NO_X emissions from reciprocating internal combustion engines, which can run under stoichiometric or fuel-rich conditions.	NO_X
Coker heaters	NOx Adsorbers (SCONOx, EMx[GT])	Technically Infeasible: The EMx technology has been demonstrated on a few emissions units such as combustion turbines, but has not been demonstrated for a large refinery process heater that combusts coker off gas or RFG. The technical differences between the few emission units to which EMx has been demonstrated in practice, and the proposed replacement coker heaters result in a (BP) determination that EMx is technically infeasible for reducing emissions from the proposed replacement coker heaters, and is	NO_X

Table 21. Initial Technical Feasibility Assessment			
Emission Unit(s)	**Control**	**Technical Feasibility Assessment**	**Applicable Pollutants**
		removed from consideration as BACT. Ecology agrees with this determination.	
Coker heaters	Oxidation temperature minimization	Technically Infeasible: The techniques intended to reduce NO_X emissions by reducing oxidation temperatures in the combustion zone, are listed in Section 4.2.1 as FGR, staged combustion, fuel staging combustion, LEA, OFA, and water/steam injection. The coker heaters will heat a stream of residual oil to greater than 900°F as it is delivered to the coke drums to begin the coking process. Control alternatives that result in cooler flame temperatures compromise the ability of the heater to quickly heat the residual oil to the temperature at which long-chain hydrocarbon molecules become unstable and begin breaking apart (i.e., the coking process begins). Effective and timely heating to the required temperature ensures that the residual oil will be delivered to the coke drum before the coking reactions begin, which reduces the need for cleaning operations.	NO_X
Coker heaters	Cyclone separator	Technically Infeasible: Combustion processes produce PM as unburned solid carbon (soot), unburned vapors or gases that subsequently condense, and the unburnable portion of the fuel (ash). Because gaseous fuels contain little or no ash, and a burner operated with GCPs combusting gaseous fuels typically does not generate much soot, the majority of the PM resulting from combusting gaseous fuel is condensed unburnt fuel or combustion products. Past BP source tests indicates the filterable and condensable portions of particulate in RFG-fired heaters and boilers are 25 percent and 75 percent, respectively. A cyclone would only be capable of capturing the filterable portion. According to BPs application for this project, filterable particulate in gaseous combustion source exhaust is typically less than one micron in size.	PM
Coker heaters	Dry ESP and WESP	Technically Infeasible: The low particulate concentration from gaseous fuel combustion would not allow significant charge buildup on the particles, resulting in poor migration to the collecting plates. In addition, 75 percent of the particulate emissions from gaseous fuel combustion is in vapor form (condensable) at stack conditions and ESP are generally not designed to collect vapors.	PM

Table 21. Initial Technical Feasibility Assessment			
Emission Unit(s)	**Control**	**Technical Feasibility Assessment**	**Applicable Pollutants**
Coker heaters	Fabric filter	Technically Infeasible: Past BP source tests indicates the filterable and condensable portions of particulate in RFG fired heaters and boilers are 25 percent and 75 percent, respectively. As a result, the majority of the PM will not be collected by a fabric filter. Also, due to the low particulate concentration, a cake will be slow to form (assuming one forms at all), resulting in poor collection efficiency. To capture the compounds that will become condensable PM, the gas stream would need to be cooled before reaching the baghouse. However, cooling would result in condensation of acids, and subsequent corrosion of the filter media and baghouse structure.	PM
Coker heaters	Wet scrubber (for PM)	Technically Infeasible: Wet collection depends on the inertia of the PM in the flue gas to impact the scrubbing liquid and be collected. However, the fine particulate generated by gaseous fuel combustion (less than one micron in size) has little inertia, so the particles follow the gas stream without impacting the scrubbing liquid and being collected.	PM
Coker heaters	FGD	Technically Infeasible: BP found no instances of FGD, or any other add-on control technology, being used to reduce SO_2 in exhaust from any refinery process heater. While this technology has been proven effective on large coal-fired boilers, it has never been demonstrated on gas-fired coker heaters such as those proposed by BP.	SO_2
Coker heater fugitive components	LDAR monitoring	Technically Feasible:	VOC, GHG
Coker heater fugitive components	Optical gas imagining LDAR monitoring	Technically Feasible:	VOC, GHG

4.2.3. Modes of Operation

The operating modes described in the following limits are defined as:

- Forced draft mode is when the forced draft fan is operating.
- Natural draft mode is when the forced draft fan is not operating.
- Normal operations mode is when hot residual oil at normal coking temperatures (900°F or higher) is sent to the coking drum to produce coke. Online cleaning is part of the normal operations mode.
- Standby mode occurs when circulating process materials to maintain unit temperatures when not producing coke from the heater.
- Startup mode is the period between when fuel gas is introduced to the heater burners to heat process materials for coking and ends when process material leaving the heater reaches normal coking temperatures (900°F).
- Pre-startup activities include equipment preparation and verification activities following maintenance events (e.g., curing refractory, general mechanical checkout of equipment, instrument system review, pressure testing, and purging equipment).
- Shutdown mode starts when fuel gas to the heater burners is stopped and ends when heater stack oxygen level reaches 18 percent, or greater, as measured by the Continuous Emission Monitoring System (CEMS).

4.2.4. NO_X BACT for coker heater direct emissions

This section addresses NO_X control including: ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for NO_X.

4.2.4.1. Ranking of BACT controls for NO_X

The potential control options listed in Table 21, above, are ranked in Table 22 based on the control efficiencies documented as being achieved in practice.

Table 22. Ranking of Control Technologies for Coker Heaters (NO_X BACT)

Type of Control Technology	Control Efficiency	Ranking
ULNBs w/GCPs and SCR	0.01 lb/MMBtu	1
ULNBs w/GCPs	0.035 to 0.06 lb/MMBtu	2
Conventional burners w/GCPs	0.10 lb/MMBtu	3

4.2.4.2. Evaluation of BACT impacts for NO_X

Facilities that have proposed SCR for NO_X have done so to net out of PSD, for modeling considerations, or because they were in nonattainment areas. BP, which is located in an attainment area, has not netted out of PSD and has found SCR economically infeasible at approximately $40,000 per ton of NO_X removed when compared to highest permitted uncontrolled amount of pollutant emissions. Because NSPS/NESHAP requirements are not considered in calculating the baseline emissions, NWCAA reviewed recent (2015) source test data on the existing coker heaters and found emsisions of 0.074 lb/MMBtu. According to page B.38 of the 1990 NSR Guidance Manual, the "historic upper bound operating data, typical for the source or industry, may be used in defining baseline emissions in evaluating the cost effectiveness of a control option for a specific source." Based on 0.074 lb/MMBtu, the new coker heater capacity of 303 MMBtu/hr, and total annual costs provided by BP of $2,621,652 the cost per ton of the SCR option is calculated as follows:

$$303\frac{MMBtu}{hr}\ x\ \frac{0.074\frac{lb}{MMBtu}x\frac{8760\ hr}{yr}x\ 1\ ton}{2000\ lb} = \frac{\$31{,}000}{ton}$$

Ecology considers $31,000/ton to be economically infeasible.

Because BP proposes BACT to be the next highest ranked control option, no further evaluation is needed.

4.2.4.3. BACT selection for NO_X

As noted in the application, BP's "proposed replacement coker heaters will be of a balanced-draft design. Forced-draft heaters tend to have greater NOx emissions but are more efficient because they consume less fuel. BP proposes to operate the coker heaters in balanced-draft mode but also requires flexibility to operate in natural draft mode during some circumstances."

Startup and shutdown modes may cause NO_X concentrations to be greater than during other operation modes (forced/balanced or natural draft).

Standby mode is anticipated by BP when residual oil is unavailable for processing. According to the application: "Standby mode includes operating only one coker heater, limiting heater firing rate to less than 120 MMBtu/hr, and recycling hot residual oil through the coker fractionator column. In standby operations, the one coker heater at reduced firing rate would have higher NOx and CO concentrations in the coker heater exhaust compared to concentrations during normal operation…. BP estimates the coker unit would operate in standby mode two – four times during a six year period."

BP proposes BACT to be use of ULNB with GCP demonstrated by meeting the following emissions limits for each coker heater.

- Concentration based limits for normal operation in forced draft mode based on a 30-day rolling average (includes startup/shutdown emissions): 6.0x10^1 parts per million volume dry (ppmvd) at zero percent oxygen.
- Mass emission rate limit for normal operation in forced draft mode: 18.2 lb/hr on a calendar day average (includes startup/shutdown emissions).
- Concentration based limits for normal operation in natural draft mode based on a 30-day rolling average (includes startup/shutdown emissions): 4.0x10^1 ppmvd at zero percent oxygen. This limit shall apply at and after 30 consecutive days of heater operation in natural draft mode. For periods of continuous normal heater operation in natural draft mode less than 30 days in duration, the limit in Condition V.A.1.a must apply.
- Mass emission rate limit for normal operation in natural draft mode: 12.1 lb/hr on a calendar day average (includes startup/shutdown emissions).
- Mass emission rate limit for standby mode: 8.0 lb/hr per heater on a rolling 24-hour average.

Ecology agrees with BP's proposed concentration based and mass based BACT determination for NO_X.

4.2.5. CO and VOC BACT for coker heater direct emissions

This section addresses CO and VOC control including: ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for CO and VOC.

4.2.5.1. Ranking of BACT controls for CO and VOC

The potential control options listed in Table 21, above, are ranked in Table 23 based on the control efficiencies documented as being achieved in practice.

Table 23. Ranking of Control Technologies for Coker Heaters (CO and VOC BACT)

Type of Control Technology	Control Efficiency	Ranking
Oxidation catalyst and GCP	CO: 0.002 lb/MMBtu (90% control) VOC: 0.0027 lb/MMBtu (50 percent control)	1
GCP	CO: 33 ppmvd at 0% O2 (0.02 lb/MMBtu VOC: 0.054 lb/MMBtu	2

4.2.5.2. Evaluation of BACT impacts for CO and VOC

BP considered energy and economic impacts of an oxidation catalyst and found that thermal efficiency of the burners would be reduced, and the cost per ton of combined CO and VOC removed would be approximately $68,000. BP determined the use of an oxidation catalyst to be economically infeasible.

4.2.5.3. BACT selection for CO and VOC

BP proposes BACT to be use GCP demonstrated by meeting the following emissions limits for each coker heater.

- CO concentration based limits for normal operation in forced and natural draft mode (excluding-standby, startup, and shutdown): 33 ppmvd at 0 percent oxygen on a 30-day rolling average.
- CO mass emission rate limit for normal operation in forced and natural draft mode: 6.1 lb/hr based on a calendar day average.
- CO mass emission rate limit for startup/shutdown modes: 75.0 lb/hr hourly average.
- CO mass emission rate limit for standby mode: 75.0 lb/hr on a rolling 24-hour average.
- VOC concentration limit of 0.0054 lb/MMBtu.

Ecology agrees with BP's proposed concentration based and mass based BACT determinations for CO and VOC.

4.2.6. PM, PM_{10}, $PM_{2.5}$ BACT for coker heater direct emissions

This section addresses (PM), PM_{10}, and $PM_{2.5}$ BACT control including: ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for (PM), PM_{10}, $PM_{2.5}$ BACT.

4.2.6.1. Ranking of BACT controls for (PM), PM_{10}, and $PM_{2.5}$ BACT

The potential control options listed in Table 21, above, are ranked in Table 24 based on the control efficiencies documented as being achieved in practice.

Table 24. Ranking of Control Technologies for Coker Heaters (Particulate BACT)

Type of Control Technology	Control Efficiency	Ranking
Natural gas fuel	PM (filterable): 0.002 lb/MMBtu $PM_{10}/PM_{2.5}$: 0.0075 lb/MMBtu	1
Coker off gas fuel	PM (filterable): 0.0025 lb/MMBtu $PM_{10}/PM_{2.5}$: 0.01 lb/MMBtu	2

4.2.6.2. Evaluation of BACT impacts for PM, PM_{10}, and $PM_{2.5}$

BP prepared an energy impact assessment of the two alternatives. As noted in the application: "If natural gas was imported and burned in the coker heaters instead of the coker off gas, the quantity of coker off gas sent to the RFG mix drum would increase significantly. The result would be a 'fuel gas long' scenario (i.e., more fuel gas available than could be burned in refinery heaters), which would require flaring of RFG. Flaring RFG rather than combusting it in process heaters instead of natural gas, is inefficient from an energy conservation standpoint."
The first option is therefore rejected.

4.2.6.3. BACT selection for PM, PM_{10}, and $PM_{2.5}$

BP proposes BACT to be coker off gas fuel with GCP and demonstrated by meeting the following emission limits for each coker heater.

- For PM, concentration based limit of 0.0025 lb/MMBtu.
- For $PM_{10}/PM_{2.5}$, concentration based limit of 0.010 lb/MMBtu.

Ecology agrees with BP's proposed mass emission BACT determination for PM, PM_{10}, and $PM_{2.5}$.

4.2.7. SO_2 and H_2SO_4 BACT for coker heater direct emissions

This section addresses SO_2 and H_2SO_4 control including ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for SO_2 and H_2SO_4.

4.2.7.1. Ranking of BACT controls for SO_2 and H_2SO_4

The potential control options listed in Table 21, above, are ranked in Table 25 based on the control efficiencies documented as being achieved in practice.

Table 25. Ranking of Control Technologies for Coker Heaters (SO_2 and H_2SO_4 BACT)

Type of Control Technology	Control Efficiency	Ranking
Limiting the sulfur in gaseous fuel	H_2S: 25 to 35 ppmv SO_2: 0.023 lb/MMBtu to 0.034 lb/MMBtu	1
Limiting the sulfur in gaseous fuel	H_2S: 160 ppmv	2

4.2.7.2. Evaluation of BACT impacts for SO_2 and H_2SO_4

Because use of spray tower is not known to have been demonstrated in practice for a refinery heater, it is not included in the table ranking above. In addition, BP estimated BACT costs to be approximately $20,000 per ton removed of SO_2 and H_2SO_4 combined, making it economically infeasible.

Types of methods to reduce sulfur in fuel include cryogenic fuel gas treatment, gas phase merox treatment, lean oil absorption with compressor, and lean oil absorption without compressor. BP has found the first three of these to be too costly for BACT at approximately $68,500 per ton removal, $26,600 per ton removed, and $18,300 per ton removed, respectively.

4.2.7.3. BACT selection for SO_2 and H_2SO_4

BP proposes BACT to be limiting sulfur in gaseous fuel with the use of coker off gas and good operating practices as demonstrated by meeting the following emission limits for each coker heater:

- For SO_2, mass emission rate limit of 37 lb/hr on a calendar day average (includes startup/shutdown emissions) for both heaters combined.
- For SO_2, mass emission rate limit of 132 tons per year (tpy) for both heaters combined, on a 12-month rolling total
- For H_2SO_4 , concentration based limit of 0.0053 lb/MMBtu.

Ecology agrees with BP's proposed concentration and mass based BACT determination for SO_2 and H_2SO_4.

In addition, although not BACT, BP has decided to include a lean oil absorption system with a new compressor prior to the lean oil absorption system.

As noted in the application, "the lean oil absorption system is designed to process approximately 44 percent of the coker off gas stream.... One additional benefit of the lean oil absorption system is sulfur removal from the processed coker off gas because mercaptans will be removed with the light hydrocarbons. BP anticipates the lean oil absorption system will reduce annual average sulfur concentrations in the coker off gas 39 percent (from 600 ppm S down to 366 ppm S). This will also reduce SO_2 emissions from the replacement coker heaters by 39 percent. With the lean oil absorption system, the replacement coker heaters are expected to achieve an annual average SO_2 emission rate of 36 ppmvd at 0% O2 (0.050 lb/MMBtu). H_2SO_4 emissions are expected to be 0.0040 lb/MMBtu."

With the compressor installed prior to the lean oil absorption system, "the compressed coker off gas results in additional C3 (propanes) and C4 (butanes) hydrocarbons recovered in the lean oil system and processed in the light ends unit for saleable product. Recovering additional C3 and

C4 hydrocarbons also reduce the sulfur in the coker off gas by up to 65 percent (removal of mercaptans in C3 and C4 hydrocarbons) compared to expected annual sulfur concentrations."

4.2.8. GHG BACT for coker heater direct emissions

This section addresses GHG control including ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for GHG.

4.2.8.1. Ranking of BACT controls for GHG

The potential control options listed in Table 21 above, are ranked in Table 26 based on the control efficiencies documented as being achieved in practice.

Table 26. Ranking of Control Technologies for Coker Heaters (GHG BACT)

Type of Control Technology	Control Efficiency	Ranking
CCS	Up to approximately 85 percent.	1
Low carbon fuels; Energy efficient design; Good combustion practices	These are considered baseline alternatives for reducing GHGs.	2

4.2.8.2. Evaluation of BACT impacts for GHG

Taking into account the economic impacts of CCS, BP found that annual operating costs would be approximately twice the cost of the two replacement coker heaters.

Taking into account energy and environmental impacts of CCS, BP found that "the increased energy requirements would result in additional emissions of all pollutants other than CO_2."

For energy efficient design, BP considered using pipeline natural gas as fuel for the replacement heaters. However, BP decided it was more efficient use of energy resources to continue using coker off gas as fuel for the coker heaters instead of purchasing additional natural gas. With online cleaning (or spalling) also provided with the new coker heaters, BP will save energy by reducing the frequency and time required for offline cleaning.

Based on economic, energy, and environmental impacts, CCS is removed from consideration as BACT.

4.2.8.3. BACT selection for GHG

BP therefore proposes the following as BACT: "use of low-carbon fuels (i.e., coker off gas and/or RFG), energy efficient design, and good combustion practices as demonstrated by meeting the following emissions limits for each coker heater:

- Mass emission rate limit of 36,631 lb/hr on a calendar year average.

Ecology agrees with BP's proposed BACT determination for GHG.

4.2.9. BACT for coker heater fugitive component leaks

This section addresses BACT for emissions (leaks) from the coker heater/heat exchanger components. The applicable PSD pollutant emissions from leaks include VOCs and GHG.

4.2.9.1. Ranking of BACT controls for VOC and GHG from component leaks

The potential control options listed in Table 21, above, are ranked in Table 27 based on the control efficiencies documented as being achieved in practice.

Table 27. Ranking of Control Technologies for Components (VOC and GHG BACT)

Type of Control Technology	Control Efficiency	Ranking
LDAR monitoring	Standard leak rates	1
Optical gas imaging LDAR monitoring	Camera leak detection is on a qualitative basis; additional Method 21 monitoring required to quantify leak rate	2

4.2.9.2. Evaluation of BACT impacts for VOC and GHG from component leaks

Because BP selects both options with similar control efficiency, no further evaluation is necessary.

4.2.9.3. BACT selection for VOC and GHG from component leaks

BP proposes BACT to be both of the LDAR alternatives in Table 27.

For VOC and GHG from component leaks, BP proposes an LDAR program that meets the applicable requirements of 40 CFR 60 Subpart GGGa and its referenced Subpart VVa. BP believes that emission rate limits are not appropriate for a fugitive source, and, therefore, does not propose specific BACT limits.

Ecology agrees with BP's proposed BACT determination for VOC and GHG from component leaks.

5. AMBIENT AIR QUALITY IMPACTS ANALYSIS

5.1. Regulatory Requirements

For PSD, an ambient Air Quality Impacts Analysis (AQIA) is required for all pollutants that are emitted in significant quantities to determine the ambient impacts associated with the construction and operation of the proposed modifications. The main purpose of the air quality analysis is to demonstrate that new emissions emitted from the proposed major stationary source or major modification will not cause or contribute to a violation of any applicable NAAQS or PSD increment.

The AQIA starts with preliminary modeling for each pollutant to determine whether an applicant can forego detailed analysis and preconstruction monitoring. If the projected ambient concentration increase for a given pollutant (from the project) is below the PSD Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMCs) for each averaging period, no further analysis of the ambient impact is required for that pollutant. For those pollutants with averaging periods that have project impacts greater than the SIL, a full impact analysis (taking into account other increment consuming sources) is used to demonstrate compliance with NAAQS and PSD increments.

Typically, the AQIA includes an analysis of impacts to local areas that are within 50 kilometers (km) of the project, and a regional air quality impact assessment for impacts beyond 50 km. For projects in Washington State, this latter analysis usually includes impacts on Class I areas. The AERMOD dispersion model was used for predicting local impact concentrations. The CALPUFF dispersion model was used for predicting impact concentrations at greater distances. The CMAQ model was used to predict ozone concentrations. The sources, buildings locations, and building heights modeled for this project with EPA's Building Profile Input Program for the PRIME algorithm (BPIP PRIME versions 04274) are shown in Figure 4.

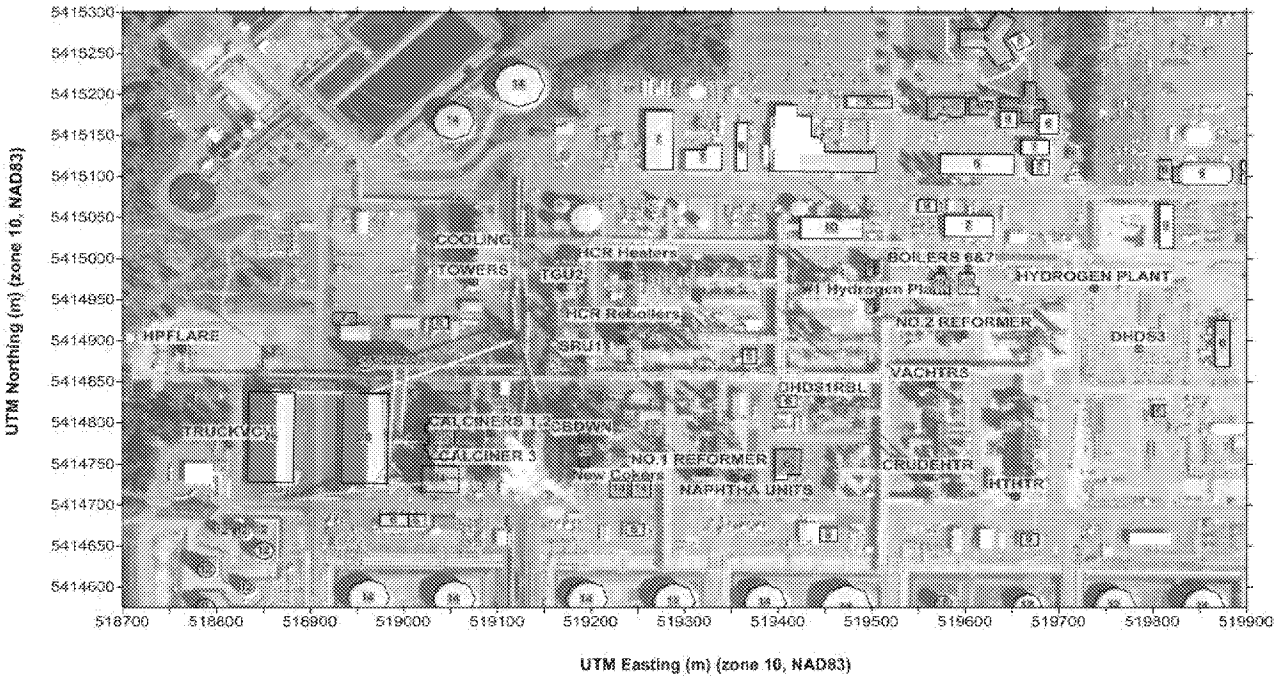


Figure 4. Source and building locations with heights

(Source: BP Cherry Point Refinery Coker Heater Replacement Project application, prepared by Ramboll Environ, received 3/28/2016)

5.2. Maximum Criteria Pollutant Concentrations Predicted by AERMOD

Using project emissions only, AERMOD predicted impacts for criteria pollutants compared to SILS and monitoring de minimis levels or significant monitoring concentrations (SMCs) are presented in Table 28.

Table 28. Maximum Criteria Pollutant Concentrations Predicted by AERMOD

Criteria Pollutant	Averaging Period	Max AERMOD Concentration In Class II Areas (µg/m³)	SIL* (µg/m³)	SMC† (µg/m³)	Is AERMOD Concentration Greater than SIL or SMC?
PM_{10}	24-hr	1.0	5	10	No
	Annual	< 1.0	1	---	No
$PM_{2.5}$	24-hr	0.9	0.07, 1.2, 1.2	4	No
	Annual	0.24	0.06, 0.3, 0.3	---	No
SO_2	1-hr	7.6	---	---	No
	3-hr	5.4	25	---	No
	24-hr	1.6	5	13	No
	Annual	0.6	1	---	No

Table 28. Maximum Criteria Pollutant Concentrations Predicted by AERMOD					
Criteria Pollutant	Averaging Period	Max AERMOD Concentration In Class II Areas (µg/m³)	SIL* (µg/m³)	SMC† (µg/m³)	Is AERMOD Concentration Greater than SIL or SMC?
NO_2	1-hr	2.8	---	---	No
	Annual	0.5	1	14	No
CO	1-hr	42.8 (164.7)†	2000	---	No
	8-hr	8.8 (31.7)†	500	575	No

∗ Listed SILs and SMCs were promulgated on October 20, 2010, and became effective December 20, 2010. $PM_{2.5}$ SILs are for Class I, II, and III areas, respectively, and are the only SILs with different values for the three different Class areas (I, II, and III). $PM_{2.5}$ SIL and SMC in PSD rules were vacated on January 22, 2013.

† Values in parenthesis represent startup/shutdown/standby.

Because project impacts are not greater than the SILs, a full impact analysis (taking into account other increment consuming sources) is not required to demonstrate compliance with NAAQS and Class II PSD increments. NAAQS compliance is assumed and compliance with WAAQS is assumed by compliance with NAAQS. AERMOD predicted impacts for toxic air pollutants (TAPs) compared Acceptable Source Impact levels (ASILs) are presented in Table 29.

Table 29. Maximum TAP Concentrations Predicted by AERMOD				
TAP	Averaging Period	Max AERMOD Concentration (µg/m³)	ASIL (µg/m³)	Is AERMOD Concentration Greater than ASIL?
Acrolein	24-hr	2.80E-04	0.060	No
Arsenic	Annual	9.42E-07	3.03E-04	No
Benzene	Annual	1.01E-05	0.0345	No
Beryllium	Annual	6.23E-07	4.17E-04	No
Cadmium	Annual	5.19E-06	0.000238	No
CO	1-hr	44.0	23,000	No
		(164.7)*		No
Hexavalent chromium	Annual	2.64E-07	6.67E-06	No
Formaldehyde	Annual	0.00035	0.167	No
H_2SO_4	24-hr	0.057	1	No
H2S	24-hr	0.014	2	No
Nickel	Annual	0.00001	0.0042	No
NO_X	1-hr	11.0	470	No
SO_2	1-hr	12.8	660	No
Benzo(a)pyrene	Annual	2.74E-07	9.09E-04	No
7,12-Dimethylbenzanthracene	Annual	7.54E-08	1.41E-05	No

∗ Values in parenthesis represent startup/shutdown/standby.

5.2.1. Secondary $PM_{2.5}$ formation

AERMOD results were scaled to take into account the impacts of potential formation of secondary $PM_{2.5}$. Precursors of $PM_{2.5}$ include NO_X, SO_2, and VOCs. Under specific atmospheric conditions, these precursors may coagulate onto existing particles or nucleate into new particles. Based on the analysis presented as stated in the application, "the assessments indicate that secondary $PM_{2.5}$ formation is minimal within the project region. Conservative modeling of emissions indicates the cumulative impact of primary and secondary $PM_{2.5}$ is below both the 24-hour and annual SILs, negating the need for regional modeling."

5.3. Ozone Impacts

NO_X and VOCs are precursors to ozone. BP's proposed increases in NO_X and VOC emissions are such that they require an analysis of the effect that the proposed increase in these emissions would have on the area's ozone levels.

5.3.1. Ozone background information

EPA has set primary and secondary ozone standards to protect human health and welfare. On March 12, 2008, EPA revised the primary and secondary ozone standards to 0.075 ppm for an 8-hour average. And EPA lowered it again in December 2015 to 0.070 ppm for an 8-hour average.

Ozone is formed in the troposphere when sunlight causes complex photochemical reactions involving oxides of nitrogen (NO_X), VOCs, and carbon monoxide (CO) that originate chiefly form gasoline engines and burning of other fossil fuels. Woody vegetation is another major source of VOC emissions to NO_X emissions within the surrounding airshed, and the relative reactivities of the VOC species. NO_X and VOCs can be transported long distances by regional weather patterns before they react to create ozone in the atmosphere, where it can persist for several weeks. Because ozone is a regional pollutant, precursor sources both near and far can contribute to ozone formation.

Breathing ozone can trigger a variety of health problems for humans, including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Elevated levels of ozone can also reduce lung function by inflaming the linings of the lungs. Repeated exposure to elevated concentrations of ozone may permanently scar lung tissue. Ozone is also phytotoxic, causing damage to a variety of vegetation (Ashmore et al., 2004). Ozone pollution has been shown to reduce plant growth, alter species composition, and predispose trees to insect and disease attack. Ozone also causes direct foliar injury to some plant species. Ozone affected leaves are marked with discoloration and lesions, and they age more rapidly than normal leaves (EPA, 2007).

Ozone enters plants through leaf stomata, causing changes in biochemical and physiological process. The mesophyll cells under the upper epidermis of leaves are the most sensitive to ozone, and those are the first cells to die. The adjacent epidermal cells then die, forming a small

black or brown interveinal necrotic lesion that becomes visible on the upper surface of the leaf. These lesions, termed oxidant stipple, are quite specific indicators that the plant has been exposed to ozone. There are other plant symptoms that can result from exposure to ozone. However, these symptoms are non-specific for ozone since other stressors can also cause them to occur. In general, the most reliable indicator that ozone has impacted vegetation is oxidant stipple.

In addition to effecting individual plants, ozone can also affect entire ecosystems. Plants growing in areas with high exposure to ambient ozone may undergo natural selection for ozone tolerance (EPA, 2007). The final result could be the elimination of the most ozone sensitive genotypes from the area (National Park Service, 2010).

While VOCs and NO_X are recognized as precursors to the formation of ground level ozone, which is regulated as a criteria pollutant, the FLAG guidance states that "current information indicates most FLM areas are NO_X limited" with respect to the formation of ground level ozone. A NO_X limited region is one where the concentration of ozone depends on the amount of NO_X in the atmosphere. This occurs when there is a lack of Nitrogen Dioxides, thus inhibiting ozone titration when oxygen mixes with VOCs. In these regions, controlling NO_X would reduce ozone concentrations. A VOCs limited region is one where concentration of ozone depends on the amount of VOCs in the atmosphere. In these regions, controlling VOCs would reduce ozone concentrations. The FLAG guidance further states that "until there is enough information available for FLAG to determine whether ozone formation in each FLM area is primarily limited by NO_X or VOC emissions, we will assume all FLM areas are NOx limited and will focus on control of NO_X emissions" (FLAG Executive Summary and Section 3.4.5).

Based on this information, BP provoded the following ozone study.

5.3.2. BP ozone study results

BP's consultant Ramboll Environ (RE) used the U.S. EPA's Community Multi-scale Air Quality model (CMAQ) to simulate July 25–30, 1998.

As described in BPs application:

"This is one of the more severe historical ozone episodes, and similar modeling analyses have been used in several analyses to estimate the effects on ozone concentrations from Project increases in emissions of NOx and VOCs greater than 100 TPY. The modeling simulations were based on those developed by Washington State University (WSU) Laboratory for Atmospheric Research in support of a state implementation plan (SIP) for Ozone for the Portland, OR and Vancouver, WA region. The WSU database was used as the base case scenario to analyze future emission scenarios for the Puget Sound Clean Air Agency (PSCAA). In those analyses and the current analysis, a three-day period beginning July 26, 1998 was selected because the episode had the highest observed ozone levels in recent years for the Seattle/Portland airshed… Two cases were run: a base case using all the sources in the emission inventory used by WSU and a

'PTE' case that also include the increased emissions associated with the project. The difference between the ozone concentrations predicted by the two runs is used to evaluate the implications to regional ozone due to the Project. ...Ozone concentrations decreased in the region close to the facility due to 'NOx titration,' where $NO + O_3 \rightarrow NO_2 + O_2$. Elsewhere, increases in ozone concentration are predicted to be very small, typically less than 1 ppb, and limited to the area within about 75 km of the facility. The model-predicted increase in ozone concentration at the Enumclaw monitoring site, which for the period 2006-2008 did not attain the NAAQS..., is less than 0.1 ppb."

RE concluded, and Ecology agrees, that the Project will have an insignificant effect on regional ozone concentrations.

5.4. Impacts on Class I Areas

In addition to addressing NAAQS and PSD increments, PSD rules require an analysis of air quality related values (AQRVs) on Federally mandated Class I areas are defined in the Clean Air Act as having special national or regional value from a natural, scenic, recreational, or historic perspective. Class I areas include national parks over 6,000 acres and wilderness areas and memorial parks over 5,000 acres as of 1977. The impacts to these areas are stringently regulated because they have remained relatively untouched by development.

On June 17, 2016, the Federal Land Managers (FLMs), specifically the National Park Service (NPS) provided comments to Ecology regarding BP's affect on visibility and deposition in Class I areas.

According to separate modeling performed by the NPS, the NPS believes that "emissions from the refinery are currently causing visibility impairment at Olympic NP and North Cascades NP and significantly contributing to excess nitrogen deposition at both parks." In addition, the NPS also believes that the Coker Replacement project itself "will significantly increase the impacts of visibility-impairing pollutants at Olympic NP and significantly increase nitrogen deposition at North Cascades NP."

As described in Section 3.1 of this TSD, there are a series of emission calculation tests that a PSD applicant must follow, which are different for new and existing equipment involved with the project. BP's baseline dates were based on various 24 month periods within the last 10 years, and varied by pollutant, consistent with PSD regulations. The BP baseline dates are provided in Table 2 of this TSD. As seen in Table 2, emissions from the year 2014 (average of 2013–2014) was the chosen baseline period for only one pollutant (H_2SO_4). Deviations in baseline dates used in BPs application, are consistent with PSD regulations and are provided in Table 3. PSD regulations also allow excludable emissions as described in Section 3.2.2, as well as a contemporaneous emissions netting period (approximaltey seven years for this project) as described in Section 3.3.1.

Ecology interprets impacts based on the PSD regulations that we, as a SIP approved PSD program must follow. Based on Table 31 of section 5.4.2.1, because project impacts are not greater than the SILs for Class I areas, an impact analysis (taking into account other increment consuming sources) is not required to demonstrate compliance with NAAQS and PSD increments.

The total project modeling effort performed by BP, which used a combination of AERMOD, CALPUFF, and CMAQ models, satisfies current PSD regulations and was reviewed by Ecology. Table 30 provides the items that Ecology modelers reviewed and their conclusions regarding BP's modeling. The modeling results were provided to Ecology, FLMs, EPA, and NWCAA as part of BP's application in 2016.

Table 30. PSD Modeling Review Checklist

The purpose of this checklist is to provide documentation that an applicant's ambient analysis was reviewed by an AQP modeler. If something other than "yes" is checked, please provide a brief description describing why the analysis can or cannot be used to appropriately demonstrate compliance with air quality standards.

Project Name: BP Coker replacement - 2016 resubmittal			
Reviewed by: Ranil Dhammapala	Date Review Completed: 4/1/2016		
Modeling Inputs Consistent with Draft PSD Permit			
	Yes	No	N/A
Do the PSD application and preliminary approval documents agree with the modeling inputs and outputs?[1]	x		
Have the operating scenarios, emission patterns, source parameters and plume chemistry (e.g. PVMRM, if applicable) been represented consistently and concisely in the modeling files and PSD application?	x		
Air Quality Analysis			
Was the modeling protocol followed?	x		
Steady-state model used: AERMOD Version number: 15181 Most recent version?	x		
Non-steady state model used for Class I: Calpuff Version number: V5.8.4 Level 130731 Most recent version?	x		
Have the appropriate background concentrations and/or competing sources been included?	x		
Were at least 5 years of representative meteorological data used in the modeling?	x		
Were meteorological data properly QA/QC'd?	x		
Does the modeling domain clearly contain all areas where concentrations exceed the acceptable source impact level (ASIL) and the significant impact level (SIL)?	x		

Table 30. PSD Modeling Review Checklist The purpose of this checklist is to provide documentation that an applicant's ambient analysis was reviewed by an AQP modeler. If something other than "yes" is checked, please provide a brief description describing why the analysis can or cannot be used to appropriately demonstrate compliance with air quality standards.			
Does the receptor grid spacing adequately resolve key areas?	X		
Were FLM receptors used for Class I modeling?	X		
Have dispersion modeling inputs and outputs (including POST files of hourly concentrations at designated receptors, if required) been submitted in an acceptable electronic format?	X		
[1]If a preliminary PSD approval is not yet available, answer "YES" if the modeling inputs and outputs agree with the PSD application.			

On October 14, 2016, the NPS provided helpful clarifications of their concerns in a document submitted to Ecology. The letter from NPS documented no dispute that PSD regulations were followed or that the BP application was complete, but rather emphasized the different approaches used to address PSD regulatory applicability from approaches used to address project impacts on CLASS I area AQRVs.

Ecology reviewed the FLMs' guidance on evaluating impacts of major projects on Class I areas: *Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – revised* (2010) (National Park Service, 2010), and noted different AQRV modeling approaches in FLAG than were performed by both NPS and BP.
For visibility considerations, FLAG states the following:

"Applicants should calculate the 24-hour average net emission increase for each pollutant from modified facilities as the maximum allowable 24-hour average minus the actual hourly rate averaged over the past two years (annual emissions over past two years/hours of operation over last two years)" (FLAG p. 24).

For visibility, BP initially looked at maximum short-term emissions and subtracted current permit limits or used maximum current permit limits and did not subtract the two-year average baseline described in FLAG. For long-term AQRV considerations, BP initially subtracted PSD baseline periods from emissions instead of FLAG baseline periods. Initially, BP also subtracted capabable of accommodating emissions, which is a procedure not described in FLAG.

NPS made no distinction between maximum short-term emissions for visibility and long-term emisisons for other AQRV considerations. NPS also used only one year as baseline (2014) instead of the two-year average baseline described in FLAG. In addition, NPS did not address the project's maximum allowable 24-hour average change in extinction but rather provided a review of visibility in Class I areas using deciviews. Figure 4 on page 26 of FLAG (Procedure for Visibility Assessment for Distant/Multi-Source Applications) provides a clear path for an applicant's project toward a "Presumptive No Adverse Impact" if the project's maximum

allowable 24-hour average minus the actual hourly rate averaged over the past two years "change in extinction" is less than five percent. NPS also considered impacts from the facility as a whole which is beyond the scope of FLAG for new projects under "new" source review (NSR). However, the October 14, 2016, clarifications from the NPS assisted Ecology, such that in an October 27, 2016, meeting with BP, Ecology requested additional clarifications from BP for their AQRV analysis which resulted in a lower permit limit for SO_2.

Per WAC 173-400-730(2)(a)(i): "Ecology may request additional information clarifying aspects of the application after it has been determined to be complete." On November 4, 2016, BP provided supplemental material to Ecology which show by two separate pathways in the FLAG manual, how the project (with the lower coker SO_2 permit limit of 37 lb/hr) is not expected to cause an adverse impact and that additional refined analysis is not required.

Based on Ecology's review of BP's application and modeling, Ecology has found that BP has satisfied applicable PSD regulations regarding impacts on Class I areas. Ecology has found that BP has adequately addressed AQRVs (including visibility and deposition) in accordance with the FLAG manual as discussed in the following subsections, in accordance with PSD regulations.

5.4.1. AQRVs background information

PSD regulations and guidance require additional impact analyses to evaluate the effects of the project's emissions on visibility, local soils, and vegetation in Class I and in also in Class II areas (See Section 6), and the effect of increased air pollutant concentrations on flora and fauna in the Class I areas. The additional impact analyses are also used to evaluate the effect of the project on growth in the area surrounding the project in Class II areas (See Section 6).

The analyses assess increment consumption and impacts on AQRVs in Class I areas. AQRVs include regional visibility or haze, the effects of primary and secondary pollutants on sensitive plants, the effects of pollutant deposition on soils and receiving water bodies, and other effects associated with secondary aerosol formation. The FLMs for the National Park Service, U.S. Fish and Wildlife Service, and U.S. Forest Service have the responsibility of ensuring AQRVs in the Class I areas are not adversely affected. The FLMs' guidance on evaluating impacts of major projects on Class I areas is the *Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – revised* (2010) (National Park Service, 2010).

In FLAG, the FLMs have developed a tool to screen out projects that would not have a significant impact on AQRVs based on annual emissions and distance from a Class I area. This screening tool is called the Q/D Method, which is to divide the amount of emission increases in tpy (Q) by the distance to a federal Class I area in km (D). FLAG states that "The FLM role within the regulatory context consists of considering whether emissions from a new source, or emission increases from a modified source, may have an adverse impact on AQRVs and providing comments to permitting authorities. Therefore, the agencies will consider a source locating greater than 50 km from a Class I area to have negligible impacts with respect to Class I AQRVs if its total SO_2, NO_X, PM_{10}, and H_2SO_4 annual emissions (in tpy, based on 24-hour

maximum allowable emissions), divided by the distance (in km) from the Class I area (Q/D) is 10 or less. The agencies would not request any further Class I AQRV impact analyses from such sources."

5.4.2. BP AQRV analysis

Initially, BP did not provide Q/D values in their application, but did mention at a March 2016 preapplication meeting that Q/D was less than 10. As part of their November 4, 2016, supplement, BP shows in Table 31 below that the project's Q/D is less than 10.

Table 31. Class I Areas within 300 KM of the BP Facility

Area	Distance (D) from BP to Class I Area (km)	*Q Divided by D (Q/D) (tons/km)	Is Q/D Less than 10? (Yes/No)
Alpine Lakes Wilderness Area	157	2	Yes
Glacier Peak Wilderness Area	108	3	Yes
Pasayten Wilderness Area	123	3	Yes
Olympic National Park	102	4	Yes
North Cascades National Park	78	5	Yes
Mount Rainier National Park	213	2	Yes
Goat Rocks Wilderness Area	255	1	Yes

* The Q/D values represent new emissions from the proposed coker heaters but do not take into account the tpy reductions from removal of the old coker heaters. If the tpy reductions from the old coker heaters are taken into account, the largest Q/D value is reduced to 3 tons/km.

Because Q/D is less than 10, according to the FLAG guidance manual (quoted above), "The agencies would not request any further Class I AQRV impact analyses from such sources." However, BP did complete an additional AQRV analysis as part of their application.
As noted in BP's application, "The CALPUFF modeling system is currently recommended for evaluating impacts to AQRVs in Class I Areas affected by long-range transport. Potential impacts are characterized based on predictions of total nitrogen and/or sulfur deposition flux, change in light extinction, and pollutant concentrations. Pollutant concentration predictions were also used to assess Class I Area increment consumption for pollutants subject to PSD review."

5.4.2.1. Predicted Class I area criteria pollutant concentrations compared to SILs and PSD increments

For impacts including impacts to vegetation, BP used the CALPUFF modeling system to predict concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ in regional Class I areas. This TSD does not provide all of the impact analysis figures provided in BP's application, but rather provides a summary table (Table 32) showing that all predicted concentrations are less than the SILs and PSD Class I increments.

Table 32. Maximum Criteria Pollutant Concentrations Predicted by CALPUFF					
Criteria Pollutant	Averaging Period	Max CALPUFF Concentration In Class I Areas* (µg/m³)	SIL† (µg/m³)	PSD† Increment (µg/m³)	Is CALPUFF Concentration Greater than SIL or PSD Increment?
PM_{10}	24-hr	< 1.0	5	8	No
	Annual	< 1.0	1	4	No
$PM_{2.5}$	24-hr	0.055	0.07, 1.2, 1.2	2	No
	Annual	0.0075	0.06, 0.3, 0.3	1	No
SO_2	3-hr	0.15	25	25	No
	24-hr	0.0417	5	5	No
	Annual	0.0061	1	2	No
NO_2	Annual	0.0063	1	2.5	No
CO	1-hr	< 2000	2000	--	No
	8-hr	< 500	500	--	No

* Mount Baker Wilderness Area and San Juan Islands (Class II Areas) were also addressed by the applicant even though they are not Class I areas. Maxiumum predicted results for these areas are below all SIL and PSD increment values listed.

† Listed SILs and SMCs were promulgated on October 20, 2010 and became effective December 20, 2010. $PM_{2.5}$ SILs are for Class I, II, and III areas, respectively, and are the only SILs with different values for the three different Class areas (I, II, and III). PM2.5 SIL and SMC in PSD rules were vacated on January 22, 2013.

5.4.2.2. Soils and receiving water bodies (deposition)

BP used CALPUFF to predict deposition of nitrogen and sulfur compounds emitted by the Project on soils and vegetation in regional Class I areas.

BP used NPS established Deposition Analysis Thresholds (DATs) for nitrogen and sulfur of 0.005 kg/ha/yr. The DATs provide screening criteria for the FLMs to identify potential deposition fluxes to be addressed.

This TSD does not provide all of the deposition analysis figures provided in BP's application, but rather provides a summary table from the application showing that CALPUFF-predicted maximum nitrogen and sulfur deposition fluxes do not exceed the DATs in any Class I area. As a result, the FLAG guidance manual provides a clear off-ramp from additional refined analysis for a "new or modified source," and therefore, as shown on page 67 of FLAG, BP's project has arrived into the flowchart box labelled as "presumptive no adverse impact" in terms of deposition.

Table 33. Predicted Class I Area Deposition Fluxes Compared to NPS DAT		
Class I Area of Interest	**Nitrogen Deposition (kg/ha/yr)**	**Sulfur Deposition (kg/ha/yr)**
Alpine Lakes Wilderness Area	0.0003	0.0005
Glacier Peak Wilderness Area	0.0011	0.0015
Goat Rocks Wilderness Area	0.0001	0.0001
Mount Adams Wilderness Area	0.0001	0.0001
Mount Rainier National Park	0.0001	0.0002
N. Cascades National Park	0.0026	0.0037
Olympic National Park	0.0016	0.0025
Pasayten Wilderness Area	0.002	0.0029
NPS DAT	0.005	0.005
Mount Baker Wilderness Area*	0.0037	0.0051
San Juan Island*	0.0018	0.0039
* Mount Baker Wilderness Area and San Juan Island are not Class I areas. They are included in the analysis because FLMs have requested inclusion in previous permit applications.		

5.4.2.3. Visibility (Class I areas)

As noted in BP's application, a five percent change in extinction is recommended in FLAG to indicate a "just perceptible" change to a landscape. This TSD does not provide all of the impact analysis figures provided in BP's application, but rather provides a summary table from the application showing that the 98th percentile changes in extinction for this project compared to the thresholds established by the FLMs.

As shown in Table 34, the 98th percentile changes in extinction for this project are less than the five percent threshold established by the FLMs. As a result, the FLAG guidance manual provides a clear off-ramp from additional refined analysis for a "new or modified source," and therefore, as shown on page 26 of FLAG, BP's project has arrived into the flowchart box labelled as "presumptive no adverse impact" in terms of visibility.

Table 34. Predicted Class I Area Visibility Results				
Class I Area of Interest	**98th Percentile (%) Change in Visibility**			
	2003	**2004**	**2005**	**3 year**
Alpine Lakes Wilderness	0.38	0.42	0.38	0.4
Glacier Peak Wilderness	0.87	0.89	0.96	0.89
Goat Rocks Wilderness	0.11	0.1	0.14	0.12
Mount Adams Wilderness	0.08	0.08	0.09	0.08
Mount Rainier National Park	0.18	0.18	0.2	0.19
N Cascades National Park	1.34	1.35	1.25	1.34

Table 34. Predicted Class I Area Visibility Results				
Class I Area of Interest	98th Percentile (%) Change in Visibility			
	2003	2004	2005	3 year
Olympic National Park	2.74	2.24	2.77	2.64
Pasayten Wilderness	0.78	0.95	0.77	0.87
Mount Baker Wilderness*	1.65	1.85	1.99	1.91
San Juan Islands*	3.61	2.95	3.17	3.2
* Mount Baker Wilderness Area and San Juan Islands are not Class I areas. Results are included in the analysis because the FLMs have requested inclusion in previous permit applications.				

6. ADDITIONAL IMPACTS ANALYSIS

6.1. Growth Analysis

6.1.1. Construction and growth impacts

The number of employees at BP is not expected to increase as a result of this project, and BP does not expect significant population growth in the area nor significant secondary air quality impacts due to the project. However, during construction of this project, there will be approximately 150 additional employees onsite. During this time, there will be increased traffic congestion, increased vehicle emissions, and increased demand for local skilled workers. Because construction is expected to last only two years or less, these increases are expected to be temporary and insignificant. New area homes or industry growth are not anticipated to be significant as a result of the project. Therefore, the proposed project is not expected to cause adverse construction and growth related impacts.

6.2. Visibility (Class II Areas)

As noted in the application, the 1990 draft NSR Workshop Manual provides the following description of a Class II visibility analysis in Chapter D, Section II.D:

"In the visibility impairment analysis, the applicant is especially concerned with impacts that occur within the area affected by applicable emissions. Note that the visibility analysis required here is distinct from the Class I area visibility analysis requirement. The suggested components of a good visibility impairment analysis are:" (addressed for each below the listed components in italics font):

- *"a determination of the visual quality of the area,"*

Regarding area regional haze, pre-existing visible water vapor (steam) plumes can be seen in the Cherry Point area, both from BP and other sources, which dissipate short distances from the facility due to dispersion and evaporation.

- *"an initial screening of emission sources to assess the possibility of visibility impairment, and"*

The project emissions are located within the existing BP buildings and stacks so that after the project is completed, the project emission sources are not likely to impair local visibility any more than the existing facility emission sources. According to BP's application, "the replacement coker heaters and the projected increases in emissions from other combustion units (i.e., Hydrocracker heaters) will be the largest sources of emissions associated with the Project. Although state and local regulations restrict visible emissions to a 20 percent opacity limit, emissions from gas-fired combustion units are typically less than five percent and are rarely visible.

- *"if warranted, a more in-depth analysis involving computer models."*

For Class II areas, the analysis provided for regional haze appears to be sufficient. BP performed an in-depth analysis of visibility in nearby Class I areas.

6.3. Soils and Vegetation Analysis

Regarding economic impacts of the project on vegetation and soils, or agriculture and forestry, the project emissions comply with secondary NAAQS (assumed by compliance with SILs), which were intended to address factors such as soils and vegetation.

Based on the deposition modeling described in Section 5.4.2.2, deposition rates of sulfur and nitrogen would be less than 0.8 lb/acre/yr and 0.5 lb/acre/yr, respectively, which are similar to rates modeled for a previous BP project. For that project, BP's consultant Ramboll Environ obtained information indicating that "impacts to commercial farms will be insignificant." Because deposition rates are similar from this project, Ecology believes BP has satisfactorily addressed project impacts on Class II soils and vegetation.

7. STATE ENVIRONMENTAL POLICY ACT

Under Washington State rules, a final PSD permit shall not be issued for a project until the applicant has demonstrated that State Environmental Policy Act (SEPA) review has been completed for the project. Whatcom County is the lead agency for SEPA.

Whatcom County Planning & Development Services has issued a SEPA Determination of Nonsignificance (DNS) (SEP2016-00033 August 16, 2016) for this project. The DNS determined that no significant adverse impacts are likely, and that an EIS is not required for this equipment replacement project. Therefore, Ecology concludes that the applicant has adequately demonstrated compliance with SEPA requirements.

8. PUBLIC INVOLVEMENT

This PSD permitting action is subject to a minimum 30-day public comment period under WAC 173-400-740. A newspaper public notice announcing the public comment period was published in The Bellingham Herald on November 14, 2016. In accordance with WAC 173-400-740(2)(a), application materials and other related information was made available for public inspection at two locations:

Northwest Clean Air Agency 1600 South Second Street Mount Vernon, WA 98273-5202 (360) 428-1617	Washington State Department of Ecology Air Quality Program 300 Desmond Drive SE Lacey, WA 98503 (360) 407-6800

A public meeting and hearing on the proposed PSD permit were held on December 15, 2016. The public meeting was held at 6:00 PM and the formal hearing began at 6:30 PM at the Four Points by Sheraton in Bellingham, WA. The public comment period ended on December 16, 2016, at 5:00 PM PDT.

No one provided comment at the hearing. Ecology received approximately 134 written comments during the comment period. Ecology's responses to the comments are provided in Appendix A of this TSD. BP provided separate responses, which are provided in Appendix B of this TSD. The first part of Appendix B contains BP's responses based on Ecology's comment numbering system. The last part of Appendix B contains BP's responses in their original form and with their initial numbering system summary. The original comments as they were received by Ecology, are provided in Appendix C of this TSD.

9. AGENCY CONTACT

Gary Huitsing, P.E.
Washington State Department of Ecology
Air Quality Program
P.O. Box 47600
Olympia, WA 98504-7600
(360) 407-6314
gary.huitsing@ecy.wa.gov

REFERENCES

Ashmore, M., Karlsson, P.E., and H. Pleije, New directions: a new generation of ozone critical levels for the protection of vegetation in Europe (correspondence), *Atmospheric Environment*, 38: 2213-2214, 2004.

Brace, S., Peterson, D. L., and D. Horner, Diagnosing Ozone Injury in Vascular Plants of the Pacific Northwest, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 1998.

California Air Resources Board, Statewide BACT Clearinghouse, <http://www.arb.ca.gov/bact/bact.htm>, California Environmental Protection Agency, Sacramento, California, 2014.

EPA, *Draft EPA New Source Review Workshop Manual*, 1990. Available at: <http://www.epa.gov./ttn/nsr/gen/wkshpman.pdf>

National Park Service, *Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I report – revised 2010)*, 2010. Available at: <http://www.nature.nps.gov/air/pubs/pdf/flag/Flag_2010.pdf>

South Coast Air Quality Management District, SCAQMD Clearinghouse, Diamond Bar, California, 2014. Available at: <http://www.aqmd.gov/bact/287160.htm>

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
ALW	Alpine Wilderness
AQIA	Air Quality Impacts Analysis
AQRV	Air Quality Related Values
BACT	Best Available Control Technology
CARB	California Air Resources Board
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FLAG	Federal Land Managers' Air Quality Relative Values Workgroup
FLM	Federal Land Manager
FR	Federal Register
GHG	greenhouse gas
H_2SO_4	sulfuric acid mist
HAPs	hazardous air pollutants
hr/yr	hours per year
kW	kilowatt
MACT	maximum achievable control technology
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOC	Notice of Construction
NO_X	nitrogen oxides
NPS	National Park Service
NSR	New Source Review
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in diameter

$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
PTE	potential to emit
Q/d	emissions to distance
RBLC	RACT/BACT/LAER Clearinghouse
SCR	selective catalytic reduction
SEPA	State Environmental Policy Act
SER	significant emission rate
SIL	significant impact level
SO_2	sulfur dioxide
SO_X	sulfur oxides
TAP	toxic air pollutant
tpy	tons per year
VOC	volatile organic compound
WAC	Washington Administrative Code

APPENDIX A. ECOLOGY RESPONSE TO COMMENTS

APPENDIX B. BP RESPONSE TO COMMENTS

APPENDIX C. COMMENTS RECEIVED

DEPARTMENT OF
ECOLOGY
State of Washington

PREVENTION OF SIGNIFICANT DETERIORATION (PSD) PERMIT

Issued To:	BP West Coast Products LLC BP Cherry Point Refinery
Facility Location:	4519 Grandview Road Blaine, Washington 98230
Permit Number:	**Final PSD 16-01**
Date of Permit Issuance:	**May 23, 2017**
Effective Date of Permit:	**May 23, 2017**

This PSD permit is issued under the authority of the Washington State Clean Air Act, Chapter 70.94 Revised Code of Washington; the Washington State Department of Ecology regulations for the Prevention of Significant Deterioration of Air Quality as set forth in Washington Administrative Code 173-400-500 through 750.

PREPARED BY:

Gary J. Huitsing, P.E.
Science and Engineering Section
Air Quality Program

5/23/2017
Date

APPROVED BY:

Kathy Taylor, Ph.D.
Deputy Air Quality Program Manager
Washington Department of Ecology

5/23/17
Date

TABLE OF CONTENTS

PROJECT SUMMARY 1
APPROVAL CONDITIONS 2
I. EFFECTIVE DATE OF PERMIT 2
II. PERMIT EXPIRATION 2
III. PERMIT NOTIFICATION REQUIREMENTS 2
IV. EQUIPMENT RESTRICTIONS 3
V. EMISSION LIMITS 3
VI. BACT DETERMINATIONS 6
VII. SPECIFIC OPERATING REQUIREMENTS 7
VIII. COMPLIANCE MONITORING REQUIREMENTS 8
IX. RECORDKEEPING AND REPORTING REQUIREMENTS 9
X. GENERAL RESTRICTIONS ON FACILITY OPERATIONS 10
XI. MALFUNCTION AND EXCESS EMISSIONS REPORTING 10
XII. RIGHT OF ENTRY 11
XIII. TRANSFER OF OWNERSHIP 12
XIV. ADHERENCE TO APPLICATION AND COMPLIANCE WITH OTHER ENVIRONMENTAL LAWS 12
XV. APPEAL PROCEDURES 12
ACRONYMS AND ABBREVIATIONS 13

PROJECT SUMMARY

BP West Coast Products LLC operates a refinery in Blaine, Washington, referred to as the BP Cherry Point Refinery. The BP Cherry Point Refinery (BP or refinery) produces petroleum based fuels.

This Prevention of Significant Deterioration (PSD) project referred to as the BP Coker Heaters – Replacement project (or project), will make the following changes to the refinery:

- Replace the two existing coker heaters, installed as part of the original facility in 1970, with two new coker heaters equipped with spalling (online cleaning capability).
- Install a lean oil absorption system in the coker off gas system.
- Install a compressor as part of the new lean oil absorption system.
- Install bypasses of existing heat exchangers in crude preheat system.

Changes not triggering New Source Review include:

- Replace the boiler feedwater circulation pump for the coker heaters.
- Change the main fractionator accumulator for additional sour water generation associated with online spalling capability.

Construction on this project is expected to begin sometime in 2017, and the new units are expected to start operating during the third quarter of 2019.

A PSD analysis for this project determined that it will have physical or operational changes that qualify as a major modification. Estimated project emissions are above the PSD significant emission rate (SER) thresholds both before and after considering significant net emission increases and/or decreases associated with this project for each of the following pollutants: combined emissions of nitrogen oxide and nitrogen dioxide (NO_X), carbon monoxide (CO), sulfur dioxide (SO_2), sulfuric acid mist (H_2SO_4), particulate matter (PM), PM less than 10 microns (PM_{10}), PM less than 2.5 microns ($PM_{2.5}$), volatile organic compounds (VOCs), and greenhouse gases (CO_2e).

A full technical review of the project for these pollutants, including a Best Available Control Technology (BACT) analysis, and the project's effect on national ambient air quality standards (NAAQS), PSD increments, visibility, soils, and vegetation, is required and included in a Technical Support Document (TSD) prepared by the Washington State Department of Ecology (Ecology).

The emissions of other air pollutants not subjected to PSD review are covered in the Northwest Clean Air Agency's (NWCAA) Notice of Construction (NOC) approval for this project.

APPROVAL CONDITIONS

Based on the PSD permit application submitted by BP on March 28, 2016, and the technical review performed by Ecology, Ecology finds that all requirements for issuance of this PSD permit have been satisfied. Ecology determined the application complete on April 28, 2016. Approval of the project is granted subject to the following conditions:

I. EFFECTIVE DATE OF PERMIT

In accordance with the Washington Administrative Code (WAC) 173-400-730(2)(c), the effective date of this PSD permit is one of the following dates:

A. The date of issuance of this permit; or

B. A later date if specified on the signature page of this permit.

II. PERMIT EXPIRATION

Pursuant to WAC 173-400-730(5), and unless an extension is granted by Ecology prior to expiration, BP's authorization to construct under this PSD permit expires as follows:

A. This permit expires, and re-permitting will be required before any further construction activity may occur, if:

1. Construction of has not commenced (as defined in 40 CFR § 52.21 (b)(9)) within eighteen (18) months of the effective date of this permit; or

2. Construction is discontinued for a period of eighteen (18) months or more; or

3. Construction is not completed within a reasonable time.

III. PERMIT NOTIFICATION REQUIREMENTS

A. BP's requirements in this PSD permit to notify, report to, or acquire approval or agreement from "Ecology and/or the NWCAA" may be satisfied by providing such notification, reporting, or approval request to NWCAA if the conditions of this PSD permit have been incorporated into BP's Title V Air Operating Permit issued pursuant to 40 CFR Part 70 and Chapter 173-401 WAC.

B. BP must notify Ecology and NWCAA in writing or electronic mail of the date construction of the project is commenced, postmarked or received no later than thirty (30) days after such date.

C. By March 1 of each year, BP must submit to Ecology, in writing or electronic mail, an annual report containing a brief summary of the construction activities

related to the project that occurred during the previous calendar year. This reporting obligation shall end when BP submits a notification to Ecology, in writing or electronic mail, that all construction activities related to the project have been completed. This notification of completion shall contain a brief summary of any construction activities related to the project that have not been included in a prior annual report.

IV. EQUIPMENT RESTRICTIONS

This PSD permit authorizes the construction of the new equipment associated with the coker heater replacement project, as listed in Table IV-1. However, BP may choose not to construct all of the listed equipment.

Table IV-1. New Equipment Associated with the Coker Heater Replacement Project

Equipment Description	New or Modified
Coker Heater (West)	New
Coker Heater (East)	New
Lean Oil Absorption System	New
Compressor for lean oil absorption system	New
Crude Heat Exchanger Bypasses	New

V. EMISSION LIMITS

The following emission limits apply to each coker heater unless otherwise specified. These limits include consideration of BACT determinations described in Section VI. The operating modes described in these limits are defined as:

- Forced draft mode is when the forced draft fan is operating.
- Natural draft mode is when the forced draft fan is not operating.
- Normal operations mode is when hot residual oil at normal coking temperatures (900°F or higher) is sent to the coking drum to produce coke. Online cleaning is part of the normal operations mode.
- Standby mode occurs when circulating process materials to maintain unit temperatures when not producing coke from the heater.
- Startup mode is the period between when fuel gas is introduced to the heater burners to heat process materials for coking and ends when process material leaving the heater reaches normal coking temperatures (900°F).
- Pre-startup activities include equipment preparation and verification activities following maintenance events (e.g., curing refractory, general mechanical

checkout of equipment, instrument system review, pressure testing, and purging equipment).

- Shutdown mode starts when fuel gas to the heater burners is stopped and ends when heater stack oxygen level reaches 18 percent, or greater, as measured by the Continuous Emission Monitoring System (CEMS).

A. NO_X:

1. NO_X emissions resulting from each coker heater unit must not exceed the following limits:

   a. Concentration based limits for normal operation in forced draft mode based on a 30-day rolling average (includes startup/shutdown emissions): 6.0x10^1 parts per million volume dry (ppmvd) at zero percent oxygen.

   b. Mass emission rate limit for normal operation in forced draft mode: 18.2 lb/hr on a calendar day average (includes startup/shutdown emissions).

   c. Concentration based limits for normal operation in natural draft mode based on a 30-day rolling average (includes startup/shutdown emissions): 4.0x10^1 ppmvd at 0 percent oxygen. This limit shall apply at and after 30 consecutive days of heater operation in natural draft mode. For periods of continuous normal heater operation in natural draft mode less than 30 days in duration, the limit in Condition V.A.1.a must apply.

   d. Mass emission rate limit for normal operation in natural draft mode: 12.1 lb/hr on a calendar day average (includes startup/shutdown emissions).

   e. Mass emission rate limit for standby mode: 8.0 lb/hr per heater on a rolling 24-hour average.

B. CO:

1. CO emissions resulting from each coker heater unit must not exceed the following limits:

   a. Concentration based limits for normal operation in forced and natural draft mode (excluding standby, startup, and shutdown): 33 ppmvd at zero percent oxygen on a 30-day rolling average.

   b. Mass emission rate limit for normal operation in forced and natural draft mode: 6.1 lb/hr based on a calendar day average.

c. Mass emission rate limit for startup/shutdown modes: 75.0 lb/hr hourly average.

d. Mass emission rate limit for standby mode: 75.0 lb/hr on a rolling 24-hour average.

C. SO_2:

1. SO_2 emissions resulting from both coker heater units must not exceed the following limits.

   a. Mass emission rate limit of 37 lb/hr on a calendar day average (includes startup/shutdown emissions) for both heaters combined.

   b. Mass emission rate limit of 132 tons per year for both heaters combined, on a 12-month rolling total.

D. Particulate Matter (Filterable)

1. PM (filterable) from each coker heater unit must not exceed the following limit:

   a. Concentration based limit of 0.0025 lb/MMBtu on an hourly average or as needed, consistent with test method.

E. PM_{10} and $PM_{2.5}$ (Filterable and condensable combined)

1. PM_{10} and $PM_{2.5}$ (including filterable and condensable combined particulate) from each new coker heater unit must not exceed the following limit:

   a. Concentration based limit of 0.010 lb/MMBtu on an hourly average or as needed, consistent with test method.

F. VOC

1. VOCs from each coker heater unit must not exceed the following limit:

   a. Concentration limit of 0.0054 lb/MMBtu on an hourly average or as needed, consistent with test method.

G. H_2SO_4

1. H_2SO_4 from each coker heater unit must not exceed the following limits:

a. Concentration based limit of 0.0053 lb/MMBtu on an hourly average or as needed, consistent with test method.

H. CO_2e

1. CO_2e from each new coker heater unit must not exceed the following limits:

a. Mass emission rate limit of 36,631 lb/hr on a calendar year average.

VI. BACT DETERMINATIONS

Consistent with 40 CFR § 52.21(j)(3), which requires that BACT be applied to each PSD pollutant with significant net emissions increases, the BACT determinations of this section apply to this project. Facility units not listed in this section, do not require a BACT analysis because they are not physically or operationally modified as a result of this project.

A. BACT for Coker Heaters:

Table VI-1. BACT Determinations for Coker Heaters

Pollutant	BACT Determination Description
NO_X	Ultra low NO_X Burners (ULNB) and Good Combustion Practices. These BACT determinations shall be demonstrated by compliance with the NOx BACT limits of Section V.
CO	Good Combustion Practices, demonstrated by compliance with CO BACT limits of Section V.
SO_2	Good Combustion Practices, use of coker off gas, and fuel limits for hydrogen sulfide (H_2S). These BACT determinations shall be, demonstrated by compliance with the SO_2 BACT limits of Section V.
PM (filterable)	Good Combustion Practices and use of low sulfur fuels (see SO_2 BACT determination). These BACT determinations shall be, demonstrated by compliance with the PM BACT limits of Section V.
PM_{10} (filterable and condensable)	Good Combustion Practices and use of low sulfur fuels (see SO_2 BACT determination). These BACT determinations shall be demonstrated by compliance with the PM_{10} BACT limits of Section V.
$PM_{2.5}$ (filterable and condensable)	Good Combustion Practices and use of low sulfur fuels (see SO_2 BACT determination). These BACT determinations shall be, demonstrated by compliance with the $PM_{2.5}$ BACT limits of Section V.
VOC	Good Combustion Practices demonstrated by compliance with the VOC BACT limits of Section V.
H_2SO_4	Good Combustion Practices, use of coker off gas, and fuel limits for hydrogen sulfide (H_2S). These BACT determinations shall be demonstrated by compliance with the H_2SO_4 BACT limits of Section V.
CO_2e	Good Combustion Practices, use of low-carbon fuels such as coker off gas and/or refinery fuel gas (RFG), and energy efficient design. These BACT determinations shall be, demonstrated by compliance with the CO_2e BACT limits of Section V.

B. BACT for Components of Coker Heaters, Lean Oil Absorption, and Heat Exchangers:

Table VI-2. BACT Determinations for Components of Coker Heaters, Lean Oil Absorption, Cooling Box, and Heat Exchangers	
Pollutant	**BACT Determination Description**
VOC	Implementation of Leak Detection and Repair (LDAR) program consistent with 40 CFR 60 Subpart GGGa and Subpart VVa (including recordkeeping requirements contained within each regulation).
CO_2e	Implementation of Leak Detection and Repair (LDAR) program consistent with 40 CFR 60 Subpart GGGa and Subpart VVa (including recordkeeping requirements contained within each regulation).

VII. SPECIFIC OPERATING REQUIREMENTS

The following requirements are listed as statements of fact because they are relevant to this permit. Ecology is not making them enforceable as part of this permit because they are already enforceable independent of this permit.

A. The coker heaters must comply with all applicable requirements of New Source Performance Standards (NSPS), 40 CFR Part 60.1-60.19 (Subpart A).

B. The coker heaters must comply with all applicable NSPS requirements of 40 CFR Part 60.100a-60.109a (Subpart Ja), including but not limited to the emission limits in Table VI-1.

C. The lean oil absorption system must comply with all applicable NSPS requirements of 40 CFR Part 60.1-60.19 (Subpart A).

D. The lean oil absorption system must comply with all applicable NSPS requirements of 40 CFR Part 60.660-668 (Subpart NNN).

E. New components of this project in organic HAP service, must comply with all applicable requirements of National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 63, (Subpart CC).

F. The coker unit must comply with all applicable updated NESHAP requirements of 40 CFR Part 63, (Subparts CC and UUU).

G. The coker heaters must comply with all applicable NESHAP requirements of 40 CFR Part 63, (Subpart DDDDD).

VIII. COMPLIANCE MONITORING REQUIREMENTS

BP must complete the required compliance test and certification for the following continuous emission monitoring system (CEMS) within 60 days of achieving the maximum firing rate at the coker heaters, but not later than 180 days after initial start-up. All testing (both initial and follow-up) must be conducted while heaters are fired at least 90 percent of the normal maximum operating rate (MMBtu/hr). Normal maximum operating rate is defined as the 90th percentile of the average hourly operating rates during the previous 12-month period. Retesting would be required within 60 days if the heater firing rate, based on a six (6) month average, is above 110 percent of the average firing measured during the most recent source test.

A. BP must demonstrate compliance for NO_X in Conditions V.A.1. with a CEMS that monitors NO_X and O_2 operated in accordance with 40 CFR 60 Appendix B and F, and NWCAA 367 and Appendix A. Stack flows for calculating NOx mass emissions must be determined in accordance with Condition VIII.H.

B. BP must demonstrate compliance for CO in Conditions V.B.1 with a CEMS that monitors CO and O2operated in accordance with 40 CFR 60 Appendix B and F, and NWCAA 367 and Appendix A. Stack flows for calculating NOx mass emissions must be determined in accordance with Condition VIII.H

C. BP must demonstrate compliance for SO_2 in Conditions V.C1. with a CEMS that monitors SO_2 and O_2, operated in accordance with 40 CFR 60 Appendix B and F, and NWCAA 367 and Appendix A. Stack flows for calculating SO_2 mass emissions must be determined in accordance with Condition VIII.H

D. BP must demonstrate compliance for particulate matter in Conditions V.D.1 and V.E.1 as stated in subsection i below:

   i. BP must conduct source testing using EPA Method 5 or 201A (for filterable particulate matter) and Method 202 (for condensable particulate), or other method pre-approved by the NWCAA. BP must conduct an initial stack test no more than 180 days after startup. Thereafter, conduct testing within 13 months of the most recent test. After three consecutive tests on each cooker heater that have demonstrated emissions are less than emissions limits in Condition V.D.1 and V.E.1, testing of each coker heater may be reduced to once every five years for that pollutant. If a test demonstrates emissions are greater than the emission limits in Conditions V.D.A and V.E.1, annual testing for that pollutant is required until three consecutive tests demonstrate compliance.

E. BP must demonstrate compliance for VOC in Conditions V.F.1 as stated in subsection i below:

i. BP must conduct source testing using EPA Method 25A, or other method pre-approved by the NWCAA, in coordination with NWCAA. BP must conduct an initial source test no more than 180 days after startup. Thereafter, demonstrate compliance within 20 calendar quarters of the most recent test.

F. BP must demonstrate compliance for H_2SO_4 in Conditions V.G.1. as stated in subsection i below:

i. BP must conduct source stack testing using EPA Method 8, or other method pre-approved by the NWCAA, in coordination with NWCAA. BP must conduct an initial source test no more than 180 days after startup. Thereafter, demonstrate compliance by conducting testing using EPA Method 8, or other method preapproved by the NWCAA, within 20 calendar quarters of the most recent test.

G. BP must demonstrate compliance for CO_2e in Conditions V.H.1., with fuel tracking and 40 CFR Part 98 (Subpart C).

H. Coker off gas combusted in the coker heaters must be sampled and analyzed on a weekly basis for composition using Universal Oil Products (UOP) Laboratory Test Method 539-97 "Gas Analysis by Gas Chromatography" or equivalent. The gas composition must be used to determine the heat content of the gas in terms of British thermal unit, high heat value, per standard cubic foot (Btu/scf) and to determine the EPA Method 19 Fd factor for the gas. An alternative method to EPA Method 19 can be used to determine the Fd factor if pre-approved by NWCAA.

IX. RECORDKEEPING AND REPORTING REQUIREMENTS

A. Beginning the first calendar month after source testing and CEMS certification have been reported to NWCAA and Ecology, BP must keep the following records at the site (or electronically accessible at the site):

1. The calculations and results pursuant to Condition VIII (A through H).

2. The data used to determine compliance with the Condition V (A through C) with the appropriate averaging time of the emission limit.

B. Records must be retained for not less than five (5) years after their origination.

1. At a minimum, the most recent two (2) years of data must be retained onsite (or be electronically accessible at the site). The remaining three (3) years of data may be retained off-site.

2. Records must be available for inspection by Ecology and NWCAA within ten (10) days of request.

C. By April 15 of each year, beginning with the year following the startup of the two new coker heaters authorized by this permit, BP must report in writing or electronic mail, postmarked or received by April 15 of each year, the following information to Ecology and/or NWCAA. This report can be integrated with the state annual emissions inventory report.

1. Annual Emission and emission rates of the pollutants in Condition V

D. BP must furnish Ecology and/or NWCAA, within 60 days of completion, a report of the results of any performance evaluation in Conditions VIII.A-G.

X. GENERAL RESTRICTIONS ON FACILITY OPERATIONS

A. At all times, BP must, to the extent practicable, maintain and operate the equipment listed in Table IV-1 of this permit, including any associated air pollution control equipment, in a manner consistent with good air pollution control practices for minimizing emissions.

B. Determination of whether acceptable operating and maintenance procedures are being used for the equipment listed in Table IV-1 of this permit will be based on information available to Ecology, NWCAA, EPA and/or their authorized representatives, which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source.

XI. MALFUNCTION AND EXCESS EMISSIONS REPORTING

A. Prior to incorporation of the conditions of this PSD permit into BP's Title V Air Operating Permit issued pursuant to 40 CFR Part 70 and WAC 173-401, BP must report to Ecology and NWCAA, in writing or electronic mail, following the discovery of any malfunction of air pollution control equipment, process equipment, or of a process, which results in an increase in emissions above the allowable emission limits of this permit, in accordance with WAC 173-400-107 and the following conditions:

1. BP must notify Ecology and NWCAA, in writing or electronic mail, postmarked or received no later than thirty (30) days after the end of the month in which a malfunction is discovered, for any malfunction of air pollution control equipment, process equipment, or of a process, which results in an increase in emissions above the allowable emission limits of this permit. This notification must include a description of the malfunctioning equipment, process equipment or process, the date and time of the initial malfunction (if

known), the period of time over which emissions were increased due to the malfunction, the cause of the malfunction (if known), the estimated resultant excess emissions, and the methods utilized to mitigate emissions and restore normal operations.

2. For purposes of this permit, "malfunction" means any failure of air pollution control equipment, process equipment, or of a process to operate in a normal manner.

B. After the conditions of this PSD permit have been incorporated into BP's Title V Air Operating Permit issued pursuant to 40 CFR Part 70 and WAC 173-401, BP shall report to NWCAA the discovery of any malfunction of air pollution control equipment, process equipment, or of a process, which results in an increase in emissions above the allowable emission limits specified in this permit, pursuant to the deviation reporting requirements and, if applicable, pursuant to the unavoidable excess emissions reporting requirements of that Title V Air Operating Permit.

C. Compliance with the malfunction notification requirements, as applicable, will not excuse or otherwise constitute a defense to any violation of this PSD permit or any law or regulation such malfunction may cause.

XII. RIGHT OF ENTRY

Section 114 of the federal Clean Air Act, 42 U.S.C. § 7414, and the Revised Code of Washington (RCW) 70.94.200, and WAC 173-400-105(3) provide authorized representatives of EPA, Ecology, and NWCAA certain rights to enter and inspect the source. Refusal by BP to allow such entry and inspection may be a violation of the federal Clean Air Act and/or the RCW subject to penalty as provided in those statutes. Pursuant to these statutes, authorized representatives of EPA, Ecology, and NWCAA, upon the presentation of credentials:

A. Have a right of entry to, upon, or through any premises of BP or any premises in which any records this permit requires BP to maintain are located.

B. Have the right, at reasonable times, to access and copy any records this permit requires BP to maintain.

C. Have the right, at reasonable times, to inspect any monitoring equipment or method required by this permit.

D. Have the right, at reasonable times, to sample any emissions that BP is required to sample under this permit.

XIII. TRANSFER OF OWNERSHIP

A. In the event of any changes in control or ownership of facilities to be constructed, this PSD permit will be binding on all subsequent owners and operators. The applicant must notify the succeeding owner and operator of the existence of this PSD permit and its conditions by letter, a copy of which must be forwarded to Ecology and/or NWCAA as specified in Condition III.A.

B. If the conditions of this PSD permit have been incorporated into BP's Title V Air Operating Permit issued pursuant to 40 CFR Part 70 and WAC 173-401, then the provisions for amending that Title V Air Operating Permit to allow for a change in ownership or operational control shall apply in place of the notification provisions in Condition XIII.A.

XIV. ADHERENCE TO APPLICATION AND COMPLIANCE WITH OTHER ENVIRONMENTAL LAWS

A. Pursuant to 40 CFR § 52.21(r) (1) as adopted in WAC 173-400-720(4)(vi), BP must install and operate the proposed emissions units in accordance with this PSD permit and the application on which this permit is based.

B. Pursuant to 40 CFR § 52.21(r)(3), as adopted in WAC 173-400-720(4)(vi) this PSD permit shall not relieve BP of the responsibility to comply fully with applicable provisions of the State Implementation Plan and any other requirements under local, state, or federal law.

C. Any applicant who fails to submit any relevant facts or who has submitted materially incorrect relevant information in a permit application must, upon becoming aware of such failure, or incorrect submittal, promptly submit such supplementary facts or corrected information.

D. To the extent provided by 40 CFR § 52.21(c), as adopted in WAC 173-400-720(4)(vi) for the purpose of establishing whether or not BP has violated or is in violation of any requirement of this permit, nothing in this permit shall preclude the use, including the exclusive use, of any credible evidence or information relevant to whether BP would have been in compliance with applicable requirements if the appropriate performance or reference test or procedure had been performed.

XV. APPEAL PROCEDURES

This PSD permit, or any conditions contained in it, may be appealed to:

A. The Pollution Control Hearings Board (PCHB) as provided in Chapter 43.21B RCW and Chapter 371-08 WAC.

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
ASTM	American Society for Testing and Materials
BACT	Best Available Control Technology
CFR	Code of Federal Regulations
CEMS	Continuous Emissions Monitoring System
CO	carbon monoxide
CO_2e	carbon dioxide equivalents
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FTIR	Fourier Transform Infrared (FT-IR) spectrometer
GC	Gas Chromatography
gal	gallon(s)
GHG	greenhouse gases
H_2SO_4	sulfuric acid mist
HVLP	High Volume Low Pressure
kW	kilowatt
lb	pound(s)
lb/hr	pound(s) per hour
mm Hg	millimeters of mercury column
MMBtu/hr	million British thermal units per hour
MSDS	Material Safety Data Sheet
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_X	nitrogen oxides
NWCAA	Northwest Clean Air Agency
O_2	oxygen
PCHB	Pollution Control Hearings Board
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter

ppm	parts per million
ppmv	parts per million by volume
ppmvd	parts per million by volume on a dry basis
PSD	Prevention of Significant Deterioration of Air Quality
RCW	Revised Code of Washington
scf	standard cubic feet
SCR	selective catalytic reduction
SO_2	sulfur dioxide
tpy	tons per year
ULSD	ultra-low sulfur diesel
U.S.C.	United States Code
VOC	volatile organic compounds
WAC	Washington Administrative Code

DEPARTMENT OF
ECOLOGY
State of Washington

PREVENTION OF SIGNIFICANT DETERIORATION (PSD) PERMIT

Issued To:	Tesoro Refining & Marketing Company LLC Anacortes Refinery
Facility Location:	10200 March Point Road Anacortes, Washington 98221
Permit Number:	**Final PSD 17-01**
Date of Permit Issuance:	**July 18, 2017**
Effective Date of Permit:	**July 18, 2017**

This PSD permit is issued under the authority of the Washington State Clean Air Act, Chapter 70.94 Revised Code of Washington; the Washington State Department of Ecology regulations for the Prevention of Significant Deterioration of Air Quality as set forth in Washington Administrative Code 173-400-700 through 750.

PREPARED BY:

GARY J. HUITSING STATE OF WASHINGTON 42376 REGISTERED PROFESSIONAL ENGINEER

Gary J. Huitsing, P.E. — Date: 7/18/17
Science and Engineering Section
Air Quality Program

APPROVED BY:

Stuart A. Clark — Date: 7/18/17
Air Quality Program Manager
Washington Department of Ecology

TABLE OF CONTENTS

PROJECT SUMMARY 3
APPROVAL CONDITIONS 4
I. EFFECTIVE DATE OF PERMIT 4
II. PERMIT EXPIRATION 4
III. PERMIT NOTIFICATION REQUIREMENTS 4
IV. EQUIPMENT RESTRICTIONS 5
V. EMISSION LIMITS 6
VI. BACT DETERMINATIONS 7
VII. SPECIFIC OPERATING REQUIREMENTS 8
VIII. COMPLIANCE MONITORING REQUIREMENTS 9
IX. RECORDKEEPING AND REPORTING REQUIREMENTS 10
X. GENERAL RESTRICTIONS ON FACILITY OPERATIONS 11
XI. MALFUNCTION AND EXCESS EMISSIONS REPORTING 11
XII. RIGHT OF ENTRY 12
XIII. TRANSFER OF OWNERSHIP 12
XIV. ADHERENCE TO APPLICATION AND COMPLIANCE WITH OTHER ENVIRONMENTAL LAWS 13
XV. APPEAL PROCEDURES 13
ACRONYMS AND ABBREVIATIONS 14

PROJECT SUMMARY

Tesoro Refining & Marketing Company LLC operates a refinery in Anacortes, Washington, referred to as the Anacortes Refinery. The Tesoro Anacortes Refinery (Tesoro or Refinery) produces petroleum-based products.

This Prevention of Significant Deterioration (PSD) project referred to as the Clean Products Upgrade Project (CPUP or project), will make the following changes to the refinery:

- Build an Aromatics Recovery Unit (ARU) capable of producing 15,000 barrels per day of mixed xylenes, a feedstock used to make clothing, film for medical x-rays, plastics, cleaners, and many other products we use every day.

- Install a new Marine Vapor Emission Control (MVEC) system that will reduce emissions of volatile organic compounds (VOCs). The MVEC System will control hydrocarbon emissions from marine vessels during loading operations.

- Expand the Naphtha Hydrotreater (NHT) to process 46,000 barrels of naphtha per day. This will allow Tesoro to further reduce the sulfur content in gasoline as required by the new federal Tier 3 regulations.

- Install a new Isomerization (Isom) unit to increase the amount of octane available to the refinery. Coupled with the NHT expansion project, this provides more flexibility for production of gasoline.

Construction on this project is expected to begin sometime in 2017, and the new units are expected to start operating sometime in 2018.

A PSD analysis for this project determined that it will have physical or operational changes that qualify as a major modification. Estimated project emissions are above the PSD significant emission rate (SER) thresholds both before and after considering significant net emission increases and/or decreases associated with this project for each of the following pollutants: particulate matter (PM) less than 10 microns (PM_{10}), PM less than 2.5 microns ($PM_{2.5}$), and greenhouse gases (CO_2e).

A full technical review of the project for these pollutants, including a Best Available Control Technology (BACT) analysis, and the project's effect on national ambient air quality standards (NAAQS), PSD increments, visibility, soils, and vegetation, is required and included in a Technical Support Document (TSD) prepared by the Washington State Department of Ecology (Ecology) on March 21, 2017.

The emissions of other air pollutants not subjected to PSD review are covered in the Northwest Clean Air Agency's (NWCAA) Notice of Construction (NOC) approval for this project.

APPROVAL CONDITIONS

Based on the PSD permit application submitted by Tesoro on April 12, 2016, along with supplemental information submitted in May 17, 2016, and the technical review performed by Ecology, Ecology finds that all requirements for issuance of this PSD permit have been satisfied. Ecology determined the application complete in May 17, 2016. Tesoro provided a consolidated application in June 2016. Approval of the project is granted subject to the following conditions:

I. EFFECTIVE DATE OF PERMIT

In accordance with 40 CFR §124.15 and §124.19, and the Washington Administrative Code (WAC) 173-400-730(2)(c), the effective date of this PSD permit is one of the following dates:

A. The date of issuance of this permit, or

B. A later date if specified on the signature page of this permit.

II. PERMIT EXPIRATION

Pursuant to 40 CFR §52.21(r)(2) and WAC 173-400-730(5), and unless an extension is granted by Ecology prior to expiration, Tesoro's authorization to construct under this PSD permit expires as follows:

A. This permit expires, and re-permitting will be required before any further construction activity may occur, if:

1. Construction of has not commenced (as defined in 40 CFR §52.21 (b)(9)) within eighteen (18) months of the effective date of this permit; or

2. Construction is discontinued for a period of eighteen (18) months or more; or

3. Construction is not completed within a reasonable time.

III. PERMIT NOTIFICATION REQUIREMENTS

A. Tesoro's requirements in this PSD permit to notify, report to, or acquire approval or agreement from "Ecology and/or the NWCAA" may be satisfied by providing such notification, reporting, or approval request to NWCAA if the conditions of this PSD permit have been incorporated into Tesoro's Title V Air Operating Permit issued pursuant to 40 CFR Part 70 and Chapter 173-401 WAC.

B. Tesoro must notify Ecology and NWCAA in writing or electronic mail of the date construction of the project is commenced, postmarked, or received no later than thirty (30) days after such date.

C. By December 31 of each year, Tesoro must submit to Ecology, in writing or electronic mail, an annual report containing a brief summary of the construction activities related to the project that occurred during the previous calendar year. This reporting obligation shall end when Tesoro submits a notification to Ecology, in writing or electronic mail, that all construction activities related to the project have been completed. This notification of completion shall contain a brief summary of any construction activities related to the project that has not been included in a prior annual report.

IV. EQUIPMENT RESTRICTIONS

This PSD permit authorizes the construction of the following new and modified equipment as listed in Table IV-1 and includes authorization for their related CPUP equipment and subcomponent parts. However, Tesoro may choose not to construct all of the listed equipment.

Table IV-1. New and Modified Equipment Associated with the CPUP

Equipment Description	New and/or Modified
Natural Gas-fired Steam boiler (F-6870)	New
Reformate Feedstock Tank 285	New
Mixed Xylenes Product Tank 286	New
Mixed Xylenes Product Tank 287	New
MVEC System	New
Fugitive Equipment at Isom Unit	New
Fugitive Equipment at ARU	New
Fugitive Equipment at ARU Tankage	New
Fugitive Equipment at CR/NHT	Modified
Fugitive Equipment at MVEC	New

V. EMISSION LIMITS

The following emission limits apply to this project. These limits include consideration of best available control technology (BACT) determinations described in Section VI.

A. PM_{10} (filterable and condensable combined)

1. PM_{10} (including filterable and condensable combined particulate) from boiler F-6870 must not exceed the following limits:

   a. Mass emission rate limit of 4.38 lb/hr on an hourly average (includes startup/shutdown emissions).

2. PM_{10} (including filterable and condensable combined particulate) from the MVEC system must not exceed the following limits:

   a. Mass emission rate limit of 0.89 lb/hr on an hourly average (includes startup/shutdown emissions).

B. $PM_{2.5}$ (filterable and condensable combined)

1. $PM_{2.5}$ (including filterable and condensable combined particulate) from boiler F-6870 must not exceed the following limits:

   a. Mass emission rate limit of 4.38 lb/hr on an hourly average (includes startup/shutdown emissions).

2. $PM_{2.5}$ (including filterable and condensable combined particulate) from the MVEC system must not exceed the following limits:

   a. Mass emission rate limit of 0.89 lb/hr on an hourly average (includes startup/shutdown emissions).

C. CO_2e

1. CO_2e from boiler F-6870 must not exceed the following limits:

   a. Heat input rate limit of 117 lb CO_2e/MMBtu.

   b. Mass emission limit of 299,524 tpy on a 12-month rolling average.

2. CO_2e from the MVEC system must not exceed the following limits:

   a. 29,439 tpy on a 12-month rolling average.

VI. BACT DETERMINATIONS

Consistent with 40 CFR §52.21(j)(3), which requires that BACT be applied to each PSD pollutant with significant net emissions increases, the BACT determinations of this section apply to this project. Facility emission units not listed in this section do not require a BACT analysis because they are not physically or operationally modified as a result of this project.

A. BACT for Boiler Unit F-6870

Table VI-1. BACT Determinations for Boiler Unit F-6870

Pollutant	BACT Determination Description
PM_{10} (filterable and condensable)	Good Combustion Practices and use of clean fuels (use of natural gas). These BACT determinations shall be demonstrated by compliance with the PM_{10} BACT limit of Section V.
$PM_{2.5}$ (filterable and condensable)	Good Combustion Practices and use of clean fuels (use of natural gas). These BACT determinations shall be demonstrated by compliance with the $PM_{2.5}$ BACT limit of Section V.
CO_2e	Utilizing low emitting processes and use of clean fuels (use of natural gas). These BACT determinations shall be demonstrated by compliance with the CO_2e BACT limit of Section V.

B. BACT for MVEC System

Table VI-2. BACT Determinations for the MVEC System

Pollutant	BACT Determination Description
PM_{10} (filterable and condensable)	Good Combustion Practices and use of clean fuels (use of natural gas). These BACT determinations shall be demonstrated by compliance with the PM_{10} BACT limit of Section V.
$PM_{2.5}$ (filterable and condensable)	Good Combustion Practices and use of clean fuels (use of natural gas). These BACT determinations shall be demonstrated by compliance with the $PM_{2.5}$ BACT limit of Section V.
CO_2e	Utilizing low emitting processes and use of clean fuels (use of natural gas). These BACT determinations shall be demonstrated by compliance with the CO_2e BACT limit of Section V.

C. BACT for Fugitive Components

Table VI-3. BACT Determinations for Fugitive Components (includes fugitive components in both VOC and natural gas service)	
Pollutant	**BACT Determination Description**
CO_2e	For the ARU Unit and ARU Tankage: Implementation of Leak Detection and Repair (LDAR) program consistent with 40 CFR 60 Subpart VVa and 40 CFR 63 Subpart H (including recordkeeping requirements contained within each regulation).
	For the CR/NHT, Isom unit, and MVEC: Implementation of Leak Detection and Repair (LDAR) program consistent with 40 CFR 60 Subpart GGGa and 40 CFR 63 Subpart CC (including recordkeeping requirements contained within each regulation).

VII. SPECIFIC OPERATING REQUIREMENTS

The following requirements are listed as statements of fact because they are relevant to this permit. Ecology is not making them enforceable as part of this permit because they are already enforceable independent of this permit.

A. Project units must comply with all applicable requirements of New Source Performance Standards (NSPS), 40 CFR Part 60.1-60.19 (Subpart A).

B. The new boiler (Unit F-6870) must comply with all applicable NSPS requirements of 40 CFR Part 60.40b-49b (Subpart Db).

C. The medium reformate feedstock storage tank (TK-285) and the new mixed xylenes product storage tanks (TK-286 and TK-287) must comply with all applicable NSPS requirements of 40 CFR Part 60.110b-60.117b (Subpart Kb).

D. The ARU must comply with all applicable NSPS requirements of 40 CFR Part 60.480a-489a (Subpart VVa).

E. The components in new Isom unit, the existing CR/NHT process unit, and the new MVEC must comply with all applicable NSPS requirements of 40 CFR Part 60.590a-593a (Subpart GGGa).

F. ARU vent streams must comply with all applicable NSPS requirements of 40 CFR Part 660-668 (Subpart NNN).

G. The ARU individual drain system (IDS), new Isom unit drains, and also new drains at the NHT and/or MVEC (if constructed) must comply with all applicable NSPS requirements of 40 CFR Part 690-699 (Subparts QQQ).

H. Project units must comply with all applicable requirements of National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 63 (Subpart A).

I. Project equipment waste streams and related control systems must comply with all applicable NESHAP requirements of 40 CFR Part 63 (Subpart FF).

J. ARU heat exchangers and maintenance wastewater must comply with all applicable NESHAP requirements of 40 CFR Part 61 (Subpart F).

K. ARU process wastewater and vents streams, the medium reformate feedstock storage tank (TK-285), and the new mixed xylenes product storage tanks (TK-286 and TK-287) must comply with all applicable NESHAP requirements of 40 CFR Part 63 (Subpart G).

L. The ARU must comply with all applicable NESHAP requirements of 40 CFR Part 63 (Subpart H).

M. New equipment in organic HAP service, heat exchange systems, and wastewater streams at the CR/NHT, Isom, and MVEC must comply with all applicable NESHAP requirements of 40 CFR Part 63 (Subpart CC).

N. The new boiler (Unit F-6870) must comply with all applicable NESHAP requirements of 40 CFR Part 63 (Subpart DDDDD).

VIII. COMPLIANCE MONITORING REQUIREMENTS

A. Tesoro must monitor compliance for particulate matter in Conditions V.A.1 and V.B.1 for the boiler as stated in subsections 1 and 2 below:

1. Tesoro must conduct source testing using EPA Method 5 or 201A (for filterable particulate matter) and Method 202 (for condensable particulate), or other method pre-approved by the NWCAA, in coordination with NWCAA. Tesoro must conduct an initial stack test no more than 180 days after startup. Thereafter, conduct testing at least once every 20 quarters. Prior to initial testing of the boiler, the operational rate must be preapproved by NWCAA.

2. Tesoro must use emissions factors, determined from source testing to demonstrate compliance with limits, calculated on an hourly-average basis.

B. Tesoro must monitor compliance for particulate matter in Conditions V.A.2 and V.B.2. for the MVEC system as stated in subsections 1 and 2:

1. Tesoro must conduct source testing using EPA Method 5 or 201A (for filterable particulate matter) and Method 202 (for condensable particulate), or other method pre-approved by the NWCAA, in coordination with NWCAA. Tesoro must conduct an initial stack test no more than 180 days after startup. Thereafter, conduct testing at least once every 20 quarters. Tesoro may

propose and use an alternate compliance requirement if approved in advance by NWCAA.

2. This Condition applies only if source testing is used to demonstrate compliance: Tesoro must use emissions factors, determined from source testing to demonstrate compliance with limits, calculated on an hourly-average basis.

C. Tesoro must monitor compliance for CO_2e in Conditions V.C with fuel tracking and 40 CFR Part 98 (Subpart C).

D. Tesoro must follow the recordkeeping requirements in WAC 173-400-720(4)(b)(iii)(D) to monitor compliance in circumstances where there is a reasonable possibility (as defined in WAC 173-400-720(4)(b)(iii)(D)) that a project that is not a part of a major modification may result in a significant emissions increase of such pollutant.

IX. RECORDKEEPING AND REPORTING REQUIREMENTS

A. Beginning the first calendar month of operation of the CPUP, Tesoro must keep the following records at the site (or electronically accessible at the site):

1. The calculations and results pursuant to Condition VIII (A through D).

2. The records from Condition IX.A.1 of this permit must be calculated for the immediate past twelve (12) months. For the purpose of this record, the immediate past twelve (12) moths shall not include any month prior to the month that the CPUP began operation.

B. Records must be retained for not less than five (5) years after their origination.

1. At a minimum, the most recent two (2) years of data must be retained onsite (or be electronically accessible at the site). The remaining three (3) years of data may be retained offsite.

2. Records must be available for inspection by Ecology and NWCAA within ten (10) days of request.

C. Beginning the first calendar year after completion of the project, Tesoro must annually report in writing or electronic mail, postmarked or received before January 31 for the previous calendar year, the following information to NWCAA.

1. The maximum value for the calendar year calculated pursuant to Condition VIII.A.2 and VIII.B.2.

D. Tesoro must keep records and submit reports with regard to Condition VIII.D as specified in WAC 173-400-720(4)(b)(iii)(D).

E. Tesoro must furnish Ecology and/or NWCAA, as specified in Condition III.A., a written report of the results of performance tests no later than 60 days after completion of the tests.

X. GENERAL RESTRICTIONS ON FACILITY OPERATIONS

A. At all times, Tesoro must, to the extent practicable, maintain and operate the equipment listed in Table IV-1 of this permit, including any associated air pollution control equipment, in a manner consistent with good air pollution control practices for minimizing emissions.

B. Determination of whether acceptable operating and maintenance procedures are being used for the equipment listed in Table IV-1 of this permit will be based on information available to Ecology, NWCAA, EPA and/or their authorized representatives, which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source.

XI. MALFUNCTION AND EXCESS EMISSIONS REPORTING

A. Prior to incorporation of the conditions of this PSD permit into Tesoro's Title V Air Operating Permit issued pursuant to 40 CFR Part 70 and Chapter 173-401 (WAC), Tesoro must report to Ecology and NWCAA, in writing or electronic mail, following the discovery of any malfunction of air pollution control equipment, process equipment, or of a process, which results in an increase in emissions above the allowable emission limits of this permit, in accordance with WAC 173-400-107 and the following conditions:

1. Tesoro must notify Ecology and NWCAA, in writing or electronic mail, postmarked or received no later than thirty (30) days after the end of the month in which a malfunction is discovered, for any malfunction of air pollution control equipment, process equipment, or of a process, which results in an increase in emissions above the allowable emission limits of this permit. This notification must include a description of the malfunctioning equipment, process equipment or process, the date and time of the initial malfunction (if known), the period of time over which emissions were increased due to the malfunction, the cause of the malfunction (if known), the estimated resultant excess emissions, and the methods utilized to mitigate emissions and restore normal operations.

2. For purposes of this permit, "malfunction" means any failure of air pollution control equipment, process equipment, or of a process to operate in a normal manner.

B. After the conditions of this PSD permit have been incorporated into Tesoro's Title V Air Operating Permit issued pursuant to 40 CFR Part 70 and Chapter 173-401 (WAC), Tesoro shall report to NWCAA the discovery of any malfunction of air pollution control equipment, process equipment, or of a process, which results in an increase in emissions above the allowable emission limits specified in this permit, pursuant to the deviation reporting requirements and, if applicable, pursuant to the unavoidable excess emissions reporting requirements of that Title V Air Operating Permit.

C. Compliance with the malfunction notification requirements, as applicable, will not excuse or otherwise constitute a defense to any violation of this PSD permit or any law or regulation such malfunction may cause.

XII. RIGHT OF ENTRY

Section 114 of the federal Clean Air Act, 42 U.S.C. §7414, and the Revised Code of Washington (RCW) 70.94.200, and WAC 173-400-105(3) provide authorized representatives of EPA, Ecology, and NWCAA certain rights to enter and inspect the source. Refusal by Tesoro to allow such entry and inspection may be a violation of the federal Clean Air Act and/or the RCW subject to penalty as provided in those statutes. Pursuant to these statutes, authorized representatives of EPA, Ecology, and NWCAA, upon the presentation of credentials:

A. Have a right of entry to, upon, or through any premises of Tesoro or any premises in which any records this permit requires Tesoro to maintain are located.

B. Have the right, at reasonable times, to access and copy any records this permit requires Tesoro to maintain.

C. Have the right, at reasonable times, to inspect any monitoring equipment or method required by this permit.

D. Have the right, at reasonable times, to sample any emissions that Tesoro is required to sample under this permit.

XIII. TRANSFER OF OWNERSHIP

A. In the event of any changes in control or ownership of facilities to be constructed, this PSD permit will be binding on all subsequent owners and operators. The applicant must notify the succeeding owner and operator of the existence of this

PSD permit and its conditions by letter, a copy of which must be forwarded to Ecology and/or NWCAA as specified in Condition III.A.

B. If the conditions of this PSD permit have been incorporated into Tesoro's Title V Air Operating Permit issued pursuant to 40 CFR Part 70 and Chapter 173-401 (WAC), then the provisions for amending that Title V Air Operating Permit to allow for a change in ownership or operational control shall apply in place of the notification provisions in Condition XIII.A.

XIV. ADHERENCE TO APPLICATION AND COMPLIANCE WITH OTHER ENVIRONMENTAL LAWS

A. Pursuant to 40 CFR §52.21(r)(1), Tesoro must install and operate the proposed emissions units in accordance with this PSD permit and the application on which this permit is based.

B. Pursuant to 40 CFR §52.21(r)(3), this PSD permit shall not relieve Tesoro of the responsibility to comply fully with applicable provisions of the State Implementation Plan and any other requirements under local, state, or federal law.

C. Any applicant who fails to submit any relevant facts or who has submitted materially incorrect relevant information in a permit application must, upon becoming aware of such failure, or incorrect submittal, promptly submit such supplementary facts or corrected information.

D. To the extent provided by 40 CFR §52.12(c), for the purpose of establishing whether or not Tesoro has violated or is in violation of any requirement of this permit, nothing in this permit shall preclude the use, including the exclusive use, of any credible evidence or information relevant to whether Tesoro would have been in compliance with applicable requirements if the appropriate performance or reference test or procedure had been performed.

XV. APPEAL PROCEDURES

This PSD permit, or any conditions contained in it, may be appealed to:

A. The Pollution Control Hearings Board (PCHB) as provided in Chapter 43.21B RCW and Chapter 371-08 WAC.

ACRONYMS AND ABBREVIATIONS

BACT	Best Available Control Technology
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2e	carbon dioxide equivalents
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
Gal	gallon(s)
GHG	greenhouse gases
H_2SO_4	sulfuric acid mist
lb	pound(s)
lb/hr	pound(s) per hour
MMBtu/hr	million British thermal units per hour
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_X	nitrogen oxides
NWCAA	Northwest Clean Air Agency
O_2	oxygen
PCHB	Pollution Control Hearings Board
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
ppm	parts per million
ppmv	parts per million by volume
ppmvd	parts per million by volume on a dry basis
PSD	Prevention of Significant Deterioration of Air Quality
RCW	Revised Code of Washington
tpy	tons per year
VOC	volatile organic compounds
WAC	Washington Administrative Code

DEPARTMENT OF
ECOLOGY
State of Washington

TECHNICAL SUPPORT DOCUMENT FOR: TESORO REFINING & MARKETING COMPANY LLC, ANACORTES REFINERY CLEAN PRODUCTS UPGRADE PROJECT

Prepared by

Air Quality Program
Washington Department of Ecology
Olympia, Washington

July 18, 2017

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 1
2. INTRODUCTION 1
   2.1. The Permitting Process 1
      2.1.1. The PSD process 1
      2.1.2. The NOC process 3
   2.2. Site and Project Description 3
      2.2.1. Site description 3
      2.2.2. Project description 3
3. PSD APPLICABILITY REVIEW 9
   3.1. Overview and Permitting History 9
   3.2. Significant Emissions Increases Calculation 10
      3.2.1. Actual-to-potential test for new project units 10
   3.3. Significant Net Emissions Increase Calculations 18
      3.3.1. Netting rules 18
4. BACT 20
   4.1. Definitions and Policy Concerning BACT 20
   4.2. BACT Analysis for CPUP 21
      4.2.1. Available control technologies 21
      4.2.2. BACT feasibility review 23
      4.2.3. PM_{10} and $PM_{2.5}$ BACT for new boiler 24
      4.2.4. GHG BACT for new boiler 25
      4.2.5. PM_{10} and $PM_{2.5}$ BACT for MVEC 26
      4.2.6. GHG BACT for MVEC 27
      4.2.7. GHG BACT for fugitive components 28
   4.3. Toxic Air Pollutants 29
5. AMBIENT AIR QUALITY IMPACTS ANALYSIS 29
   5.1. Regulatory Requirements 29
   5.2. Maximum Criteria Pollutant Concentrations Predicted by AERMOD 29
      5.2.1. Secondary $PM_{2.5}$ formation 30
   5.3. Ozone Impacts 31
      5.3.1. Ozone background information 31
   5.4. Impacts on Class I Areas 32
      5.4.1. AQRV background information 33

ED_013256A_00000456-00002

5.4.2. Tesoro AQRV analysis 33
6. ADDITIONAL IMPACTS ANALYSIS 35
6.1. Construction and Growth Impacts 35
6.2. Visibility 36
6.3. Soils and Vegetation Analysis 36
7. STATE ENVIRONMENTAL POLICY ACT 37
8. PUBLIC INVOLVEMENT 37
9. AGENCY CONTACT 38
REFERENCES 39
ACRONYMS AND ABBREVIATIONS 40
APPENDIX A. ECOLOGY'S RESPONSE TO COMMENTS 42

ED_013256A_00000456-00003

LIST OF FIGURES

Figure 1. High level process flow diagram of project (new processes, equipment, and flows shown in red) 5

LIST OF TABLES

Table 1. Summary of Emission Units Affected by the CPUP 4
Table 2. Emission Increases of Regulated NSR Pollutants for New Boiler (tpy) 11
Table 3. Emissions Increases of Regulated NSR Pollutants for New Tanks 285, 286, and 287 . 11
Table 4. Emissions Increases of Regulated NSR Pollutants for New MVEC System (tpy) 12
Table 5. Emissions Increases of Regulated NSR Pollutants for New Equipment at Isom Unit (tpy) 12
Table 6. Emissions Increases of Regulated NSR Pollutants for New Equipment at ARU and ARU Tankage (tpy) 12
Table 7. Emissions Increases of Regulated NSR Pollutants for ARU (tpy) 13
Table 8. Tesoro's Chosen Dates for Baseline Actual Emissions 14
Table 9. Emissions Increases of Regulated NSR Pollutants for Unit F-6600 (tpy) 14
Table 10. Emissions Increases of Regulated NSR Pollutants for Unit F-6601 (tpy) 14
Table 11. Emissions Increases of Regulated NSR Pollutants for Unit F-6602 (tpy) 15
Table 12. Emissions Increases of Regulated NSR Pollutants for Unit F-6650 (tpy) 15
Table 13. Emissions Increases of Regulated NSR Pollutants for Units F-6651, F-6652, ... 15
Table 14. Emissions Increases of Regulated NSR Pollutants for Unit F-6654 (tpy) 16
Table 15. Emissions Increases of Regulated NSR Pollutants for Unit F-6655 (tpy) 16
Table 16. Emissions Increases of Regulated NSR Pollutants for Existing Storage Tanks* (tpy) 17
Table 17. Total Estimated Project Emissions, Net Emissions, and SERs 18
Table 18. Netting Analysis Changes in Emissions (tpy) 19
Table 19. Total Estimated Project Net Emissions and SERs 20
Table 20. Technical Feasibility Assessment 23
Table 21. Ranking of Control Technologies for New Boiler (PM_{10}/$PM_{2.5}$ BACT) 25
Table 22. Ranking of Control Technologies for New Boiler (GHG BACT) 26
Table 23. Ranking of Control Technologies for MVEC (PM_{10}/$PM_{2.5}$ BACT) 26
Table 24. Ranking of Control Technologies for MVEC (GHG BACT) 27
Table 25. Ranking of Control Technologies for Fugitive Components (GHG BACT) 28
Table 26. Maximum Criteria Pollutant Concentrations Predicted by AERMOD 30
Table 27. Maximum Criteria Pollutant Concentrations Predicted by AERMOD 32
Table 28. Class I Areas within 200 KM of the Tesoro Facility 34

ED_013256A_00000456-00004

1. EXECUTIVE SUMMARY

Tesoro Refining & Marketing Company LLC operates a Refinery in Anacortes, Washington, referred to as the Anacortes Refinery. The Tesoro Anacortes Refinery (Tesoro) produces petroleum based products.

This Prevention of Significant Deterioration (PSD) project referred to as the Clean Products Upgrade Project (CPUP or project), will make the following changes to the refinery:

- Add equipment capable of producing a product used to make clothing, film for medical x-rays, plastics, cleaners, and many other products.
- Install a new Marine Vapor Emission Control (MVEC) System that will reduce emissions of volatile organic compound (VOC) air pollutants.
- Expand existing equipment that will allow Tesoro to further reduce the sulfur content in gasoline as required by new federal fuel regulations.
- Install new equipment to increase the amount of octane available to be used in fuels.

All of these modifications will meet air quality regulations as part of this PSD permit.

The Washington State Department of Ecology (Ecology) received the initial PSD application on August 10, 2015, and the application fee on August 13, 2015. Tesoro provided a revised application on April 21, 2016. Tesoro submitted supplemental material to Ecology on May 17, 2016, and Ecology determined Tesoro's application to be complete on May 17, 2016. Tesoro provided a consolidated application in June 2016. On January 10, 2017 Tesoro provided a clarification to the figure 1 flow diagram.

2. INTRODUCTION

2.1. The Permitting Process

2.1.1. The PSD process

PSD permitting requirements in Washington State are established in Title 40, Code of Federal Regulations (CFR) 52.21; Washington Administrative Code (WAC) 173-400-700 through 750. Washington State implements its PSD program as a State Implementation Plan (SIP)-approved program. This SIP-approved program became effective May 29, 2015.[1]

Federal and state rules require PSD review of all new or modified air pollution sources that meet certain criteria in an attainment or unclassifiable area with the NAAQS. The objective of the PSD program is to prevent significant adverse environmental impact from emissions into the atmosphere by a proposed new major source, or major modification to an existing major source. The program limits degradation of air quality to that which is not considered "significant."

[1] 80 FR 23721, April 29, 2015.

Under WAC 173-400-720 through 750, a project proposed at an existing major stationary source is subject to PSD review if the project either is a "major modification" to an existing "major stationary source," or is a major stationary source unto itself.

To be considered a major modification, the following three project aspects are considered: physical or operational changes resulting from the project, project emissions compared with significant emission rates (SER), and significant net emission increases (and/or decreases).

Unless a physical change or change in the method of operation of a major stationary source is exempted by applicable regulation 40 CFR 52.21(b)(2)(iii)(a through k), it is a major modification if the change results in both a significant emissions increase and a significant net emissions increase at the source. "Significant emissions increase" means that the emissions increase for any regulated PSD pollutant is greater than the PSD SER threshold for that regulated pollutant.

This project will have physical or operational change consistent with the definition of "major modification" in 40 CFR 52.21(b)(2)(i). In addition, estimated project emissions are above the PSD SER thresholds both before and after considering significant net emission increases and/or decreases associated with the project for each of the following pollutants: particulate matter (PM) less than 10 microns (PM_{10}), PM less than 2.5 microns ($PM_{2.5}$), and greenhouse gases (CO_{2e}).

PSD rules are designed to keep an area with "good" air in compliance with the NAAQS. The distinctive requirements of PSD are Best Available Control Technology (BACT), air quality analysis (allowable increments and comparison with the National Ambient Air Quality Standards (NAAQS)), and analysis of impacts of the project on visibility, vegetation, and soils.

PSD rules require the utilization of BACT for certain new or modified emission units, which is the most effective air pollution control equipment and procedures that are determined to be available after considering environmental, economic, and energy factors.

A full technical review of the project for these pollutants, including a (BACT) analysis, and the project's effect on NAAQS, PSD increments, visibility, soils and vegetation, is required and included in this Technical Support Document (TSD).

The emissions of other air pollutants not subjected to PSD review are covered in the Northwest Clean Air Agency's (NWCAA) Notice of Construction (NOC) approval for this project

A summary of project component descriptions is provided in Section 2.2.2., with a more detailed PSD review process description for this project provided in Section 3. BACT information for this project is included in Section 4. An ambient impact analysis is presented in Section 5 and an additional growth impact analysis is presented in Section 6. These sections form the basis of the permit approval conditions.

2.1.2. The NOC process

This project is subject to NOC permitting requirements under state of Washington regulations Chapters 173-400 and 173-460 (and/or local air regulations where applicable). NWCAA is the permitting authority for air pollutants not included in PSD permitting. This includes the New Source Review (NSR) permitting of criteria pollutants that are not PSD-applicable, air toxics issues under federal maximum achievable control technology (MACT) and state 173-460 WAC, and Title V permitting requirements. The procedure for issuing an NOC permit was established in Chapter 70.94 RCW.

WAC 173-400-110 outlines the NSR procedures for permitting criteria pollutants. These procedures are further refined in WAC 173-400-113 (requirements for new sources located in attainment or unclassifiable areas) and/or local air requirements where applicable. WAC 173-460-040 NSR supplements the requirements contained in Chapter 173-400 WAC (and/or local air requirements where applicable) by adding additional requirements for sources of toxic air pollutants (TAPs).

2.2. Site and Project Description

2.2.1. Site description

The Tesoro site facility is located in a Class II area that is designated as "attainment or unclassifiable" for the purpose of PSD permitting for all pollutants.

2.2.2. Project description

The proposed project will not increase the current footprint acreage of the site. The refinery produces petroleum based fuels.

The project will make the following changes to the refinery:

- Build an Aromatics Recovery Unit (ARU) capable of producing 15,000 barrels per day of mixed xylenes, a feedstock used to make clothing, film for medical x-rays, plastics, cleaners and many other products we use every day.
- Install a new MVEC System that will reduce emissions of VOCs. The MVEC System will control hydrocarbon emissions from marine vessels during loading operations.
- Expand the Naphtha Hydrotreater (NHT) to process 46,000 barrels of naphtha per day. This will allow Tesoro to further reduce the sulfur content in gasoline as required by the new federal Tier 3 regulations.
- Install a new Isomerization (Isom) unit to increase the amount of octane available to the refinery. Coupled with the NHT expansion project, this provides more flexibility for production of gasoline.

According to the application: "the affected non-modified process units are the Catalytic Reformer (CR) and Catalytically Cracked Gasoline Splitter (CGS), as well as specific [existing] storage tanks." A summary of all emission units affected by the project are listed in Table 1.

Table 1. Summary of Emission Units Affected by the CPUP

Equipment Unit	New/Existing Unit (Change in Utilization)
Natural gas-fired steam boiler (F-6870)	New
Reformate Feedstock Tank 285	New
Mixed Xylenes Product Tank 286	New
Mixed Xylenes Product Tank 287	New
MVEC System	New
Fugitive Equipment at Isom Unit	New
Fugitive Equipment at ARU	New
Fugitive Equipment at ARU Tankage	New
Fugitive Equipment at CR/NHT	New
Fugitive Equipment at MVEC	New
NHT Feed Heater (F-6600)	Existing unit (change in utilization)
NHT Stabilizer Column Reboiler (F-6601)	Existing unit (change in utilization)
CR Feed Heater (F-6650)	Existing unit (change in utilization)
CR Inter-reactor Heater 1 (F-6651)	Existing unit (change in utilization)
CR Inter-reactor Heater 2 (F-6652)	Existing unit (change in utilization)
CR Inter-reactor Heater 3 (F-6653)	Existing unit (change in utilization)
CR Column Heater (F-6654)	Existing unit (change in utilization)
CR Regeneration Heater (F-6655)	Existing unit (change in utilization)
RSC Reboiler (F-6602)	Existing unit (change in utilization)
Existing Storage Tank 13	Existing unit (change in utilization)
Existing Storage Tank 14	Existing unit (change in utilization)
Existing Storage Tank 17	Existing unit (change in utilization)
Existing Storage Tank 231	Existing unit (change in utilization)

The following figure from the application shows a high level process flow diagram of the CPUP. A more detailed description of the project major components is provided in the following subsections.

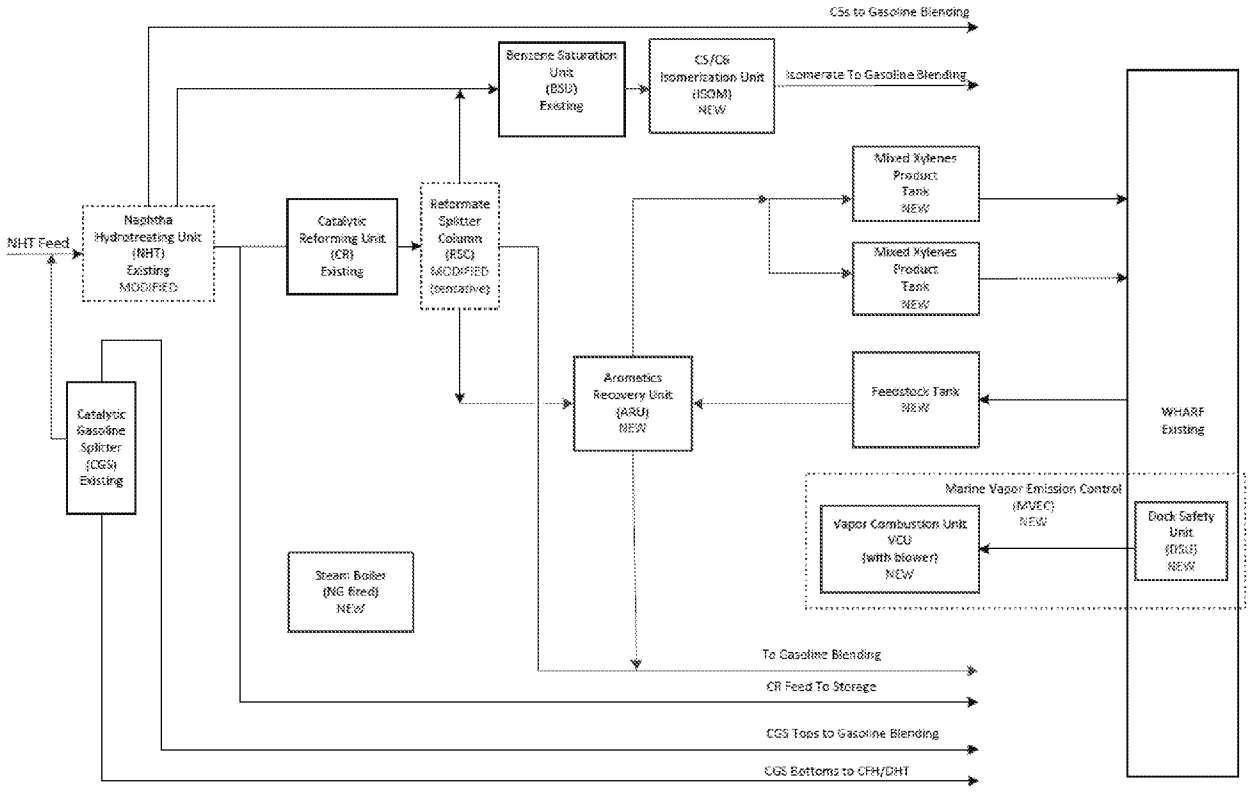


Figure 1. High level process flow diagram of project (new processes, equipment, and flows shown in red) (Source: Tesoro CPUP application, prepared by Barr Engineering Company, dated June 2016)

2.2.2.1. New aromatic recovery unit

The new aromatic recovery unit (ARU) will be located downstream of the existing catalytic reforming (CR) unit. The following excerpts from the Tesoro PSD application prepared by Barr Engineering Company (Barr) describe the ARU:

The ARU "will process heavy reformate from the CR, as well as a medium reformate that will be imported from external sources. The heavy reformate consists of several gasoline-range chemical compounds that includes mixed xylenes. The ARU will use both distillation and extractive distillation with Sulfolane solvent to produce a mixed xylenes product that meets commercial specification for petrochemical feedstock and will also produce a byproduct used for gasoline fuel blending. The proposed ARU will be designed to produce up to 15,000 barrels per day of the mixed xylenes product, which will be sold on the global petrochemical market primarily for polyester manufacturing.

"The imported medium reformate feedstock from external sources will be unloaded and the mixed xylenes product will be loaded using the existing refinery wharf system. The loading and

unloading operations will use existing piping. The medium reformate feedstock and mixed xylenes product will be stored in new storage tanks that will be constructed adjacent to the existing tankage area of the refinery. The new storage tanks consist of two mixed xylenes product storage tanks and one medium reformate feedstock storage tank. The new product storage tanks will have a gross volume of 193,000 barrels (TK-287) and 384,000 barrels (TK-286), respectively, and the feedstock tank (TK-285) will have a gross volume of 384,000 barrels. The new storage tanks will each be equipped with a floating roof with primary and secondary seals to control hydrocarbon emissions.

"A new, natural gas-fired steam boiler (F-6870) will be installed to provide the process steam needed for the Project. The new steam boiler will be equipped with a combination of low NOx burners and Selective Catalytic Reduction (SCR) to control NOx emissions and Catalytic Oxidation to control CO emissions. The distillation columns in the ARU will have miscellaneous process vents that will be routed to either the firebox of the new boiler or to the fuel gas system via the flare gas header. New emissions units associated with the ARU Unit will include F-6870, new storage tanks TK-285, TK-286, and TK-287, and new component equipment in VOC/TAP service."

2.2.2.2. MVEC system installation

The following excerpts from the Tesoro PSD application prepared by Barr describe the MVEC:

"Displaced vapors associated with new refinery loading activities of mixed xylenes product, in addition to vapors from existing gasoline-range materials and crude oil loading operations, will be routed to a new MVEC System to control hydrocarbons emissions, which are regulated as VOCs. The displaced marine vessel vapors will be collected by vapor hoses and routed to a Dock Safety Unit (DSU) that will be stationed on the wharf structure. The DSU is an essential piece of the overall MVEC System to ensure the safety for the ships, vessels and the overall MVEC System. Included in those safety requirements is a new 3" natural gas supply line to the DSU to supply enrichment gas for non-inerted vessels, supplied via an existing natural gas source from within the refinery. The vapors exiting the DSU will be routed through an existing line available on the wharf/causeway structure, to the new Vapor Combustion Unit (VCU) located in the refinery. Natural gas will also be added as support gas to assist combustion in the VCU during loading of inerted vessels.

"The MVEC installation will result in a significant decrease in VOC emissions from the existing marine loading operations. Combustion of the collected vapors and natural gas support/enrichment gases will result in emissions of other criteria pollutants. The Project will include modification and addition of equipment in VOC/TAP service."

2.2.2.3. Naphtha Hydrotreater (NHT) Expansion Project

The following excerpts from the Tesoro PSD application prepared by Barr describe the NHT: "Tesoro operates an existing naphtha hydrotreater that uses hydrogen and a fixed bed catalyst to remove contaminants, such as sulfur, from the naphtha that is produced from upstream processing units. In particular, the naphtha feed is mixed with hydrogen and is heated by a furnace (F-6600) and by heat exchange with the reactor effluent prior to entering the NHT reactor. The NHT reactor is filled with a catalyst that promotes several reactions in which the hydrogen and sulfur react to create hydrogen sulfide and nitrogen combines with hydrogen to form ammonia. The product streams from the NHT include process gas, light gasoline to gasoline blending, and feed to the downstream Benzene Saturation Unit (BSU) and Catalytic Reformer (CR).

"The purpose of the NHT expansion project is to meet Tier 3 gasoline sulfur standards. Because the NHT is a critical process unit for producing low sulfur gasoline, the most effective way to reduce the sulfur content of the gasoline is to hydrotreat more of the existing refinery Catalytic Cracking Unit (CCU) gasoline that is not currently hydrotreated by changing the operational cutpoints at the Catalytically Cracked Gasoline Splitter (CGS); the side-cut to the NHT will be increased and the top draw will be decreased. Therefore, Tesoro proposes to increase the processing capacity from 40,000 barrels per day to 46,000 barrels per day at the NHT by hydrotreating more of the existing CCU Gasoline. This capacity increase will be accomplished by replacing the existing hydrotreating reactor, replacement and addition of other equipment such as pumps, vessels, and heat exchangers, and modifications to distillation columns. The existing hydrotreating reactor will be replaced with a larger reactor allowing for higher catalyst volume, resulting in reduced catalyst degradation and therefore longer catalyst life. The additional treated product from the NHT will provide additional feed to the CR and BSU.

"The Project will include modification and addition of component equipment in VOC/HAP service. Process throughput rates are expected to increase at the NHT as a result of the Project. The affected emissions units at the NHT include the NHT feed heater (F-6600) and NHT Stabilizer column reboiler furnace (F-6601). Tesoro plans to improve the energy efficiency of the NHT to maintain firing rates at F-6600 and F-6601 near historical levels.... The new proposed steam boiler, will be designed to accommodate a small steam demand increase anticipated at the NHT."

2.2.2.4. New isomerization process unit

The following excerpts from the Tesoro PSD application prepared by Barr describe the new Isom:

"Tesoro proposes to install a C5/C6 Isomerization (Isom) Unit that will be integrated as part of the Benzene Saturation Unit (BSU), located adjacent to the existing BSU equipment. The BSU processes light naphtha from the overhead of the NHT's dehexanizer column and light benzene-rich reformate from the overhead of the CR's Reformate Splitter Column to catalytically hydrogenate the benzene into cyclohexane. The liquid product from the BSU reactor will feed

the Isom Unit. Perchloroethylene, a chemical already used within the refinery, will be stored in a new tank within the Isom Unit and injected into the process to promote the reaction to produce isomerate. Isomerate is a low sulfur, low benzene, relatively high octane gasoline blending component that will allow the refinery to economically meet the new Tier 3 clean fuel standards.

"Emissions changes from the Isom Unit will be a result of increased steam usage needed to operate the unit, and additional component equipment (e.g. pumps, valves, flanges, etc.). Configuration changes are required to integrate the existing BSU with the Isom Unit, which includes but is not limited to re-aligning the existing stabilization column to the end of the Isom Unit.... The new proposed steam boiler.... will be designed to accommodate the anticipated steam demand increase from the Isom Unit."

2.2.2.5. Reformate splitter column

The existing reformate splitter column (RSC) will be affected by the CPU project. The following excerpts from the Tesoro PSD application prepared by Barr describe the affected RSC unit:

"The reformate product from the CR is currently split in the RSC into heavy reformate and light reformate streams. Tesoro proposes to install a new side-draw stream to extract the range of hydrocarbons referred to as the C7 stream (hydrocarbons with seven carbon molecules). The C7 stream will then be blended directly into gasoline product. The change will include modification and addition of component equipment in VOC/HAP service. While process throughput rates are not expected to increase at the RSC, an increase in the utilization rate will increase at the affected emission unit, the RSC Reboiler (F-6602)."

2.2.2.6. Catalytic reformer

The existing catalytic reformer (CR) will be affected by the CPU project. The following excerpts from the Tesoro PSD application prepared by Barr describe the affected CR unit:

"The catalytic reforming unit uses fixed-bed catalytic reactors to increase the octane rating of its gasoline range feed. The reformate product is currently split in the Reformate Splitter Column (RSC) into heavy reformate and light reformate streams. The light reformate is fed to the BSU, while the heavy reformate is currently sent to gasoline component storage for use in gasoline fuel blending. The heavy reformate will become the feed to the ARU as a result of this [CPU] Project and a new C7 side-cut will be directed to gasoline fuel blending. The Project does not involve any physical changes or changes in the processing capacity of the CR. However, increased rates at the NHT are expected to result in an increased utilization of the CR. The affected emission units are the CR process heaters (F-6650, F-6651, F-6652, F-6653, F-6654, and F-6655)."

2.2.2.7. Catalytically cracked gasoline splitter

The existing catalytically cracked gasoline splitter (CGS) will be affected by the CPU project. The following excerpts from the Tesoro PSD application prepared by Barr describe the affected CGS unit:

"The CGS separates the CCU Gasoline into light, middle and heavy fractions. The light fraction is treated with caustic and directed to storage or gasoline blending; the middle fraction is fed to the NHT; and the heavy fraction is fed to the Clean Fuels Hydrotreater (CFH)… Tesoro proposes to decrease the production rate of the light fraction and increase the production rate of the middle fraction. As a result of reducing the overall top draw (light fraction), Tesoro expects that the CGS Column Reboiler (F-104) will require less firing; therefore, no emissions increase is expected at the CGS, and F-104 is not an affected emissions unit."

2.2.2.8. Existing storage tanks

Existing storage tanks 13, 14, 17, and 231 are used to store feedstocks, intermediates, and products at the refinery. Tesoro has determined that material vapor pressure and/or throughput may increase at Tanks 13, 4, 17, and 231 as a result of the Project. These tanks are considered non-modified affected emission units.

3. PSD APPLICABILITY REVIEW

3.1. Overview and Permitting History

As noted in Section 2.2.1, the proposed project will require a PSD permit because both the project's emissions increase and the net contemporaneous emissions increase caused by the project exceed PSD SERs for NSR pollutants, including greenhouse gases (GHGs). This section describes how the PSD applicability determination was performed.

The proposed project at Tesoro requires PSD review. In accordance with the requirements of 40 CFR 52.21(a)(2), these emission increases associated with the new and existing units is based on their potential to emit (PTE) or projected actual emissions and baseline actual emissions (BAE).

After determining in Section 2.1.1. that there are no physical and operational changes of this project exempted by 40 CFR 52.21(b)(2)(iii)(a through k), (Step 1), the significant emissions increase analysis looks only at the emissions from the proposed project and is referred to here as Step 2. The significant net emissions increase analysis looks at additional increases and decreases from "contemporaneous" projects at the source and is referred to here as Step 3.

For the significant emissions increase analysis, the review involves both new emissions units and modification of existing units. The PSD regulations require use of the hybrid test for projects that involve both the addition of new emissions units and the modification of existing emissions units (40 CFR 52.21(a)(2)(iv)(f)). Under the hybrid test, a significant emissions increase of a regulated NSR pollutant is projected to occur if the sum of the emissions increases for each

emissions unit, using the actual-to-projected-actual applicability test (40 CFR 52.21(a)(2)(iv)(c) for modified units and the actual-to-potential applicability test (40 CFR 52.21(a)(2)(iv)(d)) for new units, equals or exceeds the significance threshold for that pollutant as defined in paragraph 40 CFR 52.21(b)(23).

The actual-to-projected-actual applicability test involves adding the projected actual emissions from existing emissions units that are modified as part of the project or that are otherwise expected to experience an emission increase as a result of the project, and then subtracting the past actual emissions (called the "baseline actual emissions") from those units.

In lieu of projecting future actual emissions for a particular existing emissions unit, an applicant can choose instead to use the unit's PTE as the unit's post project emissions (40 CFR 52.21(b)(41)(ii)(d)). The actual-to-potential test, which is required for all new units being constructed as part of the project, involves totaling the potential emissions of the proposed new emissions units, then subtracting baseline actual emissions of those units. A new unit that is being constructed as part of the project has a baseline actual emission rate of zero (40 CFR 52.21(b)(48)(iii)).

If the project would result in a significant emissions increase, then a significant net emissions increase analysis is often conducted. However, EPA has clearly stated that calculating a net emissions increase is at the source's option (see, for example, 67, Federal Register 80186, at 80197 [December 31, 2002]). Therefore, a source may seek a PSD permit based on a calculated significant emission increase alone. For the CPUP, which is an existing major source for PSD, Tesoro found that emissions for three (4) regulated NSR pollutants were considered to have significant emissions increases. Tesoro also performed a netting analysis for VOC, which netting out of PSD, (see sections 3.3.1 and 3.3.2). As a results of the netting analysis, only three pollutants had significant net emissions increases.

The CPUP, therefore, triggers PSD review for the three regulated NSR pollutants.

3.2. Significant Emissions Increases Calculation

The project will involve both modifying existing emission units and constructing new emission units. Therefore, the hybrid test, described in the previous section, is required. Test results for both new and modified units are presented in this section followed by a summary hybrid test table.

3.2.1. Actual-to-potential test for new project units

For new units, Tesoro calculated potential emissions for the new units and assumed baseline actual emissions are zero.

3.2.1.1. Actual-to-potential test for new boiler (F-6870)

The calculations for new boiler emissions were based the BACT limit emission rates listed in Section 4.2, and the following parameters:

- Maximum heat input (vendor): 584 MMBtu/hr
  (calculated): 572.55 Mscf/hr; 5,115,840 MMBtu/yr; 5,015,529 Mscf/yr
- Hours of operation: 8760 hr/yr
- Average NG heat content: 1020 BTU/scf
- Exhaust gas volume flow 143,186 acfm

The results of the new boiler emission calculations are listed in Table 2.

Table 2. Emission Increases of Regulated NSR Pollutants for New Boiler (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
PTE	18.9	27.9	19.2	19.2	19.2	6.4	(a)	14.1	299,524	(a)	(a)

(a) Zero, negligible, or not applicable.

3.2.1.2. Actual-to-potential test for new feedstock and product tanks

The calculations for new feedstock Tank 285 and mixed xylenes product Tanks 286 and 287 emissions were based on the highest estimated potential VOC emissions, which results from assuming gasoline stored in the tanks. The VOC emissions from the new storage tank were calculated with TankESP software.

The results of the new tank emission calculations are listed in Table 3.

Table 3. Emissions Increases of Regulated NSR Pollutants for New Tanks 285, 286, and 287

Emission Unit	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
Feedstock tank 285	*	*	*	*	*	*	*	14.6	*	*	*
Mixed xylenes product tank 286	*	*	*	*	*	*	*	13.8	*	*	*
Mixed xylenes product tank 287	*	*	*	*	*	*	*	7.2	*	*	*

* Zero, negligible, or not applicable.

3.2.1.3. Actual-to-potential test for new MVEC system

The calculations for MVEC system were based on the BACT limit emission rates listed in Section 4.2, and the following parameters:

- Gas usage rate (vendor): 120 MMBtu/hr
  (calculated): 339,276 MMBtu/yr; 117,647 scfh; 332, 623,716 scf/yr
- Hours of operation: 8760 hr/yr
- Average NG heat content: 1020 BTU/scf
- Exhaust gas volume flow: 39,141 acfm

The potential emissions for new marine vapor emission control (MVEC) system including fugitives are listed in Table 4.

Table 4. Emissions Increases of Regulated NSR Pollutants for New MVEC System (tpy)

Emission Unit	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
MVEC	14.0	3.1	1.3	1.3	1.3	32.6	*	15.4	29,439	*	*
MVEC fugitives	*	*	*	*	*	*	*	1.1	28	*	*

* Zero, negligible, or not applicable.

3.2.1.4. Actual-to-potential test for new fugitive equipment at Isom unit

The potential emissions for new fugitive equipment at Isom unit are listed in Table 5.

Table 5. Emissions Increases of Regulated NSR Pollutants for New Equipment at Isom Unit (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
PTE	*	*	*	*	*	*	*	9.2	230	*	*

* Zero, negligible, or not applicable.

3.2.1.5. Actual-to-potential test for new fugitive equipment at ARU and ARU tankage

The potential emissions for new fugitive equipment at ARU and ARU Tankage are listed in Table 6.

Table 6. Emissions Increases of Regulated NSR Pollutants for New Equipment at ARU and ARU Tankage (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
ARU	*	*	*	*	*	*	*	1.4	36	*	*
ARU tankage	*	*	*	*	*	*	*	0.2	4	*	*

* Zero, negligible, or not applicable.

3.2.1.6. Actual-to-potential test for new fugitive equipment at CR/NHT

The potential emissions for the new fugitive equipment at CR and NHT are listed in Table 7.

Table 7. Emissions Increases of Regulated NSR Pollutants for ARU (tpy)											
Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
PTE	*	*	*	*	*	*	*	5.5	137	*	*
* Zero, negligible, or not applicable.											

3.2.2. Actual-to-projected-actual applicability test for modified, debottlenecked, or other affected emissions units

Debottlenecking is the term used for situations when emission units upstream or downstream from the unit(s) undergoing a physical change or change in the method of operation will experience an emission increase as result of the project.

Other affected emissions units could experience increased utilization due to the project. Tesoro has determined that certain emission units upstream or downstream from the unit(s) undergoing a physical change or change in the method of operation will experience increased utilization as result of the project. Additional emissions from units with increased utilization are calculated using an actual-to-projected-actual applicability test.

As described in Section 3.1, the actual-to-projected-actual applicability test involves adding the projected actual emissions from existing emissions that are expected to experience an emission increase as a result of the project, and then subtracting the past actual emissions (called the "baseline actual emissions") from those units.

When calculating projected actual emissions, 40 CFR 52.21(b)(41)(ii)(c) requires that Tesoro: "Shall exclude, in calculating any increase in emissions that results from the particular project, that portion of the unit's emissions following the project that an existing unit could have accommodated during the consecutive 24-month period used to establish the baseline actual emissions under paragraph (b)(48) of this section and that are also unrelated to the particular project, including any increased utilization due to product demand growth…" These emissions are referred to in this TSD as "Excludables."

For existing emission units that are being modified, debottlenecked, or other affected units experiencing increased utilization as part of the project, the PSD baseline actual emissions are emissions averaged over a 24 consecutive month period. According to 40 CFR 52.21(b)(48)(ii), the 24 month period must occur "within the 10-year period immediately preceding either the date the owner or operator begins actual construction of the project, or the date a complete permit application is received."

For a regulated NSR pollutant, when a project involves more than one emission unit, only one 24 consecutive month period may be used to determine the baseline actual emissions for all

emission units being changed. However, a different 24 consecutive month period can be used for each regulated NSR pollutant (40 CFR 52.21(b)(48)(ii)(d)).

For baseline emissions, Tesoro chose the following 24-month periods for the pollutant:

Table 8. Tesoro's Chosen Dates for Baseline Actual Emissions	
24-month Period	**Pollutant(s)**
January 2013–December 2014	VOC
June 2006–May 2008	NO_X, CO, PM, PM_{10}, $PM_{2.5}$, CO_2e
March 2008–February 2010	SO_2, H_2SO_4

Ecology performed a thorough review of Tesoro's chosen BAE dates for comparison to Ecology emission inventory data. Ecology found only minor discrepancies which were for PM emissions for Unit F-6655. These were the result of roundoff error and do not affect the emission calculations or conclusions of this TSD.

3.2.2.1. NHT feed heater (Unit F-6600) actual-to-projected-actual applicability test

Table 9 presents Tesoro's estimated emissions for Unit F-6600.

Table 9. Emissions Increases of Regulated NSR Pollutants for Unit F-6600 (tpy)											
Emissions	**CO**	**NO_X**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**H_2SO_4**	**VOC**	**CO_2e**	**H_2S**	**Pb**
BAE	17.0	20.2	1.5	1.5	1.5	3.2	0.0	0.8	22,435	*	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	624	*	*
Projected emissions	17.0	20.2	1.5	1.5	1.5	2.2	0.0	1.1	23,058	*	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	*	*
* Zero, negligible, or not applicable.											

3.2.2.2. NHT stabilizer column reboiler (Unit F-6601) actual-to-projected-actual applicability test

Table 10 presents Tesoro's estimated emissions for NHT Stabilizer Column Reboiler Unit F-6601.

Table 10. Emissions Increases of Regulated NSR Pollutants for Unit F-6601 (tpy)											
Emissions	**CO**	**NO_X**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**H_2SO_4**	**VOC**	**CO_2e**	**H_2S**	**Pb**
BAE	15.7	18.7	1.4	1.4	1.4	2.9	0.0	0.9	20,728	*	*
Excludables	3.4	4.1	0.3	0.3	0.3	0.0	0.0	0.2	5,311	*	*
Projected emissions	19.1	22.8	1.7	1.7	1.7	2.5	0.0	1.3	26,039	*	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	*	*
* Zero, negligible, or not applicable.											

3.2.2.3. Reformate splitter column reboiler (Unit F-6602) actual-to-projected-actual applicability test

Table 11 presents Tesoro's estimated emissions for reformate splitter column (RSC) Reboiler Unit F-6602.

Table 11. Emissions Increases of Regulated NSR Pollutants for Unit F-6602 (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	*	*
Excludables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	*	*
Projected emissions	0.1	5.7	1.2	1.2	1.2	0.1	0.0	0.9	18,245	*	*
Change in emissions	0.1	5.7	1.2	1.2	1.2	0.1	0.0	0.2	18,245	*	*

* Zero, negligible, or not applicable.

3.2.2.4. CR feed heater (Unit F-6650) actual-to-projected-actual applicability test

Table 12 presents Tesoro's estimated emissions for CR Feed Heater Unit F-6650.

Table 12. Emissions Increases of Regulated NSR Pollutants for Unit F-6650 (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	2.5	41.6	3.8	3.8	3.8	6.4	0.1	2.2	56,023	*	*
Excludables	9.1	30.4	0.8	0.8	0.8	0.3	0.0	1.1	14,133	*	*
Projected emissions	51.6	171.9	4.7	4.7	4.7	6.6	0.1	3.4	70,156	*	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	*	*

* Zero, negligible, or not applicable.

3.2.2.5. CR inter reactor heaters 1, 2, and 3 (Units F-6651, F-6652, and F-6653) actual-to-projected-actual applicability test

Table 13 presents Tesoro's estimated emissions for CR Inter Reactor Heaters 1, 2, and 3 (Units F-6651, F-6652, F-6653, respectively).

Table 13. Emissions Increases of Regulated NSR Pollutants for Units F-6651, F-6652, and F-6653 (tpy)

Emission Unit	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
F-6651											
BAE	35.1	116.8	3.2	3.2	3.2	5.4	0.1	1.8	46,237	*	*
Excludables	2.6	8.8	0.2	0.2	0.2	0.0	0.0	0.7	5,013	*	*
Projected emissions	37.7	125.6	3.4	3.4	3.4	4.8	0.1	2.5	51,250	*	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*	*
F-6652											

Table 13. Emissions Increases of Regulated NSR Pollutants for Units F-6651, F-6652, and F-6653 (tpy)											
Emission Unit	**CO**	**NO_X**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**H_2SO_4**	**VOC**	**CO_2e**	**H_2S**	**Pb**
BAE	19.1	22.7	1.7	1.7	1.7	2.8	0.0	1.0	25,158	*	*
Excludables	4.9	4.9	0.4	0.4	0.4	0.0	0.0	0.3	6,368	*	*
Projected emissions	23.2	27.6	2.1	2.1	2.1	3.0	0.0	1.5	31,526	*	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	*	*
F-6653											
BAE	10.9	12.9	1.0	1.0	1.0	1.9	0.0	0.6	14,335	*	*
Excludables	1.1	1.3	0.1	0.1	0.1	0.0	0.0	0.2	1,936	*	*
Projected emissions	12.0	14.2	1.1	1.1	1.1	1.5	0.0	0.8	16,271	*	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*	*
* Zero, negligible, or not applicable.											

3.2.2.6. CR column heater (Unit F-6654) actual-to-projected-actual applicability test

Table 14 presents Tesoro's estimated emissions for CR Column Heater Unit F-6654.

Table 14. Emissions Increases of Regulated NSR Pollutants for Unit F-6654 (tpy)											
Emissions	**CO**	**NO_X**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**H_2SO_4**	**VOC**	**CO_2e**	**H_2S**	**Pb**
BAE	10.3	12.2	0.9	0.9	0.9	1.5	0.0	0.5	13,523	*	*
Excludables	1.3	1.5	0.1	0.1	0.1	0.0	0.0	0.1	2,177	*	*
Projected emissions	11.5	13.7	1.0	1.0	1.0	1.5	0.0	0.8	15,699	*	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	*	*
* Zero, negligible, or not applicable.											

3.2.2.7. CR regeneration heater (Unit F-6655) actual-to-projected-actual applicability test

Table 15 presents Tesoro's estimated emissions for CR Regeneration Heater Unit F-6655.

Table 15. Emissions Increases of Regulated NSR Pollutants for Unit F-6655 (tpy)											
Emissions	**CO**	**NO_X**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**H_2SO_4**	**VOC**	**CO_2e**	**H_2S**	**Pb**
BAE	2.3	2.7	0.2	0.2	0.2	0.4	0.0	0.1	3,044	*	*
Excludables	0.5	0.6	0.0	0.0	0.0	0.0	0.0	0.1	826	*	*
Projected emissions	2.8	3.4	0.3	0.3	0.3	0.4	0.0	0.2	3,870	*	*
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*	*
* Zero, negligible, or not applicable.											

3.2.2.8. Existing storage tanks actual-to-projected-actual applicability test

Table 16 presents Tesoro's estimated emissions for the existing storage tanks.

Table 16. Emissions Increases of Regulated NSR Pollutants for Existing Storage Tanks* (tpy)

Emissions	CO	NO_X	PM	PM_{10}	$PM_{2.5}$	SO_2	H_2SO_4	VOC	CO_2e	H_2S	Pb
BAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	0.0	†	†
Projected emissions‡	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.8	0.0	†	†
Change in emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	0.0	†	†

* Existing storage tanks include: Tanks 13, 14, 17, and 231. Emissions were calculated by Tesoro using TanksESP.
† Zero, negligible, or not applicable.
‡ For existing tanks, the projected actual emissions are listed as provided in Tesoro's application.

3.2.3. Hybrid test - significant emissions increase analysis summary

The total emission increases relating to the project is the sum of the increases from the existing units (projected actual minus baseline actual emissions) and the PTE from the proposed newly constructed units and is presented in Table 17. The federal rule defines a SER to be equal to or exceeding any of the SERs listed in Table 17 (40 CFR 52.21(b)(23)).

In addition to regulated NSR pollutants, GHGs are subject to regulation as of January 2, 2011. EPA's PSD rule under 40 CFR 52.21(b)(49)(iv) states that "beginning January 2, 2011, the pollutant GHGs is subject to regulation if:

(a) The stationary source is a new major stationary source for a regulated NSR pollutant that is not GHGs, and also will emit or will have the potential to emit 75,000 tpy CO_{2e} or more; or

(b) The stationary source is an existing major stationary source for a regulated NSR pollutant that is not GHGs, and also will have an emissions increase of a regulated NSR pollutant, and an emissions increase of 75,000 tpy CO_2e or more."

Tesoro is an existing major stationary source for at least one regulated NSR pollutant that is not GHGs. Based on Table 17, the proposed project is expected to result in a significant increase of three (3) other NSR regulated pollutants. Therefore, because the project will result in an emissions increase of 75,000 tpy of CO_2e, the GHG emissions from the project are also subject to PSD review and are included in Table 17.

Table 17. Total Estimated Project Emissions, Net Emissions, and SERs			
Pollutant	**Project Estimated Emissions**	**SER (tpy)**	**Emissions Greater than SERs (Yes/No)**
NO_X	36.7	40	No
CO	33.0	100	No
SO_2	39.3	40	No
PM	21.6	25	No
PM_{10}	21.6	15	Yes
$PM_{2.5}$	21.6	10	Yes
VOCs	101.9	40	Yes
Lead (Pb)	Negligible	0.6	No
Sulfuric acid (H_2SO_4)	0.1	7	No
Hydrogen Sulfide (H_2S)	Negligible	10	No
CO_2e (GHGs)	353,093	75,000	Yes
Fluorides	Negligible	3	No
Total reduced sulfur (TRS)	Negligible	10	No
Reduced sulfur compounds	Negligible	10	No
Municipal waste combustor/ landfill emissions	*	†	No
* The project does not involve municipal waste. † See 40 CFR 52.21(b)(23).			

Based on Table 17, four (4) pollutants have significant emission increases.

3.3. Significant Net Emissions Increase Calculations

The steps necessary to calculate the net emission increase are outlined in 40 CFR 52.21(b)(3)(i). When a netting analysis is performed, only the pollutants that have significant emission increases need to go through the analysis.

3.3.1. Netting rules

According to 40 CFR 52.21(b)(3)(i), a net emissions increase means, with respect to any regulated NSR pollutant emitted by a major stationary source, the amount by which the sum of the following exceeds zero: the increase in emissions from a particular physical change or change in the method of operation at a stationary source; and any other increases and decreases in actual emissions at the major stationary source that are contemporaneous with the particular change and are otherwise creditable.

An increase or decrease in actual emissions is contemporaneous with the increase from the particular change only if it occurs between the date five years before construction on the particular change commences; and the date that the increase from the particular change occurs.

An increase or decrease in actual emissions is creditable only if: the reviewing authority has not relied on it in issuing a permit, which is in effect when the increase in actual emissions from the particular change occurs; and the increase or decrease in emissions did not occur at a Clean Unit (with some exceptions). It also includes increase or decrease in fugitive emissions (to the extent quantifiable), for an emissions unit that is part of one of the major source categories.

An increase or decrease in actual emissions of sulfur dioxide (SO_2), PM, or NO_X that occurs before the applicable minor source baseline date is creditable only if it is required to be considered in calculating the amount of maximum allowable increases remaining available.

An increase in actual emissions is creditable only to the extent that the new level of actual emissions exceeds the old level.

A decrease in actual emissions is creditable only to the extent that the old level of actual emissions or the old level of allowable emissions, whichever is lower, exceeds the new level of actual emissions. It must also be enforceable as a practical matter at and after the time that actual construction on the particular change begins. It must also have approximately the same qualitative significance for public health and welfare as that attributed to the increase from the particular change.

An increase that results from a physical change at a source occurs when the emissions unit on which construction occurred becomes operational and begins to emit a particular pollutant. Any replacement unit that requires shakedown becomes operational only after a reasonable shakedown period, not to exceed 180 days.

3.3.2. Netting analysis

For the Tesoro CPUP, construction is expected to occur in early 2017 and be completed in 2018. Therefore, the contemporaneous period for the CPUP extends from early 2012 through the time in 2018 when the change in project emissions occurs. Table 18 presents the Tesoro's estimated netting analysis changes in emissions, with specific project notes from the application included for each applicable project.

Table 18. Netting Analysis Changes in Emissions (tpy)

Project	Project Start Date	PM_{10}	$PM_{2.5}$	VOC	CO_2e
Rail Unloading Project	September 2012	*	*	0.6	*
Product Loading Rack Project	October 2015	*	*	13.0	*
Flare Gas Recovery Project	October 2015	*	*	1.3	*

Table 18. Netting Analysis Changes in Emissions (tpy)					
Project	**Project Start Date**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO_2e**
Heater F-101 Burner Replacement Project	May 2015	*	*	0.0	*
Heater F-103 Burner Replacement Project	May 2015	*	*	0.0	*
CCU Feed Import Project	~June 2016	*	*	2.8	*
Marine Vapor Recovery (control existing vapors)	~2017	*	*	-472.9	*
Net Emission Changes	*	*	*	-455.1	*
* Zero, negligible, or not applicable. A netting analysis was not performed for PM10, PM2.5, and CO2e.					

3.3.3. Significant net emissions increase analysis summary

Estimated project net emissions and SERs for each of these pollutant are shown in Table 19.

Table 19. Total Estimated Project Net Emissions and SERs			
Pollutant	**Net Emissions (tpy)***	**SER (tpy)**	**Net Emissions Greater than SERs (Yes/No)**
PM_{10}	21.6	15	Yes
$PM_{2.5}$	21.6	10	Yes
VOCs	-353.3	40	No
CO_2e (GHGs)	347,644	75,000	Yes
* Secondary emissions are not included for PSD applicability, but modeling impacts do include sedondary emissions. See Section 5.			

After netting, Tesoro's CPUP triggers PSD for the three (3) pollutants listed in Table 19.

4. BACT

4.1. Definitions and Policy Concerning BACT

All new major sources or major modifications are required to utilize BACT for those new and modified emission units that will experience an increase in emissions as a result of the project. BACT is defined as an emissions limitation based on the maximum degree of reduction for each pollutant subject to regulation, emitted from any proposed major stationary source or major modification, on a case-by-case basis, taking into account cost-effectiveness, economic, energy, environmental, and other impacts (40 CFR §52.21(b)(12)).

Federal guidance requires each PSD permit applicant to implement a "top-down" BACT analysis process for each new or physically or operationally changed emissions unit. Ecology has adopted the top-down BACT process for its BACT determinations. This top-down BACT analysis process consists of five basic steps described below:[2]

Step 1. Identify all available control technologies with practical potential for application to the specific emission unit for the regulated pollutant under evaluation.

Step 2. Eliminate all technically infeasible control technologies.

Step 3. Rank remaining control technologies by control effectiveness and tabulate a control hierarchy.

Step 4. Evaluate most effective controls and document results.

Step 5. Select BACT, which will be the most effective practical option not rejected, based on economic, environmental, and/or energy impacts.

If the applicant proposes to implement the most effective or "top" available control strategy, Step 4 is not necessary.

As shown above, the "top-down" BACT process starts by considering all available emission control technologies, and ranks them for further evaluation from most effective to least effective technically available control technology. The most effective emission reduction technology is then evaluated for economic feasibility. If the technology is proven infeasible based on economics, energy, or other environmental considerations, then the next most stringent level of reduction is considered. The most stringent level of emissions control that is not determined to be technically and economically infeasible is selected as BACT. While the permitting agency makes the final BACT decision, the burden is on the applicant to prove why the most stringent level of control should not be used.

Tesoro provided a 5-step top-down BACT analysis for the project, which was fully evaluated by Ecology and presented in the following subsections.

4.2. BACT Analysis for CPUP

This section presents a BACT analysis for the applicable emission units and their pollutants for CPUP.

4.2.1. Available control technologies

The EPA RACT/BACT/LAER Clearinghouse (RBLC), recent petroleum refinery BACT determinations, and other emission reduction information sources were reviewed to provide the following list of available control options. While these options have been identified as available,

[2] See EPA's *Draft New Source Review Workshop Manual*, 1990; and PSD and Title V Permitting Guidance for Greenhouse Gases <http://www.epa.gov/nsr/ghgdocs/ghgpermittingguidance.pdf>.

they are not necessarily feasible (technically, economically, or otherwise). Some technologies such as selective catalytic reduction (SCR), are not included because they focus on pollutants (NO_X) which do not trigger PSD NSR review for CPUP. In addition, an SCR could potentially increase particulate emissions. The available technologies as reviewed in the application and by Ecology are listed below.

4.2.1.1. Dry electrostatic precipitator

A dry electrostatic precipitator (ESP) removes particles from an air stream by electrically charging the particles, then passing them through a force field that causes them to migrate to an oppositely charged collector plate. An ESP generally refers to a dry ESP unless specifically noted otherwise. The dust from the collector plates falls into a collection hopper at the bottom of the ESP. The collection efficiency of an ESP depends on particle diameter, electrical field strength, gas flowrate, and plate dimensions. A dry ESP is used for dry pollutants and uses a dry collecting surface.

4.2.1.2. Wet electrostatic precipitator

This control technology is identical to a dry ESP except that a wet electrostatic precipitator (WESP) has a wet collecting surface and can be used for both wet and dry pollutants. The water addition can perform a number of tasks. It can change the electrical properties of the fly ash and can improve (or reduce) removal efficiency. The water is also used to remove sticky ashes from the ESP collector plates or to condense and remove semi-volatile compounds like some high molecular weight organic compounds. Unlike a dry ESP which removes only dry pollutants, a wet ESP can potentially remove solid, liquid, and soluble gas pollutants.

4.2.1.3. Wet scrubber

Wet scrubbers intercept dust particles using droplets of liquid (usually water). The larger, particle-enclosing water droplets are separated from the remaining droplets by gravity. The solid particulates are then separated from the water.

4.2.1.4. Fabric filter (baghouse)

A fabric filter (baghouse) consists of several fabric filters, typically configured in long, vertically suspended sock-like configurations. Dirty gas enters from one side, often from the outside of the bag, passing through the filter media and forming a particulate cake. The cake is removed by shaking or pulsing the fabric, which loosens the cake from the filter, allowing it to fall into a bin at the bottom of the baghouse. A variety of fabrics is available to cover fuel gas temperatures up to about 650°F. Baghouses are unsuitable for use on water saturated gas streams.

4.2.1.5. Clean fuels

Clean fuels such as low sulfur fuel and natural gas cause comparably lower emissions than other common fuels.

4.2.1.6. Good combustion practices and design

This is the most basic combustion modification technique available. Good combustion practices (GCP) imply that the emission unit is operated within parameters that minimize emissions of air pollutants and maximize combustion efficiency. A properly operated emission unit will minimize the formation of PM emissions. Good operating practices for combustion units typically consist of controlling parameters such as fuel feed rates and air/fuel ratios. Sometimes, an operating practice that minimizes one pollutant, increases the formation of another pollutant. Operators can control the combustion stoichiometry to minimize pollutant formation while achieving efficient fuel combustion. As noted in the application: "An inherently low-emitting production process is one that maximizes product (in this case steam) yield and thermal efficiency while minimizing pollutant emissions. This is typically achieved by utilizing equipment design that minimizes fuel and energy use. Energy efficiency is the term typically used to encompass these concepts." Proper design of combustion units (e.g., boilers) concerns features such as the fuel and combustion air delivery system and the shape and size of the combustion chamber.

4.2.1.7. Carbon capture and storage

Carbon Capture and Storage or Sequestration (CCS) technology includes three stages: removing or segregating CO_2 from the gas stream; compressing and transporting the CO_2; and permanently storing the CO_2.

4.2.1.8. Leak detection and repair

A leak detection and repair monitoring program (or LDAR) consists of five main elements: identifying components that could have potential leaks; a definition of a leak for a specific component; monitoring components; repairing components; and recordkeeping.

4.2.2. BACT feasibility review

Table 20 addresses the technical feasibility of implementing each control technology from Section 4.2.1. for the project.

Table 20. Technical Feasibility Assessment

Emission Unit(s)	Control	Technical Feasibility Assessment	Applicable Pollutants
Boiler, MVEC	Clean fuels	Technically feasible	PM_{10}, $PM_{2.5}$, GHG
Boiler, MVEC	GCPs and design	Technically feasible	PM_{10}, $PM_{2.5}$, GHG
Fugitive components	LDAR monitoring	Technically feasible	GHG

Table 20. Technical Feasibility Assessment			
Emission Unit(s)	**Control**	**Technical Feasibility Assessment**	**Applicable Pollutants**
Fugitive components	Optical gas imaging LDAR monitoring	Technically feasible	GHG
Boiler, MVEC	CCS	Technical feasibility is uncertain: As noted in the application, CCS is available to be considered as a Step 1 BACT control, but it is a developing technology and not fully commercially available.	GHG
Boiler, MVEC	Fabric filter	Technically infeasible: A fabric filter is technically infeasible because particulate emissions from the boiler and MVEC are primarily condensable particulate matter.	PM_{10}, $PM_{2.5}$
Boiler, MVEC	Dry ESP	Technically infeasible: A dry ESP is technically infeasible because particulate emissions from the boiler and MVEC are primarily condensable particulate matter.	PM_{10}, $PM_{2.5}$
Boiler, MVEC	WESP	Technically infeasible: A WESP is potentially more technically feasible for condensable particulate than a dry ESP or fabric filter, but for a natural gas fired boiler and MVEC, both with very low particulate concentrations, a WESP is not effective enough to be considered technically feasible.	PM_{10}, $PM_{2.5}$
Boiler, MVEC	Wet scrubber	Technically infeasible: A wet scrubber is potentially more technically feasible for condensable particulate than a dry ESP or fabric filter, but for a natural gas fired boiler and MVEC, both with very low particulate concentrations, a wet scrubber is not effective enough to be considered technically feasible.	PM_{10}, $PM_{2.5}$

4.2.3. PM_{10} and $PM_{2.5}$ BACT for new boiler

This section addresses $PM_{10}/PM_{2.5}$ control including: ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for $PM_{10}/PM_{2.5}$.

4.2.3.1. Ranking of boiler BACT controls for $PM_{10}/PM_{2.5}$ for the boiler

The potential control options listed in Table 20, above, are ranked in Table 21 based on the control efficiencies documented as being achieved in practice.

Table 21. Ranking of Control Technologies for New Boiler ($PM_{10}/PM_{2.5}$ BACT)		
Type of Control Technology	**Control Efficiency**	**Ranking**
Clean fuels	0.0075 lb/MMBtu	1
GCP and design	0.0075 lb/MMBtu	2

4.2.3.2. Evaluation of BACT impacts for $PM_{10}/PM_{2.5}$ for new boiler

Because Tesoro selects both options with similar control efficiency, no further evaluation is necessary.

4.2.3.3. BACT selection for $PM_{10}/PM_{2.5}$ for new boiler

Tesoro proposes that BACT is clean fuels with good design methods and operating practices, with a BACT limit of 0.0075 lb/MMBtu, and a mass emissions limit of 4.4 lb/hr. The compliance demonstration will be based upon applying an emission factor that will be calculated using the average of three (3) 1-hour stack test runs measured using EPA Methods 5/202. Method 201A can be used as an alternate method for Method 5.

For start-up and shutdown emissions, Tesoro proposes that good combustion practices will prevent the short-term NAAQS from being exceeded. Tesoro bases this on their dispersion modeling, which demonstrates that the new boiler will comply with the NAAQS using an emission rate of 4.4 lb/hr $PM_{10}/PM_{2.5}$. This emission rate is based on the proposed BACT performance standard of 0.0075 lb/MMBtu and the maximum heat input capacity of 584 MMBtu/hr. Tesoro does not expect that boiler emission rates will exceed 4.4 lb/hr during start-up and shutdown "because the firing rate will be much less than the maximum heat input capacity, and the emissions performance will not be significantly different than during normal operations as a result of following good combustion practices."

Ecology agrees with Tesoro's proposed mass emission BACT determination for PM_{10} and $PM_{2.5}$, but with an extra significant figure after the decimal as listed in the permit (4.38 pounds per hour).

4.2.4. GHG BACT for new boiler

This section addresses GHG control including: ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for GHG.

4.2.4.1. Ranking of boiler BACT controls for GHG for the boiler

The potential control options listed in Table 20 above, are ranked in Table 22 based on the control efficiencies documented as being achieved in practice.

Table 22. Ranking of Control Technologies for New Boiler (GHG BACT)		
Type of Control Technology	**Control Efficiency**	**Ranking**
CCS	• 90% CO_{2e} capture • 12 lb CO_{2e}/MMBtu	1
Clean fuels	117 lb CO_{2e}/MMBtu	2
GCP and design (inherently low-emitting processes)	117 lb CO_{2e}/MMBtu	3

4.2.4.2. Evaluation of BACT impacts for GHG for new boiler

Tesoro estimates that CCS would have an installed capital cost of $101 million, an annualized operating cost of $17.8 million/year, and a pollution control cost of approximately $101 per ton. The CSS option is not economically feasible because the capital costs is approximately equal to 30% of the full CPUP cost, and 10 times greater that the estimated installed costs of the boiler. Because Tesoro selects both of the remaining options with similar control efficiency, no further evaluation is necessary.

4.2.4.3. BACT selection for GHG for new boiler

After eliminating the infeasible control efficiency options in Table 20, Tesoro proposes that BACT is clean fuels with good design methods and inherently low-emitting process, with a BACT limit of 117 lb CO_{2e}/MMBtu and 299,524 tpy on a 12-month rolling average basis.

Ecology accepts Tesoro's BACT proposal for GHG emissions from the new boiler.

4.2.5. PM_{10} and $PM_{2.5}$ BACT for MVEC

This section addresses $PM_{10}/PM_{2.5}$ control including: ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for $PM_{10}/PM_{2.5}$.

4.2.5.1. Ranking of MVEC BACT controls for $PM_{10}/PM_{2.5}$

The potential control options listed in Table 20 above, are ranked in Table 23 based on the control efficiencies documented as being achieved in practice.

Table 23. Ranking of Control Technologies for MVEC ($PM_{10}/PM_{2.5}$ BACT)		
Type of Control Technology	**Control Efficiency**	**Ranking**
Clean fuels	0.0075 lb/MMBtu	1
GCP and design	0.0075 lb/MMBtu	2

4.2.5.2. Evaluation of BACT impacts for $PM_{10}/PM_{2.5}$ for MVEC

Because Tesoro selects both options with similar control efficiency, no further evaluation is necessary.

4.2.5.3. BACT Selection for $PM_{10}/PM_{2.5}$ for MVEC

Tesoro proposes that BACT is clean fuels with good design methods and operating practices, with a BACT limit of 0.0075 lb/MMBtu, and a mass emissions limit of 0.9 lb/hr. The compliance demonstration will be based upon applying an emission factor that will be calculated using the average of three (3) 1-hour stack test runs measured using EPA Methods 5/202. Method 201A can be used as an alternate method for Method 5.

For start-up/shutdown emissions, Tesoro believes good combustion practices will be protective of the short-term NAAQS. Tesoro basis this on their dispersion modeling, which demonstrates that the MVEC will comply with the NAAQS using an emission rate of 0.9 lb/hr $PM_{10}/PM_{2.5}$. Tesoro does not expect that MVEC emission rates will exceed 0.9 lb/hr during start-up and shutdown "because the firing rate will be much less than the maximum heat input capacity, and the emissions performance will not be significantly different than during normal operations as a result of following good combustion practices."

Ecology accepts Tesoro's BACT proposal for $PM_{10}/PM_{2.5}$ emissions for the MVEC system.

4.2.6. GHG BACT for MVEC

This section addresses GHG BACT control including: ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for GHG.

4.2.6.1. Ranking of BACT controls for GHG BACT

The potential control options listed in Table 20 above, are ranked in Table 24 based on the control efficiencies documented as being achieved in practice.

Table 24. Ranking of Control Technologies for MVEC (GHG BACT)

Type of Control Technology	Control Efficiency	Ranking
CCS	• 90% CO_2 capture • 2,944 tpy CO_2e	1
Clean fuels	29,439 tpy CO_2e	2

4.2.6.2. Evaluation of BACT impacts for GHG

Tesoro estimates that CCS would not be economically feasible based upon the evaluation conducted for the boiler. The MVEC has a significantly smaller capacity than the boiler and operates intermittently..

4.2.6.3. BACT selection for GHG

Tesoro proposes that BACT is clean fuels with a BACT limit of 29,439 tpy CO_2e.

Ecology accepts Tesoro's BACT proposal for GHG emissions from the MVEC system.

4.2.7. GHG BACT for fugitive components

This section addresses GHG control including ranking of control technologies; evaluating economic, energy, and environmental impacts; and selection of BACT for GHG.

4.2.7.1. Ranking of BACT controls for GHG

The potential control options listed in Table 20 above, are ranked in Table 25 based on the control efficiencies documented as being achieved in practice.

Table 25. Ranking of Control Technologies for Fugitive Components (GHG BACT)

Type of Control Technology	Control Efficiency	Ranking
LDAR monitoring	Standard leak rates	1
Optical gas imaging LDAR monitoring	Camera leak detection is on qualitative basis; additional Method 21 monitoring required to quantify leak rate	2

4.2.7.2. Evaluation of BACT impacts for GHG

Because Tesoro selects the top control option, no further evaluation is necessary.

4.2.7.3. BACT selection for GHG

GHG emissions from fugitive components are assumed to be methane. As noted in the application, because both VOC and methane emissions are released from fugitive components in the gaseous state, VOC leak rates for both VOC and methane emissions are used. Tesoro proposes that BACT is "an LDAR monitoring program in accordance with the applicable requirements for each affected process unit. Components in natural gas service will also be included in the LDAR monitoring program. The ARU process unit will be subject to LDAR requirements under 40 CFR 60 Subpart VVa and 40 CFR 63 Subpart H. The CR/NHT and Isom Unit are subject to LDAR requirements under 40 CFR 60 Subpart GGGa and 40 CFR 63 Subpart CC."

Ecology accepts Tesoro's BACT proposal for GHG emissions from the fugitive components.

4.3. Toxic Air Pollutants

PSD rules require the applicant to consider emissions of TAPs during the course of a BACT analysis, but specifically exempt all pollutants subject to regulation under Section 112 of the federal Clean Air Act from regulation under the PSD program.
The emissions of TAPs will be covered in the NWCAA NOC approval for this project.

5. AMBIENT AIR QUALITY IMPACTS ANALYSIS

5.1. Regulatory Requirements

For PSD, an ambient Air Quality Impacts Analysis (AQIA) is required for all pollutants that are emitted in significant quantities to determine the ambient impacts associated with the construction and operation of the proposed modifications. The main purpose of the air quality analysis is to demonstrate that new emissions emitted from the proposed major stationary source or major modification will not cause or contribute to a violation of any applicable NAAQS or PSD increment.

The AQIA starts with preliminary modeling for each pollutant to determine whether an applicant can forego detailed analysis and preconstruction monitoring. If the projected ambient concentration increase for a given pollutant is below the PSD Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMCs) for each averaging period, no further analysis of the ambient impact is required for that pollutant. While secondary emissions are not included when determining PSD applicability, they are included when considering air quality impacts. The impacts to Class I and Class II areas (see Tables 27 and 26 respectively), include approximately 0.084 tons per year PM emisisons from secondary vessel unloading operations.

For those pollutants with averaging periods that have impacts greater than the SIL, a full impact analysis (taking into account other increment consuming sources) is used to demonstrate compliance with NAAQS and PSD increments.

Typically, the AQIA includes an analysis of impacts to local areas that are within 50 kilometers (km) of the project, and a regional air quality impact assessment for impacts beyond 50 km. For projects in Washington State, this latter analysis usually includes impacts on Class I areas.

The AERMOD dispersion model was used for predicting local impact concentrations. The Community Multi-Scale Air Quality (CMAQ) model was used to develop the background concentrations.

5.2. Maximum Criteria Pollutant Concentrations Predicted by AERMOD

Using project emissions only, AERMOD predicted impacts for criteria pollutants compared to SILs and Monitoring de minimis levels or SMCs are presented in Table 26.

Table 26. Maximum Criteria Pollutant Concentrations Predicted by AERMOD for Class II					
Criteria Pollutant	Avg. Period	Max AERMOD Concentration In Class II Areas (µg/m³)	SIL* (µg/m³)	SMC* (µg/m³)	Is AERMOD Concentration Greater than Applicable SIL or SMC?
PM_{10}	24-hr	2.73	5	10	No
	Annual	0.14	1	---	No
$PM_{2.5}$	24-hr	1.06	0.07, 1.2, 1.2	4	No
	Annual	0.13	0.06, 0.3, 0.3	---	No

* Listed SILs and SMCs were promulgated on October 20, 2010 and became effective December 20, 2010. $PM_{2.5}$ SILs are for Class I, II, and III areas, respectively, and are the only SILs with different values for the three different Class areas (I, II, and III). PM2.5 SIL and SMC in PSD rules were vacated on January 22, 2013.

Because project impacts are not greater than the SILs, a full impact analysis (taking into account other increment consuming sources) is not required to demonstrate compliance with NAAQS and Class II PSD increments. NAAQS compliance is assumed and compliance with WAAQS is assumed by compliance with NAAQS.

In addition to considering NAAQS, Ecology also considered the general vicinity around this project with regards to general environmental justice concerns. In Ecology's analysis, it is noted that Section 6 of this TSD considered construction and area growth affects (temporary and minimal) due to this project as well as visibility (stack plumes dissipate short distances from the facility due to dispersion and evaporation, of which this project is only a small contributor). Based on this information, along with consideration of the general population of the area, Ecology concludes that minority or low-income populations will not experience disproportionately high and adverse human health or environmental effects due to exposure to relevant criteria pollutants as a result of this project.

The PSD pollutants (PM_{10}, $PM_{2.5}$ and GHG) are not considered TAPs. Furthermore, the project will not result in any increased use of existing stationary diesel engines and no new diesel engines will be installed so that the TAP referred to as diesel engine exhaust, particulate or DEEP, will not be emitted by the project. Therefore, a comparison to ASILs is not included in this TSD.

5.2.1. Secondary $PM_{2.5}$ formation

Precursors of $PM_{2.5}$ include NO_X, SO_2, and VOCs. Under specific atmospheric conditions, these precursors may coagulate onto existing particles or nucleate into new particles. Based on the analysis presented as stated in the application and in consultation with Ecology modelers, "As part of the EPA modeling guidance for $PM_{2.5}$, the modeling requirements for projects with

emission increases of direct $PM_{2.5}$ above the SER, but the increases of NO_X and SO_2 are below the SER… only the modeling of primary $PM_{2.5}$ is needed - a modeling evaluation of secondary $PM_{2.5}$ is not required."

5.3. Ozone Impacts

NO_X and VOCs are precursors to ozone. Because the proposed emission increases in VOCs and NO_X from the CPUP will not exceed 100 tpy for either pollutant, a demonstration that the project would not cause or significantly contribute to a violation of the ozone NAAQS was not required. However, the following background information for ozone is provided.

5.3.1. Ozone background information

EPA has set primary and secondary ozone standards to protect human health and welfare. On March 12, 2008, EPA revised the primary and secondary ozone standards to 0.075 ppm for an 8-hr average. And, EPA lowered it again in December 2015 to 0.070 ppm for an 8-hr average.

Ozone is formed in the troposphere when sunlight causes complex photochemical reactions involving NO_X, VOCs, and CO that originate chiefly from gasoline engines and burning of other fossil fuels. Woody vegetation is another major source of VOC emissions to NO_X emissions within the surrounding airshed, and the relative reactivities of the VOC species. NO_X and VOCs can be transported long distances by regional weather patterns before they react to create ozone in the atmosphere, where it can persist for several weeks. Because ozone is a regional pollutant, precursor sources both near and far can contribute to ozone formation.

Breathing ozone can trigger a variety of health problems for humans, including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Elevated levels of ozone can also reduce lung function by inflaming the linings of the lungs. Repeated exposure to elevated concentrations of ozone may permanently scar lung tissue. Ozone is also phytotoxic, causing damage to a variety of vegetation (Ashmore et al., 2004). Ozone pollution has been shown to reduce plant growth, alter species composition, and predispose trees to insect and disease attack. Ozone also causes direct foliar injury to some plant species. Ozone affected leaves are marked with discoloration and lesions, and they age more rapidly than normal leaves (EPA, 2007).

Ozone enters plants through leaf stomata, causing changes in biochemical and physiological process. The mesophyll cells under the upper epidermis of leaves are the most sensitive to ozone, and those are the first cells to die. The adjacent epidermal cells then die, forming a small black or brown interveinal necrotic lesion that becomes visible on the upper surface of the leaf. These lesions, termed oxidant stipple, are quite specific indicators that the plant has been exposed to ozone. There are other plant symptoms that can result from exposure to ozone. However, these symptoms are non-specific for ozone since other stressors can also cause them to occur. In general, the most reliable indicator that ozone has impacted vegetation is oxidant stipple.

In addition to effecting individual plants, ozone can also affect entire ecosystems. Plants growing in areas with high exposure to ambient ozone may undergo natural selection for ozone tolerance (EPA, 2007). The final result could be the elimination of the most ozone sensitive genotypes from the area (National Park Service, 2010).

While VOCs and NO_X are recognized as precursors to the formation of ground level ozone, which is regulated as a criteria pollutant, the FLAG guidance states that "current information indicates most FLM areas are NO_X limited" with respect to the formation of ground level ozone. A NO_X limited region is one where the concentration of ozone depends on the amount of NO_X in the atmosphere. This occurs when there is a lack of nitrogen dioxides, thus inhibiting ozone titration when oxygen mixes with VOCs. In these regions, controlling NO_X would reduce ozone concentrations. A VOC's limited region is one where concentration of ozone depends on the amount of VOCs in the atmosphere. In these regions, controlling VOCs would reduce ozone concentrations. The FLAG guidance further states that "until there is enough information available for FLAG to determine whether ozone formation in each FLM area is primarily limited by NO_X or VOC emissions, we will assume all FLM areas are NO_X limited and will focus on control of NO_X emissions" (FLAG Executive Summary and Section 3.4.5).

5.4. Impacts on Class I Areas

As shown in Table 27, project impacts in Class I areas are not greater than the SILs. Therefore, an impact analysis (taking into account other increment consuming sources) is not required to demonstrate compliance with NAAQS and PSD increments.

Table 27. Maximum Criteria Pollutant Concentrations Predicted by AERMOD for Class I

Criteria Pollutant	Avg. Period	Max AERMOD Concentration In Class I Areas (µg/m³)	SIL* (µg/m³)	Is AERMOD Concentration Greater than Applicable SIL
PM_{10}	24-hr	0.0862	5	No
	Annual	0.0021	1	No
$PM_{2.5}$	24-hr	0.0467	0.07, 1.2, 1.2	No
	Annual	0.0018	0.06, 0.3, 0.3	No

* Listed SILs were promulgated on October 20, 2010 and became effective December 20, 2010. $PM_{2.5}$ SILs are for Class I, II, and III areas, respectively, and are the only SILs with different values for the three different Class areas (I, II, and III). PM2.5 SIL in PSD rules were vacated on January 22, 2013.

However, in addition to addressing NAAQS and PSD increments, PSD rules require an analysis of air quality related values (AQRVs) on federally mandated Class I areas. Class I areas are defined in the Clean Air Act as having special national or regional value from a natural, scenic, recreational, or historic perspective. Class I areas include national parks over 6,000 acres and wilderness areas and memorial parks over 5,000 acres as of 1977. The impacts to these areas are stringently regulated because they have remained relatively untouched by development.

5.4.1. AQRV background information

PSD regulations and guidance require additional impact analyses to evaluate the effects of the project's emissions on visibility, local soils, and vegetation in Class I and in also in Class II areas (see Section 6), and the effect of increased air pollutant concentrations on flora and fauna in the Class I areas. The additional impact analyses are also used to evaluate the effect of the project on growth in the area surrounding the project in Class II areas (see Section 6).

The analyses assess increment consumption and impacts on AQRVs in Class I areas. AQRVs include regional visibility or haze, the effects of primary and secondary pollutants on sensitive plants, the effects of pollutant deposition on soils and receiving water bodies, and other effects associated with secondary aerosol formation. The FLMs for the National Park Service, U.S. Fish and Wildlife Service, and U.S. Forest Service have the responsibility of ensuring AQRVs in the Class I areas are not adversely affected. The Federal Land Managers' (FLMs) guidance on evaluating impacts of major projects on Class I areas is the *Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – revised* (2010) (National Park Service, 2010).

In FLAG, the FLMs have developed a tool to screen out projects that would not have a significant impact on AQRVs based on annual emissions and distance from a Class I area. This screening tool is called the Q/D Method, which is to divide the amount of emission increases in tons per year (Q) by the distance to a federal Class I area in km (D). FLAG states that "The FLM role within the regulatory context consists of considering whether emissions from a new source, or emission increases from a modified source, may have an adverse impact on AQRVs and providing comments to permitting authorities. Therefore, the agencies will consider a source locating greater than 50 km from a Class I area to have negligible impacts with respect to Class I AQRVs if its total SO_2, NO_x, PM_{10}, and H_2SO_4 (sulfuric acid) annual emissions (in tons per year, based on 24-hour maximum allowable emissions), divided by the distance (in km) from the Class I area (Q/D) is 10 or less. The agencies would not request any further Class I AQRV impact analyses from such sources."

5.4.2. Tesoro AQRV analysis

For the Tesoro CPUP, the only pollutants that would have a significant net increase are $PM_{2.5}$, PM_{10}, and GHG. Note that $PM_{2.5}$ and GHG are not among the pollutants that the FLMs recommend including in the calculation of Q. The Q/D values for each Class I area in Washington is presented in Table 27.

Table 28. Class I Areas within 200 KM of the Tesoro Facility				
Area	**Distance (D) from Tesoro to Class I Area (km)**	**Quantity (Q) of Max 24-hr Emission Increase (tpy)**	**Q Divided by D (Q/D) (tons/km)**	**Is Q/D Less than 10? (Yes/No)**
Alpine Lakes Wilderness Area	118	372	3.2	Yes
Glacier Peak Wilderness Area	86	372	4.3	Yes
Pasayten Wilderness Area	117	372	3.2	Yes
Olympic National Park	72	372	5.2	Yes
North Cascades National Park	76	372	4.9	Yes
Mount Rainier National Park	173	372	2.2	Yes
Goat Rocks Wilderness Area	217	372	1.7	Yes
Mount Baker Recreation Area*	49	372	7.6	Yes
San Juan Islands	This is not a Class I area. As noted in the application: "There are several national monuments and state parks near the project area, including San Juan Islands National Monument, Moran State Park, Larrabee State Park, Bay View State Pare, and Deception Pass State Park. The closest of these sensitive Class II areas is Bay View State Park, and Washington State Parks indicates that scenic views are a feature of in this area, however, visibility concerns are not noted in the State Parks Natural Resource Management Policy. Emissions from the Project are not expected to change the overall plume visibility from the facility in any nearby scenic areas."			
Columbia River Gorge	This land, managed by the forest service, is not a Class I area, but is sometimes included in regional haze considerations by request of the FLMs. It is located farther from the project than closer Class I areas which are not expected to have adverse impacts from the project. Therefore, it is not expected to have an adverse impact.			
* Mount Baker Recreation Area is not a Class I area. As noted in the application: "Based on discussions with Ecology at the March 9, 2015, pre-application meeting, there is no specific requirement to conduct near-field visibility analyses except for the Mt. Baker, Class II scenic vista. Ecology has requested that Mt. Baker be considered a "Class I area" for visibility analysis and perform the same level of analysis as any potentially impacted Class I area."				

Because Q/D is less than 10 for all areas in Table 27, additional Class I AQRV impact analyses are not required. Also as explained in Section 5.2, because project impacts are not greater than the SILs, a full impact analysis (taking into account other increment consuming sources) is not required to demonstrate compliance with NAAQS and Class II PSD increments. NAAQS compliance is assumed and compliance with WAAQS is assumed by compliance with NAAQS.

5.4.2.1. Soils and receiving water bodies (deposition)

Ecology did not require Tesoro to perform a deposition analysis because the project emission rates for SO_2 and NO_X are below the SERs. In addition, the other pollutants emitted by the project are not expected to contribute to impacts on soil and vegetation in the area surrounding the Tesoro refinery.

5.4.2.2. Visibility (Class I areas)

Because Q/D is less than 10 for all areas in Table 27, a visibility analysis in Class I areas is are not required.

6. ADDITIONAL IMPACTS ANALYSIS

6.1. Construction and Growth Impacts

The project will increase marine traffic but not rail traffic. As noted in the application based partly on SEPA: "Additional marine traffic will be associated with delivery of medium reformate feedstock and shipment of mixed xylenes product and gasoline components. Based on expected usage rates, and typical use of marine vessels, the proposed project would generate traffic of up to 60 marine vessels per year. This is a relatively small increase in marine traffic in comparison to recent operating years (and remains well below the annual marine vessel traffic of historical operating years.)"

No new area homes or industry are anticipated during construction or after construction as a result of the CPUP. Impacts from new commercial development are assumed to be minimal as the project will occur within the existing fenceline of Tesoro property.

The number of employees at Tesoro is expected to increase by approximately 20 full-time employees as a result of this project, with approximately 40 additional vehicle trips per year. During construction of this project, there will be approximately 300 to500 additional employees on-site. Because existing traffic on the main highway to the facility (Washington State Route 20) has approximately 30,000 vehicles daily, the increased traffic due to construction and also once operational, are both expected to be negligible by comparison.

During this time, there will be increased traffic congestion, increased vehicle emissions, and increased demand for local skilled workers. However, because construction is expected to last only one to two years, these increases are expected to be temporary and insignificant. Therefore, the proposed project is not expected to cause adverse construction and growth related impacts.

6.2. Visibility

As noted in the application, the 1990 draft NSR Workshop Manual provides the following description of a Class II visibility analysis in Chapter D, Section II.D:

"In the visibility impairment analysis, the applicant is especially concerned with impacts that occur within the area affected by applicable emissions. Note that the visibility analysis required here is distinct from the Class I area visibility analysis requirement. The suggested components of a good visibility impairment analysis are:" (addressed for each below the listed components in italics font):

- *"a determination of the visual quality of the area,"*

Regarding area regional haze, pre-existing visible water vapor (steam) plumes can be seen in the Anacortes Industrial Park area, both from Tesoro and other sources, which dissipate short distances from the facility due to dispersion and evaporation.

- *"an initial screening of emission sources to assess the possibility of visibility impairment, and"*

The project emissions are located within the existing Tesoro buildings and stacks so that after the project is completed, the project emission sources are not likely to impair local visibility any more than the existing facility emission sources.

- *"if warranted, a more in-depth analysis involving computer models."*

As noted in the application: "The *Q/D* screening values for the Project indicate that emissions from the Project will not significantly impact visibility in either Class I or sensitive Class II areas." For other Class II areas, the analysis provided for regional haze appears to be sufficient.

6.3. Soils and Vegetation Analysis

Regarding economic impacts of the project on vegetation and soils, or agriculture and forestry, the project emissions comply with secondary NAAQS (assumed by compliance with SILs), which were intended to address factors such as soils and vegetation.

The following excerpt from the application which further addresses project impacts on soils and vegetation is pasted below:

"Adverse impacts to soils from air emissions are evaluated through an assessment of pollutant deposition. Sulfate and nitrate deposition are of interest due to the potential for acidification of soils. However, sulfate and nitrate deposition in soils is not expected to be of concern because the net increase of sulfur dioxide (SO_2) and nitrogen oxide (NO_X) emissions as a result of the Project will be below the respective significant emission rates. The Project will also have ammonia emissions, which could result in a small increase in nitrogen deposition….

"Deposition from ammonia emissions, in addition to that from NO_X species, is of interest to vegetation and terrestrial ecosystems because of the ammonia's nitrogen content. Due to the selective catalytic reduction (SCR) process in the proposed boiler, the maximum amount of ammonia estimated to be emitted from the project will be 11.5 tons per year (tpy). Ammonia does not have a significant emission rate with which to provide perspective on the importance of emissions to other resources, including soils and vegetation. Additionally, deposition from ammonia emissions is also of interest because ammonia is "relatively soluble in water and may be subject to both wet and dry deposition" and is expected to deposit locally. Recent studies indicate that vulnerable ecosystems are protected at nitrogen deposition rates below 5 to 10 kilograms of nitrogen per hectare per year (kg N/(ha•yr)). Using assumptions designed to overestimate rather than underestimate deposition, potential local deposition of ammonia from project emissions is estimated to be 0.09 kg N/(ha•yr) (see Table 1-1.) Current background nitrogen deposition is 0.55 kg N/(ha•yr). Thus, the potential nitrogen deposition from ammonia in addition to background rates in local terrestrial areas is 0.64 kg N/(ha•yr)—below the levels protective of vulnerable ecosystems, meaning that adverse impacts to soils and vegetation due to nitrogen from project ammonia emissions are not anticipated."

Based on these deposition calculations in the application, Ecology believes Tesoro has satisfactorily addressed project impacts on Class II soils and vegetation.

7. STATE ENVIRONMENTAL POLICY ACT

Under Washington State rules, a final PSD permit shall not be issued for a project until the applicant has demonstrated that State Environmental Policy Act (SEPA) review has been completed for the project. Skagit County is the lead agency for SEPA.

On July 10, 2017, Skagit County issued the Final Environmental Impact Statement (EIS) in accordance with the SEPA process. As noted in the Final SEPA EIS: "no new significant impacts have been identified" and "seven days following publication of the Final EIS, permits for the Proposed Action may be issued based on the regulatory requirements for each permit process."

Ecology concludes that the applicant has adequately demonstrated compliance with SEPA requirements.

8. PUBLIC INVOLVEMENT

This PSD permitting action is subject to a minimum 30-day public comment period under WAC 173-400-740. A newspaper public notice announcing the public comment period was published in the Skagit Valley Herald on March 27, 2017. In accordance with WAC 173-400-740(2)(a), application materials and was made available for public inspection at:

Northwest Clean Air Agency
1600 South Second Street
Mount Vernon, WA 98273-5202
(360) 428-1617

Washington State Department of Ecology
Air Quality Program
300 Desmond Drive SE
Lacey, WA 98503
(360) 407-6800

A public hearing on the proposed PSD was held on April 27, 2017, at the Anacortes High School, in Anacortes, WA. Four people provided verbal comments.

The public comment period closed on April 28, 2017, at 5 PM PDT. Ecology received a total of 26 comments about the proposed permit (including the comments received during the public hearing). The comments are numbered in the order they were received. Verbal comments from the hearing are numbered from #7 through #14. The initial transcript of the verbal comments contained some errors, and was edited by NWCAA for clarity. Ecology's response to comments is provided in Appendix A of this TSD.

9. AGENCY CONTACT

Gary Huitsing, P.E.
Washington State Department of Ecology
Air Quality Program
P.O. Box 47600
Olympia, WA 98504-7600
(360) 407-6314
gary.huitsing@ecy.wa.gov

REFERENCES

Ashmore, M., Karlsson, P.E., and H. Pleije, New directions: a new generation of ozone critical levels for the protection of vegetation in Europe (correspondence), *Atmospheric Environment*, 38: 2213-2214, 2004.

Brace, S., Peterson, D. L., and D. Horner, Diagnosing Ozone Injury in Vascular Plants of the Pacific Northwest, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 1998.

California Air Resources Board, Statewide BACT Clearinghouse, <http://www.arb.ca.gov/bact/bact.htm>, California Environmental Protection Agency, Sacramento, California, 2014.

EPA, *Draft EPA New Source Review Workshop Manual*, 1990. Available at: <http://www.epa.gov./ttn/nsr/gen/wkshpman.pdf>

-----, *EPA Air Pollution Control Cost Manual*, Sixth Edition (EPA 452/B-02-001), January 2002. Available at: <http://www.epa.gov/oaqps001/lead/pdfs/2002_01_cost_control_%20manual.pdf>

-----, Review of the National Ambient Air Quality Standards for Ozone: Policy Assessment of Scientific and Technical Information, EPA-452/R-07-007, 2007.

-----, RACT/BACT/LAER Clearinghouse, RBLC Database, Technology Transfer Network Clean Air Technology Center, 2014. Available at: <http://cfpub.epa.gov/RBLC/index.cfm?action=Home.Home&lang=en>

National Park Service, *Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I report – revised 2010)*, 2010. Available at: <http://www.nature.nps.gov/air/pubs/pdf/flag/Flag_2010.pdf>

South Coast Air Quality Management District, SCAQMD Clearinghouse, Diamond Bar, California, 2014. Available at: <http://www.aqmd.gov/bact/287160.htm>

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
ALW	Alpine Wilderness
AQIA	Air Quality Impacts Analysis
AQRV	Air Quality Related Values
BACT	Best Available Control Technology
CARB	California Air Resources Board
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FLAG	Federal Land Managers' Air Quality Relative Values Workgroup
FLM	Federal Land Manager
FR	Federal Register
GHG	greenhouse gas
H_2SO_4	sulfuric acid mist
HAPs	hazardous air pollutants
hr/yr	hours per year
kW	kilowatt
MACT	maximum achievable control technology
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOC	Notice of Construction
NO_X	nitrogen oxides
NPS	National Park Service
NSR	New Source Review
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
PTE	potential to emit

Q/d	emissions to distance
RBLC	RACT/BACT/LAER Clearinghouse
SCR	selective catalytic reduction
SEPA	State Environmental Policy Act
SER	significant emission rate
SIL	significant impact level
SO_2	sulfur dioxide
SO_X	sulfur oxides
TAP	toxic air pollutant
tpy	tons per year
VOC	volatile organic compound
WAC	Washington Administrative Code

APPENDIX A. ECOLOGY'S RESPONSE TO COMMENTS

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
Comment 1	Hold Tesoro accountable to the highest possible extent for any damage to our airshed. I have asthma as do an increasing number of children. Use the highest, not the lowest, bar for the refinery's operation. Frequent reviews of operating permits and real teeth in penalties! We need to increase use of renewables and electric vehicles instead of obsolete and polluting ones. Plan 7 generations ahead as tribes recommend. Do not kick the problem downfield for my great grandchildren to suffer with. It may be part of our last chance to reduce warming and turn the seasons and skies back to how they were when I was a child. **Ecology's Response to Comment 1:** Ecology's proposed PSD permit incorporated the high standards the state of Washington has adopted for this type of air source. We have required the refinery to use the Best Available Control Technology (BACT) for their project. BACT was required for greenhouse gases. The PSD process also requires the review of expected impacts as they relate to health-based standards. The project will control ship-loading emissions, which will reduce the health risk by converting the volatile organic compounds (VOC) to carbon dioxide and water. The NWCAA minor air permit will address emissions of air toxics per Washington Administrative Code (WAC) 173-460. About planning for the future, last year Ecology created a new section in the Air Quality Program named the "Climate Policy Section." This new section is implementing Ecology's Clean Air Rule that addresses greenhouse gases in the state of Washington. This comment did not result in a change to the permit.	Faye Tompkins
Comment 2	I am 100% behind the Tesoro project. Please issue the permits. **Ecology's Response to Comment 2:** Thank you for your support of Ecology's proposed permit. If the comments submitted regarding the proposed permit does not result in a change to the permit, Ecology intends to issue the permit. This comment did not result in a change to the permit.	Jim Duffy
Comment 3	To Whom It May Concern:	Ruth LeBrun

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	I feel compelled to comment upon the proposed "Clean Products Upgrade Project" at the Tesoro Refinery in Anacortes. YES - Do install a system that captures air emissions during marine vessel loading. YES - Do upgrade a production unit to help reduce the sulfur content in gasoline. NO!! - Do not allow "adding aa unit" to make high-octane products that can be added too gasoline, and ABSOLUTELY NO - Do not allow "adding a unit" to separate mixed xylenes as a separate product. BOTTOM LINE: We do NOT need increased marine and train traffic carrying toxic substances that risk the fragile air, water and land habitats of FidaIgo Island and Skagit County. We do not need industry that increases our risk for environmental degradation. Thank you for your consideration. **Ecology's Response to Comment 3:** Tesoro included a system to collect emissions from the loading of ships in their project. Ecology addressed the emissions from this system in the permit. Ecology did address the upgrade to a production unit to reduce the amount of sulfur content in the gasoline. Tesoro included this upgrade in their proposed project. Ecology addressed emissions from this effort in the permit. Tesoro includes adding a unit to make products that can be added to gasoline to increase the octane in the gasoline they produce at the refinery. The PSD permit program does not allow Ecology to step in and change the applicant's project. The PSD program carefully reviews the proposed project to ascertain if emission will significantly impact ambient air. Ecology has analyzed this part of the project and included permit requirements that is protective of the environment. The proposed project does include adding equipment to separate xylenes. Ecology has described this part of the project in detail in Sections 1 and 2 of the Technical Support Document (TSD). The air	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	emissions have been addressed in the permit and are protective of the environment. This comment did not result in a change in the permit.	
Comment 4	Our primary interest is to request that Ecology review the Anacortes refinery in the next round of regional haze planning. **Ecology's Response to Comment 4:** Regional haze planning is beyond the scope of this PSD permit action. Ecology is in the process of planning for Regional Haze 2021. Ecology has already been in contact with the National Park Service (NPS) regarding this effort. This comment did not result in a change to the permit.	Don Shepherd, National Park Service, Air Resources Division Lakewood, CO
Comment 5	Tesoro Refining & Marketing Company LLC (Tesoro) is proposing a Clean Products Upgrade Project (CPUP) which would be a major modification at the Anacortes Refinery in Washington. The facility is located 76 km from North Cascades National Park (NP), 77 km from Olympic NP, and 176 km from Mt. Rainier NP, all Class I areas administered by the National Park Service (NPS). The value of clean air in these national parks is reflected in the laws establishing the parks and visitor values illustrated by surveys. The enabling legislation for North Cascades NP establishes the park "to preserve for the benefit, use, and inspiration of present and future generations certain majestic mountain scenery, snowfields, glaciers, alpine meadows, and other unique natural features in the North Cascade Mountains of the State of Washington."[1] In the 2015 Mt. Ranier NP Foundation Document, clean air, scenic vistas, and viewsheds are identi fied as "fundamental values." The Foundation recognizes ". . . unimpaired clean air allows for enjoyment of the park's spectacular views and supports healthy ecosystems. Majestic mountain scenery and spectacular vistas are abundant within and outside the park. The visual landscape and its components provide a look and feel that is relatively unchanged from the park's early years and contribute to an emotional connection for visitors along with the timelessness of Mount Rainier as a traditional national park."[2] In a survey conducted at Olympic NP in 2000, visitors ranked scenic views as one of the most important park resources to protect.[3]	Susan M. Johnson, Chief, Policy, Planning, and Permit Review Branch, United States Department of the Interior, National Park Service, Air Resources Division Denver, CO

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	The proposed CPUP is a major modification for particulate matter less than or equal to 10 microns in diameter (PM10) and particulate matter less than or equal to 2.5 microns in diameter (PM2.5) due to a 21.6 ton-per-year (tpy) increase in these pollutants, as well as a 347,644 tpy increase in greenhouse gases (GHG). The CPUP also includes several minor modifications emitting other criteria pollutants. The proposed modifications include a new steam boiler, a Marine Vapor Emission Control system, an expansion of the Naphtha Hydrotreater and an Aromatics Recovery Unit. The project expands the ability of the Anacortes refinery to deliver cleaner local transportation fuels and global feedstocks for polyester production but does not increase the refinery's capacity to process crude or change the crude slate processed. We reviewed Tesoro's April 2016 permit application and associated draft permits from the Washington Department of Ecology and the Northwest Clean Air Agency. We recognize that the Tesoro modification is major for PM 10 and GHG, and that Tesoro has employed effective controls to minimize the emissions from the modification. We commend Tesoro for the addition of Selective Catalytic Reduction (SCR) on the new boiler which minimized the NOx increase at the facility. Tesoro also proposes to collect and combust the displaced vapors from loading marine vessels along with natural gas introduced at the dock safety unit to keep the gas within safe ranges. This project reduces volatile organic compound (VOC) emissions from the facility by over 300 tpy. We appreciate the addition of controls for VOC on the marine loading facility and the reduction in VOC is significant. **Ecology's Response to Comment 5:** The PSD permit review includes an analysis of the proposed project's effect on Class I areas. The class I analysis for this project is discussed in Section 5.4 of the TSD. In addition, the PSD permit does include requirements to address the emissions resulting from the project. This comment did not result in a change in the permit.	
Comment 6	**NPS Analysis of Impacts on Air Quality Related Values** We understand that, for this modification, the only PSD-applicable pollutants are particulate and GHG. The following modeling was done based on the current pre-modification (2014 - 2015) annual emissions from the entire facility. <u>The visibility comments provided here do not apply to the currently-proposed modification</u>. In our review of the	Susan M. Johnson, Chief, Policy, Planning, and Permit Review

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	Tesoro Anacortes refinery, our primary concerns are visibility and nitrogen deposition impacts at North Cascades NP and Olympic N P based on current emissions from the entire facility. We modeled pre-modification 2014 - 2015 average annual emissions from the facility (as described below) to estimate these current impacts. **CALPUFF Model** The NPS air quality impact analysis applied the EPA CALPUFF 5.8 suite of models. (CALLPUFF version 5.8 Level 070623, CALMET Level 070623, POSTUTlL Level 070623, and CALPOST Version 6.221.) The modeling was performed in the regulatory mode with the switch MREG l. The pollutants modeled for both the existing emissions scenario (2014A-annual) and (2015-annual) were S02, S04, NO, elemental carbon, organic carbon, and PM2.5; in pounds per hour units. The stack parameters and locations, the CALMET data, and the Class I discrete receptors were all from the major modification modeling analysis Tesoro submitted to the State of Washington's Department of Ecology. The three years (2003 - 2005) of CALMET used 12 months of MM5 prognostic data, NWS upper air data, and NWS surface stations. The model domain consists of 115 four-kilometer east-west grid cells and 105 north-south four-kilometer grid cells with ten vertical layers. The hourly ozone data used in the modeling were from 38 ozone monitors. These monitors were located in the three national parks being analyzed, 14 ozone monitors sites in Washington, 9 ozone monitors from sites located in Oregon, 4 ozone monitor sites in Idaho, and 7 ozone monitor sites located in British Columbia, Canada. The monthly ammonia (NHi) background data of 17 ppb) was from a monitoring study conducted in the Frazer Valley, British Columbia, Canada approximately 10 kilometers north of the US-Canada boundary. This historical and conservative ammonia monitoring data has been applied by Washington for many years. The Anacortes refinery consists of 62 different stacks and sources. Many of the stacks only emit small amounts of air pollutants. Therefore, the NPS air quality impact analysis focused on only the large emitting stacks/sources. NPS grouped the emission points into 7 groups. Group 1: Crude heaters and CGS heaters; Group 2: Vacuum flash heater, Catalytic Cracker heaters, DIIT heater, and CFH heater; Group 3: Mai n Boiler; Group 4: N HT heaters; Group 5: Catalytic Reform heaters; Group 6: CCU Boilers; and Group 7: Small engines and points without stacks. The VOC-only sources were not modeled.	Branch, United States Department of the Interior, National Park Service, Air Resources Division Denver, CO

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	The CALPU FF outputs from the 7-stack scenario were run through the post processor POSTUTIL for both visi bility and acid deposition in separate runs. In the POSTUTIL visibility run, the option switch MNITRATE, which recomputes the HN03/N03 partition, was set = 1 so as not to overestimate the formation of particulate nitrate. The visibility impacts were modeled with CALPOST version 6.22 1 following the methodology found in the Federal Land Managers' Air Quality Related Values Work Group 2010 Phase I Report-Revised (2010 FLAG)[4] using Method 8, Mode 5. This Method incorporates background extinction coefficients which are computed from monthly concentrations representative of North Cascades, Olympic, and Mount Rainier NPs for ammonium sul fate (BKS04), ammonium nitrate (BKN03), coarse particulates (BKPMC), organic carbon (BKOC), soil (BKSOIL), elemental carbon (BKEC) and sea salt (BKSJ\LT). Monthly Relative Humidity Adjustment Factors for small and large S04 and NO3 and sea salt specific to North Cascades, Olympic, and Mount Rainier NPs from FLAG are also applied. The visible haze impacts for the present and future emissions scenarios for the 7-stack configuration impacts for North Cascades, Olympic and Mount Rainier NPs are found below. According to the 2010 FLAG, "[i]f this analysis indicates that the 98th percentile values for change in light extinction are equal to or greater than 5% [0.5 deciview] for any year, then the Agencies will further scrutinize the applicant's proposal." The nitrogen and sulfur deposition impact analyses used the POSTUTIL program which combines both the wet and dry deposition concentrations of the five species modeled (S02, S04, NOx, HNO3, and N03) to produce a deposit ion of both total sulfur and total nitrogen. Nitrogen and sulfur deposition impacts for the present and future emissions scenarios for the 7-stack Configuration impacts for North Cascades, Olympic and Mount Rainier NPs are discussed below. Modeled Impacts from Tesoro (Please see Appendix A for additional details.)	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:

Class I Area	Average 98th % Delta Deciview	Average Number of days with Delta-Deciview => 0.5	% of Modeled Extinction by Species							Deposition kg/ha/yr	
			% SO4	% NO3	% OC	% EC	% PMC	% PMF	% NO2	S	N
OLYM	1.691	61.7	13.1	76.9	3.7	0.0	1.1	1.9	3.3	0.003	0.014
NOCA	0.749	32.0	13.5	74.8	3.5	0.0	1.6	2.6	4.0	0.005	0.078
MORA	0.142	0.0	16.0	76.3	3.8	0.0	0.7	2.3	1.0	0.000	0.001

Olympic National Park

At Olympic NP, our modeling of annual average emissions predicted that the highest 98th percentile 24-hour visibility impact of 1.917 dv occurred with the 2003 meteorological data[5]; the 2003 through 2005 average of the 98th percentile values was 1.691 deciview (dv), and Tesoro's emissions caused visibility impairment each year. All three years modeled showed at least 53 days with impacts greater than 0.5 dv, with an average of 61.7 days per year. Nitrate was always the dominant species impairing visibility. Nitrogen deposition exceeded our Deposition Analysis Threshold (DAT)[6] each year 2003 through 2005, peaking at 0.016 kg/ha/yr based on 2003 meteorology; the average was 0.014 kg/ha/yr.

North Cascades National Park

At North Cascades NP, our modeling of annual average emissions predicted that the highest 98th percentile 24-hour visibility impact of 0.779 dv occurred with the 2005 meteorological data[7]; the 2003 through 2005 average of the 98th percentile values was 0.749 dv, and Tesoro's emissions caused or contributed to visibility impairment each year. All three years modeled showed at least 28 days with impacts greater than 0.5 dv, with an average of 32 days per year. Nitrate was always the dominant species impairing visibility. Nitrogen deposition exceeded our DAT each year 2003 through 2005, peaking at 0.192 kg/ha/yr based on 2003 and 2004 meteorology; the average was 0.0781 kg/ha/yr.

Mount Rainier National Park

At Mount Rainier NP, our modeling of annual average emissions predicted that the highest 98th percentile visibility impact of 0.179 dv occurred with the 2003 meteorological data[8]; the 2003 through 2005 average of the 98th percentile values was 0.142 dv, and Tesoro' s emissions did not cause or contribute to visibility impairment any year. All three years modeled showed no impacts greater than 0.5 dv. Nitrate

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	was always the dominant species impairing visibility, but less so than at Olympic or North Cascades. Nitrogen deposition did not exceed our DAT in any year, peaking at 0.0018 kg/ha/yr based on 2005 meteorology; the average was 0.0012 kg/ha/yr. We understand that, for this modification, the only PSD-applicable pollutants are particulate and GHG. The above modeling was done based on the current (2014 - 2015) annual emissions from the entire facility. The visibility comments provided here do not apply to the currently-proposed modification. However, given the significant visibility impacts of the entire Tesoro facility on North Cascades and Olympic NPs, we request that the Tesoro refinery should be considered for additional controls during the next Reasonable Progress phase of the Regional Haze Rule. The most significant contributor to the visibility impacts is NOx. For this reason we would also like to commend Tesoro and the Northwest Clean Air Agency on the addition of SCR on the new boiler and the permit limit of 9 ppmdv (corrected to 3% 02). Thank you again for providing the permit for comment. We look forward to working with both Washington Department of Ecology and Tesoro on future Reasonable Progress activities. [1] Act of Oct. 2, 1968, Pub. L. No. 90-544, §101. [2] National Park Service, 2015. Foundation Document: Mount Ranier National Park, Washington. [3] Kulesza, C., Y. Le, and S.J. Hollenhorst. 2013. National Park Service Visitor Perceptions & Values of Clean Air, Scenic Views, & Dark Night Skies; 1988-2011. Natural Resource Report NPS/NRSS/ARD/NRR-2013/632. National Park Service, Ft. Collins, Colorado. [4] 2010 FLAG, p. 23. See http://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf. [5] NPS modeled the 98th percentile values for 24-hour visibility impact using meteorological data from 2003-2005. [6] 2010 FLAG p. 66. "A DAT is defined as the additional amount of nitrogen or sulfur deposition within an FLM area, below which estimated impacts from a proposed new or modified source are considered negligible." Exceedance of a DAT increases concern about potential adverse effects of deposition on ecological resources. [7] NPS modeled the 98th percentile values for 24-hour visibility impact using meteorological data from 2003 - 2005.	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	[8] NPS modeled the 98th percentile values for 24-hour visibility impact using meteorological data from 2003 - 2005. **Ecology's Response to Comment 6:** As noted above in this comment, the NPS stated that "The visibility comments provided here do not apply to the currently-proposed modification." Please note that the TSD discussed visibility in Section 5.4.2 of the TSD. As stated in the TSD, "because Q/D is less than 10 for all areas in Table 27 [Class I areas], additional Class I AQRV impact analyses are not required." This comment did not result in a change to the permit.	
Comment 7	I live in Anacortes. I've lived here about 20 years. And I'm completely opposed to this permit. I've experienced the smells from the refineries; I know that the refineries are in the top ten of air polluters in our state, the whole state. They have, the company, Tesoro, has had a horrible safety record since they started operating the refinery that was built by another oil company. They had a horrible accident not too many years ago. We all remember it if you live here. Seven people died. The explosion just about knocked me out of bed and I live in Old Town. They were fined heavily. They were cited by the Department of Labor and Industries. And now they want to build some kind of equipment that's going to allow for even more toxic substance to be manufactured here on our island. I don't see the point at all. I'm not sure anybody here wants to wear xylene clothes. I don't. I know that. And just looking at the record that they've demonstrated since they've been operating the refinery, I don't think they can be trusted to operate in the safe manner. And it is incredibly toxic stuff, I looked it up on the Internet, and it's horrible stuff. And in order to contain the pollution, I mean, you already look at that whole March Point peninsula, you can imagine the pollution that's there. I was raised in Seattle when they converted an oil tank farm for use as a park. It took eight years to decontaminate it. How long is it going to take to decontaminate that peninsula? You know, we live with it every day. I'm, quite frankly, shocked that they had the nerve to ask this community to allow them to do this. And that's my opinion. **Ecology's Response to Comment 7:**	Bruce Baglien (verbal comment presented at the April 27, 2017 public hearing)

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	Ecology has confirmed with NWCAA, the facility has been in compliance with the current air permits. The PSD process also requires the review of expected impacts as they relate to health based standards. The project will control ship-loading emissions which will reduce the health risk by converting the VOCs to carbon dioxide and water. The NWCAA minor air permit will address emissions of air toxics per Washington Administrative Code (WAC) 173-460. The PSD permit addresses air emissions from the proposed project, not worker safety. Accidents and conditions at the site are regulated by labor and industries. This comment did not result in a change to the permit.	
Comment 8	I'm a Bellingham resident. I'm a little bit of an interloper. I happen to be the Environmental Superintendent at a competitor. And I'm here to tell you that as a competitor I like this project for a lot of reasons. So, first of all, a pretty significant reduction in VOC emissions by adding the vapor combuster on the dock to cover the emissions from the evaporate losses from transferring to and from ships. So I like that part. I also like that they're going to be able to hydro treat more of the naphtha range material. By hydro-treat I mean remove the sulfur. If you get the sulfur out, you get cleaner burning gas. What that does is it allows your catalyst that's on your car to work more efficiently on NOx, CO and hydrocarbons. And it lasts longer. You probably are like me. You're going to buy gas. And if you could buy gas that was better quality that emitted less, you'd probably prefer that. I do. So beyond that, if you go to the isomerization component of the project, that's the best thing you can do for gasoline. My company did this in 2004, and I think it's a good thing for Tesoro to do here. You can get benzene emission reductions by saturating the benzene. You can get octane boost by, that will help your car's performance, and you can also get better control over the vapor pressure to lower the evaporative emissions from fuel transfers and use and storage. There's a bunch of things that I like about this on the environmental side. On the economic side, there's a couple of things I like about this that should be encouraging for the residents and the county. If Tesoro's going to spend this much money to invest in a major capital	Steve Mrazek (verbal comment presented at the April 27, 2017 public hearing)

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	project, that means they're serious about being a presence for the long term. If they're here for the long term that means they need to be able to adapt and stay competitive internationally, so that's a good sign. When you look past that, if you have international competitiveness you have employment stability. If you have employment stability you have a tax base that you can count on year after year to run the county. Don't lose sight of the fact that the State of Washington is the most trade-dependent state. We make a lot of stuff, not just us and Tesoro, but a lot of companies make a lot of things that are consumed worldwide. We don't use all our material here, we export a lot. So transportation, and clean transportation infrastructure, are critical to the continued success on an economic front for the whole state. Thank you for your time. **Ecology's Response to Comment 8:** This comment provides the commenter's overview of the benefits of the project. This comment did not result in a change to the permit.	
Comment 9	I live in Bellingham. I am here with RE Sources but also representing myself and actually my grandchildren. And my request of all the regulators here is to be tough. And building on our last speaker, yes, there's some interesting economic things going on, but let's be candid here. In addition to the upgrade, and Tesoro is trying to sell this as an upgrade, they are introducing a whole new product line and a new profit center. And if they're doing 15,000 barrels of this stuff a day based on the current market prices in Asia, they may be looking at close to a billion dollars of revenue a year. Now, I don't have all the numbers, that number may be off somewhat, but you can be sure that if they're putting this much effort and money into this equipment there is an economic payback for them. One of the issues that I have is that Tesoro has what can be called perhaps a checkered past, in addition to the terrible accident several years ago that cost seven people their lives. They are currently under a consent decree with the EPA for $10-million dollars for many different infractions in complying with regulations. So based on some of this past history and what's at stake for us I, again, ask the regulators to be very tough, to check the computations they have. They did a lot of computations; oh, gosh, we don't need a new permit on this pollutant, we're just fine. And those computations are complex. And there are	Jane Bright (verbal comment presented at the April 27, 2017 public hearing)

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	lots of ways to game the system and I would ask you if you've checked them once, check them again. A couple of things that I am very concerned about, and again, this isn't a contest. Let me just read you one statement from the consent decree, it starts; whereas the compliant, the complaint alleges that Tesoro Refinery and Marketing Company violated, and continues to violate, at its Anacortes Washington Refinery the standards and performance for petroleum refineries and the national emission standards for benzene waste operations. And this goes on. And this consent decree is not just Anacortes, it's at other places as well in the Tesoro company. My areas of concern are several, starting with PM2.5, or what is called PM5, particulate matter that is so small it gets into our lungs, deeply into our lung tissue, and crosses into our blood stream. The health effects from this include premature death, non-fatal heart attacks, irregular heartbeat, asthma, decreased lung function, increased respiratory symptoms. And when there's spikes in these, you see an increase in the emergency room visits in local hospitals. And, as usual, the most vulnerable people are elders and small children. And we are right down the street here. This school is right down the street from that refinery. The other thing that is noteworthy in terms of the economic impact and benefit is that PM2.5, as well as acid rain and other things, has an ecological impact. And those include making lakes and streams acidic, changing the nutrient balance in coastal watersdepleting the nutrients in soil, damaging sensitive forest and farm crops, affecting the diversity of ecosystems. We are an agricultural and fisheries environment economy so that as well as refineries employing people, fisheries, and farms in both Whatcom and Skagit County count as well, and I would ask as you look at some of the economic issues here that that be taken into consideration. And one of my questions on PM2.5, and I don't know if you can answer it, is the information I have, which probably is not complete, looks at rates of emission as opposed to total tonnage. And PM2.5 has both short term and long-term effects. So one of the questions is how much total tonnage on an annual basis does PM2.5 change? And I have not been able to find that information easily. Another question is the monitoring. As I read it, the monitoring for stack testing is required every 20 quarters. And for any exceedances	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	or malfunction, it gets reported 30 days after the fact. And I would say given Tesoro's history, given the seriousness of the health effects from PM2.5 that the monitoring should be much, much more stringent and more frequent. There's also a requirement to basically mail it in, or email it in. I think that this information should be online and accessible to the public at all times. It should be current. Another area of concern is greenhouse gases. In one part of the Tesoro discourse they talk about some remediation being to expensive. Again, I would say this is a brand new profit center that they're creating and too expensive for what is one of the questions. They're also relying on natural gas to manage greenhouse gases. And if you don't look at that cradle to grave you're missing a lot of the greenhouse gases. As we all know there are a lot of natural gas is coming to us by way of fracking. And some fracking operations are pretty good when it comes to methane escaped. Some of them are terrible, and I again, think that the entire source of natural gas that is going to be used and needs to be evaluated if we're going to take a serious look at greenhouse gases. Two other areas, a question about what is ammonia? By my calculations it increases 15% but I don't see any additional oversight, I don't see that if there's a current permit, it has to be on altered in any way. Again, ammonia is a very serious product to be working with, and that needs to be managed. And then, I can never say this, percoethylene. This was one of the things, one of the violations they have in the consent decree involves the benzene waste operations and the perc is used in that. So I am surprised that there aren't more monitoring and controls on perc. And then I know this is an air permit, but one of the serious issues, obviously is exposure of xylene for workers. They're much more apt to be hurt by xylene than the general public, frankly, and again, given the history here I don't know how we get OSHA involved, but we need to be looking not only at public health, but at worker health and at worker safety. And so my question for the regulators is other than more air pollution and threats to our farms and fisheries, what's in it for Washington State? Any of the proceeds, the net proceeds are going to end up in	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	Texas. They're not going to end up in Washington. So we're counting on you to protect us because there's a lot at stake here. Thank you. **Ecology's Response to Comment 9:** Ecology's proposed PSD permit incorporated the high standards the state of Washington has adopted for this type of air source. We have required the refinery to use the Best Available Control Technology (BACT) for their project. BACT was required for greenhouse gases. The PSD process also requires the review of expected impacts as they relate to health-based standards. The project will control ship-loading emissions, which will reduce the health risk by converting the VOCs to carbon dioxide and water. Accidents and conditions at the site are regulated by labor by the Washington Department of Labor and Industries. Air emissions from the proposed project are addressed in the PSD permit. The BACT analysis for $PM_{2.5}$ is discussed in Section 4.2 of the TSD. As noted in Table 19 of the TSD, this project will include 21.6 tons per year of $PM_{2.5}$. Compliance monitoring is required in the permit in Section VIII. GHG emissions are discussed in Section 4.2.7.3 of the TSD. The other pollutants mentioned in the comment (ammonia, PERC, benzene, xylene) do not directly trigger PSD review and are not part of the proposed PSD permit. The NWCAA minor air permit will address emissions of air toxics per WAC 173-460. Additional impacts of the proposed project are discussed in Section 6 of the TSD. This comment did not result in a change to the permit.	
Comment 10	We have roughly 20,000 supporters in the northwest Washington region. Our mission is to, well, we engage in public education and advocacy that will protect the health and ecosystems of the area. And generally I just like to serve as a watchdog and check on these sort of processes and operations of the refinery. And I'd like to thank the Northwest Clean Air Agency and Department of Ecology for holding this hearing and making this publicly accessible.	Edward Ury, Resources for Sustainable Communities, Bellingham, WA (verbal comment presented at the April 27,

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	So, you know, why are we, what are we looking at here. I guess I'll also preface by, you know, before getting to my comments about the air permits, that we are, of course, submitting comments on the direct environment impact statement. And, you know, as my friend over here Steve Mrazek said there is a lot to like about this project. We do like to see that this marine vapor control system would reduce volatile organic compounds. I do, of course, like to see the upgrades to have a cleaner burning fuels with lower sulfur content, to be in line of course, with the EPA Tier 3 standards. One of the main points of our comments on the draft EIS, is that what we're looking at here is an aggregation of different projects that are actually not all together necessary in that you don't have to do all of the components to do some of them. Granted they are tied together in certain ways. What we are hoping to see in the final EIS, is an alternative which has the clean products upgrades components, not the hydrotreater, the MVEC, but not, most likely not the ARU, not the components to, that are there for the purpose of processing, extracting mixed xylenes and exporting overseas, which of course, leads to major increases in impacts whereas some of the other components reduce impacts. I'd like to see an alternative on the table for permitting agencies to consider to permit the projects that reduce impacts and not the ones that increase air pollution, water pollution, more vessel traffic, and all the risks that come with that. So there may be a stage in the process where, you know, if that is an alternative being considered in the final that may effect in terms of the PSD permit, but probably not in a way that would, you know, it would – if you're going to permit it as is now there would be no reason not to with a lower impact, right? **Ecology's Response to Comment 10:** This hearing was for Ecology's proposed PSD permit for Tesoro's Clean Products Upgrade Project (CPUP). Ecology is only responding to comments on the proposed PSD permit. Tesoro includes adding a unit to make products that can be added to gasoline to increase the octane in the gasoline they produce at the refinery. The PSD permit program does not allow Ecology to step in and change the applicant's project. The PSD program carefully reviews the proposed project to ascertain if emission will significantly impact ambient air. Ecology has analyzed this part of the project and included permit requirements that is protective of the environment.	2017 public hearing)

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	This comment did not result in a change to the permit.	
Comment 11	So I was reading through the technical support document for the PSD permit and one thing really stood out to me, and all the more so given that, you know, I guess the reason we thought this was the clean products upgrade in large part is that it's a lower sulfur dioxide emissions coming out of our automotive vehicles, right? And yet this project, according to the TSD says that and into the draft EIS would result in a net tripling of sulfur dioxide concentrations in the Tesoro facilities in the sights of measurement for the model. So projected estimated emissions for sulfur dioxide as well as nitrogen oxides could be actually be above the significant emission rate. If the onsite emissions are accounted for, including the extra emissions coming from reformate vessel unloading extra added vessel traffic coming from the xylene component of the project. So the proposed project increases for sulfur dioxide is 39.3 tons per year. That's just shy of the significant emission rate of 40 tons per year. But the vessel shipment's emissions are shown at 0.9 tons per year sulfur dioxide, just from unloading, and that's not including, of course, the passages through the Salish Sea which I think is about four tons a year, and not accounting for, of course, is the transpacific trip in which some massive quantities of air pollutants are emitted by these large transocean vessels. So just if you add 0.9 plus 39.3, that's 40.2, that's above the significant emission rate. And I may be mistaken, and maybe I'm hoping folks from the agencies or Tesoro can clarify this for me, and that it looked to me, from the math, like the vessel emissions were not being included as the total project emissions increases. And I think that you might argue that if you did include them right, the background, the baseline level, would be slightly higher. **Ecology's Response to Comment 11:** When determining PSD applicability, only stationary air sources of emissions are included. Unloading activities at a facility are secondary sources. The following excerpts from the Tesoro PSD application prepared by Barr describe the MVEC: "Displaced vapors associated with new refinery loading activities of mixed xylenes product, in addition to vapors from existing gasoline-range materials and crude oil loading operations, will be routed to a	Edward Ury, Resources for Sustainable Communities, Bellingham, WA (verbal comment presented at the April 27, 2017 public hearing)

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	new MVEC System to control hydrocarbons emissions, which are regulated as VOCs. The displaced marine vessel vapors will be collected by vapor hoses and routed to a Dock Safety Unit (DSU) that will be stationed on the wharf structure. The DSU is an essential piece of the overall MVEC System to ensure the safety for the ships, vessels and the overall MVEC System. Included in those safety requirements is a new 3" natural gas supply line to the DSU to supply enrichment gas for non-inerted vessels, supplied via an existing natural gas source from within the refinery. The vapors exiting the DSU will be routed through an existing line available on the wharf/causeway structure, to the new Vapor Combustion Unit (VCU) located in the refinery. Natural gas will also be added as support gas to assist combustion in the VCU during loading of inerted vessels." As explained in the response to Comment 24, projected emissions for SO_2 and NO_X are not above significant emission increases rates that trigger PSD. The State Environmental Protection Act (SEPA) review, which may include an Environmental Impact Statement (EIS), does include other sources that are not included when determining PSD applicability for a pollutant. This comment did not result in a change to the permit.	
Comment 12	And moreover, we see the toxic air pollutant modeling results show that sulfur dioxide would also be very close to the acceptable source impact level, looking at 570 micrograms per cubic meter. The limit would be 660 for one-hour averaging periods. And according to the Northwest Clean Air Agency modeling in the draft EIS it also shows that the sulfur dioxide emissions are very, very close; 190 micrograms per cubic meter, that's a tripling upfront, 58 at the background, which is very, very close to the ambient air quality standard significant impact level of 196. Six micrograms per cubic meter, that's pretty close, so maybe if there's a slight error there, especially if you factor in the themes coming off. Just looking at the one-hour averaging periods right before things disperse, but for better or worse, like what that would do is it would put you over the SIL. And, of course, that might mean you're in violation of regional haze requirements. You would also be required to perform some soil and water deposition analyses, probably for both sulfur dioxide and for nitrous oxides. So just something that stood out to me, and I'm just kind of a layman reading through these things, but I'm hoping to see that maybe that can get	Edward Ury, Resources for Sustainable Communities, Bellingham, WA (verbal comment presented at the April 27, 2017 public hearing)

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	addressed someone can answer this question after this hearing, but I will be submitting that in our comments. **Ecology's Response to Comment 12:** This project did not trigger Tier 2 health risk analysis. The applicant performed modeling as part of the application. The modeling results demonstrated that the National Ambient Air Quality Standards (NAAQS) would not be exceeded, the amount of increment consumed was acceptable for the PSD program, and the Class I areas were not significantly affected per the PSD requirements and the Federal Land Managers Work Group (FLAG 2010) guidance for particulate matter (PM). This comment did not result in a change to the permit.	
Comment 13	And, of course, we want to look at cumulative impacts as much as possible when you look at these things and consider what are these other things going on in the background actually influence, you know, the background concentrations of air pollutants. **Ecology's Response to Comment 13:** The PSD reviewed impacts of the proposed CPUP, and found the proposed project was below the Class I and Class II SILs for PM_{10} and $PM_{2.5}$. Specifically, as discussed in Section 5.4.2 of the TSD: "Because Q/D is less than 10 for all areas in Table 27, additional Class I AQRV impact analyses [deposition analysis] are not required. …., because project impacts are not greater than the SILs, a full impact analysis (taking into account other increment consuming sources) is not required to demonstrate compliance with NAAQS and Class II PSD increments. NAAQS compliance is assumed and compliance with WAAQS is assumed by compliance with NAAQS." This comment did not result in a change to the permit.	Edward Ury, Resources for Sustainable Communities, Bellingham, WA (verbal comment presented at the April 27, 2017 public hearing)
Comment 14	And, of course, we are looking at a project that's within range of several class one areas, national parks, scenic areas, wilderness, national monuments, San Juan's. Granted, it's deemed to be below the required limits. It seems permissible, but we really want to look at these things carefully.	Edward Ury, Resources for Sustainable Communities, Bellingham, WA (verbal

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	Granted, the status quo pollution from the refinery does bring with it health impacts, visibility impacts, ecological impacts that we do deal with, you know, as a status quo in this part of the part of the state home to these four refineries. And so we're hoping, right, when we're doing these operations, right, they were always striving to do better, that we're improving, you know, we do want to keep the refineries here, we want to hold them to the highest standards, right? We want the highest standards for pollution control, we want the cleanest products we can make. And we want workers to be well compensated and be safe in the workplace. We know over the years that our friends in the United Steelworkers and Refinery Workers, Local 12591, they told me a lot of concerns they have with operations here. The, you know, certain hiring practices, you know, and we think we can be striving to be safer, and we're actually, my organization has a seat at the table right now in aprocess working with the unions pushing further the Washington State Department of Labor and Industry to improve its process safety management standards, modelling after some new standards that we've seen implemented in California. And, granted, this is a long process that's continuing, but of course, we do know what's at stake when things go wrong, of course, the horrific accident of 2010. We want to make sure that accidents don't happen, that leaks don't happen, and keep it in the pipes, right? And so, you know, given these highly volatile products that Tesoro is proposing to produce, compounded by, you know, the recent clean air act violation and the settlement agreement, and a general lack of information as to whether or not the chemical safety board's recommendations to implement the process safety culture, continuous improvement program has been successful. That's uncertain. We believe that the agencies here, Ecology and Northwest Clean Air should, through this permitting process, as much as possible ensure the prevention of any random emissions of the process other than stack emissions, ensure that all piping is sampled to prevent any random emissions that can impact worker safety and provide more focus on air emissions by requiring independent monitoring of process safety. So I hope to work some more things out and to be submitting comments in writing, but overall yeah, it may, depending on some things, it may be necessary to rework some parts of this permit before going ahead with it. So thanks again, and good evening. **Ecology's Response to Comment 14:** The PSD reviewed impacts of the proposed CPUP, and found the proposed project was below the SIL. Because project impacts are not greater than the SILs, a full impact (i.e., cumulative) analysis (taking	comment presented at the April 27, 2017 public hearing)

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	into account other increment consuming sources) is not required to demonstrate compliance with the NAAQS and Class I PSD increments. The proposed project is considered in compliance with the NAAQS. The Q/d was also examined. The Q/d results are listed in Table 27 in Section 5.4 in the TSD. Accidents and conditions at the site are regulated by Washington Department of Labor and Industries. Ecology regulates the air emissions from the proposed project, and addressed those emissions in the PSD permit. This comment did not result in a change to the permit.	
Comment 15	I strongly urge you to deny the permit to Tesoro for their proposed new xylene plant, within the urban growth area of the city of Anacortes, Washington. The care and oversights are not strong enough to allow for such a dangerous new endeavor to be implemented, no matter the temptation for profit. Tesoro has a record of egregious and catastrophic safety and clean air violations. The Northwest Clean Air Agency is not inclusive in their oversight in my opinion. For an example that I have experienced, one cannot make a complaint about smelling air pollution from the refinery when one is conducting business or visiting in Anacortes, or driving by on Highway 20, depending on which direction the wind is blowing. The NWCAA can only accept complaints from a person who is living or employed at the specific site of the pollution odor. Compounding the inadequacy of this rule is that those who live or work where the pollution bathes them can lose their sense of smell. Olfactory loss can occur as a result of exposure to toxic air pollution. Permitting projects to capture vapors, increase octane and remove sulfur from gasoline are likely a net positive for our environment, if one assumes that the substantially increasing green energy economy will be terminated. This is not the case, however, looking with a clear lens at the world's current economy. De-link the permits for the cleaning of gasoline, and the xylene plant. The sandwiching of the permit items together seems like a marketing ploy to sneak it through. The addition of ramping up new facilities for	Joanna Idczak

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	a new product (xylene) makes the title of the permit an oxymoron: "Prevention of Significant Deterioration Permit". The (widely scoped) aggregate and cumulative negative effects of permitting the xylene project is simply a gamble too risky. Allowing the risks to sensitive areas and humans defies common sense from many aspects. Immediate and severe dangers would be present as well as long term harm. Ask the people from Zhangzhou, China, where three naphtha tanks exploded at a xylene plant on April 6th, 2015. Over 600 firefighters and a unit of their army battled the conflagration for three days. People 31 miles away felt the blast. That was the second explosion in two years at that plant. Mass protests in China over the toxicity and danger of the plants forced the shelving, delay and relocation of proposals. (BBC news) Why would we accept it here? Are we a "sacrifice zone"? Our heroic and publicly financed firefighters, in case of explosion and fire, would be stretched thin and concentrated in one place. Examine the map. Think of the school children, often downwind. Think of the evacuations that could be required, as in China's blast zone. Who would help with timely evacuations? Who would be available to help us with another emergency call issue, if needed, while they are over there? There are alternatives to fossil fuel based packaging and clothing. Tesoro desires to have a xylene plant in Anacortes. It does not need to have it. We do not need to have it. We do not want it. Please deny the permit. Thank You, **Ecology Response to Comment 15:** The regulatory authority for air emissions from the Tesoro refinery is the NWCAA. Ecology is issuing a PSD permit for the CPUP. The PSD program has a careful stepped analysis that has been completed, and from that effort, this proposed permit was drafted. For odor complaints at the refinery, Ecology must refer you to the NWCAA. Washington Department of Labor and Industries regulates the Process Safety within the refineries. In regards to the proposed PSD permit, the permit requirements are protective of the environment.	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	This comment did not result in a change to the permit.	
Comment 16	I have been a resident of Anacortes since 2004. I am strongly opposed to issuing permits to build a xylene production facility at the Tesoro refinery here. As the rest of the world tries to come to grips with the effects of man-made climate change it makes no sense to expand production to a highly explosive and potentially lethal product just to export it and make a profit. We can no longer allow the greed of a few people to trump the right for the many to a healthy, sustainable future. Any analysis of the true cost of transporting millions of gallons of explosive crude oil by rail all the way to Anacortes and then extracting the even more highly explosive xylene to make a profit in the export market is environmentally irresponsible, ridiculously expensive and exposes hundreds of thousands of people to serious harm or death. The true cost of this proposal to those of us that live here and breath the air is beyond comprehension. **Ecology Response to Comment 16:** The PSD program requires a careful stepped analysis that has been completed. The BACT analysis was completed. The PSD review was used to draft the proposed permit. The TSD discusses the process Ecology followed to develop the permit. The PSD process also requires the review of expected impacts as they relate to health-based standards. This comment did not result in a change to the permit.	Tony Idczak
Comment 17	I spoke at the April 27, 2017 public hearing on the air permit hearing and am submitting the following written comments. Thank you for the opportunity to provide written comments about the Tesoro "Clean Products Upgrade Project". I live downstream from this source of continuous air pollution and have been a public health advocate focused on reducing health hazards from toxics and pollution for 20 years. I know personally the health and financial costs of illnesses such pollution causes and appreciate the efforts and challenges of all those responsible for Tesoro's regulatory compliance.	Jane Bright

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	My ask of you is to be tough, thorough and to re-examine all of the computations and assumptions presented by Teosoro and their consultants as to what thresholds are being crossed that trigger new permits before issuing a final air permit. In addition, please strengthen the monitoring and maximize all available penalties. **Ecology Response to Comment 17:** The PSD process is a rigorous process. Ecology has determined that Tesoro has followed the PSD process and properly determined that only three pollutants trigger PSD. Those pollutants are $PM_{2.5}$, PM_{10}, and GHG. Ecology has worked closely with NWCAA regarding monitoring requirements for this permit. Any penalties issued will be issued by NWCAA. The PSD process also requires the review of expected impacts as they relate to health-based standards. The project will control ship-loading emissions, which will reduce the health risk by converting the VOCs to carbon dioxide and water. The NWCAA minor air permit will address emissions of air toxics per WAC 173-460. This comment did not result in a change to the permit.	
Comment 18	I also request that you examine the $10 million Consent Decree covering Anacortes in effect until October to see if it provides any additional tools to limit the pollution and/or increase monitoring and/or penalties for non-compliance. It is also a reminder of Tesoro's track record of non-compliance. The consent decree is available at https://www.epa.gov/sites/production/files/2016-07/documents/tesoro-cd.pdf Your work is vitally important as what is at stake is our health, the health of our children and the health of our elders. Worker's health and safety are at stake as well. **Ecology's Response to Comment 18:** Ecology's air rules are specific to stationary sources. These rules were followed in developing the proposed permit. Federally enforceable permit requirements were included in the proposed permit to be protective of the environment.	Jane Bright

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	Consent Decrees are court actions that require activities or reductions. If construction permits are issued based on the Consent Decrees, these requirements will be incorporated into the Title V air permit. This comment did not result in a change to the permit.	
Comment 19	Why do you need to be extra vigilant on this project? Tesoro is selling this project as an upgrade and we welcome all pollution reductions and the reductions of sulfur in gasoline the project provides. However, Tesoro has not been forthcoming that these major modifications will also provide a new and additional profit center from a toxic substance. By producing 15,000 barrels of Xylene per day, based on Xylene's selling prices on current Asian markets, it is estimated that they could reap approximately $1 Billion in revenue annually. Any assertions that BACT options are too costly need to be assessed within that context. It is also worth noting that the net proceeds go to Tesoro headquarters in Texas minimizing the economic benefits to Washington State, Skagit County and Anacortes. As you weigh the benefits of this project, please keep this in mind. Please also remember Tesoro has a track record of concern: The following is from the above sighted consent decree: "WHEREAS, the Complaint alleges that Tesoro Refining & Marketing Company LLC violated and/or continues to violate at its Anacortes, Washington, refinery the Standards of Performance for Petroleum Refineries, 40 C.F.R. Part 60, Subparts A and J and the National Emission Standard for Benzene Waste Operations, 40 C.F.R. Part 61, Subpart FF ("Subpart FF");" The public needs you to be vigilant and set the most protective air emission standards and highest penalties for non-compliance possible. We need the regulators to represent the citizens and protect us from those emission-caused health consequences that will result from increases of pollution in our air and ultimately in our lungs and bodies. **Ecology's Response to Comment 19:** Ecology's role is to determine if the project proposed by an applicant is able to be permitted. If the proposed project will result in exceedances to National Ambient Air Quality Standards (NAAQS), Ecology will not issue a PSD permit. In this case, Ecology's review	Jane Bright

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	found that the proposed permit would result in the proposed project meeting all state and federal air requirements. The BACT analysis does include cost considerations, but the applicant's ability to pay for the permit's BACT requirements is not a primary factor when determining economic feasibility (EPA 1990 NSR Workshop Manual Section IV.D.2. (p. B.31)). The permit includes monitoring and reporting requirements that will ensure the permit limits are enforced. This comment did not result in a change in the permit.	
Comment 20	**Areas of concern:** **1. Air pollution and health** While SO2, NOx and VOCs all have direct and indirect health consequences, I am particularly concerned about a significant increase in PM2.5. While the EPA must set limits that work for both industry and public health, medical research has shown any exposure to PM2.5 is detrimental. Given the increase in PM2.5 tonnage from this project and the long-term exposure consequences, averaged emission rates are inadequate to protect health. Therefore, if there is any way to also cap total tonnage, that would be beneficial to the public. For the record, let me remind you of **health effects from PM2.5** as summarized by the EPA Particles less than 10 micrometers pose the greatest problems, because they can get **deep into your lungs, and some may even get into your bloodstream**. Exposure to such particles can affect both your **lungs and your heart**. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: • **premature death in people with heart or lung disease** • **nonfatal heart attacks** • **irregular heartbeat** • **aggravated asthma** • **decreased lung function**	Jane Bright

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	• **increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.** People with heart or lung diseases, **children, and older adults** are the most likely to be affected by particle pollution exposure. In addition to increased medical bills from increased emergency room visits, asthma medications and other health costs, there are costs to the farming and fishing industries in Skagit County and Washington. EPA also details the effects from PM2.5 as follows: • making lakes and streams acidic • changing the nutrient balance in coastal waters and large river basins • depleting the nutrients in soil • damaging sensitive forests and farm crops • affecting the diversity of ecosystems • contributing to acid rain effects. **Monitoring** by testing once every 20 quarters is not protective or useful and a 30-day after-the-fact reporting requirement for a malfunction given the consequences is detrimental to the public. Tesoro should be required to monitor and report more often. All data should be online on the Tesoro Anacortes webpage and accessible to the public. http://tesoroanacorteseis.com/ The goal and practice should be to stop any overages in real time. In addition, given that PM2.5 increases substantially with this project, Tesoro should be required to do a soils and receiving water bodies deposition analysis. **Ecology's Response to Comment 20:** The PSD review requires modeling of the emissions. The modeling showed that the pollutants of concern were below the SILs. This information is discussed in the TSD in Section 5.2 for Class I areas. The modeling also included impacts to Class II areas in Section 5.4 of the TSD. In regards to monitoring frequencies, the permit writer considered options and found that the monitoring and reporting requirements placed in the permit would ensure the regulatory agencies have the	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	knowledge and timing of violations of the permit. It will be the responsibility of the facility to return to compliance, and test to demonstrate that the facility is back in compliance. The Northwest Clean Air Agency (NWCAA) minor permit will include additional monitoring requirements for the other pollutants to insure good combustion, which will minimize PM_{10} and $PM_{2.5}$ emissions. This comment did not result in a change in the permit.	
Comment 21	**2. GHG** **Tesoro's** claim that some remediation is too expensive needs to be reviewed in light of the fact that this project results in a profitable new product. What is of most concern, however, is the reliance on natural gas to meet the GHG requirements. Given the nature of GHGs and the worldwide geographic impact, you must also consider where and how the gas is sourced and how much GHG is released in the extraction, processing and transport of the gas before it reaches Tesoro. For example, there is increasing data that methane releases vary significantly from different fracked gas sources with some operations generating significant amounts of concern. Excluding the methane and other GHGs from the source gives a distorted evaluation of the GHG compliance for this project. **Ecology's Response to Comment 21:** The facility has the choice on which approach they will take to meet GHG requirements. In this case, the facility is using natural gas. The permit addresses the emissions involved with this approach. The PSD process only can evaluate the emissions associated with the Anacortes facility project. The PSD regulations are clear that they apply only to major stationary air sources. Ecology followed our regulations and discuss the PSD process in Section 2.1 in the TSD. This comment did not result in a change in the permit.	Jane Bright
Comment 22	**3. Ammonia** It appears that Ammonia will increase approximately 15% but that increase is insufficient to trigger a new permit requirement. However,	Jane Bright

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	given the consequences of mishandling ammonia, I believe an audit of current practices and permit compliance and safety should also be required. **4. Perchloroethylene** Included in the settlement between the EPA and Tesoro is information that they violated the National Emission Standard for Benzene Waste Operations. Since it appears there will be an increase in Perchloroethylene as part of a Benzene Saturation Unit it would seem additional oversight and monitoring would be appropriate. **Ecology's Response to Comment 22:** Ammonia and perchlorate are not PSD regulated pollutants. These pollutants are regulated by NWCAA under WAC 173-460. The NWCAA minor permit has included monitoring requirements for ammonia. This comment did not result in a change in the permit.	
Comment 23	**5. Worker Safety** As you know, Tesoro has also violated OSHA laws. Given that health effects from Xylene are most likely to effect workers, the question is what can be done pro-actively to insure practices and procedures protect those most likely to be exposed. I understand this is an air permit, but as representatives acting on the public's behalf, it would seem that you have an opportunity if not an obligation to raise worker safety issues with whatever authorities have jurisdiction if worker safety and health have not already been addressed. **Conclusion:** Thank you. We all appreciate the benefits of temporary construction jobs and the permanent jobs this project would create as well as the project's several environmental benefits. For those not directly employed, however, the PM increases will also increase diseases in the community and threaten our farms and fisheries, Washington residents	Jane Bright

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	who pay the price at the emergency room with asthma and heart attacks are counting on you to protect us. We thank you for doing this tough and vital work on our behalf. **Ecology's Response to Comment 23:** The PSD permit addresses air emissions from the proposed project, not worker safety. Accidents and conditions at the site are regulated by the Washington Department of Labor and Industries. The Washington Department of Labor and Industries regulates the Process Safety within the refineries. NAAQS as provided from EPA have two classes of standards: primary standards and secondary standards. "Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings." As described on pages 30-32 and tables 26 and 27 of the TSD: "because project impacts are not greater than the SILs, a full impact analysis (taking into account other increment consuming sources) is not required to demonstrate compliance with NAAQS and Class II PSD increments. NAAQS compliance is assumed and compliance with WAAQS is assumed by compliance with NAAQS." Also, emissions from this project were below the threshold to trigger a full ozone analysis. This comment did not result in a change in the permit.	
Comment 24	Thank you for accepting our comments regarding the Prevention of Significant Deterioration (PSD) permit for the Tesoro Anacortes Refinery. *RE Sources for Sustainable Communities* (RE Sources) promotes sustainable living and protects the health of northwest Washington's people and ecosystems through the application of science, education, advocacy and action. Our vision is to see people living satisfying lives in accord with the ecosystems we depend on – generation after generation.	Eddy Ury Clean Energy Program Manager RE Sources for Sustainable Communities Bellingham, WA

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	The Tesoro Anacortes Refinery "Clean Products Upgrade Project" (CPUP) raises a number of concerns for our mission. While components of the project bring clear benefits to reduce source emissions and produce lower-sulfur fuel products, the production and export of mixed xylenes will bring significant risks and impacts. The Marine Vapor Emissions Control (MVEC) has been aggregated with the Aromatics Recovery Unit (ARU), storage tanks and the Isomerization unit to offset the source impact from Volatile Organic Compounds (VOC) and other pollutants, so as to ensure net impacts stay below regulatory limits. The Naptha Hydrotreater upgrade (NHT) is necessary for Tesoro to comply with EPA's Tier 3 standards for gasoline, and has been aggregated with the expansions for xylenes production so that the project as a whole can be dubiously referred to as a "Clean Products Upgrade." We will be requesting in our SEPA comments that the Final EIS (FEIS) include an alternative proposal for consideration, to include the NHT and MVEC upgrade components only. Be advised that should agencies select this alternative, adjustments to content in the Prevention of Significant Deterioration (PSD) permit could be necessary. Please consider our comments below regarding the Draft PSD: Though the benefits of this project are deemed to produce low-sulfur fuels to comply with EPA Tier 3 standards, data in the DEIS and TSD seems to show that this project would result in a tripling of Sulfur Dioxide concentrations at Tesoro's facilities. NCAA Modeling (Draft EIS Table 4-9) shows background concentrations at 58 micrograms per cubic meter for 1-hour averaging period. The addition from the proposed project is modeled to show a Total Concentration of 190, three-fold increase. Project Estimated Emissions for sulfur dioxide (SO2) as well as nitrogen oxides (NOx) may be above the Significant Emission Rate (SER). The Proposed Project Emissions Increase for SO2 is 39.3 tons per year (tpy), just shy of the 40 tpy SER. Vessel Shipments Emissions are not included in the Proposed Project Emissions, though they are modeled in the Draft EIS (Table 4-12) at 0.9 tpy SO2 from unloading. Emissions from vessels at berth ("dockside") are considered primary emissions for applicability purposes, as a result of a court decision in NRDC v. EPA, 725 F.2d 761 (D.C. Circuit 1984). If onsite emissions from dockside reformate vessels unloading (as a direct operation requirement for the proposed project) are added to the projected stationary source emissions, this brings the total increases above the Significant Emissions Rate.	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	Ecology's Response to Comment 24: Ecology has found that the applicant followed appropriate PSD procedures when determining which pollutants trigger PSD, as explained in the TSD. The only pollutants that trigger PSD review for this project are GHG, $PM_{2.5}$, and PM_{10}. Ecology provides the following two reasons as to why SO_2 emissions of 0.9 tons per year from vessel unloading emissions were not added to the other SO_2 emissions from this project. First: WAC 173-400-710 specifically requires that Ecology use the definition of secondary emissions as defined in WAC 173-400-030. Secondary sources of emissions are not included when considering PSD applicability of stationary sources. Because Tesoro vessel unloading emissions are from a secondary source and not a stationary source, they do not need to be included for PSD applicability considerations. Second: Tesoro has provided the following information which shows that unloading activities emit only 0.004 tpy of SO_2 instead of 0.9 tons per year. If the 0.004 additional tpy of SO_2 were added to the 39.3 tpy, the total SO_2 from the project would still be below the 40 tpy PSD threshold, and would not trigger PSD permitting requirements. However, as stated earlier, SO_2 unloading emissions do not need to be added to this PSD project's total SO_2 emissions. A similar argument holds true for NO_X. If the EIS estimated emissions of NO_X from unloading (2.1 tpy) were added to the PSD proposed project increases (36.7 tpy), it would only sum up to 38.9 tpy, which is below the 40 tpy PSD significant emission increase trigger. However, as a secondary emission, the 2.1 tpy of unloading estimated in the EIS are not added to the stationary source total of 36.7 tpy. Ecology provided a clarification to the ambient impact analysis results in Tables 26 and 27 of the TSD, which include the secondary emissions from offloading of reformate. This comment does not result in a change to the permit. ---As provided from Tesoro to Ecology on June 1, 2017---:	

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	"Tesoro calculated much lower SO_2 emissions, based upon the fuel that is actually burned in the engines (ultra-low sulfur diesel) located on the barges. Emissions of SO_2 from vessel unloading can be estimated based upon the emission factor, expected unloading rate, and diesel engine operating rates: • The emission factor of 8.09E-03*S lb/hp-hr is from AP-42 Table 3.4-1, where S is in units of % sulfur. Ultra-low sulfur diesel contains 15 ppmw of sulfur (0.0015%). The resulting emission factor is 1.2E-05 lb/hp-hr. • The total volume of reformate received will be 7,200,000 bbl/yr. There are assumed to be 4 pumps on each Articulated-tug Barge (ATB) (rated at 450 hp each (1800 hp total), and the combined pumping rate is 18,000 bbl/hr. At this rate, unloading activities would occur 400 hours/year. The engines' operational rate is 720,000 hp-hr. • Total SO_2 emissions = (1.2E-05 lb/hp-hr) * (720,000 hp-hr) = 8.7 lb/yr = 0.004 tons/yr. Additionally, of the 60 marine vessel trips per year expressed in the Draft EIS, reformate deliveries represent about 40 trips per year (barge) with the remaining 20 representing the xylene shipments to Asia. Emissions associated with loading xylene is expressed in the PSD application under the Marine Vapor Emission Control System (MVEC)." ---End of Tesoro clarification information----	
Comment 25	Moreover, Toxic Air Pollutant (TAP) Modeling (DEIS Table 4-10) results show that SO2 would be close (570/660) to the acceptable source impact level (ASIL) for one hour averaging periods. NCAA Modeling (DEIS Table 4-9) shows SO2 emissions very close (190/196) to the Ambient Air Quality Standards (AAQS) for one hour averaging period. A slight increase of only six micrograms per cubic meter in the Background Concentration of SO2 from increased vessel traffic in the area (from direct impacts if not cumulative impacts for the CPUP) would set the Sulfur Dioxide concentration over the ASIL and the AAQS, and may be in violation of Regional Haze requirements. Tesoro should be required to perform deposition	Eddy Ury Clean Energy Program Manager RE Sources for Sustainable Communities Bellingham, WA

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	analyses for SO2 and NOx on soils and receiving water bodies within 200 km of the Tesoro Facility. **Ecology's Response to Comment 25:** This project did not trigger Tier 2 health risk analysis. Also, as discussed in Section 5.4.2 of the TSD: "because Q/D is less than 10 for all areas in Table 27 [Class I areas], additional Class I AQRV impact analyses [deposition analysis] are not required." This comment does not result in a change to the permit.	
Comment 26	Tesoro is seeking permits from the Northwest Clean Air Agency that address the project's potential impacts on air quality. I live directly across from the refinery. When wind comes from the east, I can smell the pollutants. At night, there is a high-pitched whistle. During the height of summer, doors and windows must be shut. Environmentally, Tesoro is already discharging tons of waste water pollutants annually into Fidalgo Bay. The bay's sea food-clams and crabs- are toxic and its beaches are carcinogenic. I'm not opposed to the concept of Tesoro's clean products upgrade, I would like to see Tesoro clean up its act-but not at the expense environmentally and ecologically of allowing the xylene project to go forward. To be against the overall upgrade is like being against "the flag, mom and apple pie." That is why Tesoro so artfully crafted this as a "Clean Products Upgrade" and tied it to the xylene project. Tesoro is saying: "We're willing to clean up our products, if you give us the xylene in exchange." Do not allow this to be a hostage-like negotiation. Just say "NO" to xylene production. Tesoro's actions constitute a bait and switch to allow exporting of larger amounts of oil and refinery products overseas. If the clean air initiative results in more oil trains, it will lead to dirtier air in Anacortes and surrounding environs because of increasing diesel train pollution. Further, the idea that sending xylenes to Asia increases clean air is ridiculous. It only shifts the point of air pollution from Washington state to points west.	Carol O'Hearn

Comment #	Appendix A. Ecology's Response to Comments Comment or Question	Comment from:
	Tesoro experts say "the proposed action will increase marine vessel traffic by approximately 5 vessels per month." That is 60 a year. Please do the math. I'm outraged that Tesoro calls this "clean" products upgrade. It is the height of public relations spin and an oxymoron. Oxymoron means a combination of contradictory or incongruous words. This is heavy on the "moron." It is a p.r. effort on Tesoro's part to put a positive spin on a disaster in the making. Is the state of Washington going to be complicit in the disaster? Are humans, the fragile ecosystems and wildlife to be collateral damage? Just who does Tesoro consider the "morons"? The public for believing this!! Just Say No to the xylene production. **Ecology's Response to Comment 26:** Ecology has reviewed the information submitted by Tesoro, and written a PSD permit that complies with the PSD permit program. The PSD permit includes federally enforceable requirements and is protective of the environment. Ecology reviewed the comments received during the public comment period to determine if the proposed PSD permit would require any changes. After review, Ecology found that the proposed PSD permit did not require any changes. Therefore, Ecology intends to issue the PSD permit once the SEPA process has been completed. This comment does not result in a change to the permit.	

Message

From: Hardesty, Doug [Hardesty.Doug@epa.gov]
Sent: 5/3/2018 7:17:34 PM
To: Bray, Dave [Bray.Dave@epa.gov]
Subject: FW: PCA Wallula Updated Air Dispersion Modeling Protocol
Attachments: PCA Wallula PSD Modeling Protocol v2.0.pdf

Doug Hardesty
208.378.5759
Air Permit Program Lead
Stationary Source Unit, Office of Air and Waste, U.S. EPA, Region 10
950 W Bannock St, Suite 900, Boise, Idaho 83702

From: Anna Henolson [mailto:AHenolson@trinityconsultants.com]
Sent: Tuesday, December 19, 2017 5:25 PM
To: Marc E. Crooks <marc.crooks@ecy.wa.gov>; Dhammapala, Ranil (ECY) <rdha461@ecy.wa.gov>; Ghidey, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>
Cc: McAlpine, Jerrold <McAlpine.Jay@epa.gov>; Lim, MengChiu (ECY) <mlim461@ECY.WA.GOV>; Hardesty, Doug <Hardesty.Doug@epa.gov>; John Notar <john_notar@nps.gov>; Tonnie Cummings (tonnie_cummings@nps.gov) <tonnie_cummings@nps.gov>; Miller, James - FS <jamesmiller2@fs.fed.us>; Anna Henolson <AHenolson@trinityconsultants.com>; Aaron Day <ADay@trinityconsultants.com>; Holtrop, Bryan <Holtrop.Bryan@epa.gov>; Piotrowski, John <JPiotrowski@packagingcorp.com>; Butkus, Paul <PaulButkus@boisepaper.com>; charlestonramos@boisepaper.com; Courtney O'Gorman <COGorman@trinityconsultants.com>; McFadden, Kelly <McFadden.Kelly@epa.gov>; d King <kirsten_king@nps.gov>; Inloes, Scott (ECY) <SINL461@ECY.WA.GOV>
Subject: PCA Wallula Updated Air Dispersion Modeling Protocol

Hello Marc, Ranil, and Tes,

Please find attached the updated PCA Wallula air dispersion modeling protocol.

If you have any questions, please do not hesitate to call me at 253-867-5600.

Best Regards,
Anna

ANNA HENOLSON, P.E., C.M. | Managing Consultant
Trinity Consultants | 20819 72nd Avenue S., Suite 610 | Kent, WA 98032
P: 253.867.5600 | F: 253.867.5601 | E: ahenolson@trinityconsultants.com

PROJECT REPORT

Packaging Corporation of America > Wallula Mill

Air Dispersion Modeling Protocol

Prepared By:

Anna Henolson P.E., C.M. – Managing Consultant
Aaron M. Day, P.E. – Principal Consultant
Courtney O'Gorman – Consultant

TRINITY CONSULTANTS
20819 72nd Avenue South
Suite 610
Kent, WA 98032
(253) 867-5600

December 2017

Project 174801.0058

Environmental solutions delivered uncommonly well

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 1-1

2. PROJECT DESCRIPTION 2-1

3. MODELING METHODOLOGY 3-1

3.1. Modeled Pollutants and Averaging Periods 3-1

3.1.1. Short Term Averaging Period 3-1

3.1.2. Annual Averaging Period 3-1

3.2. Significance Analysis 3-1

3.3. Prevention of Significant Deteroriation Requirements 3-2

3.3.1. PSD Air Quality Related Values Analysis 3-3

3.3.2. Visibility Impact Analysis 3-5

3.3.3. Class I PSD Increment Analysis 3-5

3.3.4. Secondary $PM_{2.5}$ and Ozone Analysis 3-6

General form of MERP equation: 3-8

Ozone MERP equations for Boardman (500 tpy, Low Stacks): 3-8

3.4. Meteorological Data 3-9

3.5. Terrain Elevations 3-13

3.6. Coordinate System 3-13

3.7. Ambient Air Boundary 3-13

3.8. Receptor Grids 3-16

3.9. Building Downwash 3-17

3.10. Rural and Urban Considerations 3-18

4. MODELING EMISSION INVENTORY 4-1

4.1. No. 3 Paper Machine Rebuild Project Emission Sources 4-1

4.1.1. Point Source Parameters 4-1

4.1.2. Fugitive Source Parameters 4-1

4.1.2.1. Haul Roads 4-1

4.1.2.2. Storage Piles 4-2

4.1.2.3. Fugitive Drop Points 4-2

4.1.3. Source Emission Rates 4-2

4.2. Background and Nearby Source Inventory 4-2

5. TIER 2 NO_2 APPROACH A-1

APPENDIX A: EPA DRAFT SIL GUIDANCE A-2

APPENDIX B: Q/D CALCULATIONS B-1

APPENDIX C: QUALITY ASSURANCE PLAN C-1

APPENDIX D: SOURCE PARAMETERS D-1

ED_013256A_00000458-00002

LIST OF FIGURES

Figure 3-1. Nearest Class I Areas 3-4

Figure 3-2. Locations of Nearby Surface Stations 3-11

Figure 3-3. Onsite Station Windrose (1995-1999) 3-12

Figure 3-4. Tri-Cities Airport Station Windrose (2011-2015) 3-12

Figure 3-5. Ambient Air Boundary for Annual Modeling 3-14

Figure 3-6. Ambient Air Boundary for 24-Hour Modeling 3-15

Figure 3-7. Receptor Grids 3-17

ED_013256A_00000458-00003

LIST OF TABLES

Table 2-1. Initial Project Emission Increase Summary 2-3

Table 3-1. Significance Levels, NAAQS, and PSD Class II Increments 3-2

Table 3-2. Q/d Analysis (Future Short Term Allowable Emissions minus Baseline Annual Actual Emissions) 3-5

Table 3-3. Applicable Class I PSD Modeling SILs 3-6

Table 3-4. Ambient Concentration Comparison 3-8

Table 3-5. Onsite Station Meteorological Data Quality 3-9

ED_013256A_00000458-00004

1. EXECUTIVE SUMMARY

Packaging Corporation of America (PCA) owns and operates a kraft pulp and paper mill and corrugated container plant located in Wallula, WA (the Wallula mill). PCA is proposing to rebuild its No. 3 Paper Machine in order to increase its design capacity. This modeling protocol addresses proposed modeling methodologies that will be used to demonstrate that the criteria pollutant emissions from the No. 3 Paper Machine rebuild will not cause or contribute to a violation of the National Ambient Air Quality Standards (NAAQS) or Prevention of Significant Deterioration (PSD) increment. PCA submitted a preliminary version of the modeling protocol on December 1, 2017, which received comments and questions from the reviewing authorities. PCA is submitting this updated air dispersion modeling protocol to the Washington Department of Ecology (Ecology) for approval of the modeling methodology.[1]

All methodologies will follow the EPA's Guideline on Air Quality Models (the Guideline).[2] United States Environmental Protection Agency's (EPA's) American Meteorological Society / Environmental Protection Agency Regulatory Model (AERMOD) is the air dispersion model chosen for the demonstration. For nitrogen dioxide (NO_2) modeling, the Ambient Ratio Method 2 (ARM2) option in AERMOD is selected for predicting the conversion of nitric oxide (NO) to nitrogen dioxide (NO_2).

The No. 3 Paper Machine rebuild project is expected to trigger PSD permitting requirements for particulate matter less than 10 micrometers (PM_{10}), particulate matter less than 2.5 micrometers ($PM_{2.5}$), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), total reduced sulfur (TRS), and greenhouse gases (GHG). PCA will demonstrate compliance with the PSD requirements by completing a compliance demonstration for the NAAQS and PSD increment as applicable for each pollutant.

This modeling protocol includes the following elements:

- Section 2. Project Description
- Section 3. Modeling Methodology
- Section 4. Modeling Emission Inventory
- Section 5. Tier 2 NO_2 Approach
- Appendix A: EPA Draft SIL Guidance
- Appendix B: Q/d Calculations
- Appendix C: Quality Assurance Plan
- Appendix D: Source Parameters

[1] Some questions from the National Parks Service's review of the preliminary modeling protocol related to the project description and baseline emission rates. These will be addressed in the upcoming PSD application's description of emission calculations.

[2] Guideline on Air Quality Models; Final Rule, 40 CFR Part 51, Appendix W, January 17, 2017.

ED_013256A_00000458-00005

2. PROJECT DESCRIPTION

Packaging Corporation of America (PCA) owns and operates a kraft pulp and paper mill and corrugated container plant located in Wallula, WA (the Wallula mill). The facility is located at 31827 U.S. Highway 12, Wallula, WA and operates under Air Operating Permit (AOP) No. 00369-7. PCA is proposing to rebuild its No. 3 Paper Machine in order to increase its design capacity. The No. 3 Paper Machine will be modified to increase capacity of this machine from approximately 1,000 machine-dried tons per day (MDT/day) of coated paper to 1,400 MDT/day of unbleached linerboard. The No. 3 Paper Machine is the only emission unit modified by the project. Future emissions from the No. 3 Paper Machine include particulate matter (PM), particulate matter less than 10 micrometers (PM_{10}), particulate matter less than 2.5 micrometers ($PM_{2.5}$), and volatile organic compounds (VOC). Current and historic emissions from the No. 3 Paper Machine also include NO_x and CO from paper machine dryer combustion. However, as part of the rebuild, the No. 3 Paper Machine dryer will be replaced with steam drums. The steam supply needed by these drums will be supplied by the recovery furnaces as described in the following paragraph. PM, PM_{10}, and VOC emissions from the No. 3 Paper Machine will increase as a result of the project. However, $PM_{2.5}$ emissions will not increase, because $PM/PM_{10}/PM_{2.5}$ emissions per ton of paper produced is lower for kraft liner board than for the previously produced coated paper, and the decrease in the emission factor offsets the increase in production for $PM_{2.5}$.

The No. 3 Paper Machine rebuild project will result in associated emission increases at other parts of the mill to furnish the pulp used by the No. 3 Paper Machine. Any additional steam required by the project will be generated as a result of the increased utilization of the recovery furnaces and will not require additional firing from the power boilers.[3] On a short-term basis, the project will result in a daily increase in pulp throughput, but will not result in a short term increase in BLS throughput.

The following units will have associated emission increases from the project:

- No. 2 Recovery Furnace
- No. 3 Recovery Furnace
- No. 2 Smelt Dissolving Tank
- No. 3 Smelt Dissolving Tank
- Lime Kiln
- Black Liquor Tanks
- Brown Stock Washers
- Noncondensible Gas (NCG) Auto Vent
- Slaker
- Knot Tank
- Makedown Tank
- Deckers
- Softwood Storage Pile
- Sawdust Storage Pile
- Other Fugitive Emission Sources[4]

---

[3] Note that the power boilers and hog fuel boiler do not generate electricity. Any incremental increase in electricity demand will be purchased.

[4] Other fugitive emission sources include wastewater treatment, material handling drop points, blowers, and vehicle travel.

ED_013256A_00000458-00006

The following emission units will not be affected by the project:

- Neutral Sulfite Semi Chemical (NSSC) Pulping Process
- No. 2 Paper Machine
- No. 1 Power Boiler
- No. 2 Power Boiler
- Hog Fuel Boiler

The mill's bleach plant is a source of carbon monoxide (CO), VOC, and hazardous air pollutant (HAP) emissions that will be shut down prior to beginning operation after the No. 3 Paper Machine rebuild project. The bleach plant shutdown will result in a decrease of about 25 tons per year of VOC and 84 tons per year of CO based on actual, historical operation. Additionally, the No. 1 Paper Machine, a source of PM and VOC emissions, was recently shut down in December 2016. Emission reductions from shutting down the bleach plant sources and No. 1 Paper Machine are included in the calculation of the net emission increase from the project.

The No. 3 Paper Machine rebuild project is expected to trigger Prevention of Significant Deterioration (PSD) permitting requirements for PM_{10}, $PM_{2.5}$, nitrogen oxides (NO_x), carbon monoxide (CO), VOC, total reduced sulfur (TRS), and greenhouse gases (GHG). Table 2-1 below shows the initial estimates of the project emission increases from the No. 3 Paper Machine rebuild project.

ED_013256A_00000458-00007

Table 2-1. Initial Project Emission Increase Summary

Source	Emission Increase (tpy)										
	PM	PM_{10}	$PM_{2.5}$	SO_2	NO_x	VOC	CO	Lead	H_2SO_4	TRS	CO_2e
Emission Units											
No. 2 Recovery Boiler	0.00	0.00	0.11	0.00	0.00	0.03	38.14	4.66E-05	0.00	0.26	7,644
No. 3 Recovery Boiler	5.61	6.35	5.47	35.17	32.30	5.98	310.75	4.21E-04	0.22	0.86	97,596
No. 2 Smelt Dissolving Tank	1.24	1.29	0.95	0.00	0.00	0.00	0.00	3.28E-06	0.00	0.00	0.00
No. 3 Smelt Dissolving Tank	10.80	11.19	8.24	0.19	0.00	0.85	0.00	2.96E-05	0.00	0.39	0.00
Lime Kiln	0.00	0.00	0.00	0.00	13.93	0.36	4.05	1.39E-04	0.06	0.00	5,362
14%- Weak Black Liquor Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44%- Intermediate Black Liquor Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63%- Heavy Black Liquor Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brown Stock Washers	0.00	0.00	0.00	0.00	0.00	58.66	0.00	0.00	0.00	19.83	0.00
NCG Auto Vent	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.60	0.00
Slaker	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00
Knot Tank	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.02	0.00
Makedown Tank	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.01	0.00
Deckers	0.00	0.00	0.00	0.00	0.00	21.03	0.00	0.00	0.00	6.91	0.00
Paper Machine #3	0.77	0.77	0.00	0.00	0.00	16.42	0.00	0.00	0.00	0.00	0.00
Misc. Fugitive Emissions											
Storage Piles	0.32	0.16	0.06	0.00	0.00	2.67	0.00	0.00	0.00	0.00	0.00
Other	0.54	0.18	0.03	0.00	0.00	1.86	0.00	0.00	0.00	0.00	0.00
Emission Increases from Project	19.29	19.94	14.87	35.36	46.23	109.43	352.93	6.40E-04	0.29	28.88	110,602
Contemporaneous Decrease	-2.56	-2.56	-1.92	0.00	0.00	-35.59	-82.94	0.00	0.00	-1.17	0.00
Net Emissions Increase	**16.73**	**17.38**	**12.95**	**35.36**	**46.23**	**73.84**	**269.99**	**6.40E-04**	**0.29**	**27.71**	**110,602**
Significant Emission Rate	25	15	10	40	40	40	100	0.6	7	10	75,000
Exceeds SER?	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes

ED_013256A_00000458-00008

AERMOD is a refined, steady-state, multiple-source, Gaussian dispersion model and is the preferred model to use for industrial sources in this type of analysis. The analysis will be performed using the regulatory default model settings. This section describes the AERMOD modeling methodology proposed to conduct the ambient air quality analysis for this project.

3.1. MODELED POLLUTANTS AND AVERAGING PERIODS

As discussed in Section 2, the No. 3 Paper Machine rebuild project will trigger PSD for PM_{10}, $PM_{2.5}$, NO_x, CO, VOC, TRS, and GHG. The other pollutants (PM, SO_2, lead, and H_2SO_4) were evaluated and determined not to trigger PSD permitting, because the increases in emissions of these pollutants are below their respective SERs. Of the seven pollutants listed that do trigger PSD permitting, four have corresponding National Ambient Air Quality Standards (NAAQS) or PSD increment levels: PM_{10}, $PM_{2.5}$, NO_x (for NO_2), and CO. VOC, TRS, and GHG do not have a NAAQS or PSD increment. However, VOC is a precursor pollutant for ozone, which does have a NAAQS. VOC and NO_X are addressed as precursors to ozone under Section 3.3.3, but ozone is not modeled explicitly in AERMOD. Therefore, this report's discussion of AERMOD modeling protocol is limited to a discussion of the four pollutants triggering PSD that have a directly associated NAAQS for PSD increment: PM_{10}, $PM_{2.5}$, NO_x (for NO_2), and CO.

3.1.1. Short Term Averaging Period

The No. 3 Paper Machine is the only modified unit of the No. 3 Paper Machine rebuild project. In addition, there will be a short term increase in pulp production, resulting in short term emission increases of units that have emissions related to pulp throughput. Therefore, the No. 3 Paper Machine and fugitive emissions arising from pulp production are the only emission sources that will be included in the short term modeling analysis. Other emission units in the pulping process downstream of the pulp digesters only emit VOC and TRS, which do not have air quality standards. Pollutants with a short term averaging period included in the analysis are PM_{10} (24-hour averaging period) and $PM_{2.5}$ (24-hour averaging period). Short-term emission rates of CO are not increasing as a result of the project, because the No. 3 Paper Machine does not emit CO, and the only sources of CO affected by the project (recovery furnaces, smelt dissolving tanks, and lime kiln) will not experience an increase short-term maximum production rates. Therefore, a modeling analysis for the 1-hour and 8-hour CO NAAQS or SIL is not necessary.

3.1.2. Annual Averaging Period

Emission units with associated emission increases will be included in annual averaging period modeling analyses. These analyses include PM_{10}, $PM_{2.5}$, and NO_2. CO does not have an annual averaging period NAAQS or PSD increment. Since a modeling analysis for CO for the annual averaging period is not applicable and 1-hour and 8-hour CO NAAQS or SIL is not necessary, a modeling analysis for CO will not be conducted.

3.2. SIGNIFICANCE ANALYSIS

Initially, a significance analysis will be performed to determine if the emission increases associated with the project will significantly impact the area surrounding the facility. The significance analysis will be conducted for PM_{10} (annual and 24-hour averaging periods), $PM_{2.5}$ (annual averaging period), and NO_2 (annual averaging period), as discussed in the previous section. Modeled concentrations will be compared to significant impact

ED_013256A_00000458-00009

levels (SILs) established by Ecology. The SILs and the corresponding NAAQS and Class II PSD increments for the pollutants modeled are shown in Table 3-1.

Ecology establishes "Cause or Contribute Threshold Values" (equivalent to the SILs) in Washington Administrative Code (WAC) 173-400-113 as a screening approach for determining if a proposed project will contribute to a violation of an ambient air quality standard. For this analysis, the SILs established in WAC 173-400-113 will be used.

EPA issued draft guidance regarding the SIL for $PM_{2.5}$ for the PSD permitting program on August 1, 2016, and later revised on August 18, 2016. EPA's draft SIL guidance for $PM_{2.5}$ is provided in Appendix A. Per the guidance,

> *"...permitting authorities retain the discretion under this provision to determine on a case-by-case basis whether an impact between 0.2 μg/m³ and 0.3 μg/m³ will cause or contribute to a violation of the annual $PM_{2.5}$ NAAQS."*

The $PM_{2.5}$ SIL provided in WAC 173-400-113 falls within the range referenced by EPA in its $PM_{2.5}$ SIL guidance.

If the highest ambient concentration resulting from the modeled project emissions for a pollutant and averaging time is less than the SIL, then a further analysis will not be conducted for that pollutant and averaging time. If concentrations exceed the SIL, NAAQS "Full Impacts Analysis" analyses and/or Class II PSD Increment analyses are required for that pollutant and averaging period. It is not expected that any of the modeling analyses will exceed the SIL.

Table 3-1. Significance Levels, NAAQS, and PSD Class II Increments

Pollutant	Averaging Period	Significant Impact Levels (μg/m³)	NAAQS (μg/m³)	Class II PSD Increment (μg/m³)
PM_{10}	Annual	1.0 [a]	N/A	17
	24-hour	5 [b]	150 [f]	30
$PM_{2.5}$	Annual	0.3 [c]	15 [g]	4
	24-hour	1.2 [d]	35 [h]	9
NO_2	Annual	1.0 [e]	100 [i]	25

[a] Annual arithmetic mean
[b] Not to be exceeded
[c] Annual arithmetic mean, averaged over 3 years (5 years for a 5-year modeling analysis). EPA issued draft guidance regarding the SIL for $PM_{2.5}$ and ozone for the PSD permitting program on August 1, 2016, and later revised on August 18, 2016. Washington's $PM_{2.5}$ SIL conforms to EPA's draft SIL guidance for $PM_{2.5}$.
[d] Not to exceed the highest 3-year average (5 years for a 5-year modeling analysis) of first high impacts.
[e] Annual arithmetic mean
[f] Not to be exceeded more than once per year on average over 3 years (5 years for a 5-year modeling analysis)
[g] Annual arithmetic mean, averaged over 3 years (5 years for a 5-year modeling analysis)
[h] 98th percentile of concentrations in a given year, averaged over 3 years (5 years for a 5-year modeling analysis)
[i] Annual arithmetic mean

3.3. PREVENTION OF SIGNIFICANT DETERORIATION REQUIREMENTS

The PSD permit application must address impacts on Air Quality Related Values (AQRVs) in locations designated as Class I areas. The Federal Land Managers (FLMs) responsible for review of these impacts have established guidance documents to assist applicants in preparing the necessary information for this review. In addition, a

ED_013256A_00000458-00010

PSD increment is established for Class I areas which specifies the maximum allowable ambient concentration increase.

3.3.1. PSD Air Quality Related Values Analysis

A PSD permit application must address impacts on AQRVs in locations designated as Class I areas. The FLMs responsible for review of these impacts have established guidance documents to assist applicants in preparing the necessary information for this review.

The 2010 Federal Land Managers' Air Quality Related Values Work Group (FLAG) report outlines a screening method based on emissions and distance (reflected in a parameter called the Q/d ratio) to determine whether dispersion modeling is necessary for visibility and deposition impacts on the Class I areas.[5]

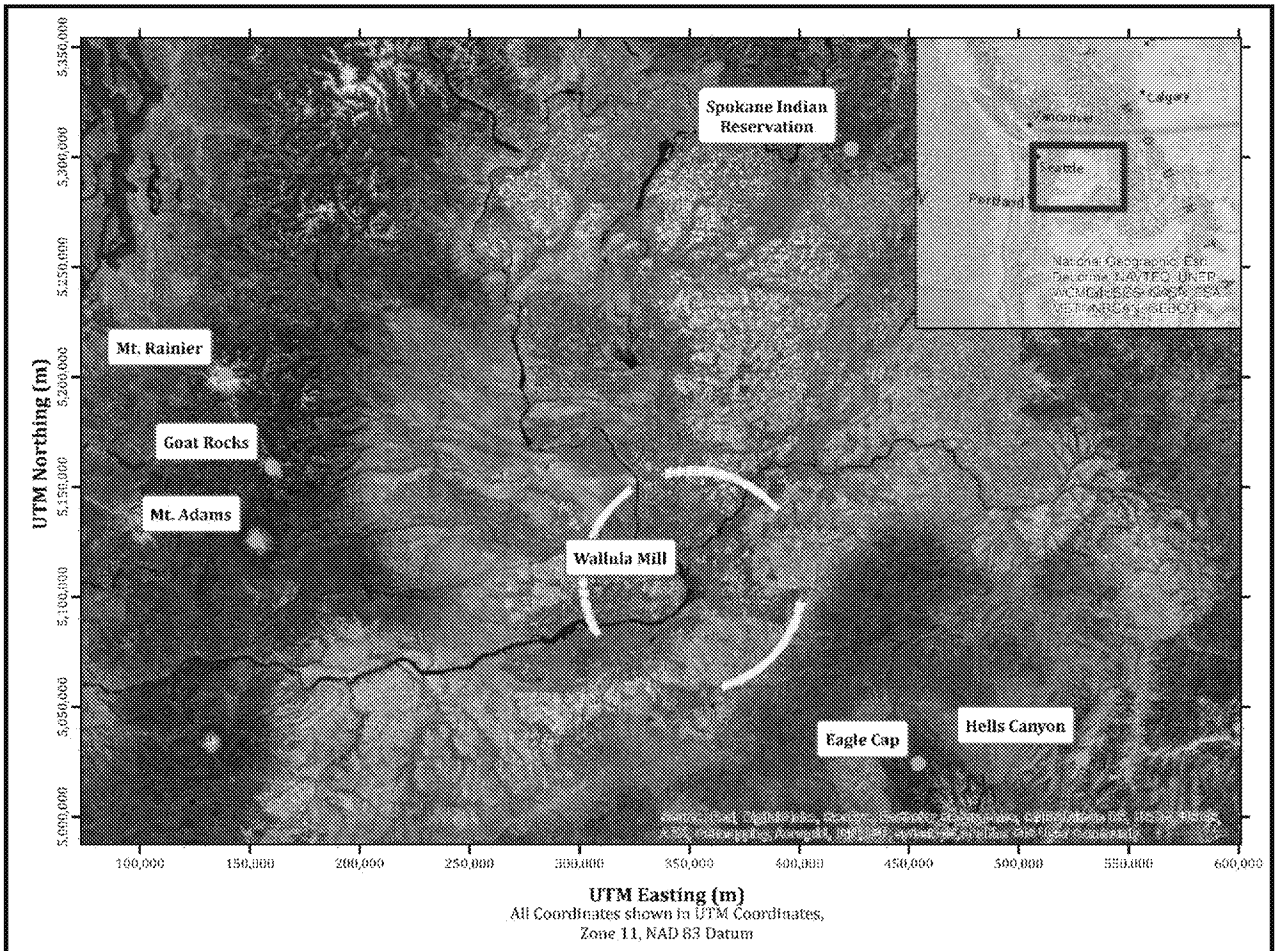
The FLAG guidance was developed based on similar screening methods used in the 2005 EPA Best Available Retrofit Technology (BART) guidelines for Regional Haze Rule. The screening method uses an emissions-over-distance (Q/d) approach using a Q/d ratio where **Q** is the sum total of increase in the PM_{10}, SO_2, NO_x, and sulfuric acid (H_2SO_4) emissions in tons per year (tpy) based on the 24-hour maximum allowable emissions, and **d** is the distance in kilometers (km) from the site to the Class I area. As specified in the 2010 FLAG guidance Section 3.2 (Initial Screening Criteria), for sources located more than 50 km from a Class I area, if the Q/d ratio is less than or equal to 10, no further AQRV analysis is necessary for the new or modified source.

Based on the Class I area maps for Washington and Oregon, the closest Class I area to the Wallula mill is the Eagle Cap Wilderness, which is located approximately 113 km from the facility. Figure 3-1 shows the Class I areas closest to the Wallula mill.

[5] Air Quality Related Value review guidance from Federal Land Manages' Air Quality Related Values Work Group (FLAG), Phase I Report - Revised (2010).

ED_013256A_00000458-00011

Figure 3-1. Nearest Class I Areas



Yellow markers indicate the receptors used for the screening level Class I PSD increment analysis discussed in Section 3.3.3.

The No. 3 Paper Machine is the only emission unit at the Wallula mill that will be modified and experience a short term production increase as a result of the project (and therefore the only unit that could have a short term emission increase as a result of the project[6]). The No. 3 Paper Machine is being modified to increase potential daily production from 1,000 machine-dried tons per day (MDT/day) of coated paper to 1,400 MDT/day of unbleached linerboard. However, paper machine emissions of PM, PM_{10}, and $PM_{2.5}$ from production of linerboard (the future operation of the No. 3 Paper Machine) are lower than the emissions from a comparable quantity of coated paper (the historical operation of the No. 3 Paper Machine). Therefore, when considering future daily allowable emissions minus past daily allowable emissions for the No. 3 Paper Machine, there is actually no increase in daily allowable PM_{10} emissions. Additionally, the No. 3 Paper Machine does not emit NO_x, SO_2, or H_2SO_4. Because there is no short term emission increase of the four visibility impairing pollutants, the Q/d ratio for the project is zero. The same conclusion is true even if the pre-project allowable

[6] Fugitive emission sources such as material handling drop points and truck traffic will also experience a short term increase in particulate emissions; however, their impacts are expected to be negligible with respect to the Q/d calculation.

ED_013256A_00000458-00012

emission rate were based on the maximum daily production that has been achieved in recent years (790 MDT/day in 2015) rather than the 1,000 MDT/day pre-project potential production. Detailed calculations are provided in Appendix B.

To provide further support to the project's minimal impact on the AQRV, we are presenting a separate Q/d calculation using a method that is much more conservative than described above for comparing the increase in daily allowable emission rates. This method includes the No. 3 Paper Machine and all non-modified units affected by the project. Rather than using the increase in 24-hour allowable emissions, this method calculates the emissions increase (Q) as future 24-hour allowable emissions minus 24-month *actual* average baseline emissions.[7] Table 3-2 below shows the emission increase for each emission unit, calculated on this conservative basis, along with the resulting conservative Q/d value. Detailed tables showing the future allowable emissions and the 24-month average baseline emissions for each emission unit are provided in Appendix B.

Table 3-2. Q/d Analysis
(Future Short Term Allowable Emissions minus Baseline Annual Actual Emissions)

Emission Unit	Emission Increase (tpy)			
	PM_{10}	SO_2	NO_x	H_2SO_4
No. 2 Recovery Boiler	3.47	126.59	30.38	0.15
No. 3 Recovery Boiler	9.23	76.79	61.92	0.40
No. 2 Smelt Dissolving Tank	3.26	0.13	0.00	0.00
No. 3 Smelt Dissolving Tank	14.92	0.34	0.00	0.00
Lime Kiln	4.90	0.17	34.16	0.33
Paper Machine #3	0.90	0.00	0.00	0.00
Storage Piles	0.16	0.00	0.00	0.00
Other Fugitive Emissions	0.18	0.00	0.00	0.00
Q (tpy), conservative method	368.41			
d (km)	113			
Q/d, conservative method	3.26			

As shown in Table 3-2, the Q/d for even this very conservative calculation method is significantly below the Q/d ratio threshold of 10 established by the FLAG guidance. Therefore, no further AQRV analysis is necessary for the project.

3.3.2. Visibility Impact Analysis

In addition to applying the Q/D screening method to address visibility impacts at distant Class I areas, a visibility impairment analysis will be conducted to demonstrate that emissions from the No. 3 Paper Machine rebuild project will not have an adverse impact on visibility at near-field locations of interest (within 50 km). Specifically, a VISCREEN analysis will be conducted for the Whitman Mission National Historic Site.

3.3.3. Class I PSD Increment Analysis

PCA will determine potential impacts of the project on Class I area PSD Increments. The first step of the Class I PSD Increment Analysis will be a Significance Analysis. Per EPA guidance, the Significance Analysis considers the emission increases associated only with the project in order to determine whether the project will have a

[7] The baseline emissions presented in Appendix B, Table B-1 represent the emissions during the 24-month baseline period used for the PSD applicability calculations.

ED_013256A_00000458-00013

significant impact on the Class I areas. The Significance Analysis will determine the modeled ground-level concentrations of PM_{10}, $PM_{2.5}$, and NO_2. The modeled ground-level concentrations of PM_{10}, $PM_{2.5}$, and NO_2 will be compared to the applicable Class I SILs to determine whether any modeled ground-level concentrations at any receptor locations exceed the SILs (i.e., "significant" receptors). The applicable SILs (proposed by the EPA) are summarized in Table 3-3.

Table 3-3. Applicable Class I PSD Modeling SILs

Pollutant	Class I SIL (μg/m³)	Averaging Period
NO_2	0.1	Annual
PM_{10}	0.2	Annual
PM_{10}	0.3	24-hour
$PM_{2.5}$	0.05	Annual
$PM_{2.5}$	0.27	24-hour

As described in the previous section, the nearest Class I area is 113 km from the facility. Due to the steady-state assumption in AERMOD, model impacts beyond 50 km are unreliable. Therefore, a series of arcs spaced 50 km from the mill with receptors spaced one degree apart will be used for the Class I Significance Analysis. The Class I arcs will cover three directions with elevations at 10 equally spaced intervals spanning the minimum and maximum elevation at the associated Class I area(s): southeast toward Eagle Cap, north-northeast toward Spokane Indian Reservation, and west-northwest toward Mt. Rainier, Goat Rocks, and Mt. Adams. Figure 3-1 shows the receptor arcs used for the Class I analyses.

If the Significance Analysis reveals that modeled ground-level concentrations exceed the applicable SIL, a Class I PSD Increment analysis will be performed for that pollutant. If the Significance Analysis reveals that modeled ground-level concentrations are below the applicable SIL, it will be concluded that the project does not significantly contribute to the PSD increment. It is expected that the modeling analyses will result in predicted concentrations below the Class I SILs for each pollutant.

3.3.4. Secondary $PM_{2.5}$ and Ozone Analysis

Secondary $PM_{2.5}$ and ozone may be formed in the atmosphere through photochemical transformation of precursor pollutants. For secondary $PM_{2.5}$, the presumed precursor pollutants are SO_2 and NO_x, which may form ammonium sulfate or ammonium nitrate; for ozone, the presumed precursor pollutants are VOC and NO_x.[8] Increases in SO_2 emissions are expected to be below the SER, while increases of NO_x and VOC are expected to exceed the SER. As such, formation of secondary $PM_{2.5}$ from NO_x and formation of ozone from VOC and NO_x will be assessed. Because the proposed model, AERMOD, does not simulate the formation of secondary pollutants in the atmosphere, other methods must be used to assess secondary pollutants. The assessment of secondary pollutants from precursor emissions from the Wallula mill will follow the *Guideline* and draft EPA Modeled Emission Rates for Precursors (MERPs) guidance.[9]

According to the *Guideline* and the MERPs guidance, EPA expects applicants to use existing empirical relationships from relevant technical information such as *air quality modeling of hypothetical industrial sources*

---

[8] 40 CFR 52.21(b)(50)(i)(b)

[9] Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program. EPA-454/R-16-006. December 2, 2016.

ED_013256A_00000458-00014

with similar source characteristics and emission rates of precursors that are located in similar atmospheric environments and for time periods that are conducive to the formation of O_3 or secondary $PM_{2.5}$.[10] In the draft MERPs guidance, EPA presents several hypothetical industrial sources. One of these hypothetical modeling analyses was conducted for a source located near Boardman, Oregon (Morrow County, identified as WUS Source 18 in the MERPs guidance Appendix Table A-1). The empirical relationships derived from this Boardman hypothetical model will be used, because the model is representative of possible impacts from the No. 3 Paper Machine rebuild project. In particular, the 500 tpy, low stacks case will be used.

The Boardman hypothetical model is representative of possible impacts from the No. 3 Paper Machine rebuild project for the following reasons:

- Proximity – Source 18 near Boardman, OR is approximately 55 km[11] from the Wallula mill.
- Terrain & Landuse – Boardman and Wallula are both located near the Columbia River (similar elevation in the 100 to 200 m range) in a rural area with primarily desert shrubland and agricultural landuse
- Climate – Because of this close proximity and similar elevation, climate characteristics are also similar (temperature and humidity).
- Regional sources of pollutants – both locations have few to moderate industrial sources, minimal commercial/urban sources, and moderate agricultural sources.
- Ambient concentrations – ambient concentrations of the two areas are also similar, particularly ozone. The ambient concentrations of the two locations using the NW AirQuest Consortium tool[12] are summarized in Table 3-4, below.

---

[10] Ibid. Page 4.

[11] Distance to Source 18 is based on the latitude/longitude coordinates 45.7895, -119.4748 provided in the MERPs data distribution memorandum from Tyler Fox (OAQPS) to the Regional Air Program Managers, "Distribution of the EPA' s modeling data used to develop illustrative examples in the draft Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and P M2.5 under the PSD Permitting Program." February 23, 2017.

[12] Lookup 2009-2011 design values of criteria pollutants. Obtained from http://lar.wsu.edu/nw-airquest/lookup.html.

ED_013256A_00000458-00015

Table 3-4. Ambient Concentration Comparison

	Boardman Source 18	Wallula Mill
Lat or UTMN	45.7895	5107261
Lon or UTME	-119.4748	351695
UTM zone		11
In Washington Oregon or Idaho	YES	YES
PM2.5 24hr μg/m^3	20	20
PM2.5 annual μg/m^3	6.9	7.2
O3 daily 8hr max ppb	62	61
O3 for PVMRM ppb	53	54
NO2 1hr ppb	24	23
NO2 annual ppb	4.7	4.4
SO2 1hr ppb	9.5	11
SO2 3hr ppb	7.4	9.2
SO2 24hr ppb	2.7	3.6
SO2 annual ppb	1.2	1.5
CO 1hr ppb	1223	1139
CO 8hr ppb	798	713
PM10 24hr μg/m^3	98	129
PM10 no extremes 24hr μg/m^3	74	97

Using the Boardman hypothetical model for the most similar source (500 tpy, Low stacks) and ozone as the pollutant, the following equations provide an example of how MERPs representative of the Wallula area will be developed:

General form of MERP equation:

$$MERP = \text{Critical Air Quality Threshold} \times \frac{\text{Modeled emission rate from hypothetical source}}{\text{Modeled air quality impact from hypothetical source}}$$

Ozone MERP equations for Boardman (500 tpy, Low Stacks):

$$NO_X\ MERP\ for\ O_3 = 1.0\ \text{ppb} \times \frac{500\ \text{tpy}\ NO_X}{1.94\ \text{ppb}} = 258\ \text{tpy}\ NO_X$$

$$VOC\ MERP\ for\ O_3 = 1.0\ \text{ppb} \times \frac{500\ \text{tpy VOC}}{0.46\ \text{ppb}} = 1{,}087\ \text{tpy VOC}$$

Note that the critical air quality threshold for ozone (8-hour averaging period) is proposed to be 1.0 parts per billion (ppb) based on the recommended value in EPA's draft SIL guidance, included as Appendix A.

As described in the draft MERPs guidance, the comparison of the Wallula mill's emission increases to these MERPs should be considered together to determine whether the mill's air quality impact would exceed the air quality threshold. The additive secondary impacts (conservatively assuming the NO_x and VOC increases cause increases in ozone in the same location at the same time) will be calculated as follows:

ED_013256A_00000458-00016

$$\frac{46.2 \text{ tpy } NO_X \text{ from Project}}{258 \text{ tpy } NO_X \text{ MERP}} + \frac{73.8 \text{ tpy VOC from Project}}{1{,}087 \text{ tpy VOC MERP}} = (18\% + 7\%) = 25\%$$

Note the project emission increase values used in the equation above represent initial estimates of emission increases due to the project. A value less than 100% indicates the critical air quality threshold will not be exceeded when considering the combined impacts of these precursors on the 8-hour daily maximum ozone concentrations. Therefore, the proposed project is expected to have an insignificant impact on ozone concentrations and no further analysis is expected to be necessary.

Additionally, for $PM_{2.5}$, the additive secondary impacts will also be conservatively added to the modeled concentration of direct/primary $PM_{2.5}$, conservatively assuming that primary and secondary impacts occur at the same location (and on the same day in the case of 24-hour $PM_{2.5}$ if applicable).

3.4. METEOROLOGICAL DATA

Five years of surface meteorological data are taken from onsite meteorological data for the Wallula mill for the years 1995 through 1999. A detailed review of the quality assurance procedures for the onsite monitoring station equipment and data will be provided as an addendum to the PSD application at a later date.

The onsite observations will be supplemented with cloud cover data from the Walla Walla Regional Airport. Other possible weather stations in the area (e.g., at the Tri-Cities or Hermiston airports) do not have complete cloud cover data for the 1995 – 1999 time period. Missing data will be filled in accordance with USEPA guidance (Procedures for Substituting Missing NWS Data for Regulatory Modeling - Atkinson and Lee). Longer periods that cannot be filled will be left as missing.

Table 3-5 presents the quality of data by quantifying percentages of missing data and number of calm wind hours.

Table 3-5. Onsite Station Meteorological Data Quality

Variable	Percent Complete, 1995	Percent Complete, 1996	Percent Complete, 1997	Percent Complete, 1998	Percent Complete, 1999
Wind Speed	94.09%	97.47%	97.97%	98.69%	99.39%
(# Calm Hours)	174	112	175	136	134
Wind Direction	94.09%	97.47%	97.97%	98.69%	99.39%
Temperature	94.03%	95.69%	97.97%	98.37%	99.39%

Mixing heights will be developed from upper air data from the nearest upper air station at Spokane International Airport (KGEG). Meteorological data for use in AERMOD-PRIME will be processed using the AERMOD meteorological preprocessor (AERMET) version 16216. One file will consist of surface scalar parameters while the other will consist of vertical profiles of meteorological data, to account for both surface and upper air effects on the dispersion of pollutants.

Because onsite station data are available and used, ASOS one-minute data will not be used in this analysis.

An AERSURFACE analysis for the onsite station location will be performed to determine AERMET stage 3 input values for surface roughness, albedo, and Bowen ratio. The surface conditions for this analysis will be evaluated

ED_013256A_00000458-00017

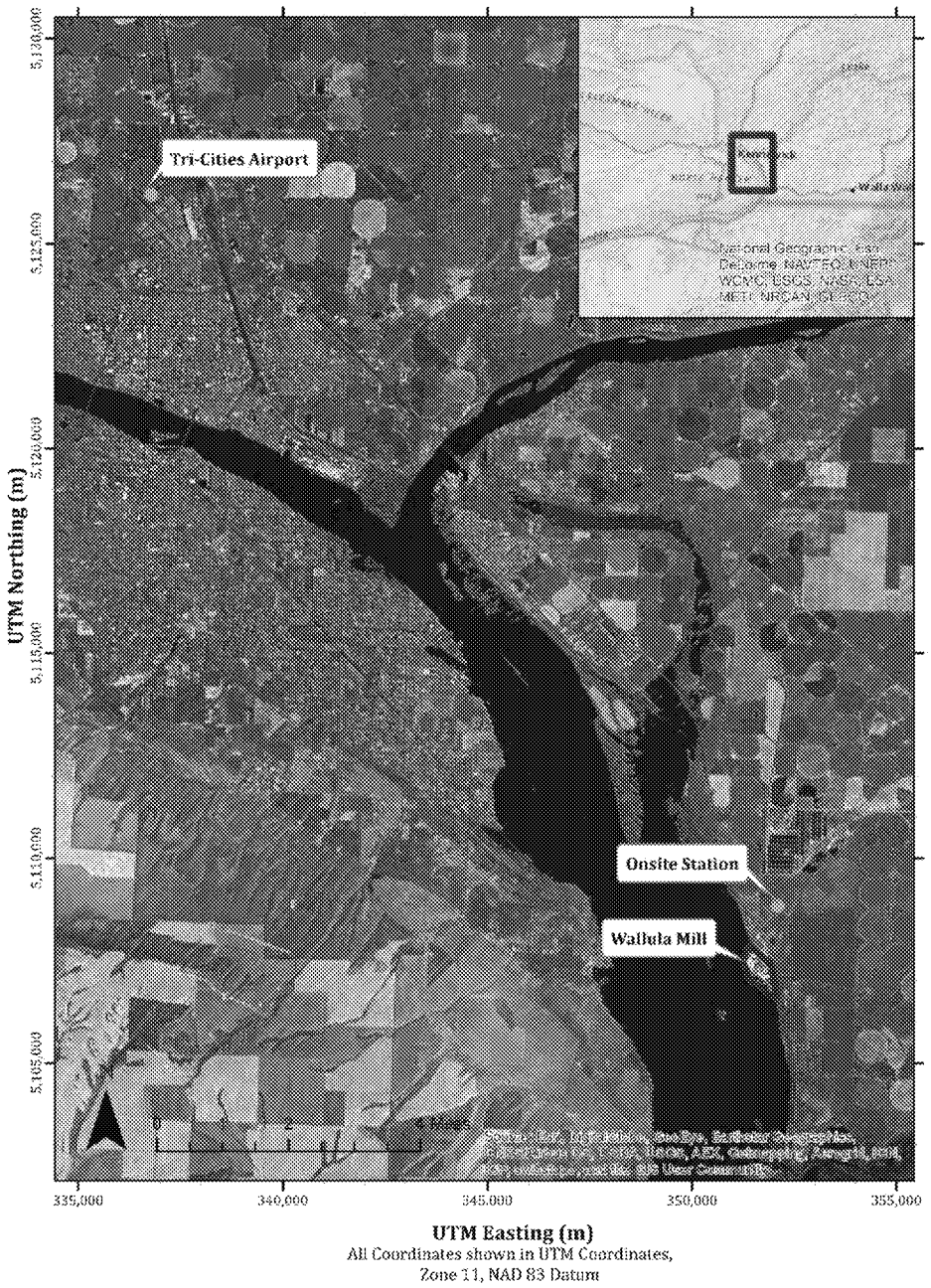
month-by-month in AERSURFACE and input month-by-month in the AERMET stage 3 input file. The AERSURFACE analysis will evaluate the climate profile of each month, wet, dry or average, based on precipitation data obtained over the years 1981 to 2010, from the Kennewick, WA surface station with Global Historical Climatology Network identifier USC00454154.[13]

Onsite station data will be used rather than data from the Tri-Cities airport or other stations, because the onsite data are most representative of meteorological conditions at the Wallula mill. Figure 3-2 shows the locations of the onsite surface station and the Tri-Cities Airport station.

[13] Walla Walla Regional Airport data were considered for this analysis, but rejected due to a large quantity of missing monthly data in the range of 1995-1999.

ED_013256A_00000458-00018

Figure 3-2. Locations of Nearby Surface Stations



Due to the location of the Wallula mill with respect to the Columbia River, the wind patterns observed at the onsite station are noticeably different from the patterns observed at the Tri-Cities Airport station. Figure 3-3 and Figure 3-4 show windroses for the onsite station and Tri-Cities Airport station, respectively.

ED_013256A_00000458-00019

Figure 3-3. Onsite Station Windrose (1995-1999)

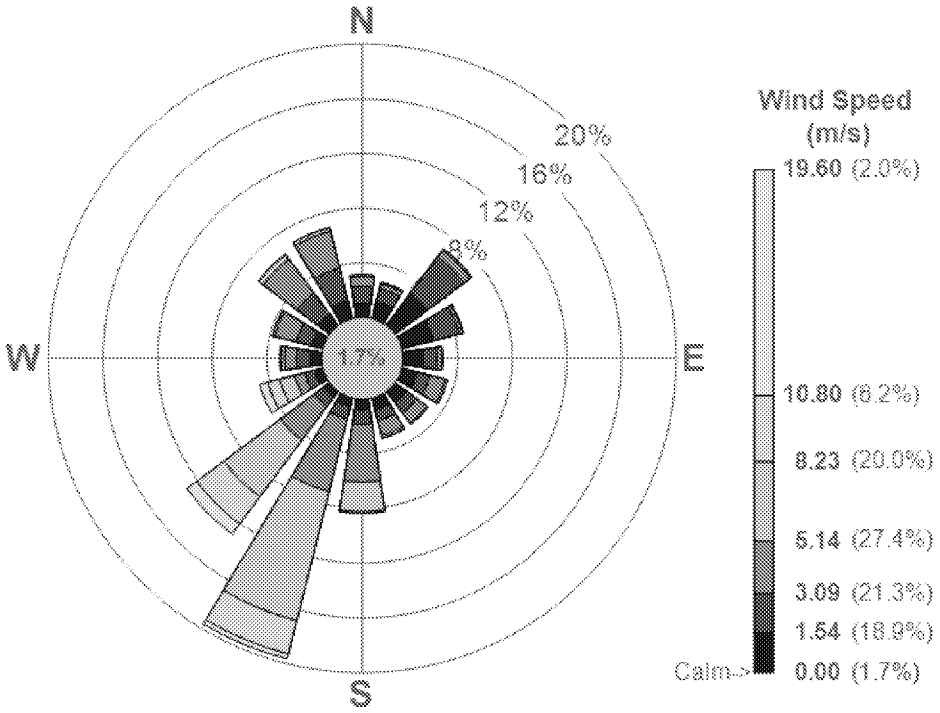
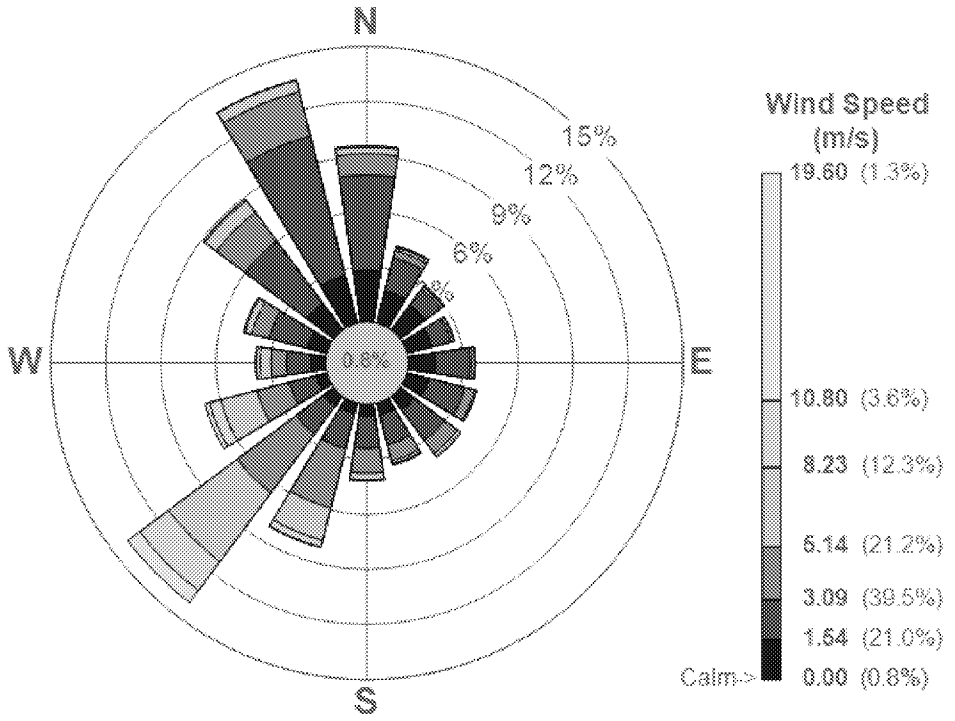


Figure 3-4. Tri-Cities Airport Station Windrose (2011-2015)



ED_013256A_00000458-00020

As shown by the windroses, the Tri-Cities Airport station has a high percentage of winds from the NNW, which are absent on the onsite station windrose. The terrain and river orientation near the mill indicate that the more frequent winds from the southwest and less frequent wind from the north-northwest observed at the onsite station are most representative of the mill. For that reason, PCA will use the onsite station data for the modeling analyses.

3.5. TERRAIN ELEVATIONS

NED terrain data will be retrieved in GeoTIFF format, in the NAD83 datum, from the Multi-Resolution Land Characteristics (MRLC) Consortium online viewer at http://www.mrlc.gov/viewerjs/. Data will be retrieved in 1/3-arc-second format. All model elements including sources and buildings will be georeferenced with respect to the NAD83 datum.

3.6. COORDINATE SYSTEM

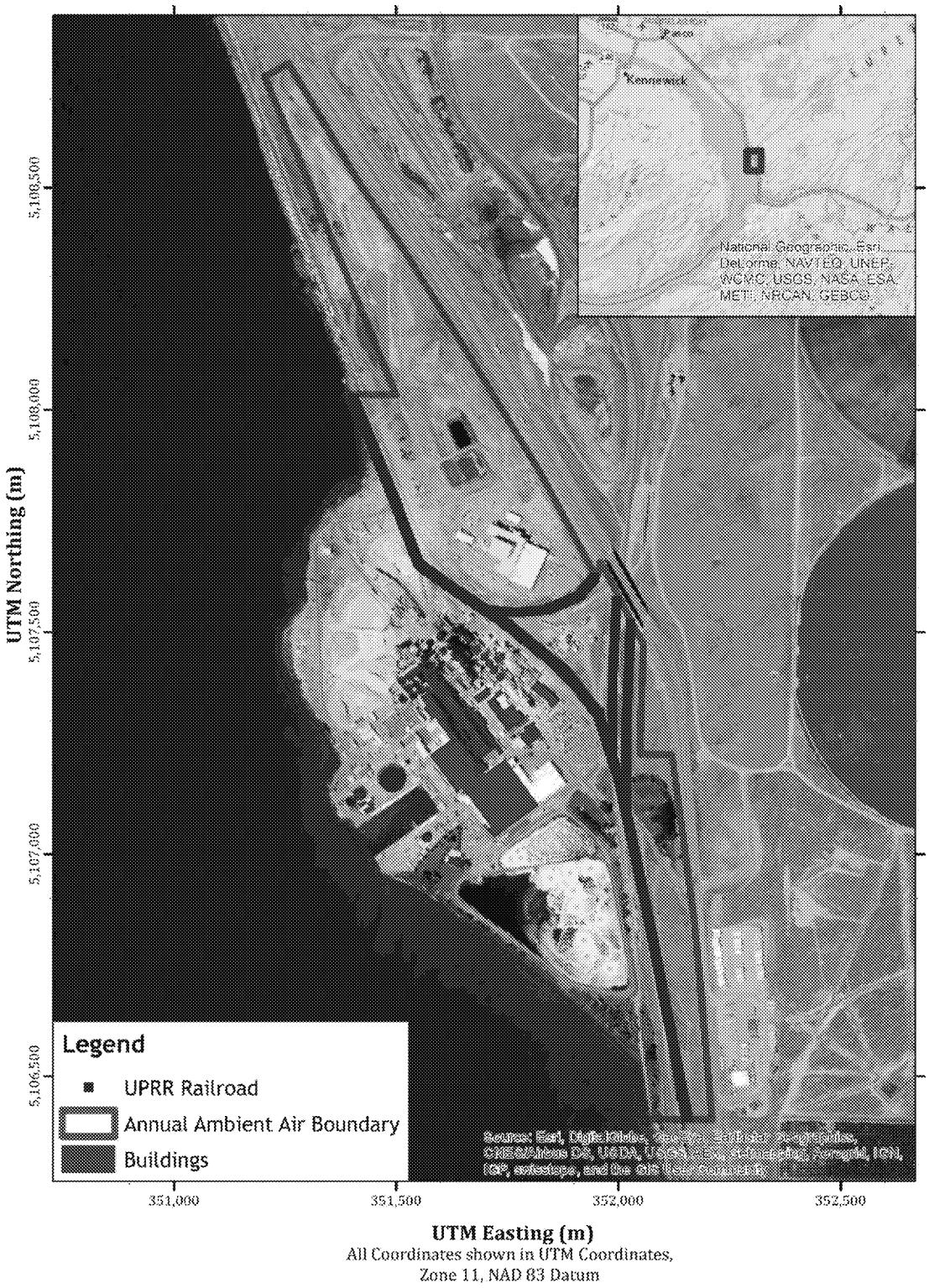
The location of emission sources, structures, and receptors will be represented in the Universal Transverse Mercator (UTM) coordinate system using the North American 1983, CONUS (NAD83) projection. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). UTM coordinates for this analysis will be based on UTM Zone 11.

3.7. AMBIENT AIR BOUNDARY

Figure 3-5 shows the ambient air boundary that will be used for the annual averaging period models.

ED_013256A_00000458-00021

Figure 3-5. Ambient Air Boundary for Annual Modeling

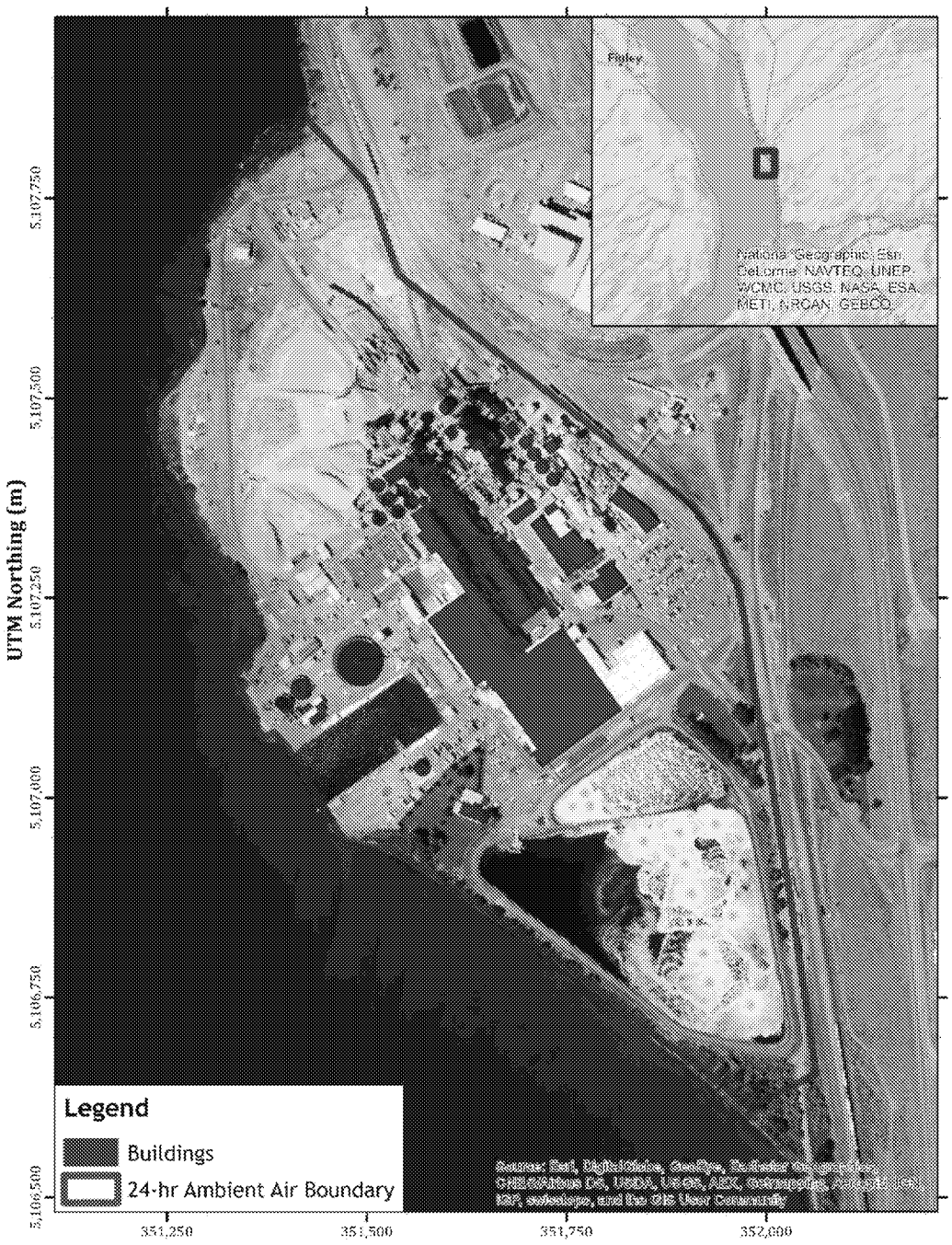


The Union Pacific Railroad (UPRR) railroad tracks run through the Wallula mill's property near the eastern boundary. For 24-hour averaging period models, the fenceline boundary is more conservative by placing it

ED_013256A_00000458-00022

adjacent to the UPRR railroad tracks in order to include the UPRR tracks as ambient air for the daily averaging period, because it would be possible (though still unlikely) for public access to occur in this area on a short term basis. Figure 3-6 shows the fenceline surrounding the main area of the mill that serves as the ambient air boundary for the 24-hour PM_{10} model.

Figure 3-6. Ambient Air Boundary for 24-Hour Modeling



ED_013256A_00000458-00023

3.8. RECEPTOR GRIDS

Three Cartesian receptor grids (i.e., a fine grid, a medium grid, and a coarse grid), as well as receptors placed on the facility's property boundary (fence line boundary), will be used for this dispersion modeling analysis.

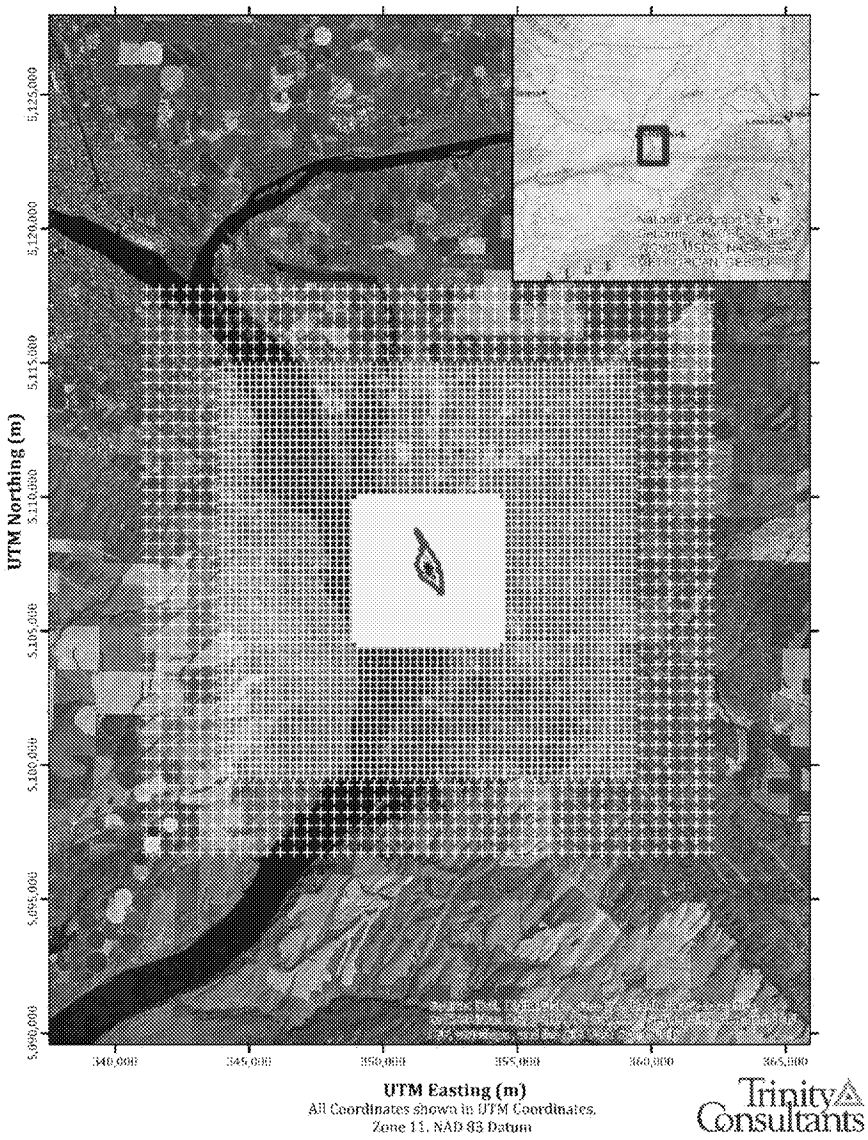
- The fence line boundary will consist of discrete receptors placed at 25-meter intervals.
- The fine grid will include 50-meter spaced receptors extending 2,000 meters from the property boundary with square receptor grid geometry.
- The medium grid will include 250-meter spaced receptors extending from 2,000 meters out to 7,000 meters with square receptor grid geometry.
- The course grid will include 500-meter spaced receptors extending from 7,000 meters out to 10,000 meters with square receptor grid geometry or until ground level impacts are no longer significant.

Maximum concentrations are expected to occur within the fine grid. If any maximum concentrations or increasing concentrations occur in the medium or coarse grids, a nested grid will be added to fully refine maximum concentrations. Figure 3-7 shows the receptor grids that will be used in the modeling analyses.

Additionally, a receptor is placed at the Whitman Mission National Historic Site, located approximately 35 km to the east of the Wallula mill.

ED_013256A_00000458-00024

Figure 3-7. Receptor Grids



3.9. BUILDING DOWNWASH

Emissions from each source will be evaluated in terms of their proximity to nearby structures. The purpose of this evaluation is to determine if stack discharges might become caught in the turbulent wakes of these structures. Wind blowing around a building creates zones of turbulence that are greater than if the buildings were absent. The concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents will be applied to all structures at the Wallula mill. The Building Profile Input Program for PRIME (BPIPPRM) Version 04274 will be used to calculate the downwash values for each point source.

ED_013256A_00000458-00025

3.10. RURAL AND URBAN CONSIDERATIONS

The AERMOD model allows the user to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions. The Wallula area does not have sufficient population or urban land use to be considered "urban" for modeling purposes. Therefore, none of the sources included in the model will utilize the URBANOPT alternative.

ED_013256A_00000458-00026

Only the Wallula mill sources affected by the project will be included in the significance analyses to determine if further NAAQS or PSD increment modeling is required.

4.1. NO. 3 PAPER MACHINE REBUILD PROJECT EMISSION SOURCES

The Wallula mill consists of several emission point sources and fugitive emission sources. The following sections describe the basis of the model parameters for the sources affected by the No. 3 Paper Machine rebuild project. Detailed tables with sources parameters are provided in Appendix D.

4.1.1. Point Source Parameters

The emission units characterized as point sources (i.e., exhausts through a stack) affected by the No. 3 Paper Machine rebuild project include the No. 2 Recovery Furnace, No. 3 Recovery Furnace, No. 2 Smelt Dissolving Tank, No. 3 Smelt Dissolving Tank, and the Lime Kiln. Temperature and exhaust velocity data will be determined based on stack test data from the last five years that have the highest flow rate. PCA is planning to increase the height of the No. 3 Smelt Dissolving Tank stack as part of the project. To accurately account for the stack height change in the significance analysis, the pre-project stack will be modeled with a negative pre-project emission rate, and the post-project stack will be modeled with the post-project emission rate.

In addition, the No. 3 Paper Machine will be modeled using the stack parameters of the 18 roof vents for the No. 3 Paper Machine Building. The Wallula mill has collected location, diameter, height, temperature, and flow rate data for each No. 3 Paper Machine roof vent. The paper machine emissions will be divided proportionally to the flow rate of each roof vent.

There are also two material handling exhaust fans that are modeled as point sources for the PM_{10} and $PM_{2.5}$ models. The point source parameters for these fans will be based on data collected by the Wallula mill during a site survey.

Appendix D, Tables D-1a and D-1b provide the point source model parameters, and Table D-7a provides the parameters for the material handling point sources.

4.1.2. Fugitive Source Parameters

4.1.2.1. Haul Roads

Truck traffic for chip and final production transportation will increase as a result of the project due to increased pulp throughput. Adjacent volume sources will be used to represent the emissions from the roadways following the 2012 Haul Road Workgroup Final Report. The release height for each volume source will be half of the top of plume height. The top of the plume height will be calculated as the truck height times 1.7. The width of the plume will be calculated as the vehicle width plus six meters for single lane roadways, since it is not expected that there will be heavy traffic moving both directions on the mill roads.

The areas that are in the volume sources' exclusion zone near receptors will be modeled as area sources rather than volume sources, as recommended in Haul Road Workgroup Final Report Submission to EPA-OAQPS Memo by Tyler Fox on March 2, 2012. Consistent with the volume sources and the guidance, the release height for each

ED_013256A_00000458-00027

area source will half of the top of plume height; the top of plume height will be the dominant type of truck height times 1.7; and the width of the area source will be the vehicle width plus 6 m for single lane roadways.

Appendix D, Tables D-5a through D-6c provide the haul road volume source and area source model parameters.

4.1.2.2. Storage Piles

The softwood and sawdust storage piles at the mill will be affected by the project due to increased pulp throughput. The storage piles will be modeled as area sources. The release height of each pile will be set equal to half of the average pile height.[14]

Appendix D, Table D-4b provides the storage pile area source model parameters.

4.1.2.3. Fugitive Drop Points

Raw materials such as softwood chips and sawdust are handled in various areas of the Wallula mill. The throughput of softwood and sawdust will increase as a result of the project; therefore, material handling drop points will be included in the significance analyses. These drop points will be modeled as volume sources, unless the point has a designated fan with a stack. The release height of each drop point will be set equal to the center of the elevation of the drop. The initial lateral dimension will be the shorter width of the opening the material is dropped from and the opening the material is dropped to, divided by 4.3, per Table 3-2 of the AERMOD User's Guide.[15] The initial vertical dimensions will be calculated based on the drop height or building height as applicable per Table 3-2 of the AERMOD User's Guide.[15] If the drop is to the ground, the initial vertical dimension will be calculated as the drop height divided by 2.15. If the drop point is close to or on a building structure, the height of the building divided by 2.15 will be used. For any other case, the initial vertical dimension will be calculated as the drop height divided by 4.3.

Appendix D, Table D-7b provides the material handling drop point volume source parameters.

4.1.3. Source Emission Rates

Emission rates for the 24-hour averaging period significance modeling will be calculated based on the future potential daily throughput of the source (future allowable emission rates) minus the 24-month averaging period baseline emissions from the PSD applicability calculations. The total short term emission rate for the No. 3 Paper Machine is included in Appendix D, Table D-2c, and the total emissions are broken out among the 18 roof vents in Table D-3.

For modified units (i.e. the No. 3 Paper Machine), the same short term future emission rate will be used for annual-averaging period models to represent the increase from baseline actual emissions to allowable annual emissions assuming continuous operation. The source emission rates for unmodified units will be based on the increase from baseline to projected actual annual emissions from the PSD applicability calculations.

4.2. BACKGROUND AND NEARBY SOURCE INVENTORY

NAAQS analyses are required to include background concentration data and an inventory of nearby sources that may cause a significant concentration gradient in the vicinity of the proposed modification. It is expected that

---

[14] National Stone, Sand and Gravel Association; "Modeling Fugitive Dust Sources with AERMOD", Section 5.2.7.

[15] U.S. EPA, AERMOD User's Guide, EPA-454/B-16-011, December 2016

ED_013256A_00000458-00028

the significance analyses (described in Section 3.2) will show compliance with the SILs, and NAAQS modeling will not be required. If NAAQS analyses are required, PCA will submit an addendum to Ecology outlining the protocol to determine background concentrations and the explicitly modeled nearby source inventory.

ED_013256A_00000458-00029

5. TIER 2 NO_2 APPROACH

The modeling analysis will be performed using Ambient Ratio Method 2 (ARM2), which is a regulatory default according to the latest guidance (Guideline on Air Quality Models; Final Rule, 40 CFR Part 51, Appendix W, January 17, 2017, Section 4.2.3.4). The model inputs for ARM2 will apply the national regulatory default for ARM2 of the minimum ambient NO_2/NO_x ratio of 0.5 and a maximum ambient ratio of 0.9. This minimum ambient ratio of 0.5 is conservative, because the Wallula sources' in-stack ratio for the recovery furnaces is 0.02 and the lime kiln is 0.044, based on NCASI data.

In order for the ARM2 approach to accurately assess the ambient ratio near the mill, separate pre- and post-project models will be run with all sources of NO_x at the mill (including those unaffected by the project), and the increase in concentration will be calculated at each receptor as the post-project NO_2 concentration minus the pre-project NO_2 concentration.

ED_013256A_00000458-00030

ED_013256A_00000458-00031

NOTE TO REVIEWERS: UPDATE TO DRAFT SILs GUIDANCE

DATE: August 18, 2016

The draft guidance, first posted on August 1, 2016, had two inadvertent errors (both on page 11) that have been corrected.

- The first error on page 11, in Table 2, was an incorrect set of recommended $PM_{2.5}$ Class I PSD increment SILs; the originally posted value for the 24-hour averaging period was 0.07 $\mu g/m^3$ but should be 0.27 $\mu g/m^3$, and for the annual averaging period, 0.04 $\mu g/m^3$ was listed but should be 0.05 $\mu g/m^3$.
- The second error on page 11, in footnote 44, was a phrase that incorrectly referred to "NAAQS" instead of "PSD increments" in describing the class area ratio.

No changes have been made to any of the supporting documents posted with the draft guidance. Please ensure that comments are made on the revised draft guidance that includes the above corrections. The public comment period closes on September 30, 2016.

[DRAFT] MEMORANDUM

SUBJECT: Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program

FROM: Stephen D. Page, Director
Office of Air Quality Planning and Standards

TO: Regional Air Division Directors, 1-10

The purpose of this memorandum is to provide guidance on compliance demonstration tools for use with ozone and fine particles ($PM_{2.5}$) in the Prevention of Significant Deterioration (PSD) permitting program. The Environmental Protection Agency has developed a new analytical approach and has used it to identify a significant impact level (SIL) for each ozone and $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS) and the $PM_{2.5}$ PSD increments. We recommend that permitting authorities[1] consider using these values to help determine whether a proposed PSD source[2] causes or contributes to a violation of the corresponding NAAQS or PSD increments. The supporting technical document[3] provides a detailed discussion of the technical analysis used to develop these values. The supporting legal memorandum provides further detail on a legal basis that permitting authorities may choose to adopt to support using SILs to show that requirements for obtaining a PSD permit are satisfied.[4] This memorandum provides the results of the technical analysis and information on the particular points in the PSD air quality analysis at which permitting authorities may decide to use these values on a case-by-case basis in the review of PSD permit applications.[5] This memorandum and the supporting documents

[1] Permitting authorities include the EPA, state, local and tribal permitting authorities.
[2] As used in this memorandum, "PSD source" means a construction or modification of a major stationary source triggering PSD permitting requirements.
[3] "Technical Basis for the EPA's Development of Significant Impact Thresholds for $PM_{2.5}$ and Ozone"; EPA/XXX-X-XX-XXX, [DATE]
[4] Legal Support Memorandum: Application of Significant Impact Levels in the Air Quality Demonstration for Prevention of Significant Deterioration Permitting under the Clean Air Act," [DATE]
[5] The term "case-by-case basis" is used in this memorandum to refer to a permitting authority's use of a SIL value in a particular air quality analysis in an individual PSD permitting action when the SIL value has not been adopted in the state's EPA-approved PSD SIP rules (or the federal PSD rules, as applicable) pursuant to section 165(a)(3) of the Clean Air Act (CAA). When the SIL value has not been adopted into the applicable PSD rules, the permitting authority's record of each PSD permitting action in which a SIL is used must contain a justification demonstrating that the particular level and use of the SIL value is consistent with the CAA and applicable PSD rules. The permitting authority's justification may make use of the policy, legal and technical analysis documents developed by the EPA. We note that in a broader sense, all PSD permit reviews are "case-by-case" under section 165(a) of the CAA; in this memorandum, for clarity we refer to the case-specific nature of PSD permit reviews as "permit-specific" when not discussing the use of a SIL value by a permitting authority on a case-by-case basis.

ED_013256A_00000458-00033

are not final agency actions and do not create any binding requirements on permitting authorities, permit applicants or the public.

I. INTRODUCTION

When a PSD permit applicant has shown through air quality modeling that the projected impact from a proposed source is less than a SIL value for a particular pollutant, the EPA believes there is a valid analytical and legal basis for the permitting authority to conclude that this showing is sufficient to demonstrate that the proposed source will not cause or contribute to a violation of a NAAQS or PSD increment for that pollutant. Permitting authorities may elect to use the SILs discussed below, and the EPA has provided policy, technical and legal analyses that permitting authorities may choose to adopt or adapt in supporting their use of the SILs in particular PSD permitting actions. The use of SILs can help satisfy PSD requirements while conserving resources for applicants and permitting authorities.

The EPA has previously issued guidance describing particular uses of SILs.[6,7,8,9] Permitting authorities have long had the discretion to apply SILs on a case-by-case basis in the review of individual permit applications, provided such use was justified in the permitting record.[10] In an effort to reduce the need for case-by-case justification by permitting authorities, in 2010, the EPA finalized a rule to codify particular $PM_{2.5}$ SIL values and specific applications of those values,[11] but in subsequent litigation the EPA found an inconsistency between the preamble and regulatory text, and the court granted the EPA's request to vacate and remand the inconsistent regulatory text.[12]

Following the litigation, the EPA initially began developing a new rule to address the inconsistencies identified in the 2010 rulemaking.[13] However, after further evaluation and the identification of a revised set of SIL values based on the technical and legal analyses described below, the EPA believes it should first obtain experience with the application of these values in the permitting program before establishing a generally applicable rule.[14] In addition, permit applicants and permitting authorities have

---

[6] Memorandum from Stephen D. Page, EPA OAQPS, to EPA Regional Air Division Directors, "Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program," August 23, 2010.
[7] Memorandum from Stephen D. Page, EPA OAQPS, to EPA Regional Air Division Directors, "Guidance Concerning the Implementation of the 1-hour NO_2 NAAQS for the Prevention of Significant Deterioration Program," June 29, 2010.
[8] Memorandum from Stephen D. Page, EPA OAQPS, to OAQPS Personnel and EPA Regional Modelers, "Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS," March 23, 2010.
[9] Memorandum from Gerald A. Emison, EPA OAQPS, to Thomas J. Maslany, EPA Air Management Division EPA Region 3, "Air Quality Analysis for Prevention of Significant Deterioration (PSD)," July 5, 1988.
[10] Order Responding to Petitioner's Request that the Administrator Object to Issuance of a State Operating Permit, In the Matter of CF&I Steel, L.P. dba EVRAZ Rocky Mountain Steel, Petition Number VIII-2011-01, at 15-17 (May 31, 2012) ("Rocky Mountain Steel Order"); In re: Mississippi Lime Company, 15 E.A.D. 349, 375-379 (EAB 2011).
[11] 75 FR 84864 (October 20, 2010).
[12] *Sierra Club v. EPA*, 705 F.3d 458 (D.C. Cir. 2013). In its litigation brief at n. 10, the EPA stated an intent to issue guidance in the near future concerning $PM_{2.5}$ SIL values remaining in 40 CFR 51.165(b). The EPA issued such guidance in May 2014. Memorandum from Stephen D. Page, EPA OAQPS, to EPA Regional Air Division Directors, "Guidance for $PM_{2.5}$ Permit Modeling," May 20, 2014.
[13] Fall 2015 Regulatory Agenda, USEPA, 80 FR 78024, December 15, 2015. Ozone and Fine Particulate Matter ($PM_{2.5}$) Significant Impact Levels (SILs) for Prevention of Significant Deterioration (PSD), RIN: 2060-AR28. *http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201510&RIN=2060-AR28.*
[14] *See SEC v. Chenery Corp.,* 332 U.S. 194, 199-203 (1947) (recognizing that some principles may warrant further development before they are ready to be codified in a rule of general applicability).

communicated a need for the EPA to develop SIL values for ozone on an expedited basis. As a result, the EPA intends at this point to take a two-step approach.

First, the EPA is providing non-binding guidance so that we may gain valuable experience and information as permitting authorities use their discretion to apply and justify the application of the SIL values identified below on a case-by-case basis in the context of individual permitting decisions. We will be seeking to learn generally about permitting agencies' experiences in applying SILs in particular PSD permitting decisions. We will also be seeking more specific information, including how often and in what types of settings the application of a SIL at the single-source assessment and cumulative assessment stages of the PSD air quality analysis has made a critical difference in whether a conclusion was reached that the proposed source will not cause or contribute to a NAAQS or PSD increment violation. The EPA intends to obtain this information through its own PSD permitting activities in states that do not have SIP-approved PSD programs, regular discussions between our regional offices and air agencies, regular conference calls with the permitting committees of national organizations of air agencies, and technical conferences of air quality modelers and others interested in permitting activities.

Second, the EPA will use this experience and information to assess, refine and, as appropriate, codify SIL values and specific applications of those values in a future, potentially binding rulemaking. [15] During this second step, to assess whether it is appropriate to codify the particular SIL values derived using EPA's technical methodology or to codify revised values, the EPA will consider what SIL values are suitable in all locations and circumstances to show that an increase in air quality concentration below the corresponding SIL value does not cause or contribute to a violation of the NAAQS or PSD increments. Until the EPA conducts a rulemaking, permitting authorities retain discretion to use or not to use the EPA-derived SILs in particular PSD permitting actions. If a permitting authority chooses to use these or other SIL values on a case-by-case basis, it must justify the values and their use in the administrative record for the permitting action.

Since the 2010 rulemaking, the EPA has examined the legal basis for using SIL values in PSD air quality impact analyses. In addition, the EPA has sought to develop an improved technical methodology for deriving SIL values. This memorandum and supporting documents are the products of this effort. They identify specific SIL values for ozone and $PM_{2.5}$ and provide a supporting justification that permitting authorities may choose to apply on a case-by-case basis. The values and supporting justification are designed so that permitting authorities can choose to apply the SIL values at any location to demonstrate that a proposed source does not cause or contribute to a violation of air quality standards. In contrast to the 2010 rulemaking, we have developed separate SIL values for the $PM_{2.5}$ NAAQS and PSD increments, and we have developed SILs for the ozone NAAQS. Since there are no PSD increments for ozone, the EPA has not developed SILs for ozone.

The EPA believes that the application of these SILs in the manner described below would be sufficient in most situations for a permitting authority to conclude that a proposed source will not cause or contribute to a violation of an ozone or $PM_{2.5}$ NAAQS or $PM_{2.5}$ PSD increment. However, this guidance is not a final agency action and does not reflect a final determination by the EPA that any particular

[15] The EPA does not at present have a schedule for a future rulemaking on ozone and $PM_{2.5}$ SILs, but we will review the status from time to time. This rulemaking will continue to appear in the EPA's regulatory agendas under longer-term actions until we develop a specific schedule.

proposed source, or class of proposed sources, does not cause or contribute to a violation or may obtain a PSD permit. A determination that a proposed source does not cause or contribute to a violation can only be made by a permitting authority on a permit-specific basis after consideration of the permit record. This guidance is not legally binding and does not affect the rights or obligations of permit applicants, permitting authorities, or others. The SIL values identified by the EPA have no practical effect unless and until permitting authorities decide to use those values in particular permitting actions. The experience of permitting authorities in using these SILs on a case-by-case basis, or in choosing to limit or forego their use in specific situations, will be valuable information for the EPA to consider in a future rulemaking. Permitting authorities retain the discretion to apply and justify different approaches and to require additional information from the permit applicant to make the required air quality impact demonstration, consistent with the relevant PSD permitting requirements.

II. BACKGROUND

A PSD permit applicant must demonstrate that "emissions from construction or operation of such facility will not cause, or contribute to, air pollution in excess of any" NAAQS or PSD increment.[16] The EPA has reflected this requirement in its PSD regulations.[17] The CAA does not specify how a permit applicant or permitting authority is to make this demonstration, but section 165(e) authorizes the EPA to determine how the analysis is to be conducted, including the use of air quality models. In accordance with this authority, the EPA has promulgated regulations that identify such models and the conditions under which they may be used in the PSD program to make the demonstration required under the Act.[18]

Using the models identified in EPA regulations, there are two basic ways that a PSD permit applicant can demonstrate that the proposed source's emissions will not cause or contribute to a violation of any NAAQS or PSD increment. One way is to demonstrate that no such violation is occurring or projected to occur in the area affected by the emissions from the proposed source.[19] A second way is to demonstrate that the emissions from the proposed source do not cause or contribute to any identified violation of the NAAQS or PSD increments.[20]

The Act does not define "cause" or "contribute." Reading these terms in context, the EPA has historically interpreted this provision in section 165(a)(3) of the CAA and associated regulations to mean that a source must have a "significant impact" on ambient air quality in order to cause or contribute to a violation.[21] Thus, the EPA and other permitting authorities have concluded that a proposed source may meet the requirements in CAA section 165(a)(3) and the EPA's PSD regulations by showing that its projected impact on air quality at the site of a modeled violation is below a level of air quality impact considered to be significant.[22]

---

[16] Section 165(a)(3) of the CAA. The EPA interprets the phrase "in excess of" to mean a violation, not the exceedance described in 40 CFR 50.1(l).
[17] 40 CFR 51.166(k); 40 CFR 52.21(k).
[18] 40 CFR 51.166(l); 40 CFR 52.21(l); 40 CFR part 51, Appendix W (Guideline on Air Quality Models).
[19] 1990 Draft NSR Workshop Manual at C.51.
[20] 40 CFR part 51, App. W, § 10.2.3.2(a); 1990 Draft NSR Workshop Manual at C.52.
[21] In re Prairie State Generating Co., 13 E.A.D. 1, 105 (EAB 2006). This EAB opinion includes a long discussion of EPA's prior guidance with other examples.
[22] 1990 Draft NSR Workshop Manual at C.52.

Historic Use of SILs

In the context of section 165(a)(3) of the CAA, the EPA has historically used pollutant-specific concentration levels known as "significant impact levels" to identify the degree of air quality impact that "causes, or contributes to" a violation of a NAAQS or PSD increment.[23] Consistent with EPA guidance, proposed sources have met the requirement to demonstrate that they do not cause or contribute to a violation by showing that the ambient air quality impacts resulting from the proposed source's emissions would be below these concentration levels.[24] The SIL values have served as a compliance demonstration tool to make the required demonstration in the PSD program. They have helped to reduce the burden on permitting authorities and permit applicants to conduct often time-consuming and resource-intensive air dispersion modeling where such modeling was unnecessary to demonstrate that a permit applicant meets the requirements of section 165(a)(3), consistent with the procedures set forth originally in 1977 in the "Guidelines for Air Quality Maintenance Planning and Analysis, Vol 10 (Revised) and Procedures for Evaluating Air Quality Impact of New Stationary Sources."[25]

Recent Status of SILs for Ozone and $PM_{2.5}$

Stakeholders have long sought compliance demonstration tools for ozone and secondarily-formed $PM_{2.5}$. In July 2010, Sierra Club petitioned the EPA to designate computer models to use in determining if major proposed sources of air pollution cause or contribute to violations of the ozone or $PM_{2.5}$ NAAQS. In January 2012, the EPA granted the petition and committed to engage in rulemaking to evaluate whether updates to Appendix W are warranted and, as appropriate, incorporate new analytical techniques or models for ozone and secondarily-formed $PM_{2.5}$. In granting the petition, the EPA explained that the "complex chemistry of ozone and secondary formation of $PM_{2.5}$ are well-documented and have historically presented significant challenges to the designation of particular models for assessing the impacts of individual stationary sources on the formation of these air pollutants."[26] Because of these considerations, the EPA's past judgment had been that it was not technically sound to designate with particularity specific models that must be used to assess the impacts of a single source on ozone and secondarily-formed $PM_{2.5}$ concentrations. Instead, the EPA established a consultation process with permitting authorities for determining (on a permit-specific basis) the analytical techniques that should be used for single-source analyses for both ozone and secondarily-formed $PM_{2.5}$.

The EPA has responded to the Sierra Club petition by proposing revisions to Appendix W.[27] As discussed in the Appendix W proposed language, recent technical advances have made it reasonable for the EPA to provide more specific guidelines that identify appropriate analytical techniques or models that may be used in compliance demonstrations for the ozone and $PM_{2.5}$ NAAQS. The EPA expects that the final Appendix W revisions will include criteria and process steps for choosing single-source analytical techniques or models to estimate ozone impacts from precursor nitrogen oxide and volatile organic compound emissions. The ozone SIL value recommended in this guidance is intended to

[23] 61 FR 38250, 38293 (July 23, 1996); 72 Fed. Reg. 54112, at 54139 (September 21, 2007).
[24] 1990 Draft NSR Workshop Manual at C.51-C.52.
[25] October 1977, U.S. EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711. Specific applications of how SILs have been used in the PSD program are discussed later in this memorandum.
[26] Letter from Gina McCarthy, Assistant Administrator, EPA Office of Air and Radiation, to Robert Ukeiley, Sierra Club, January 4, 2012.
[27] 80 FR 45340 (July 29, 2015).

complement the Appendix W updates by providing a threshold that may be used to determine whether an impact predicted by the chosen technique or model causes or contributes to a violation. With respect to $PM_{2.5}$, the EPA expects the final Appendix W revisions will include criteria and process steps for choosing single-source analytical techniques or models to assess concentrations of direct and secondarily-formed $PM_{2.5}$.

In the 2010 $PM_{2.5}$ SILs rule, the EPA established SIL values for $PM_{2.5}$ in paragraph (k)(2) of 40 CFR 51.166 and 52.21 of the PSD regulations. In January 2013, the U.S. Court of Appeals for the District of Columbia Circuit granted the EPA's request to vacate and remand the paragraph (k)(2) provision in both PSD regulations so the EPA could correct them.[28] Paragraph (k)(2) as promulgated in 2010 included numerical values of $PM_{2.5}$ SILs and statements about their role in completing an air quality impact analysis with regard to the $PM_{2.5}$ NAAQS and PSD increments. Specifically, the 52.21(k)(2) rule text stated that if the impact of a proposed source seeking a federal PSD permit were below the relevant SIL value(s), then the proposed source would be deemed to not cause or contribute to a violation. The 51.166(k)(2) rule text stated that a state's PSD rules could contain a similar provision. The EPA asked the court to vacate and remand the (k)(2) paragraphs of both PSD regulations so that the EPA could correct an inconsistency between (1) that rule text, which left no discretion for the permitting authority, and (2) our statements in the preamble to the 2010 $PM_{2.5}$ SILs rule, which identified circumstances where it may not be appropriate for a permitting authority to rely solely on the $PM_{2.5}$ SILs as a basis for concluding that a proposed source does not cause or contribute to a violation.[29]

The court left intact the $PM_{2.5}$ NAAQS SIL values contained in 40 CFR 51.165(b)(2), because the regulatory text therein did not say that a showing that a proposed source has an impact equal to or less than the SIL value is always deemed to not cause or contribute. The regulatory text contained at 51.165(b)(2) says that, at a minimum, an impact greater than the listed SIL must be considered significant, but does not compel the opposite conclusion for impacts equal to or below that value.[30]

III. RECOMMENDED SIL VALUES FOR USE IN AIR QUALITY IMPACT DEMONSTRATION REQUIRED TO OBTAIN A PSD PERMIT

As discussed above, the EPA has interpreted the phrase "cause, or contribute to" in section 165(a)(3) of the Act to mean that a proposed source is prevented from obtaining a permit if the proposed source will have a "significant impact" on air pollutant concentrations that violate the standards. In this context, the EPA believes permitting authorities may read the phrase "cause, or contribute to" to be inapplicable to an air quality impact that is insignificant. This interpretation is more fully explained in the legal support

[28] *Sierra Club v. EPA*, 294 F.3d 155, 160 (D.C. Cir. 2002).

[29] These preamble statements were the following: "[N]otwithstanding the existence of a SIL, permitting authorities should determine when it may be appropriate to conclude that even a *de minimis* impact will 'cause or contribute' to an air quality problem and to seek remedial action from the proposed new source or modification." *See* 75 FR 64864 at 64892. "[T]he use of a SIL may not be appropriate when a substantial portion of any NAAQS or increment is known to be consumed." *See* 75 FR 64864 at 64894. "[W]e earlier provided an example of when it might be appropriate to require a modified source to mitigate its contribution to a violation of a NAAQS or increment even when the predicted ambient impact of the proposed emissions increase would result in what is normally considered to be *de minimis*." *See* 75 FR 64864 at 64894.

[30] Section 165(b)(2) is phrased such that an impact equal to the listed value is treated the same as impacts below the listed value. This contrasts to the approach in (k)(2), and in this guidance, that an impact equal to the SIL is treated the same as impacts above the SIL.

memorandum. In this context, the EPA believes an insignificant impact is an impact on air quality concentrations that is small and not meaningful. (The EPA has often described such an impact as "trivial" or "*de minimis*".)

The term "contribute," as used in the context of section 165(a)(3), is ambiguous. In the absence of specific language in section 165(a)(3) regarding the degree of contribution that is required (such as the term "significantly"), the EPA has the discretion under this provision to exercise its judgment to determine the degree of impact that "contributes" to adverse air quality conditions based on the particular context in which the term "contribute" is used. The EPA may also identify criteria or factors that may be used to determine whether something "contributes," including qualitative or quantitative criteria that are appropriate to the particular context.[31] For purposes of implementing section 165(a)(3) of the Act, the EPA has found it more expedient and practical to use a quantitative threshold (expressed as a level of change in air quality concentration) to determine whether increased emissions from proposed construction or modification of a source will contribute to air quality concentrations in violation of applicable standards. The EPA believes that the permitting process can be streamlined without compromising air quality, if the EPA and permitting authorities are able to identify a quantitative threshold or dividing line between an insignificant and significant impact on air pollutant concentration. Using a quantified threshold for this purpose is permissible as long as the EPA or the appropriate permitting authority provides a reasoned explanation for why impacts below that value do not constitute a contribution to a violation in this context.

To determine what is (and is not) a significant impact in the context of section 165(a)(3) of the Act, the EPA has generally supported using the values in 40 CFR 51.165(b).[32] The EPA has described these levels as "significance levels."[33] Section 51.165(b)(2) was originally promulgated by the EPA in 1987 as part of an offset program that permitting authorities could apply after it was determined that construction at a stationary source was predicted to cause or contribute to a violation of the NAAQS.[34] This regulation provides that a proposed source planning to locate in an attainment area will be considered to "cause or contribute to" a violation of the NAAQS if its impact would exceed specific values identified in the regulations. For example, section 51.165(b) states that a proposed source impact any larger than 5 micrograms per cubic meter ($\mu g/m^3$) for the 24-hour SO_2 NAAQS causes or contributes to a violation of that NAAQS. The section refers to these values as "significance levels." Values are not provided for every NAAQS, and in particular not for ozone (and until 2010 not for $PM_{2.5}$), but for those NAAQS

[31] See *Catawba County, N.C. v. EPA*, 571 F.3d 20, 39 (D.C. Cir. 2009). In this case interpreting the term "contributes" in section 107(d) of the CAA, the court held that the EPA is not required to establish a quantitative or objective, bright-line test to define a contribution by sources to adverse air quality conditions in a nearby area in the context of designations with respect to attainment of a NAAQS. The court recognized that the EPA has the discretion to use a totality-of-the-circumstances test if the agency defines and explains the criteria that it is applying. While this opinion said that a quantified threshold is not required to define contribution in the context of section 107(d), the court's reasoning does not preclude PSD permitting authorities from choosing to use a quantitative level of impact to represent a contribution to a violation of the NAAQS or PSD increment when implementing section 165(a)(3) of the CAA.

[32] Emison Memo at footnote 5 references 40 CFR 51.165(b), which defines "significant," and the NSR Workshop Manual at C.26-C.28 lists values from 40 CFR 51.165(b)(2) for the purpose of defining the area of "significant ambient impact."

[33] The EPA initially promulgated these same concentration values in 1979 as the "significance levels" under which a source locating in the "clean" portion of a nonattainment area may be exempt from the preconstruction review requirements in Appendix S to Part 51, 44 FR 3274, 3283 (January 16, 1979).

[34] 52 FR 24672, 24713 (July 1, 1987).

covered in this regulation, the application is the same. Over time, these air quality concentration significance levels in section 51.165(b) have become known as "significant *impact levels*"[35] [emphasis added] in order to distinguish them from the significant *emissions rates* reflected in the definition of the term "significant," which serve a different function in the PSD program.[36] The EPA has also issued guidance memoranda that have provided recommended SIL values for the 1-hour NO_2 and SO_2 NAAQS, to be used for the purpose of determining what are (and are not) significant impacts for these pollutants.[37] The EPA has also observed that permitting authorities have discretion to develop their own SIL values, provided that such values are properly supported in permitting authority actions or decisions in which the values are used to make the required showing.[38]

The EPA's basis for the values in section 51.165(b)(2) of its regulations has generally been a percentage of the applicable PSD increments for each pollutant. The EPA used a similar approach in 2010 to add $PM_{2.5}$ values to section 51.165(b)(2) and establish $PM_{2.5}$ values in sections 51.166(k)(2) and 52.21(k)(2). However, given limitations in the rationale supporting them, the EPA recognized in the preamble to the 2010 $PM_{2.5}$ SILs rule that a permitting authority may not be able to apply the SIL values derived through this approach in every situation to show that proposed construction does not cause or contribute to a violation of standards. The EPA acknowledged that "the use of a SIL may not be appropriate when a substantial portion of any NAAQS or increment is known to be consumed." The EPA also said that "notwithstanding the existence of a SIL, permitting authorities should determine when it may be appropriate to conclude that even a *de minimis* impact will 'cause or contribute' to an air quality problem and to seek remedial action from the proposed new source or modification."[39] To guard against the improper use of the 2010 SILs for $PM_{2.5}$ in such circumstances, the EPA later recommended that permitting authorities use those SILs only where they could establish that the difference between background concentrations in a particular area and the NAAQS was greater than those SIL values.[40] This approach was intended to guard against misuse of the SILs that were based on a percentage of the $PM_{2.5}$ PSD increments.

Since that $PM_{2.5}$ modeling guidance was issued, the EPA has developed a new technical method for determining a concentration level that can be considered an insignificant impact on air pollutant concentrations for ozone and $PM_{2.5}$ in the context of PSD permitting. This technical method, referred to as the air quality variability approach, is described in the supporting technical docuement. Given the improvements reflected in this method, the EPA does not see a need for permitting authorities to show that the difference between background concentrations and the relevant NAAQS is greater than the SIL

---

[35] The first reference to "significant impact levels" is in the 1980 NSR Workshop Manual, which the EPA subsequently updated in the 1990 draft. It is worth noting that the 1977 comments to the proposed Appendix W rule (45 FR 58543) addressed whether a single-source screening technique should be used to determine if a cumulative modeling analysis would be required in a preconstruction review; industry and state agency comments indicated both groups favored some use of a tool to alleviate resource burden.

[36] Section 52.21(b)(23) also uses the term "significance" and applies discrete values for determining if a proposed source is significant. This regulation states that significance is any net emissions increase equal to or exceeding 40 tons per year (TPY) for ozone, and, for direct emissions of $PM_{2.5}$, 10 TPY (40 TPY for SO_2 and 40 TPY NO_2 unless demonstrated not to be a $PM_{2.5}$ precursor).

[37] Page memoranda at footnotes 5 and 6.

[38] 77 FR 37038 (June 20, 2010); 14 E.A.D. 723 (EAB 2010).

[39] 75 FR 64864, 64892.

[40] Memorandum from Stephen D. Page, EPA OAQPS, to EPA Regional Air Division Directors, "Guidance for $PM_{2.5}$ Permit Modeling," May 20, 2014.

value before applying one of the recommended $PM_{2.5}$ SIL values, as previously stated. The EPA's intention with this new method is to derive SIL values that are more universally applicable to a range of conditions, including those where a substantial portion of the NAAQS or PSD increment is known to be consumed. The EPA does not consider its qualifying statements from the preamble of the 2010 rule (quoted in the prior paragraph) to be applicable to the $PM_{2.5}$ SIL values derived with this new method; however, permitting authorities retain discretion to decide to apply or not to apply SILs as a general matter, or in particular permitting actions based on information in the administrative record.

In order for a concentration level to be used to show that the air quality impact of a proposed source does not cause or contribute to a violation of the NAAQS or PSD increment, the concentration value must represent a level of impact on ambient air quality that is insignificant or not meaningful. An insignificant impact on air pollutant concentrations can be identified and quantified based on an assessment of the variability of air quality, using data from the U.S. ambient $PM_{2.5}$ and ozone monitoring network. Due to fluctuating meteorological conditions and changes in day-to-day source operations, there is an inherent variability in the air quality in the area of a monitoring site. This variability can be characterized through the application of a well-established statistical framework for quantifying uncertainty in population statistics. The analysis described in the supporting technical document quantifies the fluctuations in pollutant concentrations (as measured by design values) and, for each NAAQS, determines a value for a concentration difference that is meaningful in the context of inherent variability. Changes of less than this magnitude may be considered to be in the "noise" of observed design values. This technical analysis provides a basis for a permitting authority to conclude that concentration increases below this SIL do not cause or contribute to violations of the relevant NAAQS or PSD increments.

SILs for NAAQS

Using this air quality variability approach, the EPA derived SIL values for the 8-hour ozone NAAQS and each $PM_{2.5}$ NAAQS averaging period, which are applicable to attainment and unclassifiable areas. The SIL values for the NAAQS are listed in Table 1. Each SIL value is based on the level, averaging period and statistical form of its corresponding NAAQS. For example, for ozone the recommended SIL value is based on the 4th highest daily maximum 8-hour concentration, averaged over 3 years. The derived value from the air quality variability analysis is 1.0 parts per billion (ppb), and we recommend the case-by-case application of this value as the SIL for the 8-hour ozone NAAQS.

For the 24-hour $PM_{2.5}$ NAAQS, the SIL value we recommend is 1.2 $\mu g/m^3$. The derived value from the air quality variability analysis is 1.3 $\mu g/m^3$ and is based on an analysis of the 98th percentile 24-hour concentrations averaged over 3 years; however, 40 CFR 51.165(b)(2) still lists 1.2 $\mu g/m^3$ as the SIL value for the 24-hour $PM_{2.5}$ NAAQS, and, pending further evaluation by the EPA, we recommend it for maintaining consistency with the rule. In the 2010 $PM_{2.5}$ SILs rulemaking, the EPA determined that an impact above this value will be considered to cause or contribute to a violation of the 24-hour $PM_{2.5}$ NAAQS at any location that does not meet this standard. In the same rule, the EPA also sought to establish that an impact below this value would not cause or contribute to a violation of this NAAQS but acknowledged that there could be circumstances where this conclusion was not always valid. Even though the ambient air quality variability approach indicates that an impact below 1.3 $\mu g/m^3$ is not significant, 51.165(b)(2) remains in the EPA's regulations and the agency is presently bound by its prior conclusion (that an impact above 1.2 $\mu g/m^3$ is significant and will cause or contribute to a violation of

the 24-hour $PM_{2.5}$ NAAQS). Thus, the EPA cannot conclude at this time that an impact between 1.2 $\mu g/m^3$ and 1.3 $\mu g/m^3$ is an insignificant impact or an impact that will not cause or contribute to a violation of the NAAQS. However, based on the ambient air quality variability approach, the EPA is able to conclude that impacts below 1.2 $\mu g/m^3$ are insignificant at any location and will not cause or contribute to a violation of the NAAQS.[41] The case-by-case use of this recommended SIL value should be justified in the record for each permit.

For the annual $PM_{2.5}$ NAAQS, we recommend 0.2 $\mu g/m^3$ as the SIL value, which is the value derived from the air quality variability analysis and is based on a 3-year average of annual average concentrations. The case-by-case use of this recommended SIL value should be justified in the record for each permit. This value is lower than the value of 0.3 $\mu g/m^3$ listed in 51.165(b)(2). Since section 51.165(b)(2) does not address whether an impact below 0.3 $\mu g/m^3$ causes or contributes to a violation of the NAAQS, permitting authorities retain the discretion under this provision to determine on a case-by-case basis whether an impact between 0.2 $\mu g/m^3$ and 0.3 $\mu g/m^3$ will cause or contribute to a violation of the annual $PM_{2.5}$ NAAQS. Based on the ambient air quality variability approach, the EPA's judgment is that an impact below 0.2 $\mu g/m^3$ is insignificant and should be considered to not cause or contribute to any violation of the annual $PM_{2.5}$ NAAQS that is identified.

Table 1. Recommended SIL Values for Ozone and $PM_{2.5}$ NAAQS

Criteria Pollutant (NAAQS level)	NAAQS SIL concentration
Ozone 8-hour (70 ppb)	1.0 ppb
$PM_{2.5}$ 24-hour (35 $\mu g/m^3$)	1.2 $\mu g/m^3$*
$PM_{2.5}$ annual (12 $\mu g/m^3$ or 15 $\mu g/m^3$)	0.2 $\mu g/m^3$

* The table takes into account the SIL value for the 24-hour $PM_{2.5}$ NAAQS that is in section 51.165(b)(2). Refer to the guidance discussion for details.

We recommend that these SIL values apply everywhere, regardless of the class of the airshed.[42] For $PM_{2.5}$, this recommendation is different than what was provided in the vacated (k)(2) paragraphs, where the SIL value that would be used for NAAQS purposes was different for Class I areas than for Class II and III areas. The EPA recognizes that, historically, Congress has provided special protections to Class I areas, via PSD increments. The EPA believes that because each ozone and $PM_{2.5}$ NAAQS is uniform throughout the class areas, no class-specific protection via SILs is necessary when assessing whether a source causes or contributes to a violation of the NAAQS.

---

[41] 40 CFR 165(b)(2) provides that a source impact higher than one of the listed significance levels is to be considered significant. A source impact exactly equal to a significance level need not be considered significant. In contrast, in this memorandum, consistent with past guidance, we are recommending that a value exactly equal to a recommended SIL be considered significant. Thus, these two approaches treat a value equal to the stated level differently. In practice, we do not expect this to be a practical difference because it will be very unusual for a source's impact to exactly equal one of the recommended SIL values.

[42] When Congress established the PSD program requirements under the 1977 CAA Amendments, it included specific numerical increment levels for SO_2 and particulate matter (expressed at that time as "total suspended particulate") for Class I, II and III areas. Congress designated Class I areas (including certain national parks and wilderness areas) as areas of special national concern, where the need to prevent deterioration of air quality is the greatest. Consequently, the PSD increments are the smallest in Class I areas. The increments of Class II areas are larger than those of Class I areas and allow for a moderate degree of emissions growth. Class III areas have the largest increments, but to date no Class III areas have been designated. The EPA subsequently defined Class I, II and III increments for NO_2 and PM_{10}, and $PM_{2.5}$ in multiple rulemakings.

SILs for PSD Increment

There are no PSD increments established for ozone, and, thus, no ozone SIL values are needed for PSD increment compliance purposes. We used the air quality variability approach to develop increment SILs for the $PM_{2.5}$ PSD increments (Table 2), but in an indirect way. The SIL values for the $PM_{2.5}$ PSD increments are derived from the NAAQS SIL values and reflect that, under the PSD regulations, the allowable PSD increment values are different for Class I, II and III areas. For Class II areas (which comprise most of the U.S.) and Class III areas (of which there are currently none), we recommend that the values of the NAAQS SILs also be used for PSD increment SILs. For Class I areas, we are recommending annual and 24-hour PSD increment SIL values that are lower than the NAAQS SIL values. The EPA recognizes that Class I areas have historically been provided special protection.[43] To achieve this additional protection, we applied the ratios of the Class I and Class II allowable PSD increments to the NAAQS SIL values derived in our technical analysis.[44] The EPA believes these values for Class I areas will continue to reflect this higher level of protection through the PSD increment SILs.

Table 2. Recommended SIL Values for $PM_{2.5}$ Increment

Criteria Pollutant (averaging period)	PSD increment SIL concentration		
	Class I	Class II	Class III
$PM_{2.5}$ (24-hour)	0.27 $\mu g/m^3$	1.2 $\mu g/m^3$	1.2 $\mu g/m^3$
$PM_{2.5}$ (annual)	0.05 $\mu g/m^3$	0.2 $\mu g/m^3$	0.2 $\mu g/m^3$

IV. APPLICATION OF SILS

The EPA recommends that permitting authorities consider using these SIL values for $PM_{2.5}$ and ozone on a case-by-case basis at the same points in the PSD air quality analysis as SIL values historically have been used in the PSD program, as described below, with one exception regarding defining the spatial extent for modeling.

First, permitting authorities may elect to use the SIL values reflected in this memorandum in a preliminary (single-source) analysis that considers only the impact of the proposed source in the permit application on air quality to determine whether a full (or cumulative) impact analysis is necessary before reaching a conclusion as to whether the proposed source would (or would not) cause or contribute to a violation.[45] A model result predicting that a proposed source's maximum impact will be below the corresponding SIL value recommended above generally may be considered to be a sufficient demonstration that the proposed source will not cause or contribute to a violation of the applicable NAAQS or PSD increment. If the single-source analysis shows that a proposed source will not have a significant impact on air quality, permitting authorities may generally conclude there is no need to conduct a cumulative impact analysis to assess whether there will be any violations of the NAAQS or

[43] The CAA section 169A declares a national goal of preventing future and remedying any existing impairment of visibility in Class I areas.

[44] The Class I PSD increment SIL value starts with the NAAQS SIL value as the base number and is further constrained by the ratio of the associated Class I and II PSD increments. For the annual $PM_{2.5}$ NAAQS, the NAAQS SIL value is reduced by the ratio of 1:4, because the Class I PSD increment is 1 $\mu g/m^3$ and the Class II PSD increment is 4 $\mu g/m^3$. The ratio of 2:9 is used for the 24-hour $PM_{2.5}$ NAAQS. For the 24-hour NAAQS, we are using the 51.165(b)(2) value of 1.2 $\mu g/m^3$ as our base number.

[45] 1990 Draft NSR Workshop Manual at C.24-C.25, C.51.

PSD increment. However, upon considering the permit record in an individual case, if a permitting authority has a basis for concern that a demonstration that a proposed source's impact is below the relevant SIL value at all locations is not sufficient to demonstrate that the proposed source will not cause or contribute to a violation, then the permitting authority should require additional information from the permit applicant to make the required air quality impact demonstration.

Second, where the preliminary analysis described in the prior paragraph is not sufficient, permitting authorities may choose to use the recommended SIL values in a cumulative impact analysis for a NAAQS, which, in addition to the proposed source, includes the impact of existing sources (on and offsite), and the appropriate background concentration. The EPA has described this application of a SIL as a "culpability analysis."[46] Where a cumulative impact analysis predicts a NAAQS violation, the permitting authority may further evaluate whether the proposed source will cause or contribute to the violation by comparing the proposed source's modeled contribution to that violation to the corresponding SIL value. If the modeled impact is below the SIL value at the violating receptor during the violation, the EPA believes this will be sufficient in most cases for a permitting authority to conclude that the source does not cause or contribute to (is not culpable for) the predicted violation; thus, allowing the permit to be issued. If the proposed source's modeled impact is higher than or equal to the SIL value at the violating receptor during a violation, then a permit should not be issued unless (1) further modifications are made to the proposed source to reduce the proposed source's impact to an insignificant level at the affected receptor during the violation, or (2) the proposed source obtains sufficient emissions reductions from other sources to compensate for its contribution to the violation.[47]

Third, permitting authorities may decide to use the SIL values recommended above in a cumulative impact analysis for a PSD increment. According to 40 CFR 51.166(c)(1) and 52.21(c), an allowable PSD increment based on an annual average may not be exceeded and the allowable PSD increment for any other time period may be exceeded during one such period per year at any one location. In either case, the PSD increment SILs recommended above may be used to determine if the proposed source will cause or contribute to that exceedance. If the cumulative impact analysis shows an annual average $PM_{2.5}$ PSD increment exceedance or a 24-hour PSD increment exceedance at a location, then the comparison of the proposed source's impact at that location during the exceedance to the corresponding SIL value may be used to determine whether the proposed source will cause or contribute to the exceedance(s) at that receptor. If the modeled impact is below the SIL and all other PSD requirements are met, then the permitting authority may conclude that the source does not cause or contribute to a violation of the PSD increment.

Finally, SILs have been used in defining the spatial extent of the modeling domain for a cumulative impact analysis. Because an impact from a proposed source below a SIL value is considered not to cause or contribute to a violation, the EPA has previously recognized that there was no informational value in placing modeling receptors farther from the proposed source than the most distant point at which the proposed source's impact is equal to or greater than the applicable SIL value. Streamlining the modeling demonstration to reduce the number of receptors to those of value in determining if the proposed source will cause or contribute to a violation of the applicable NAAQS or PSD increment has enabled permit applicants and reviewers to complete the required modeling with a reasonable effort. As discussed

[46] Prairie State, 13 E.A.D. at 100; Mississippi Lime, 15 E.A.D. at 374.

[47] 1990 Draft NSR Workshop Manual at C.52-C.53; this latter alternative is referred to as a PSD offset, and state implementation plans may include on offset program based on federal regulations at 40 CFR 51.165(b).

earlier, the EPA recently proposed updates to its Guideline on Air Quality Models. The revisions include providing an appropriate, revised basis for determining the modeling domain for NAAQS and PSD increment assessments. Once finalized, the revised Appendix W will be the appropriate resource to use when considering the extent of the modeling domain.

The SILs identified in this memorandum should not influence Air Quality Related Values analyses, which are independent reviews by the Federal Land Managers during the application review process.

Before a rulemaking is conducted and subject to limitations described in this memorandum, we recommend that permitting authorities consider using the values in the above tables on a case-by-case basis to support air quality analyses and demonstrations required for issuance of PSD permits. Permitting authorities that implement the PSD program under an EPA-approved implementation plan may also choose to use these recommended SILs. Since this memorandum is neither a final determination nor a binding regulation, permitting authorities retain the discretion not to use SILs as described here, either in specific cases or programmatically.

To ensure an adequate record, any PSD permitting decision that is based on the guidance in this memorandum should incorporate the information contained in this memorandum and the supporting technical and legal supporting documents. The permitting authority should also consider any additional information in the record that is relevant to making the required demonstration.

The permitting authorities also retain the discretion to use other values that may be justified separately from this memorandum as levels of insignificant impact, subject to one limitation for the $PM_{2.5}$ NAAQS. Since the EPA has established by regulation that a $PM_{2.5}$ impact greater than certain values will cause or contribute to a violation of the relevant NAAQS, permitting authorities may not use a value higher than 1.2 $\mu g/m^3$ for the 24-hour $PM_{2.5}$ NAAQS or a value higher than 0.3 $\mu g/m^3$ for the annual $PM_{2.5}$ NAAQS. Because ozone is not addressed in section 51.165(b)(2), permitting authorities are not precluded from developing a higher ozone NAAQS SIL value than recommended in this guidance. Likewise, section 51.165(b)(2) does not address PSD increments and, thus, does not constrain the discretion of a permitting authority to use a higher SIL value that a permitting authority may develop for increment purposes. Permitting authorities are also not precluded from developing and using lower SIL values than recommended in this guidance. The case-by-case use of a SIL value should be supported by a comparable record in each instance that shows that the value represents a level below which a proposed source does not cause or contribute to a violation of the NAAQS or PSD increment.

Please inform your permitting authorities of the guidance provided by this memorandum. If you have questions regarding policy or general implementation, please contact Raj Rao at *rao.raj@epa.gov* or (919) 541-5344. For questions regarding the supporting technical document, please contact Tyler Fox at *fox.tyler@epa.gov* or (919) 541-5562. For questions regarding the supporting legal document, please contact Brian Doster at *doster.brian@epa.gov* or (202) 564-1932.

APPENDIX B: Q/D CALCULATIONS

ED_013256A_00000458-00046

Table B-1. PSD Baseline Emissions (24-Month Average)

Emission Unit	Baseline (tpy)			
	PM_{10}	SO_2	NO_x	H_2SO_4
No. 2 Recovery Boiler	7.65	341.70	72.74	0.33
No. 3 Recovery Boiler	25.95	430.62	299.17	1.77
No. 2 Smelt Dissolving Tank	3.04	0.28	0.00	0.00
No. 3 Smelt Dissolving Tank	30.60	1.52	0.00	0.00
Lime Kiln	49.19	1.82	52.18	0.82
Paper Machine #3	4.38	0.00	0.00	0.00
Storage Piles	1.00	0.00	0.00	0.00
Other Fugitive Emissions	0.21	0.00	0.00	0.00

Table B-2. Past Potential Emissions(Only Modified Units)

Emission Unit	Past Potential		Past Potential Emissions (24-Hour Basis) (tpy)			
	Daily Throughput	Throughput Unit	PM_{10}	SO_2	NO_x	H_2SO_4
Paper Machine #3	1033.33	ADTFP/day	7.54	0.00	0.00	0.00

[1] The historic emission factors (used for 2008-2016) for PM/PM_{10} and $PM_{2.5}$ are the median factors of Mill Codes A, B, and F, which produce coated papers, from NCASI Technical Bulletin No. 1020, Table A-17b.

Historic PM_{10} Emission Factor (lb/ADTFP) 0.04

Table B-3. Maximum Daily Future Potential Emissions

Emission Unit	Potential Daily Throughput	Throughput Unit	Maximum Potential Emissions (tpy)			
			PM_{10}	SO_2	NO_x	H_2SO_4
No. 2 Recovery Boiler [1]	0.75	MMlbs/day	11.12	468.29	103.12	0.48
No. 3 Recovery Boiler [2]	3.40	MMlbs/day	35.18	507.41	361.08	2.17
No. 2 Smelt Dissolving Tank [3]	0.75	MMlbs/day	6.31	0.41	0.00	0.00
No. 3 Smelt Dissolving Tank [4]	3.40	MMlbs/day	45.53	1.86	0.00	0.00
Lime Kiln [5]	300	tons CaO/day	54.09	1.99	86.35	1.15
Paper Machine #3 [6]	1446.67	ADTFP/day	5.28	0.00	0.00	0.00
Storage Piles [7]	--	--	1.16	0.00	0.00	0.00
Other Fugitive Emissions [7]	--	--	0.39	0.00	0.00	0.00

[1] Maximum potential emissions from the No. 2 Recovery Boiler are calculated using the potential daily throughput and the following emission factors. Daily emissions are scaled up to 365 days per year.

PM_{10} Emission Factor (lb/TBLS)	0.16
SO_2 Emission Factor (lb/TBLS)	6.84
NO_x Emission Factor (lb/TBLS)	1.51
Sulfuric Acid Emission Factor (lb/TBLS)	0.007

[2] Maximum potential emissions from the No. 3 Recovery Boiler are calculated using the potential daily throughput and the following emission factors. Daily emissions are scaled up to 365 days per year.

PM_{10} Emission Factor (lb/TBLS)	0.11
SO_2 Emission Factor (lb/TBLS)	1.64
NO_x Emission Factor (lb/TBLS)	1.16
Sulfuric Acid Emission Factor (lb/TBLS)	0.007

[3] Maximum potential emissions from the No. 2 Smelt Dissolving Tank are calculated using the potential daily throughput and the following emission factors. PM_{10} emissions included CPM. Daily emissions are scaled up to 365 days per year.

PM_{10} Emission Factor (lb/TBLS)	0.09
SO_2 Emission Factor (lb/TBLS)	0.006

[4] Maximum potential emissions from the No. 3 Smelt Dissolving Tank are calculated using the potential daily throughput and the following emission factors. PM_{10} emissions included CPM. Daily emissions are scaled up to 365 days per year.

PM_{10} Emission Factor (lb/TBLS)	0.15
SO_2 Emission Factor (lb/TBLS)	0.006

[5] Maximum potential emissions from the lime kiln are calculated using the potential daily throughput and the following emission factors. The PM_{10} emission factor includes the CPM emission factor. Daily emissions are scaled up to 365 days per year.

PM_{10} Emission Factor (lb/ton CaO)	0.99
SO_2 Emission Factor (lb/ton CaO)	0.04
NO_x Emission Factor (lb/ton CaO)	1.58
Sulfuric Acid Emission Factor (lb/ton CaO)	0.021

[6] Maximum potential emissions from Paper Machine #3 are calculated using the potential post-project daily throughput and the following emission factor. The post-project emission factor for PM_{10} is the factor for Mill Code D, which produces kraft linerboard, from NCASI Technical Bulletin No. 1020, Table A-17b. Daily emissions are scaled up to 365 days per year.

Projected PM_{10} Emission Factor (lb/ADTFP)	0.02

[7] Maximum daily future potential fugitive emissions (storage piles and other fugitive emissions) are assumed to be equal to the projected maximum emissions from the PSD calculations. Scaling to 365 days/yr operation is not needed, because fugitive emissions are calculated assuming continuous operation.

Table B-4. Future Daily Allowable Emissions Minus Past PSD Baseline (24-Month Average)

Emission Unit	Emission Increase (tpy)			
	PM_{10}	SO_2	NO_x	H_2SO_4
No. 2 Recovery Boiler	3.47	126.59	30.38	0.15
No. 3 Recovery Boiler	9.23	76.79	61.92	0.40
No. 2 Smelt Dissolving Tank	3.26	0.13	0.00	0.00
No. 3 Smelt Dissolving Tank	14.92	0.34	0.00	0.00
Lime Kiln	4.90	0.17	34.16	0.33
Paper Machine #3	0.90	0.00	0.00	0.00
Storage Piles	0.16	0.00	0.00	0.00
Other Fugitive Emissions	0.18	0.00	0.00	0.00
Q (tpy)	368.41			
d (km)	113			
Q/d	3.26			

Table B-5. Max Daily Future Potential Emissions Minus Past Potential

Emission Unit	Emission Increase (tpy)			
	PM_{10}	SO_2	NO_x	H_2SO_4
Paper Machine #3	0.00	0.00	0.00	0.00
Q (tpy)	0.00			
d (km)	113			
Q/d	0.00			

APPENDIX C: QUALITY ASSURANCE PLAN

ED_013256A_00000458-00050

Ambient Monitoring Station

Site, Construction

Quality Assurance Plan

Boise Cascade Corporation

Wallula, Washington

1980

MET STATION COORDINATES

46° 07' 02" N Longitude

118° 54' 86" W Latitude

ELEVATION

462 feet

MAGELLAN GPS 310

Reading from 8 satelites

ADDENDUM
PRE-CONSTRUCTION PSD AMBIENT MONITORING PLAN

BOISE CASCADE CORPORATION
PULP AND PAPER COMPLEX
WALLULA, WASHINGTON

October 1981

157D1

ADDENDUM TO
MONITORING PLAN FOR BOISE CASCADE
WALLULA, WASHINGTON

RESPONSES TO EPA COMMENTS, DATED APRIL 1, 1981, ON THE PROPOSED MONITORING NETWORK

1. *Previous modeling studies have shown that the maximum annual SO_2 and TSP concentrations occur northeast of the mill. The proposed monitoring site is to be located 1.5 kilometers (km) to the north-northeast of the mill. Based on the previous modeling study, the proposed monitoring location would not measure the maximum TSP and SO_2 concentrations from the mill. In addition, a short-term modeling analysis must be performed to determine the short-term maximum SO_2 and TSP impact areas. If the short-term maximum impact location is different from the annual maximum impact areas location, then monitoring would be necessary at each location.*

   In locating the proposed new ambient monitoring network, it was Boise Cascade's objective to find a monitoring site or sites that would be representative of both long- and short-term maximum air pollutant concentrations from existing sources in the area. Boise Cascade is the only significant major stationary source in the area. The selection of the monitoring site was the result of subjective judgment based on available information, screening and dispersion analysis, and familiarity with the local area. In siting the station, the primary elements considered were source impact analysis; distance from the source, roads, and obstructions; topography; meteorology; site accessibility; power availability; and security.

   The original modeling study used meteorological data from an MRI mechanical weather station located at the Wallula Fire Station about 1.6 km south-southeast of the mill. It would not be suitable to base the siting of the new monitoring station solely on data from this meteorological station. The equipment's accuracy and resolution does not meet present PSD criteria. In addition, the existing weather station was not oriented to the dominant topographical feature of the "Wallula Gap" with respect to the mill and the Columbia River.

   As stated in the monitoring plan, the location of the proposed new monitoring site (about 1.5 km north-northeast of the pulp mill) was selected for the following reasons:

157D3

- Downwind from the mill, in line with the dominant winds
- Unobstructed from the mill to the site (open terrain with little vegetation)
- In the area of projected maximum impacts
- Located on a hill that is the highest terrain feature in the north-northeasterly direction from the mill
- Access, security, and availability of power

Appendix A, submitted with the original monitoring plan, includes a short-term dispersion analysis using PTMAX and PTMTP models. These models indicate that the short-term maximum sulfur dioxide and particulate impact areas will be approximately 1 to 1.6 km from the pulp mill.

2. *In a PSD analysis it is necessary to use meteorological data which represents meteorological conditions at the source emission point. In this case it may be necessary for Boise Cascade to set up another meteorological monitoring station at the mill site, or demonstrate the representativeness of the proposed site.*

   In the siting of a meteorological monitoring station, it is essential that the data will be representative of the atmospheric dispersion conditions at the source and at the location where the source may have significant impact on air quality. The representativeness of the proposed site is demonstrated by its location about 1.6 km downwind from the mill, with no obstructions, open terrain, and little vegetation between it and the mill. The location is on the hill that is the highest terrain feature north-northeast from the mill. The proposed station and equipment will allow for the collection of meteorological data that will comply with present PSD criteria and permit detailed meteorological analysis and subsequent improvement of the dispersion modeling estimates. The meteorological data from the proposed new monitoring station will be representative of the atmospheric conditions in both the areas of the source and maximum impact areas.

3. *Mixing height data will have to be collected for input to an air quality model for a PSD analysis, unless it can be demonstrated that mixing heights are not a critical parameter in model predictions of maximum pollutant impacts.*

ED_013256A_00000458-00055

Before conducting the PSD analysis, discussions will be held with the EPA and/or permit-granting authority in the selection of appropriate EPA-approved air quality dispersion models. For those models requiring mixing height data, Spokane National Weather Service or equivalent station data will be used.

4. *Due to uncertainties in dispersion modeling in a complex terrain, it is frequently necessary to place monitors at more than one location. In this situation, it is suggested that Boise Cascade consider monitoring for SO_2 in a second location, rather than use a second monitor as backup at one location.*

   Boise Cascade is the only significant sulfur dioxide emission source in the area. The location of the proposed monitoring site is downwind of the mill during prevailing winds and is in the area where projected maximum short-term and long-term impacts can be measured.

5. *We recommend that Boise Cascade keep accurate hourly emissions data from the mill. This data plus meteorological monitoring data could be used in future modeling studies, which would aid in interpretation of the air quality monitoring data.*

   Emission data from the mill's major sources of particulate and sulfur dioxide will continue to be monitored and recorded.

6. *More photographs should be made of the proposed monitoring site. A photograph in each cardinal direction from the proposed site is necessary, and a closeup picture of each existing air quality sampler or where a future sampler will be located is required. Ground cover should be located in the closeup photograph.*

   The attached photographs of the proposed monitoring site include one in each cardinal direction from the site and a closeup picture of the new station's location.

7. *No scale was given for the topographical map displayed in Figure 1 of the monitoring plan.*

   A USGS standard 7.5-minute topographical map was reduced 50 percent for the topographical map shown in Figure 1. The new scale is 1:12,000.

8. *The frequency of data reporting was not included in the monitoring plan.*

157D5

A summary of the air quality data, the raw air quality data, and the quality assessment data will be submitted to EPA and/or the permit-granting authority at the time of submittal of the PSD application.

9. *A complete list comparing the proposed meteorological system specifications with PSD required specifications was not made.*

   A complete list comparing the proposed meteorological system specifications with the required PSD specifications is attached.

10. *The MRI mechanical weather station does not meet PSD criteria.*

    The MRI mechanical weather station will be used as a backup system.

11. *Sigma Meters have been known to give erroneous readings. It is suggested that Boise Cascade verify sigma meter readings by direct arithmetic calculation of the standard deviation using a large number (360 or more) of instantaneous direction values over the overaging line of concern.*

    The standard deviation of the horizontal wind direction (sigma) will be digitally calculated using an Apple Computer. A sigma meter will not be used.

12. *The technique for estimation of Pasquill stability categories was not discussed.*

    Pasquill stability categories will be estimated using the sigma theta technique (standard deviation of horizontal wind direction fluctuations) as specified in OAQPS Guideline Services Proposed Revisions, October 1980, Appendix C, Mitchell and Timbre.

RESPONSES TO EPA COMMENTS, DATED APRIL 1, 1981, ON THE QUALITY ASSURANCE PLAN

The following quality assurance program will be implemented by Boise Cascade for the new monitoring network:

1. *It is unclear whether the SO_2 and TSP calibration procedures are adequate with respect to the regulations and guidelines.*

157D6

CALIBRATION

SO_2

The Teco 43 analyzer will be calibrated as directed by the analyzer's operation or instruction manual at the time of initial installation. Calibration of the analyzer will establish the relationship between actual pollutant concentrations (in ppm, ppb, $\mu g/m^3$, etc.) and the analyzer output (chart reading, output volts, digital readout, etc.). This relationship will be used to convert subsequent analyzer response values to corresponding pollutant concentrations until superseded by a later calibration.

The calibration will be performed by challenging the analyzer with a known concentration of audit gas over four audit points in addition to zero concentration. The auditing standards and calibration will be traceable to the National Bureau of Standards (NBS) Gaseous Standard Reference Materials (SRM).

Recalibration of each analyzer will be performed:

- No later than 3 months after the most recent calibration or performance audit
- After any one of the following:
  - -- An interruption of a few days in analyzer operation
  - -- Repairs that might affect the calibration
  - -- Physical relocation of the analyzer
  - -- Any other indication (including excessive zero and span drift) of possible inaccuracy

The four calibration points to be used are defined in 40 CFR, Part 58, Appendix B as follows:

Audit Point	Concentration Range, ppm
1	0.03 - 0.08
2	0.15 - 0.20
3	0.40 - 0.45
4	0.80 - 0.90

TSP

At the time of installation, the orifice flow for each high-volume sampler will be calibrated by a five-point calibration procedure. The calibration points will range

ED_013256A_00000458-00058

from the low to high end of a calibration curve. The instruments will be operated somewhere in the middle range.

The samplers will be calibrated after major maintenance (e.g., replacement of motor or motor brushes); any time the flow rate measuring device has to be replaced or repaired; or any time a one-point audit check deviates more than ±7 percent from the calibration curve. A one-point flow rate audit check will be performed once per month.

In addition to the five-point orifice calibration procedure, the following calibrations and schedules will be maintained:

- Analytical Balance--A set of three standard weights will be checked on the analytical balance at the time of initiation of this sampling network and during every quarterly audit from that time on.

- Relative Humidity Indicator--The relative humidity indicator will be checked against a wet bulb/dry bulb psychrometer every 6 months. A two-point calibration will be made. If the difference between the indicator and the corresponding psychrometer readings are not within ±6 percent, the indicator will be recalibrated or replaced.

- Elapsed-Time Meter--The elapsed-time meter will be checked every 6 months against a timepiece of known accuracy.

- On-Off Timer--The on-off timer will be calibrated quarterly using a calibrated elapsed-time indicator.

2. *The discussion of zero and span checks does not state that the artificial test atmosphere used for Level 1 checks are NBS-traceable as required by 40 CFR, Part 58, Appendix B.*

ZERO AND SPAN CHECKS

Automated Analyzers

Zero and span checks will be used to:

- Provide data to allow analyzer adjustment for zero and span drift

- Provide a decision point on when to calibrate the analyzer

- Provide a decision point on invalidation of monitoring data

ED_013256A_00000458-00059

Level 1 and level 2 checks will be used in the following manner:

- Level 1 checks will be performed once every 2 weeks. These consist of an artificial test concentration at zero and 70 to 90 percent of the measurement range. These are passed through as much of the sampling train as feasible. Level 1 checks will be used to make zero and span adjustments according to Table 9.1 from Section 2.0.9 (p. 7) of Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, USEPA, July 1979.

- Level 2 checks will be performed every 24 hours (automatically) at 70 to 90 percent of full range.

All artificial test atmospheres will be NBS traceable.

3. *There is no discussion of control checks and their frequency, as required by 40 CFR, Part 58, Appendix B.*

CALCULATIONS--QUALITY CONTROL

SO_2 Calculations

At the end of each sampling quarter a precision probability interval will be calculated for each analyzer. Directions and guidelines for these calculations are given in Reference 3. At the same time, the percentage difference for each audit concentration will be calculated for each anayzer audited during that time.

TSP Calculations

At the end of each sampling quarter, estimates of TSP precision will be obtained from the collocated sampler results. Directions for these calculations are followed from Reference 3.

In addition, a set of approximately 7 percent of calculated TSP valves will be recalculated during each calculated lot. If the original and repeat calculations do not agree, all calculations for the lot will be checked and corrected as necessary.

SO_2 Quality Control

A one-point precision check will be carried out once every two weeks after the Level 1 check at a concentration level between 0.08 and 0.10 ppm SO_2. This precision check will be passed through the sampling train to make sure that no deviations from the analyzers response occur from the opera-

ED_013256A_00000458-00060

tional mode. All checks will be made by NBS traceable gases.

TSP Quality Control

This sampling site will have collocated high-volume samplers as a means for quality control. One sampler will be designated as the reference sampler and the other as the duplicate sampler. Both will be operated on a schedule of every day corresponding to the national sampling schedule.

4. *There is no discussion of data recording and validation provisions as required by 40 CFR, Part 58, Appendix B.*

DATA VALIDATION AND REPORTING

The first level of data validation is accepting or rejecting monitoring data based upon routine analyzer checks. Results from Level 1 zero and span checks will be used first to validate data. The zero and span drift limits for analyzer adjustment, calibration, and data validation are listed in Table 9.1 of Reference 1.

5. *There is no discussion concerning the documentation of quality control information as required by 40 CFR, Part 58, Appendix B.*

DOCUMENTATION OF QUALITY CONTROL INFORMATION

To standardize the procedure used by various field operators and different laboratory analysts, operational procedures will be documented in a reference manual. In addition, a record of all quality control functions and routine operational tasks will be recorded with operator initials in a log book.

6. *There is little, if any, direct discussion of preventative and remedial maintenance, as required by 40 CFR, Part 58, Appendix B.*

PREVENTIVE AND REMEDIAL MAINTENANCE

Preventive and remedial maintenance will be initiated as suggested by the instrument instruction manuals.

7. *There is no mention of enlisting in EPA's national performance audit program as required by 40 CFR, Part 58, Appendix B.*

NATIONAL PERFORMANCE AUDIT PROGRAM

Boise Cascade will participate in EPA's national performance audit program upon operation of the PSD monitoring network.

8. *The plan is almost entirely deficient in the discussion of procedures governing precision and audit checks for both TSP and SO_2 instruments.*

AUDITS

The SO_2 analyzer will be independently audited each sampling quarter. The audit will be made by challenging an analyzer with a known concentration of audit gas over four audit points in addition to zero concentration. The standards and equipment used for auditing will be different from the standards and equipment used for the regular calibration and spanning. The auditing standards and calibration will be traceable to the NBS Gaseous SRM.

At the same time, the flow rate of the high-volume sampler will be audited. The device used for auditing will be different from the one used for routine calibration of the sampler being audited.

After each quarterly audit, the precision probability interval for each instrument will be calculated.

Every 6 months, the meteorological equipment will undergo independent auditing and calibration. The calibration will involve use of a synchronous motor with a known RPM or a known voltage output. Compass readings will be used to check directional sensor orientation. In addition, the data handling and reduction procedure will be inspected and reviewed.

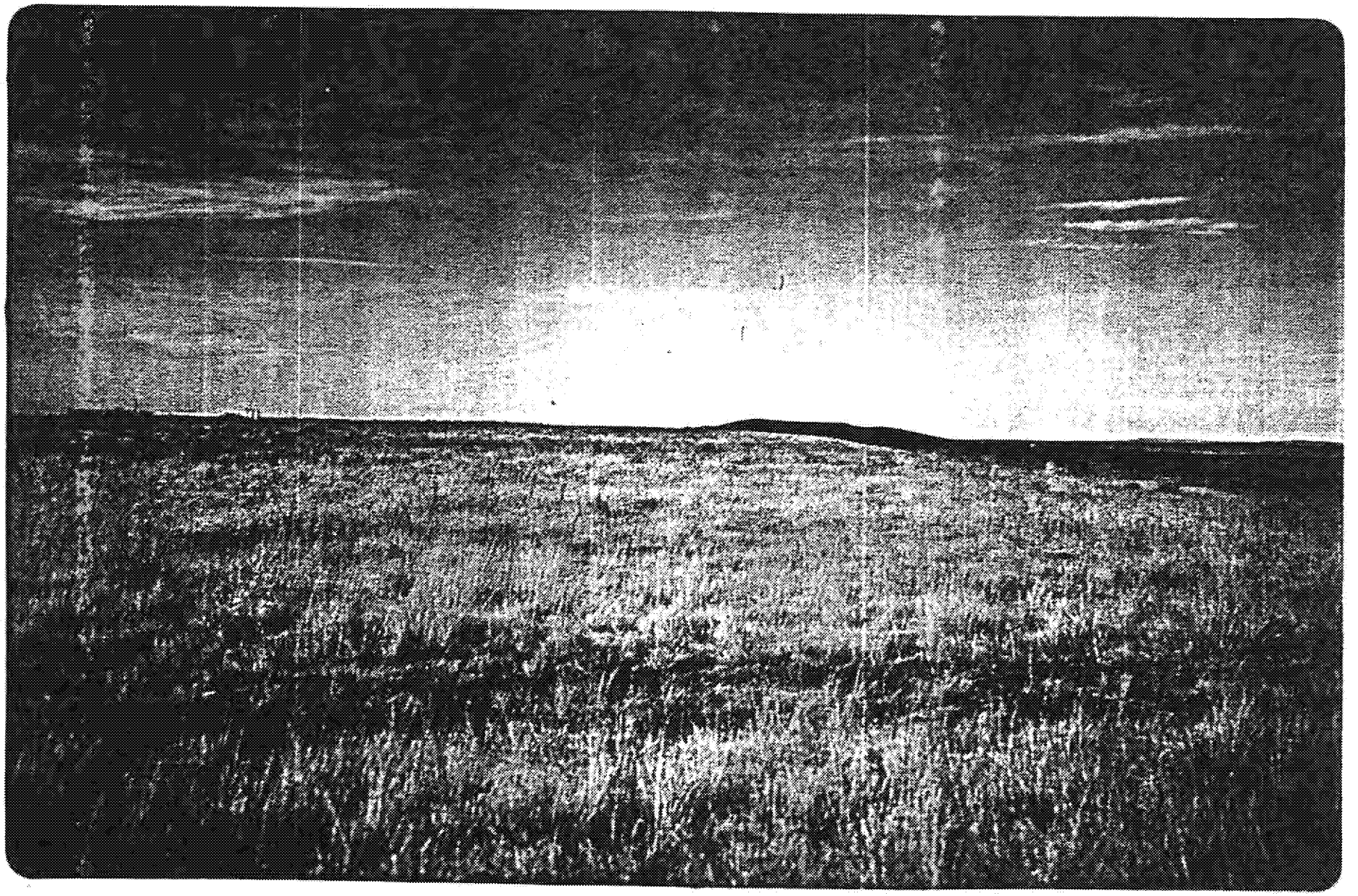
ED_013256A_00000458-00062

ATTACHMENT

Boise Cascade has selected a Climatronics Wind Mark III wind measuring system. A comparison of the system specifications of the Wind Mark III system with PSD-required specifications is shown below:

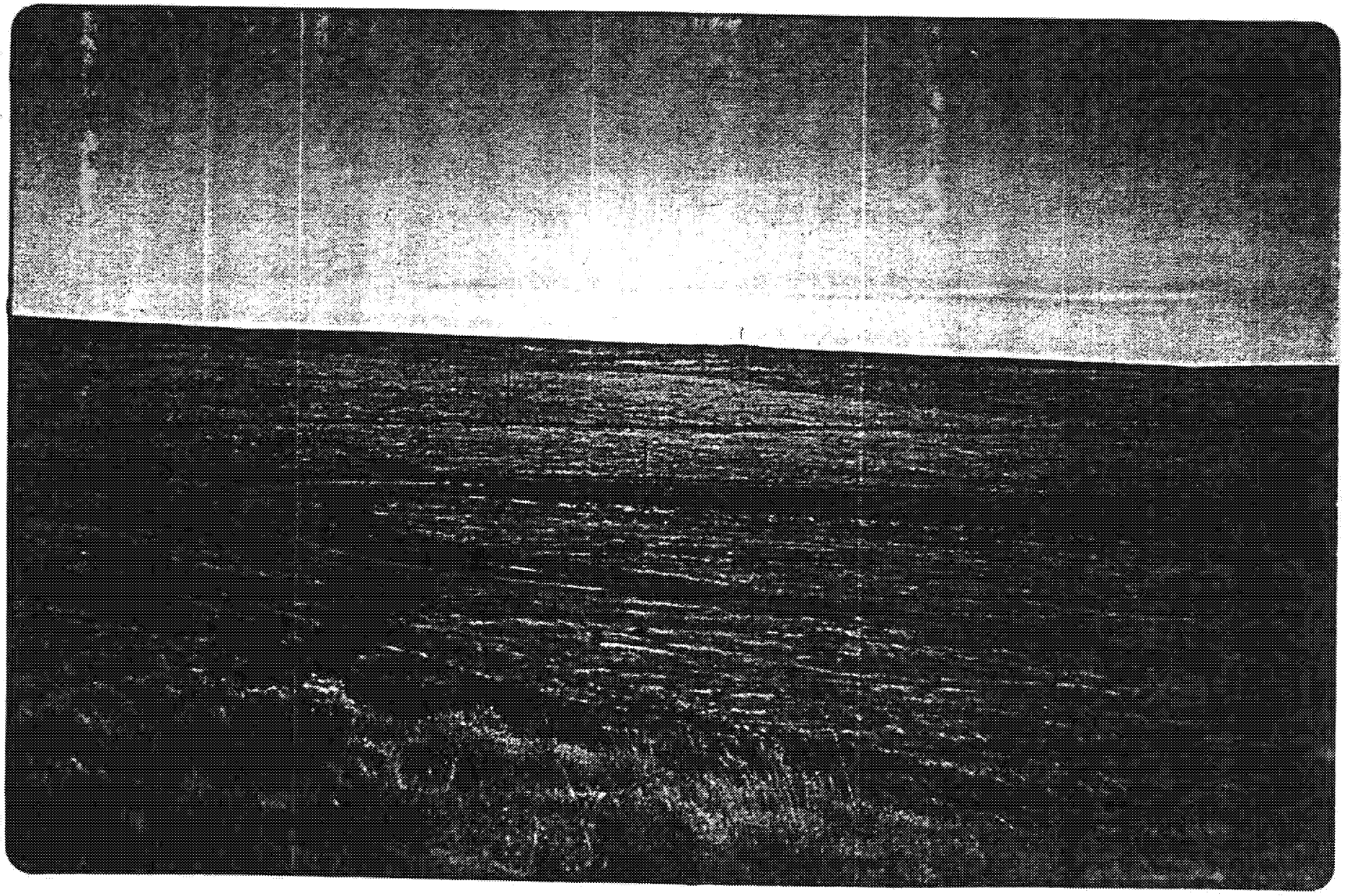
Parameter	Required Specifications	Wind Mark III Specification
Horizontal wind speed		
Starting threshold	<0.5 m/sec	0.33m/sec
Accuracy	<0.25m/sec	0.22m/sec
Horizontal wind direction		
Damping ratio	0.4-0.65	0.4-0.6
Distance constant	5m	2.44m
Accuracy	3°	+1.5°

157D11



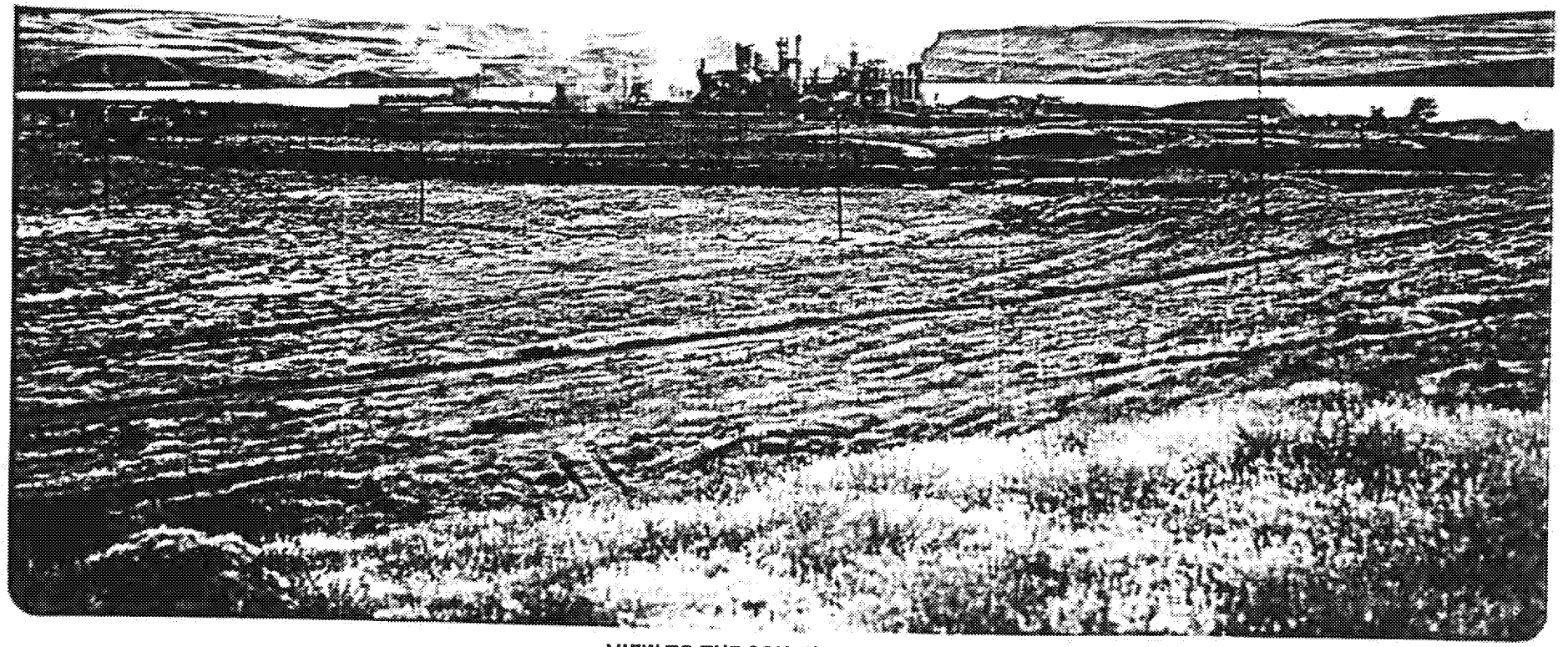
VIEW TO THE NORTH, PROPOSED
METEOROLOGICAL AND AMBIENT MONITORING STATION

ED_013256A_00000458-00064



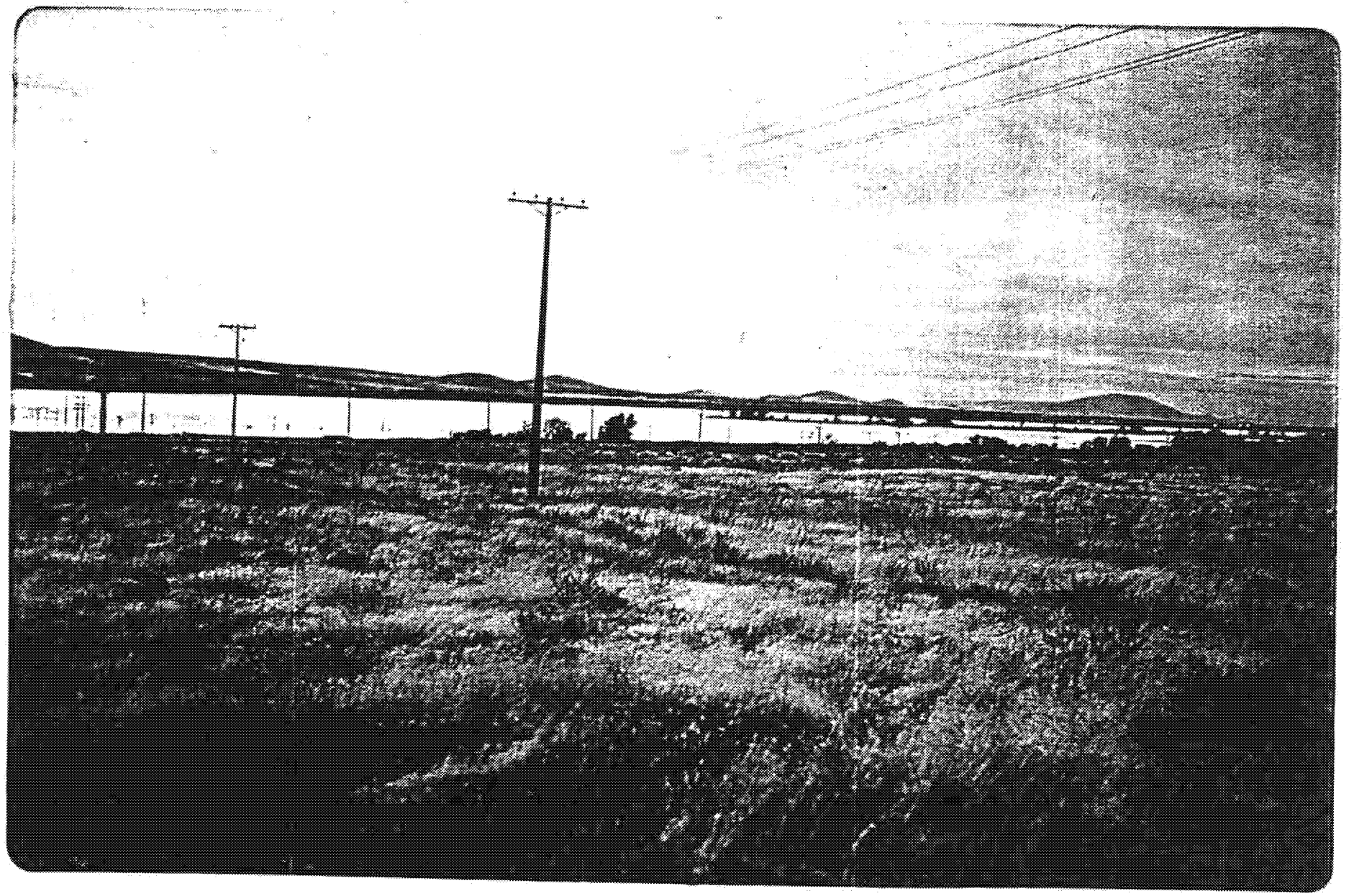
VIEW TO THE EAST, PROPOSED
METEOROLOGICAL AND AMBIENT MONITORING STATION

ED_013256A_00000458-00065



VIEW TO THE SOUTH, PROPOSED
METEOROLOGICAL AND AMBIENT MONITORING STATION

ED_013256A_00000458-00066



VIEW TO THE WEST, PROPOSED
METEOROLOGICAL AND AMBIENT MONITORING STATION

ED_013256A_00000458-00067

VIEW OF PROPOSED
METEOROLOGICAL AND AMBIENT MONITORING STATION

ED_013256A_00000458-00068

PRE-CONSTRUCTION PSD AMBIENT MONITORING PLAN

BOISE CASCADE CORPORATION
PULP AND PAPER COMPLEX
WALLULA, WASHINGTON

SUBMITTED TO
DEPARTMENT OF ECOLOGY
OFFICE OF OPERATIONS
INDUSTRIAL SECTION
OLYMPIA, WASHINGTON

JANUARY 1981

157D2

BOISE CASCADE
WALLULA PULP MILL
AMBIENT MONITORING PROGRAM

A. INTRODUCTION

With respect to 40 CFR 52.21 Prevention of Significant Deterioration of Air Quality Regulations, Boise Cascade Corporation's Wallula Pulp Mill requests review of their ambient monitoring network for future PSD considerations.

This document describes the existing ambient monitoring program and data base that has been gathered at Wallula. In addition, it will describe the modifications to be made to this monitoring network. We request that this program be reviewed for comparison with state monitoring network requirements and EPA PSD equipment specifications and quality assurance procedures. The data collected in this monitoring program will be used to meet data requirements for future PSD applications.

B. DATA BASE

In early 1978, EPA issued a PSD permit to Boise Cascade for expansion of its Wallula Kraft pulp mill. The PSD permit application was submitted to EPA by Boise Cascade on November 10, 1977. The application described details of the expansion and included an ambient air quality modeling analysis prepared by URS engineers. A technical analysis, including BACT determination and Air Quality Impact analysis, was performed by EPA Region X using information contained in that application.

The existing data base was obtained from instrumentation installed for purposes of gathering data for the original PSD application. An ambient monitoring station has been

ED_013256A_00000458-00071

operating on the roof of the Wallula Volunteer Fire Station in the town of Wallula approximately 1 mile to the south-southeast of the pulp mill since 1976 (see Figure 1). The roof of the fire station is approximately 12 feet above the ground. The monitoring network consists of a meteorological monitor (measuring wind speed, wind direction, and temperature), an SO_2 analyzer, and a high-volume particulate sampler. The meteorological sensor is approximately 12 feet above the roof of the fire station; the SO_2 probe is approximately 10 feet above the roof; and the high-volume sampler is approximately 4 feet above the roof.

The anemometer is an MRI Model 1071 Mechanical Weather Station. It was installed in April 1976. Operation has continued to the present. One year's data from April 1976 to April 1977 were used in the original PSD application.

The SO_2 analyzer has been a Phillips Model 9755/00 with automatic calibration. The unit was installed in February 1977. Data taken from February 1977 through July 1977 were used in the original PSD application. The analyzer was operated until the end of August 1979.

The high-volume particulate sampler was installed in April 1976. It is a General Metals sampler with a constant-flow controller manufactured by Sierra Instruments. Operation has continued on a 5 days per week basis up to the present. Sampling interval is 8:00 a.m. to 8:00 a.m. The flow rate has been calibrated once per month. Data from May 1976 through April 1977 were used in the original PSD application.

C. REVISIONS TO MONITORING PROGRAM

Because of future expansion plans at the Wallula Volunteer Fire Station, Boise Cascade plans to relocate its ambient monitoring network and to upgrade the instrumentation and

ED_013256A_00000458-00072

quality assurance procedures of its program so as to reflect recent environmental regulations and guidelines.

Location of the proposed new monitoring site has been chosen after consideration of factors such as terrain, availability of power and the ambient impact analysis of the original PSD application. This expansion phase is expected to be completed by the end of 1980.

Wind data taken at the Wallula monitoring site from April 1976 through April 1977 show the dominant winds to be blowing from the southwest during all seasons. Figures 2 through 6 are the annual and seasonal wind roses and are taken from the PSD application.

The modeling results for particulates and SO_2 from the PSD application are contained as Figures 7 and 8. The projected maximum impact zones correspond with the dominant wind flow patterns and have similar patterns and orientation.

The location of the proposed new monitoring site is approximately 1.5 km to the north-northeast of the pulp mill and in line with the dominant winds (Figure 1). The site is on a hill approximately 125 feet higher than the pulp mill near a potato warehouse with UTM coordinates of 5109.145N, 352.390E. This location has been chosen for the following reasons:

- Downwind from the mill--Measurements at the Wallula station show the dominant winds to be from the southwest on an annual basis. The proposed monitoring location is to the north-northeast of the mill.

- Unobstructed flow from mill to the site--As Figure 9 shows, the terrain between the proposed monitoring site and the mill is flat with little vegetation.

ED_013256A_00000458-00073

- Location on a hill--Figure 10 shows the hill where the proposed monitoring site is to be located. The monitors will be located near the crest of the hill, the highest terrain feature in the north-northeasterly direction from the mill.

- Availability of power--Figure 10 shows a string of power poles running along the crest of the hill. This power source is essential.

- Security--The proposed monitoring site is within visual range of the mill and can be equipped with adequate lighting for observation.

- Near area of projected maximum impacts--The modeling results from the original PSD application (Figures 7 and 8) show the maximum impact areas to be in a valley slightly to the south of the proposed monitoring site. However, this modeling analysis used the wind data collected at the Wallula fire station. Physical features such as the Wallula Gap, the building, trees, and the accuracy of the wind sensor itself may be different than those affecting the plumes from the mill. In addition, recent modeling using the EPA PTMAX model performed by CH2M HILL shows the maximum impacts from the major point sources to be less than 2 km from the source, as is the proposed monitoring location. Considering these factors and those mentioned above, this site on the hill is the best location available to operate the ambient monitoring program as described.

The proposed new station will monitor meteorology, SO_2, and particulate matter. The following sections will describe the new equipment which will be used to monitor the same parameters as were measured by the original monitoring network.

All of the monitors will be housed in a temperature controlled instrument shelter. The new shelter will be 8 feet wide by 14 feet long by 8 feet high, and the temperature will be maintained between 20°C and 30°C. The temperature will be controlled by a heat pump with a baseboard heater as a backup.

A new meteorological monitoring network will be installed consisting of components manufactured by Climatronics Corporation. The new system will measure wind speed, wind direction and temperature on a 10-meter tower. The system will be continuously recording on a strip chart located in the instrument shelter. The wind system sensors will have a starting threshold of 0.25 mph and a 0° to 560° measurement range for direction. The Climatronics sensors will include a Wind Mark III wind speed and direction sensor (P/N 100108), a dual element thermistor (P/N 100093), a multiplex strip chart recorder (P/N 1000586) and a digital standard deviation computer (P/N 101035). The MRI mechanical weather station will be used as a backup instrument and as a check for the accuracy of the historical data.

A new TECO Model No. 43 SO_2 unit will be installed. The instrument includes a Model No. 143 internal timer and self calibration permeation tube traceable to NBS standards. The instrument uses a designated EPA equivalent method. The probe for the monitor will be 3 to 15 meters above ground level, located in open terrain and more than 1 meter vertically and horizontally away from the instrument shelter and high-volume samplers. The original Phillips unit has been rebuilt and recalibrated and will be installed as a backup.

A second high-volume sampler has been purchased in order to operate collocated samplers. The instruments will be identical and will be installed on the roof of the instrument shelter 3 meters apart from each other.

D. CALIBRATION

The following quality assurance program will be implemented by Boise Cascade for the new monitoring network:

SO_2

Each analyzer will be calibrated as directed by the analyzer's operation or instruction manual at the time of initial installation. Calibration of each analyzer will establish the relationship between actual pollutant concentrations (in ppm, ppb, $\mu g/m^3$, etc.) and the analyzer output (chart reading, output volts, digital readout, etc.). This relationship will be used to convert subsequent analyzer response values to corresponding pollutant concentrations until superseded by a later calibration.

Recalibration of each analyzer will be performed:

- No later than 3 months after the most recent calibration or performance audit
- Following any one of the following:
  - An interruption of a few days in analyzer operation
  - Repairs that might affect the calibration
  - Physical relocation of the analyzer
  - Any other indication (including excessive zero and span drift) of possible inaccuracy

ED_013256A_00000458-00076

Zero and Span Checks

Automated Analyzers

Zero and span checks will be used to:

- Provide data to allow analyzer adjustment for zero and span drift
- Provide a decision point on when to calibrate the analyzer
- Provide a decision point on invalidation of monitoring data

Level 1 and level 2 checks will be used in the following manner.

- Level 2 checks will be performed every 24 hours (automatically) at 70 to 90 percent of full range.
- Level 1 checks will be performed once every 2 weeks. These consist of an artificial test concentration at zero and 70 to 90 percent of the measurement range. These are passed through as much of the sampling train as feasible. Level 1 checks will be used to make zero and span adjustments according to Table 9.1 from Section 2.0.9 (p. 7) of Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, USEPA, July 1979.

High-Volume Sampler

On a schedule of every third day, the high-volume samplers will be operated. The time schedule will be midnight to midnight.

ED_013256A_00000458-00077

The samplers will be calibrated after major maintenance (i.e., replacement of motor or motor brushes), any time the flow rate measuring device has to be replaced or repaired, or any time a one-point audit check deviates more than ±7 percent from the calibration curve. A one point flow rate audit check will be performed once per month.

Filter analysis will be performed by Boise Cascade. All guidelines for balance calibration, filter conditioning, filter reweighing, and TSP recalculation will be followed. The guidelines appear in the EPA document "Quality Assurance for Air Pollution Measurement Systems, Volume II--Ambient Air Specific Methods," EPA-600/4-77-027a.

Meteorology

The meteorological equipment will be calibrated for direction and signal output when installed. Observation of the system, including time marking the chart, chart spanning, and compass check, will be done on a weekly basis.

E. AUDITS

Each sampling quarter the SO_2 analyzer will be independently audited. The audit will be made by challenging the analyzer with a known concentration of audit gas over 4 audit points in addition to zero concentration. The standards and equipment used for auditing will be different from the standards and equipment used for the regular calibration and spanning. The auditing standards and calibration will be traceable to the National Bureau of Standards (NBS) gaseous Standard Reference Materials (SRM).

At the same time, the flow rate of the high-volume sampler will be audited. The device used for auditing will be different from the one used for routine calibration of the sampler being audited.

ED_013256A_00000458-00078

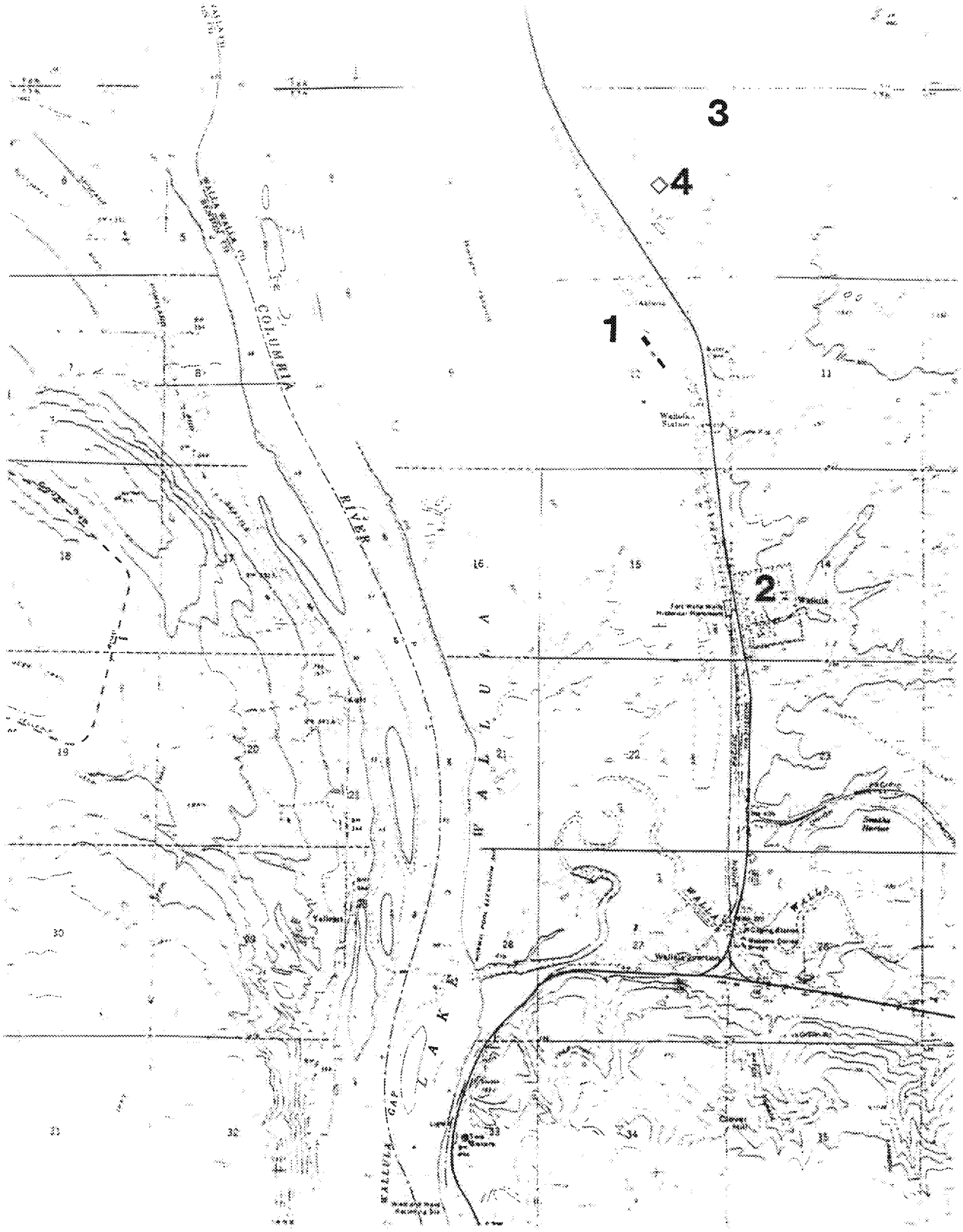
After each quarterly audit, the precision probability interval for each instrument will be calculated.

Every 6 months, the meteorological equipment will undergo independent auditing and calibration. The calibration will involve use of a synchronous motor with a known RPM or a known voltage output. Compass readings will be used to check directional sensor orientation. In addition, the data handling and reduction procedure will be inspected and reviewed.

F. SUMMARY

Boise Cascade believes the monitoring station described in this document to be sufficient to derive significant information on the air quality impacts of TSP and SO_2 from the existing sources at the Wallula Pulp Mill. The network for measuring concentrations of these two pollutants and meteorology has been designed as a basic system capable of accepting additions or modifications as future mill plans and regulations may require. Expansion of this network, which may or may not be at this location, will not be made without DOE and EPA approval prior to installation. Please advise us as to any deficiencies seen in this document so that modifications can be made prior to the implementation of this program.

ED_013256A_00000458-00079



1. Boise Cascade Wallula Pulp Mill
2. Existing Ambient Monitoring Site
3. Proposed Monitoring Site
4. Potato Warehouse

Figure 1 ↑
Boise Cascade Ambient Monitoring Sites

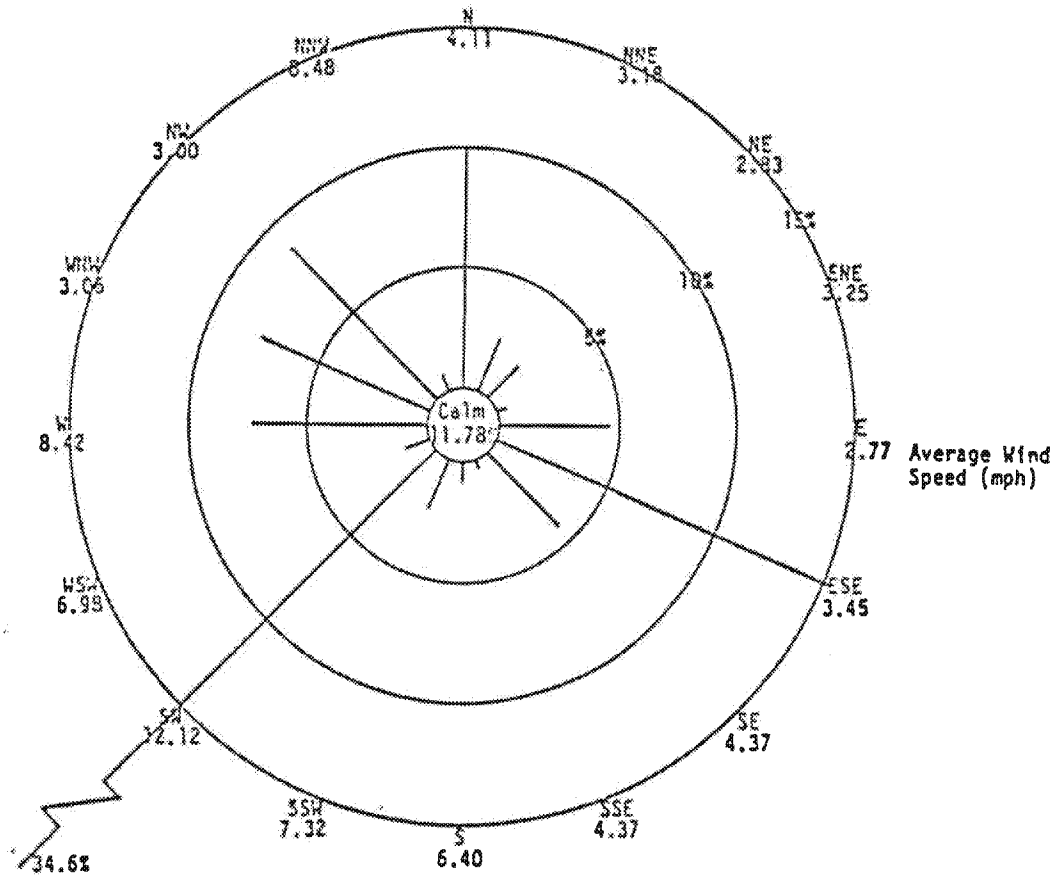


Figure 2
Annual Wind Rose
April 1976 through April 1977
Wallula, Washington

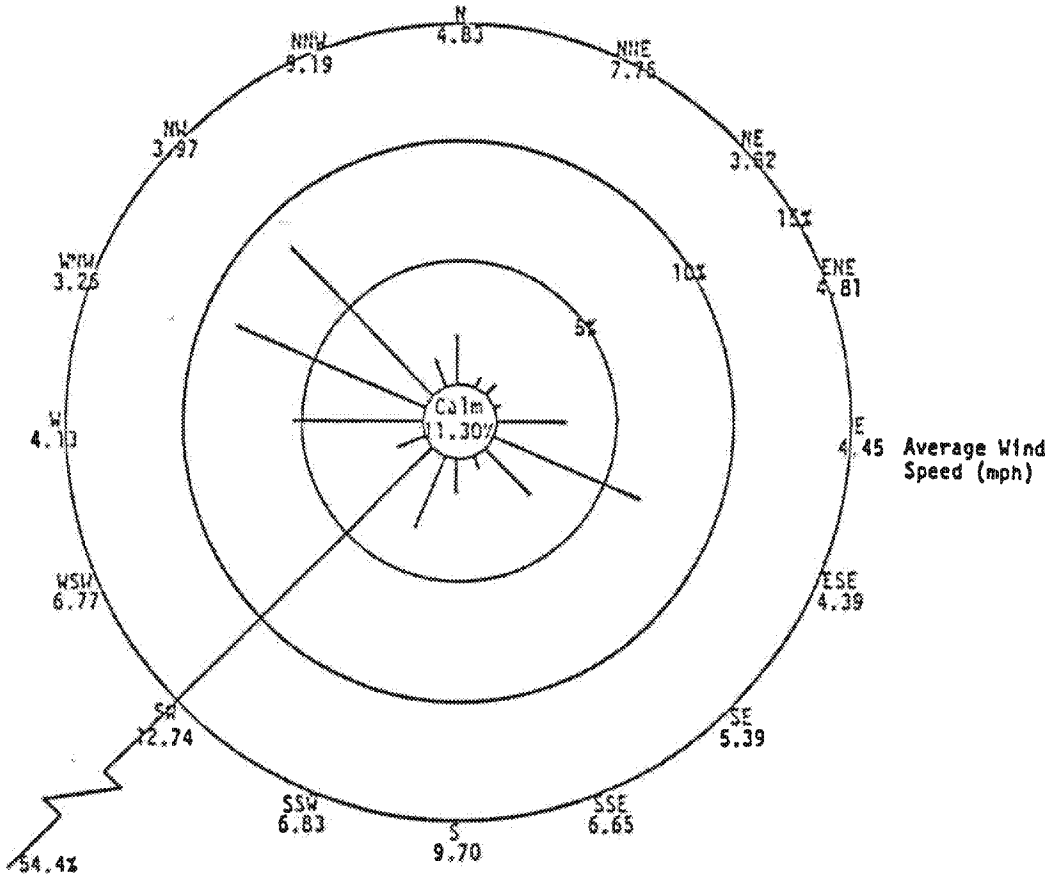


Figure 3
Spring Wind Rose
April through May 1976
Wallula, Washington
March 1977

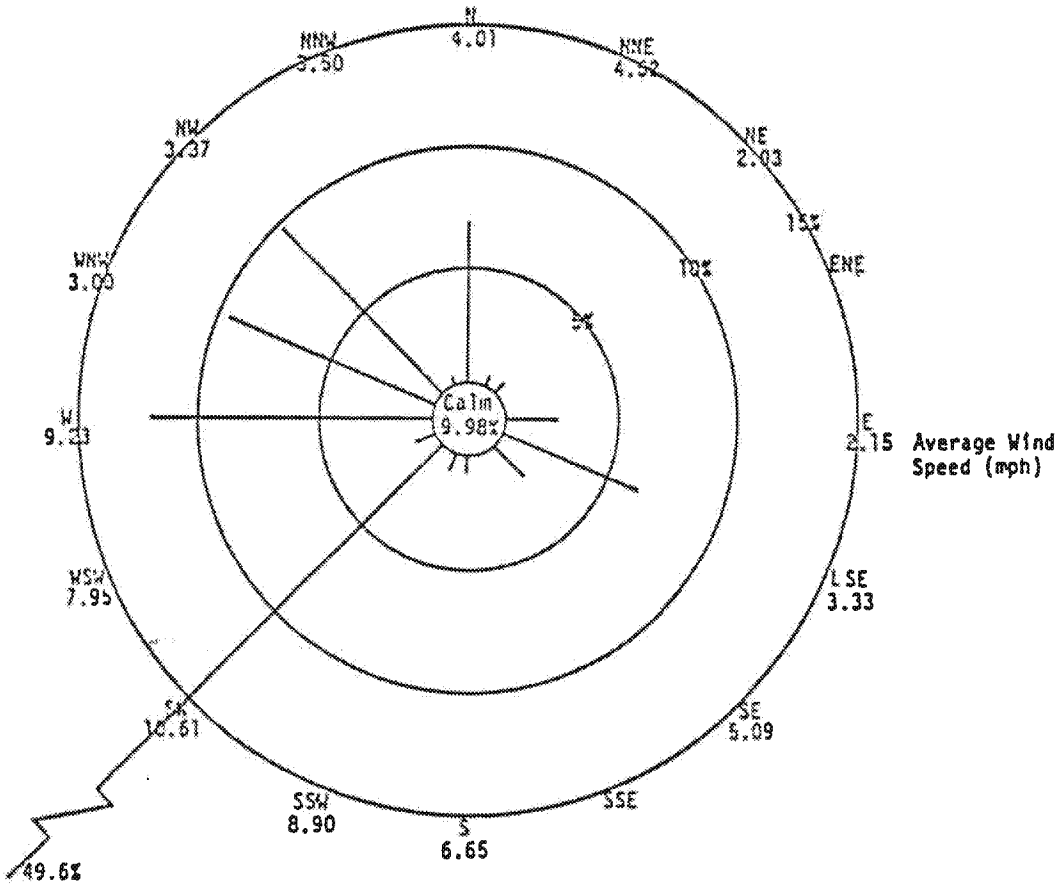


Figure 4
Summer Wind Rose
June through Aug 1976
Wallula, Washington

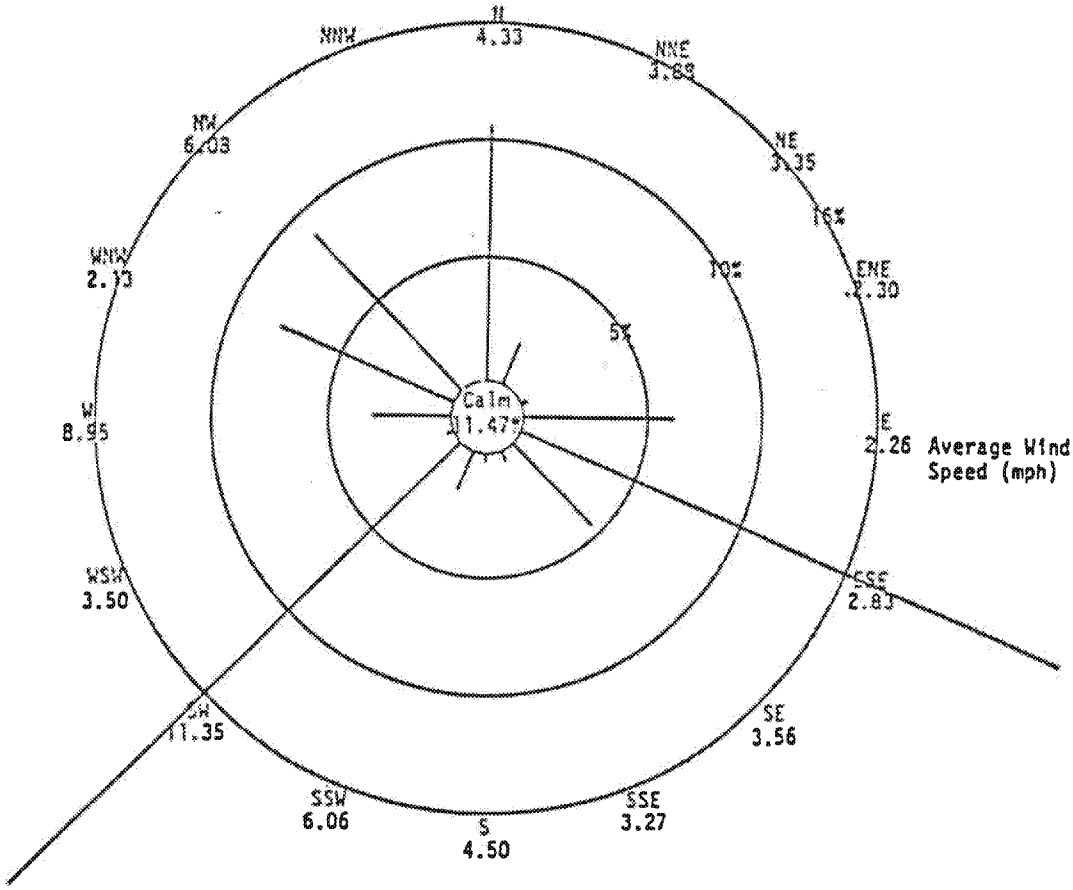


Figure 5
Fall Wind Rose
Sept through Nov 1976
Wallula, Washington

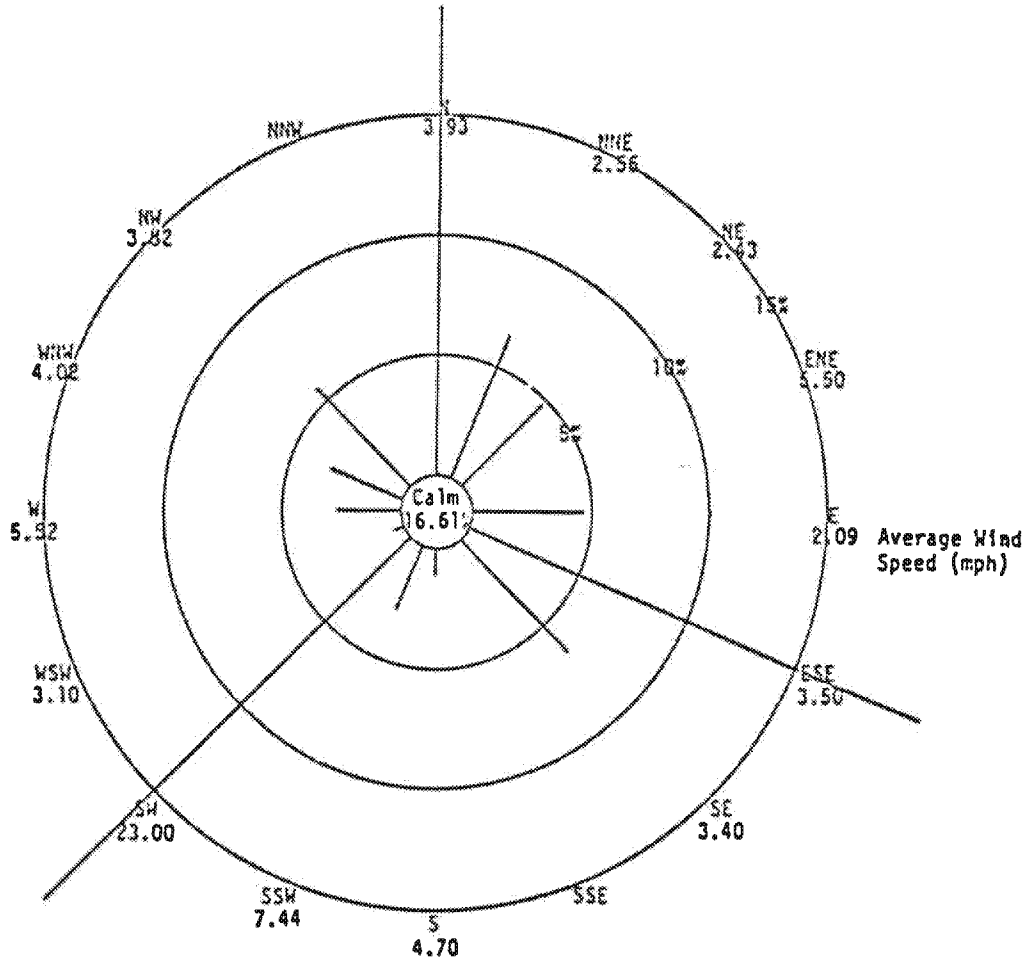
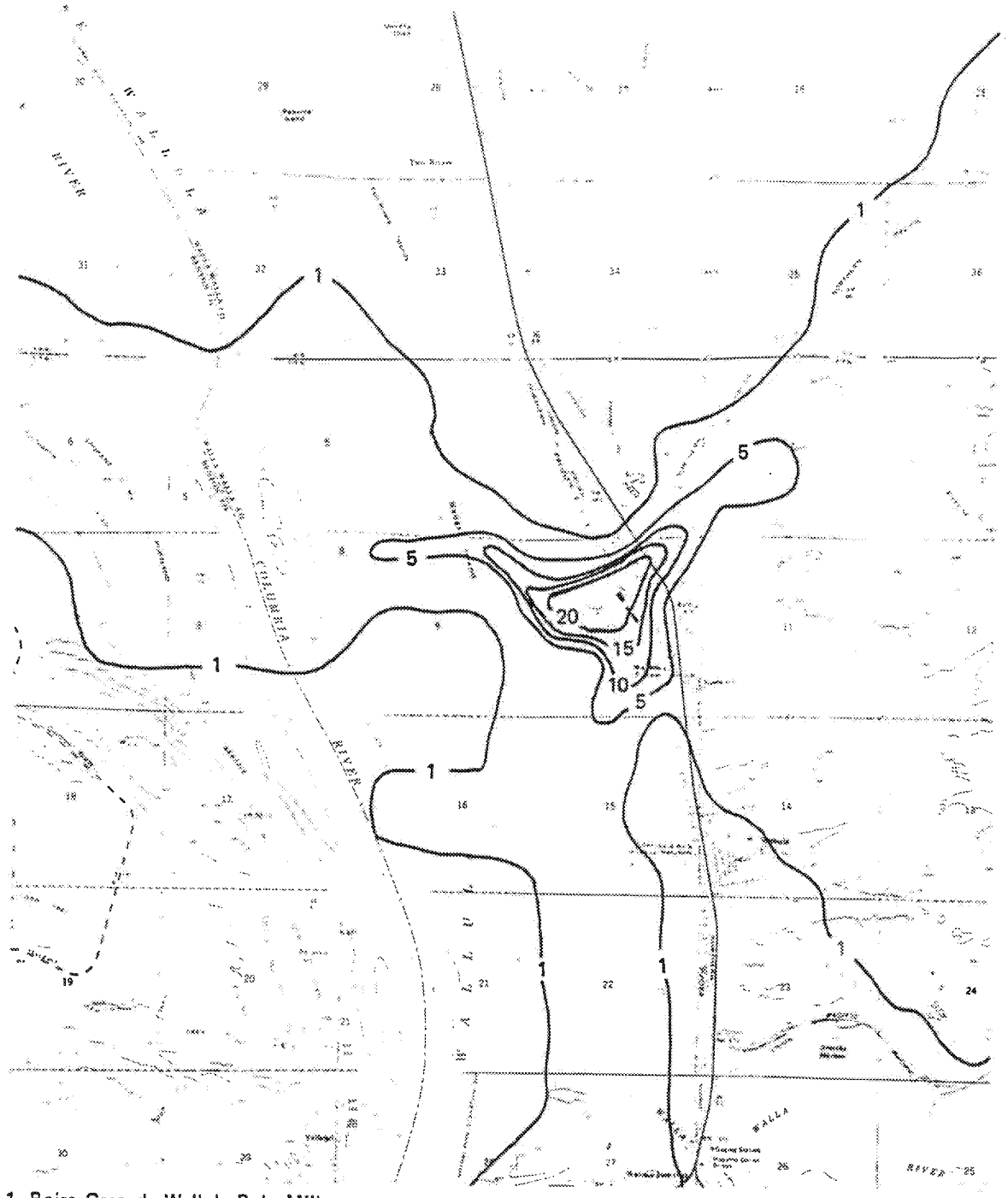
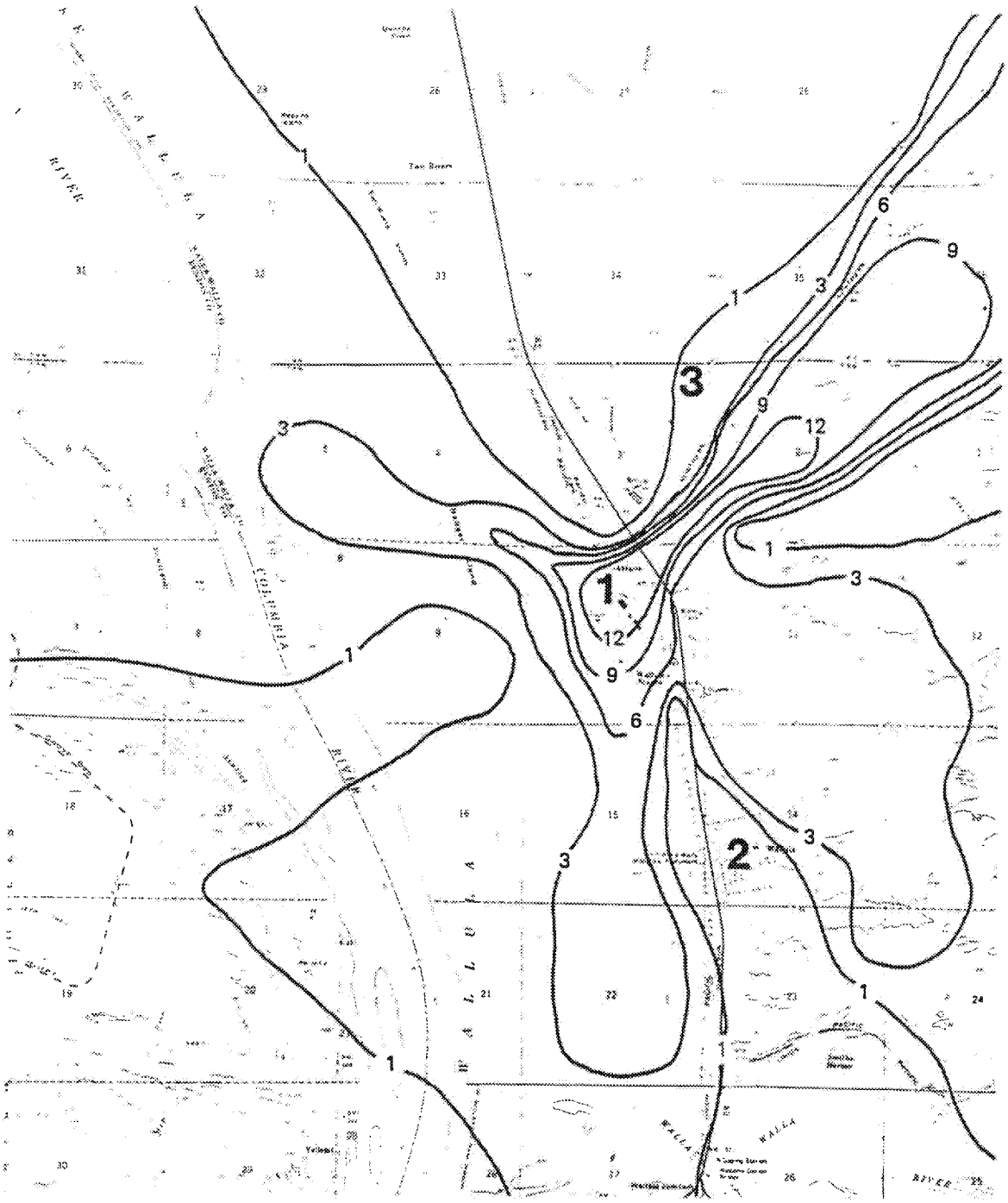


Figure 6
Winter Wind Rose
Dec 1976 through Feb 1977
Wallula, Washington



1. Boise Cascade Wallula Pulp Mill
2. Existing Ambient Monitoring Site
3. Proposed Monitoring Site

Figure 7
Annual Average Particulate Concentrations ($\mu g/m^3$)



1. Boise Cascade Wallula Pulp Mill
2. Existing Ambient Monitoring Site
3. Proposed Monitoring Site

Figure 8
Annual Average Sulfer Dioxide Concentrations($\mu g/m^3$)

APPENDIX A

The EPA approved PTMAX and PTMTP models were run by CH2M HILL to aid in determination of maximum air quality impacts from the existing Wallula pulp mill. All source data inputs and stack characteristics are from the original PSD application.

PTMAX was run for the three largest SO_2 sources and the five largest particulate sources. The results of this model run, shown on the following pages, indicates that most of the individual sources have maximum 1 hour impacts occurring under conditions of A stability and 3.0 m/sec and at distances less than 1 km.

This meteorological condition was then used to run the PTMTP model for the three SO_2 sources. Only these three sources were used since the SO_2 emissions are far greater than the particulate emissions. The model results predict that maximum 1 hour concentrations from the combined sources will occur approximately 0.6 km from the plant site. Since conditions of A stability and 3.0 m/sec are not likely to occur very often or for long time periods, a more likely persistent condition of C stability and 10.0 m/sec was also run. These results predict that maximum 1 hour concentrations from the combined sources will occur approximately 1.6 km from the source. The results of the PTMTP run follows the PTMAX results.

ED_013256A_00000458-00088

SO2--NO. 2 RECOVERY BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 28.48
PHYSICAL STACK HEIGHT (M) = 53.34
STACK GAS TEMP (DEG K) = 449.67
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.75
STACK DIAMETER (M) = 3.66
VOLUME FLOW (CU M/SEC) = 102.58

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	2.5417E-05	1.550	1363.6(2)
1	0.8	2.9884E-05	1.254	872.2(2)
1	1.0	3.2107E-05	1.136	708.5(2)
1	1.5	3.6070E-05	0.955	490.1(2)
1	2.0	3.8668E-05	0.848	380.9(2)
1	2.5	4.0422E-05	0.775	315.4(2)
1	3.0	4.1604E-05	0.722	271.7(2)
2	0.5	7.8109E-06	7.653	1363.6(2)
2	0.8	1.0894E-05	5.089	872.2(2)
2	1.0	1.2676E-05	4.203	708.5(2)
2	1.5	1.6416E-05	3.000	490.1(2)
2	2.0	1.9415E-05	2.382	380.9(2)
2	2.5	2.1849E-05	2.005	315.4(2)
2	3.0	2.3844E-05	1.750	271.7(2)
2	4.0	2.6844E-05	1.426	217.1(2)
2	5.0	2.8901E-05	1.228	184.4
3	2.0	1.3875E-05	5.093	380.9(2)
3	2.5	1.6133E-05	4.138	315.4(2)
3	3.0	1.8070E-05	3.513	271.7(2)
3	4.0	2.1154E-05	2.746	217.1(2)
3	5.0	2.3423E-05	2.296	184.4
3	7.0	2.6286E-05	1.791	146.9
3	10.0	2.8065E-05	1.420	118.9
3	12.0	2.8334E-05	1.278	107.9
3	15.0	2.8037E-05	1.136	97.0

4	0.5	9.9000E+01	999.000(1)	1363.6(2)
4	0.8	1.0919E-06	131.575(3)	872.2(2)
4	1.0	1.5204E-06	87.143	708.5(2)
4	1.5	2.7299E-06	42.218	490.1(2)
4	2.0	4.0101E-06	27.446	380.9(2)
4	2.5	5.1954E-06	19.549	315.4(2)
4	3.0	6.3315E-06	15.149	271.7(2)
4	4.0	8.4159E-06	10.417	217.1(2)
4	5.0	1.0161E-05	7.957	184.4
4	7.0	1.2748E-05	5.509	146.9
4	10.0	1.5104E-05	3.908	118.9
4	12.0	1.5987E-05	3.343	107.9
4	15.0	1.6629E-05	2.819	97.0
4	20.0	1.6622E-05	2.340	86.1
5	2.0	2.0255E-05	13.187	158.2
5	2.5	1.8632E-05	12.088	150.7
5	3.0	1.7355E-05	11.277	144.9
5	4.0	1.5439E-05	10.138	136.5
5	5.0	1.4039E-05	9.360	130.6
6	2.0	1.0148E-05	35.053	140.3
6	2.5	9.7723E-06	31.280	134.1
6	3.0	9.4378E-06	28.571	129.3
6	4.0	8.8669E-06	24.879	122.4
6	5.0	8.3946E-06	22.434	117.4

SO2--NO. 3 RECOVERY BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 29.19
PHYSICAL STACK HEIGHT (M) = 53.34
STACK GAS TEMP (DEG K) = 434.67
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.91
STACK DIAMETER (M) = 4.12
VOLUME FLOW (CU M/SEC) = 132.12

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	2.2366E-05	1.630	1518.6(2)
1	0.8	2.6396E-05	1.318	969.1(2)
1	1.0	2.8410E-05	1.194	786.0(2)
1	1.5	3.2072E-05	1.001	541.7(2)
1	2.0	3.4545E-05	0.888	419.6(2)
1	2.5	3.6275E-05	0.811	346.4(2)
1	3.0	3.7488E-05	0.754	297.5(2)
2	0.5	6.5998E-06	8.445	1518.6(2)
2	0.8	9.2390E-06	5.599	969.1(2)
2	1.0	1.0777E-05	4.621	786.0(2)
2	1.5	1.4047E-05	3.288	541.7(2)
2	2.0	1.6700E-05	2.603	419.6(2)
2	2.5	1.8902E-05	2.185	346.4(2)
2	3.0	2.0732E-05	1.902	297.5(2)
2	4.0	2.3568E-05	1.542	236.5(2)
2	5.0	2.5584E-05	1.322	199.9
3	2.0	1.1741E-05	5.665	419.6(2)
3	2.5	1.3732E-05	4.588	346.4(2)
3	3.0	1.5466E-05	3.882	297.5(2)
3	4.0	1.8298E-05	3.016	236.5(2)
3	5.0	2.0443E-05	2.508	199.9
3	7.0	2.3314E-05	1.939	158.0
3	10.0	2.5366E-05	1.521	126.6
3	12.0	2.5867E-05	1.362	114.4
3	15.0	2.5908E-05	1.203	102.2

4	0.5	4.9628E-07	217.343(3)	1124.0(2)
4	0.8	1.0225E-06	89.265	717.1(2)
4	1.0	1.4363E-06	58.914	581.5(2)
4	1.5	2.6107E-06	30.049	400.7(2)
4	2.0	3.7647E-06	18.979	310.2(2)
4	2.5	4.9168E-06	13.713	256.0(2)
4	3.0	6.0434E-06	10.634	219.8(2)
4	4.0	8.0793E-06	7.286	174.6
4	5.0	9.8273E-06	5.543	147.5
4	7.0	1.2608E-05	3.783	116.5
4	10.0	1.5257E-05	2.649	93.2
4	12.0	1.6251E-05	2.259	84.2
4	15.0	1.7087E-05	1.892	75.1
4	20.0	1.7451E-05	1.550	66.1
5	2.0	1.8356E-05	9.722	133.4
5	2.5	1.7049E-05	8.858	126.6
5	3.0	1.6011E-05	8.222	121.4
5	4.0	1.4432E-05	7.331	113.9
5	5.0	1.3261E-05	6.725	108.5
6	2.0	1.1713E-05	22.378	117.3
6	2.5	1.1446E-05	19.790	111.7
6	3.0	1.1190E-05	17.941	107.4
6	4.0	1.0721E-05	15.436	101.2
6	5.0	9.9916E-06	13.962	96.7

SO2--NO. 1 POWER BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 15.88
PHYSICAL STACK HEIGHT (M) = 38.98
STACK GAS TEMP (DEG K) = 616.33
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 10.64
STACK DIAMETER (M) = 2.44
VOLUME FLOW (CU M/SEC) = 49.75

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	1.8626E-05	1.414	1124.0(2)
1	0.8	2.1996E-05	1.143	717.1(2)
1	1.0	2.3674E-05	1.035	581.5(2)
1	1.5	2.6756E-05	0.869	400.7(2)
1	2.0	2.8838E-05	0.769	310.2(2)
1	2.5	3.0293E-05	0.702	256.0(2)
1	3.0	3.1331E-05	0.654	219.8(2)
2	0.5	6.1596E-06	6.411	1124.0(2)
2	0.8	8.6433E-06	4.250	717.1(2)
2	1.0	1.0088E-05	3.507	581.5(2)
2	1.5	1.3170E-05	2.495	400.7(2)
2	2.0	1.5688E-05	1.976	310.2(2)
2	2.5	1.7773E-05	1.658	256.0(2)
2	3.0	1.9516E-05	1.442	219.8(2)
2	4.0	2.2232E-05	1.169	174.6
2	5.0	2.4165E-05	1.001	147.5
3	2.0	1.1617E-05	4.064	310.2(2)
3	2.5	1.3610E-05	3.290	256.0(2)
3	3.0	1.5346E-05	2.783	219.8(2)
3	4.0	1.8191E-05	2.163	174.6
3	5.0	2.0366E-05	1.798	147.5
3	7.0	2.3270E-05	1.389	116.5
3	10.0	2.5387E-05	1.088	93.2
3	12.0	2.5932E-05	0.972	84.2
3	15.0	2.6025E-05	0.858	75.1

4	0.5	4.9784E-07	217.343(3)	1124.0(2)
4	0.8	1.0258E-06	89.265	717.1(2)
4	1.0	1.4408E-06	58.914	581.5(2)
4	1.5	2.6190E-06	30.049	400.7(2)
4	2.0	3.7765E-06	18.979	310.2(2)
4	2.5	4.9323E-06	13.713	256.0(2)
4	3.0	6.0625E-06	10.634	219.8(2)
4	4.0	8.1048E-06	7.286	174.6
4	5.0	9.8583E-06	5.543	147.5
4	7.0	1.2648E-05	3.783	116.5
4	10.0	1.5305E-05	2.649	93.2
4	12.0	1.6302E-05	2.259	84.2
4	15.0	1.7141E-05	1.892	75.1
4	20.0	1.7507E-05	1.550	66.1
5	2.0	1.8414E-05	9.722	133.4
5	2.5	1.7103E-05	8.858	126.6
5	3.0	1.6062E-05	8.222	121.4
5	4.0	1.4477E-05	7.331	113.9
5	5.0	1.3303E-05	6.725	108.5
6	2.0	1.1750E-05	22.378	117.3
6	2.5	1.1482E-05	19.790	111.7
6	3.0	1.1225E-05	17.941	107.4
6	4.0	1.0754E-05	15.436	101.2
6	5.0	1.0023E-05	13.962	96.7

PARTICULATE--NO. 2 RECOVERY BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 2.50
PHYSICAL STACK HEIGHT (M) = 53.34
STACK GAS TEMP (DEG K) = 449.67
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.75
STACK DIAMETER (M) = 1.37
VOLUME FLOW (CU M/SEC) = 14.37

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	1.3121E-05	0.858	390.2(2)
1	0.8	1.4276E-05	0.712	263.9(2)
1	1.0	1.4614E-05	0.656	221.8(2)
1	1.5	1.4834E-05	0.565	165.6
1	2.0	1.4567E-05	0.512	137.6
1	2.5	1.4086E-05	0.478	120.7
1	3.0	1.3526E-05	0.453	109.5
2	0.5	6.5266E-06	2.435	390.2(2)
2	0.8	8.2764E-06	1.704	263.9(2)
2	1.0	9.0713E-06	1.454	221.8(2)
2	1.5	1.0273E-05	1.113	165.6
2	2.0	1.0794E-05	0.940	137.6
2	2.5	1.0946E-05	0.834	120.7
2	3.0	1.0890E-05	0.763	109.5
2	4.0	1.0475E-05	0.673	95.4
2	5.0	9.9134E-06	0.618	87.0
3	2.0	9.2089E-06	1.666	137.6
3	2.5	9.5548E-06	1.444	120.7
3	3.0	9.6705E-06	1.298	109.5
3	4.0	9.5344E-06	1.116	95.4
3	5.0	9.1713E-06	1.008	87.0
3	7.0	8.2770E-06	0.887	77.4
3	10.0	7.0439E-06	0.796	70.2
3	12.0	6.3688E-06	0.761	67.4
3	15.0	5.5473E-06	0.727	64.6

4	0.5	1.3240E-06	28.661	390.2(2)
4	0.8	2.2459E-06	14.426	263.9(2)
4	1.0	2.7997E-06	10.791	221.8(2)
4	1.5	3.8793E-06	6.689	165.6
4	2.0	4.6129E-06	4.951	137.6
4	2.5	5.1032E-06	4.007	120.7
4	3.0	5.4186E-06	3.421	109.5
4	4.0	5.6929E-06	2.748	95.4
4	5.0	5.6877E-06	2.379	87.0
4	7.0	5.3860E-06	1.982	77.4
4	10.0	4.7715E-06	1.701	70.2
4	12.0	4.3874E-06	1.597	67.4
4	15.0	3.8895E-06	1.494	64.6
4	20.0	3.2473E-06	1.395	61.8
5	2.0	5.3405E-06	6.642	107.8
5	2.5	4.7491E-06	6.218	103.9
5	3.0	4.3021E-06	5.903	100.9
5	4.0	3.6388E-06	5.472	96.6
5	5.0	3.1782E-06	5.177	93.5
6	2.0	3.7195E-06	14.530	98.5
6	2.5	3.3061E-06	13.529	95.3
6	3.0	2.9931E-06	12.790	92.8
6	4.0	2.5437E-06	11.751	89.2
6	5.0	2.2314E-06	11.039	86.6

PARTICULATE--NO. 3 RECOVERY BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 4.80
PHYSICAL STACK HEIGHT (M) = 53.34
STACK GAS TEMP (DEG K) = 434.67
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.91
STACK DIAMETER (M) = 4.12
VOLUME FLOW (CU M/SEC) = 132.12

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	3.6778E-06	1.630	1518.6(2)
1	0.8	4.3406E-06	1.318	969.1(2)
1	1.0	4.6717E-06	1.194	786.0(2)
1	1.5	5.2740E-06	1.001	541.7(2)
1	2.0	5.6805E-06	0.888	419.6(2)
1	2.5	5.9650E-06	0.811	346.4(2)
1	3.0	6.1646E-06	0.754	297.5(2)
2	0.5	1.0853E-06	8.445	1518.6(2)
2	0.8	1.5193E-06	5.599	969.1(2)
2	1.0	1.7721E-06	4.621	786.0(2)
2	1.5	2.3099E-06	3.288	541.7(2)
2	2.0	2.7462E-06	2.603	419.6(2)
2	2.5	3.1083E-06	2.185	346.4(2)
2	3.0	3.4091E-06	1.902	297.5(2)
2	4.0	3.8755E-06	1.542	236.5(2)
2	5.0	4.2070E-06	1.322	199.9
3	2.0	1.9308E-06	5.665	419.6(2)
3	2.5	2.2581E-06	4.588	346.4(2)
3	3.0	2.5432E-06	3.882	297.5(2)
3	4.0	3.0089E-06	3.016	236.5(2)
3	5.0	3.3616E-06	2.508	199.9
3	7.0	3.8338E-06	1.939	158.0
3	10.0	4.1712E-06	1.521	126.6
3	12.0	4.2536E-06	1.362	114.4
3	15.0	4.2603E-06	1.203	102.2

4	0.5	9.9000E+01	999.000(1)	1518.6(2)
4	0.8	1.3917E-07	161.921(3)	969.1(2)
4	1.0	1.9419E-07	106.993(3)	786.0(2)
4	1.5	3.5134E-07	51.207	541.7(2)
4	2.0	5.2411E-07	32.491	419.6(2)
4	2.5	6.8916E-07	23.138	346.4(2)
4	3.0	8.4639E-07	17.629	297.5(2)
4	4.0	1.1405E-06	12.015	236.5(2)
4	5.0	1.4017E-06	9.068	199.9
4	7.0	1.7941E-06	6.197	158.0
4	10.0	2.1763E-06	4.329	126.6
4	12.0	2.3326E-06	3.673	114.4
4	15.0	2.4694E-06	3.059	102.2
4	20.0	2.5200E-06	2.506	90.0
5	2.0	3.0299E-06	14.205	164.9
5	2.5	2.7953E-06	12.997	156.9
5	3.0	2.6103E-06	12.107	150.8
5	4.0	2.3314E-06	10.857	141.9
5	5.0	2.1267E-06	10.004	135.5
6	2.0	1.4590E-06	38.648	145.9
6	2.5	1.4113E-06	34.393	139.3
6	3.0	1.3680E-06	31.343	134.2
6	4.0	1.2929E-06	27.194	126.8
6	5.0	1.2297E-06	24.452	121.5

PARTICULATE--NO. 1 POWER BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 1.20
PHYSICAL STACK HEIGHT (M) = 38.98
STACK GAS TEMP (DEG K) = 616.33
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 10.63
STACK DIAMETER (M) = 2.43
VOLUME FLOW (CU M/SEC) = 49.30

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	1.4181E-06	1.411	1118.1(2)
1	0.8	1.6744E-06	1.140	713.4(2)
1	1.0	1.8020E-06	1.033	578.5(2)
1	1.5	2.0363E-06	0.867	398.7(2)
1	2.0	2.1941E-06	0.767	308.8(2)
1	2.5	2.3043E-06	0.701	254.8(2)
1	3.0	2.3828E-06	0.652	218.8(2)
2	0.5	4.6992E-07	6.380	1118.1(2)
2	0.8	6.5928E-07	4.230	713.4(2)
2	1.0	7.6942E-07	3.491	578.5(2)
2	1.5	1.0044E-06	2.483	398.7(2)
2	2.0	1.1959E-06	1.967	308.8(2)
2	2.5	1.3544E-06	1.650	254.8(2)
2	3.0	1.4868E-06	1.436	218.8(2)
2	4.0	1.6931E-06	1.164	173.9
2	5.0	1.8395E-06	0.998	146.9
3	2.0	8.8624E-07	4.043	308.8(2)
3	2.5	1.0380E-06	3.274	254.8(2)
3	3.0	1.1701E-06	2.770	218.8(2)
3	4.0	1.3863E-06	2.153	173.9
3	5.0	1.5514E-06	1.790	146.9
3	7.0	1.7712E-06	1.383	116.1
3	10.0	1.9306E-06	1.084	92.9
3	12.0	1.9711E-06	0.969	83.9
3	15.0	1.9770E-06	0.856	74.9

4	0.5	3.8150E-08	215.064(3)	1118.1(2)
4	0.8	7.8597E-08	88.353	713.4(2)
4	1.0	1.1039E-07	58.320	578.5(2)
4	1.5	2.0050E-07	29.792	398.7(2)
4	2.0	2.8890E-07	18.816	308.8(2)
4	2.5	3.7717E-07	13.607	254.8(2)
4	3.0	4.6343E-07	10.554	218.8(2)
4	4.0	6.1897E-07	7.236	173.9
4	5.0	7.5246E-07	5.507	146.9
4	7.0	9.6443E-07	3.760	116.1
4	10.0	1.1655E-06	2.636	92.9
4	12.0	1.2406E-06	2.249	83.9
4	15.0	1.3036E-06	1.885	74.9
4	20.0	1.3301E-06	1.545	66.0
5	2.0	1.4001E-06	9.685	133.1
5	2.5	1.3003E-06	8.825	126.3
5	3.0	1.2210E-06	8.192	121.2
5	4.0	1.1003E-06	7.305	113.7
5	5.0	1.0109E-06	6.701	108.3
6	2.0	8.9530E-07	22.264	117.1
6	2.5	8.7471E-07	19.691	111.5
6	3.0	8.5499E-07	17.854	107.2
6	4.0	8.1892E-07	15.363	101.0
6	5.0	7.6178E-07	13.908	96.5

4	0.5	3.8150E-08	215.064(3)	1118.1(2)
4	0.8	7.8597E-08	88.353	713.4(2)
4	1.0	1.1039E-07	58.320	578.5(2)
4	1.5	2.0050E-07	29.792	398.7(2)
4	2.0	2.8890E-07	18.816	308.8(2)
4	2.5	3.7717E-07	13.607	254.8(2)
4	3.0	4.6343E-07	10.554	218.8(2)
4	4.0	6.1897E-07	7.236	173.9
4	5.0	7.5246E-07	5.507	146.9
4	7.0	9.6443E-07	3.760	116.1
4	10.0	1.1655E-06	2.636	92.9
4	12.0	1.2406E-06	2.249	83.9
4	15.0	1.3036E-06	1.885	74.9
4	20.0	1.3301E-06	1.545	66.0
5	2.0	1.4001E-06	9.685	133.1
5	2.5	1.3003E-06	8.825	126.3
5	3.0	1.2210E-06	8.192	121.2
5	4.0	1.1003E-06	7.305	113.7
5	5.0	1.0109E-06	6.701	108.3
6	2.0	8.9530E-07	22.264	117.1
6	2.5	8.7471E-07	19.691	111.5
6	3.0	8.5499E-07	17.854	107.2
6	4.0	8.1892E-07	15.363	101.0
6	5.0	7.6178E-07	13.908	96.5

PARTICULATE--LIME KILN

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 2.23
PHYSICAL STACK HEIGHT (M) = 22.86
STACK GAS TEMP (DEG K) = 348.55
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.75
STACK DIAMETER (M) = 1.37
VOLUME FLOW (CU M/SEC) = 14.37

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	2.8124E-05	0.640	210.2(2)
1	0.8	3.1677E-05	0.517	140.0
1	1.0	3.3057E-05	0.469	116.5
1	1.5	3.5450E-05	0.384	85.3
1	2.0	3.6705E-05	0.331	69.7
1	2.5	3.7398E-05	0.292	60.3
1	3.0	3.7428E-05	0.265	54.1
2	0.5	1.7828E-05	1.385	210.2(2)
2	0.8	2.3324E-05	0.955	140.0
2	1.0	2.6017E-05	0.807	116.5
2	1.5	3.0560E-05	0.607	85.3
2	2.0	3.3116E-05	0.505	69.7
2	2.5	3.4585E-05	0.436	60.3
2	3.0	3.5266E-05	0.390	54.1
2	4.0	3.5475E-05	0.333	46.3
2	5.0	3.4831E-05	0.298	41.6
3	2.0	3.1852E-05	0.790	69.7
3	2.5	3.4001E-05	0.675	60.3
3	3.0	3.5249E-05	0.598	54.1
3	4.0	3.6111E-05	0.504	46.3
3	5.0	3.5768E-05	0.449	41.6
3	7.0	3.3661E-05	0.386	36.2
3	10.0	2.9805E-05	0.340	32.2
3	12.0	2.7433E-05	0.322	30.7
3	15.0	2.4366E-05	0.304	29.1

4	0.5	5.7245E-06	9.870	210.2(2)
4	0.8	9.8531E-06	5.092	140.0
4	1.0	1.2417E-05	3.786	116.5
4	1.5	1.7739E-05	2.307	85.3
4	2.0	2.1636E-05	1.683	69.7
4	2.5	2.4520E-05	1.345	60.3
4	3.0	2.6598E-05	1.135	54.1
4	4.0	2.8472E-05	0.923	46.3
4	5.0	2.8640E-05	0.822	41.6
4	7.0	2.7494E-05	0.708	36.2
4	10.0	2.4761E-05	0.624	32.2
4	12.0	2.2955E-05	0.591	30.7
4	15.0	2.0534E-05	0.556	29.1
4	20.0	1.7321E-05	0.519	27.5
5	2.0	1.8796E-05	2.806	64.8
5	2.5	1.6980E-05	2.603	61.8
5	3.0	1.5589E-05	2.452	59.5
5	4.0	1.3560E-05	2.238	56.2
5	5.0	1.2122E-05	2.090	53.8
6	2.0	1.7206E-05	4.733	57.7
6	2.5	1.5674E-05	4.328	55.2
6	3.0	1.4482E-05	4.031	53.3
6	4.0	1.2714E-05	3.617	50.5
6	5.0	1.1345E-05	3.390	48.5

PARTICULATE--HOG FUEL BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 3.00
PHYSICAL STACK HEIGHT (M) = 22.40
STACK GAS TEMP (DEG K) = 346.89
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.78
STACK DIAMETER (M) = 2.10
VOLUME FLOW (CU M/SEC) = 33.87

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	1.6846E-05	0.839	372.0(2)
1	0.8	1.9491E-05	0.682	240.9(2)
1	1.0	2.0726E-05	0.620	197.2
1	1.5	2.2970E-05	0.515	138.9
1	2.0	2.4242E-05	0.454	109.8
1	2.5	2.5229E-05	0.407	92.3
1	3.0	2.6070E-05	0.369	80.7
2	0.5	8.5369E-06	2.332	372.0(2)
2	0.8	1.1711E-05	1.568	240.9(2)
2	1.0	1.3470E-05	1.306	197.2
2	1.5	1.6958E-05	0.948	138.9
2	2.0	1.9497E-05	0.765	109.8
2	2.5	2.1366E-05	0.653	92.3
2	3.0	2.2759E-05	0.577	80.7
2	4.0	2.4565E-05	0.478	66.1
2	5.0	2.5537E-05	0.414	57.4
3	2.0	1.7305E-05	1.302	109.8
3	2.5	1.9562E-05	1.076	92.3
3	3.0	2.1339E-05	0.928	80.7
3	4.0	2.3818E-05	0.746	66.1
3	5.0	2.5298E-05	0.638	57.4
3	7.0	2.6493E-05	0.517	47.4
3	10.0	2.6174E-05	0.429	39.9
3	12.0	2.5389E-05	0.395	37.0
3	15.0	2.3939E-05	0.361	34.1

4	0.5	1.7946E-06	26.307	372.0(2)
4	0.8	3.3995E-06	12.392	240.9(2)
4	1.0	4.5278E-06	8.874	197.2
4	1.5	7.1989E-06	5.032	138.9
4	2.0	9.6821E-06	3.438	109.8
4	2.5	1.1841E-05	2.609	92.3
4	3.0	1.3652E-05	2.114	80.7
4	4.0	1.6538E-05	1.550	66.1
4	5.0	1.8629E-05	1.243	57.4
4	7.0	2.0818E-05	0.947	47.4
4	10.0	2.1086E-05	0.786	39.9
4	12.0	2.0679E-05	0.724	37.0
4	15.0	1.9730E-05	0.662	34.1
4	20.0	1.7929E-05	0.601	31.1
5	2.0	1.5648E-05	3.787	77.8
5	2.5	1.4415E-05	3.464	73.8
5	3.0	1.3449E-05	3.226	70.8
5	4.0	1.1913E-05	2.910	66.3
5	5.0	1.0793E-05	2.695	63.2
6	2.0	1.4064E-05	6.669	68.3
6	2.5	1.3007E-05	6.036	65.0
6	3.0	1.2170E-05	5.573	62.5
6	4.0	1.0902E-05	4.932	58.9
6	5.0	9.9658E-06	4.499	56.2

BOISE CASCADE -WALLULA- SO2 CONCENTRATIONS

MULTIPLE SOURCE MODEL DBT51, VERSION 78010

* * * S O U R C E S * * *

NO	Q (G/SEC)	HP (M)	TS (DEG K)	VS (M/SEC)	D (M)	VF (M**3/SEC)	R (KM)	S (KM)
1	28.5	53.3	449.7	9.8	3.7	102.6	0.000	0.000
2	29.2	53.3	434.7	9.9	4.1	132.1	0.000	0.000
3	15.9	39.0	616.3	10.6	2.4	49.8	0.000	0.000

* * * R E C E P T O R S * * *

NO	RREC (KM)	SREC (KM)	Z (M)
1	0.000	0.100	0.0
2	0.000	0.200	0.0
3	0.000	0.300	0.0
4	0.000	0.400	0.0
5	0.000	0.500	0.0
6	0.000	0.600	0.0
7	0.000	0.700	0.0
8	0.000	0.800	0.0
9	0.000	0.900	0.0
10	0.000	1.000	0.0
11	0.000	1.100	0.0
12	0.000	1.200	0.0
13	0.000	1.300	0.0
14	0.000	1.400	0.0
15	0.000	1.500	0.0
16	0.000	1.600	0.0
17	0.000	1.700	0.0
18	0.000	1.800	0.0
19	0.000	1.900	0.0
20	0.000	2.000	0.0

* * * M E T E O R O L O G Y * * *

NO	THETA (DEG)	U (M/SEC)	KST	HL (M)	T (DEG K)
1	180.0	3.0	1	1000.	293.

HOUR # 1

* * * R E C E P T O R N U M B E R * * *

S	HFIN	PARTIAL CONCENTRATIONS (G/M**3)					
		1	2	3	4	5	6
1	272.	5.357E-16	1.889E-08	1.630E-06	1.170E-05	3.091E-05	4.562E-05
2	298.	7.341E-17	7.538E-09	9.507E-07	8.472E-06	2.572E-05	4.150E-05
3	220.	7.124E-12	3.439E-07	5.405E-06	1.766E-05	3.004E-05	3.439E-05

TOTAL CONCENTRATION (G/M**3)

7.125E-12 3.703E-07 7.986E-06 3.783E-05 8.667E-05 1.215E-04

HOUR # 1

```
* * * R E C E P T O R   N U M B E R * * *
              7          8          9         10         11         12

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  272.   4.533E-05 3.929E-05 3.307E-05 2.669E-05 2.146E-05 1.771E-05
 2  298.   4.312E-05 3.794E-05 3.206E-05 2.640E-05 2.151E-05 1.792E-05
 3  220.   3.050E-05 2.569E-05 2.031E-05 1.583E-05 1.244E-05 1.009E-05

            TOTAL CONCENTRATION (G/M**3)

           1.189E-04 1.029E-04 8.544E-05 6.892E-05 5.542E-05 4.572E-05
```

HOUR # 1

```
* * * R E C E P T O R   N U M B E R * * *
             13         14         15         16         17         18

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  272.   1.527E-05 1.376E-05 1.276E-05 1.201E-05 1.138E-05 1.083E-05
 2  298.   1.556E-05 1.407E-05 1.307E-05 1.231E-05 1.167E-05 1.110E-05
 3  220.   8.597E-06 7.695E-06 7.121E-06 6.699E-06 6.347E-06 6.036E-06

            TOTAL CONCENTRATION (G/M**3)

           3.943E-05 3.552E-05 3.295E-05 3.102E-05 2.940E-05 2.796E-05
```

HOUR # 1

```
* * * R E C E P T O R   N U M B E R * * *
             19         20

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  272.   1.033E-05 9.873E-06
 2  298.   1.058E-05 1.012E-05
 3  220.   5.757E-06 5.505E-06

            TOTAL CONCENTRATION (G/M**3)

           2.667E-05 2.550E-05
```

AVERAGE CONCENTRATIONS FOR 1 HOURS.

```
* * * R E C E P T O R   N U M B E R * * *
              1          2          3          4          5          6

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1         5.357E-16 1.889E-08 1.630E-06 1.170E-05 3.091E-05 4.562E-05
 2         7.341E-17 7.538E-09 9.507E-07 8.472E-06 2.572E-05 4.150E-05
 3         7.124E-12 3.439E-07 5.405E-06 1.766E-05 3.004E-05 3.439E-05

            TOTAL CONCENTRATION (G/M**3)

           7.125E-12 3.703E-07 7.986E-06 3.783E-05 8.667E-05 1.215E-04
```

```
* * * R E C E P T O R   N U M B E R * * *
              7          8          9         10         11         12

 S            PARTIAL CONCENTRATIONS (G/M**3)

 1          4.533E-05 3.929E-05 3.307E-05 2.669E-05 2.146E-05 1.771E-05
 2          4.312E-05 3.794E-05 3.206E-05 2.640E-05 2.151E-05 1.792E-05
 3          3.050E-05 2.569E-05 2.031E-05 1.583E-05 1.244E-05 1.009E-05

            TOTAL CONCENTRATION (G/M**3)

            1.189E-04 1.029E-04 8.544E-05 6.892E-05 5.542E-05 4.572E-05
* * * R E C E P T O R   N U M B E R * * *
             13         14         15         16         17         18

 S            PARTIAL CONCENTRATIONS (G/M**3)

 1          1.527E-05 1.376E-05 1.276E-05 1.201E-05 1.138E-05 1.083E-05
 2          1.556E-05 1.407E-05 1.307E-05 1.231E-05 1.167E-05 1.110E-05
 3          8.597E-06 7.695E-06 7.121E-06 6.699E-06 6.347E-06 6.036E-06

            TOTAL CONCENTRATION (G/M**3)

            3.943E-05 3.552E-05 3.295E-05 3.102E-05 2.940E-05 2.796E-05
* * * R E C E P T O R   N U M B E R * * *
             19         20

 S            PARTIAL CONCENTRATIONS (G/M**3)

 1          1.033E-05 9.873E-06
 2          1.058E-05 1.012E-05
 3          5.757E-06 5.505E-06

            TOTAL CONCENTRATION (G/M**3)

            2.667E-05 2.550E-05
```

BOISE CASCADE -WALLULA- SO2 CONCENTRATIONS

MULTIPLE SOURCE MODEL DBT51, VERSION 78010

* * * S O U R C E S * * *

NO	Q (G/SEC)	HP (M)	TS (DEG K)	VS (M/SEC)	D (M)	VF (M**3/SEC)	R (KM)	S (KM)
1	28.5	53.3	449.7	9.8	3.7	102.6	0.000	0.000
2	29.2	53.3	434.7	9.9	4.1	132.1	0.000	0.000
3	15.9	39.0	616.3	10.6	2.4	49.8	0.000	0.000

* * * R E C E P T O R S * * *

NO	RREC (KM)	SREC (KM)	Z (M)
1	0.000	0.100	0.0
2	0.000	0.200	0.0
3	0.000	0.300	0.0
4	0.000	0.400	0.0
5	0.000	0.500	0.0
6	0.000	0.600	0.0
7	0.000	0.700	0.0
8	0.000	0.800	0.0
9	0.000	0.900	0.0
10	0.000	1.000	0.0
11	0.000	1.100	0.0
12	0.000	1.200	0.0
13	0.000	1.300	0.0
14	0.000	1.400	0.0
15	0.000	1.500	0.0
16	0.000	1.600	0.0
17	0.000	1.700	0.0
18	0.000	1.800	0.0
19	0.000	1.900	0.0
20	0.000	2.000	0.0

* * * M E T E O R O L O G Y * * *

NO	THETA (DEG)	U (M/SEC)	KST	HL (M)	T (DEG K)
1	180.0	10.0	3	1000.	293.

HOUR # 1

* * * R E C E P T O R N U M B E R * * *

S	HFIN	PARTIAL CONCENTRATIONS (G/M**3)					
		1	2	3	4	5	6
1	119.	6.512E-22	2.702E-10	1.142E-07	1.186E-06	3.682E-06	6.821E-06
2	127.	1.725E-22	1.388E-10	7.270E-08	8.397E-07	2.779E-06	5.376E-06
3	93.	2.165E-14	7.008E-08	1.908E-06	6.428E-06	1.105E-05	1.431E-05
		TOTAL CONCENTRATION (G/M**3)					
		2.165E-14	7.049E-08	2.095E-06	8.453E-06	1.751E-05	2.651E-05

HOUR # 1

* * * R E C E P T O R N U M B E R * * *

S	HFIN	PARTIAL CONCENTRATIONS (G/M**3)					
		7	8	9	10	11	12
1	119.	9.759E-06	1.260E-05	1.763E-05	2.174E-05	2.472E-05	2.664E-05
2	127.	7.932E-06	1.006E-05	1.327E-05	1.727E-05	2.046E-05	2.275E-05
3	93.	1.650E-05	2.097E-05	2.373E-05	2.507E-05	2.537E-05	2.500E-05
		TOTAL CONCENTRATION (G/M**3)					
		3.419E-05	4.363E-05	5.464E-05	6.408E-05	7.055E-05	7.438E-05

```
HOUR #  1
* * * R E C E P T O R   N U M B E R * * *
            13        14        15        16        17        18

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  119.   2.768E-05 2.804E-05 2.791E-05 2.743E-05 2.672E-05 2.585E-05
 2  127.   2.424E-05 2.505E-05 2.535E-05 2.525E-05 2.487E-05 2.429E-05
 3   93.   2.420E-05 2.316E-05 2.200E-05 2.081E-05 1.962E-05 1.847E-05

            TOTAL CONCENTRATION (G/M**3)

           7.611E-05 7.626E-05 7.526E-05 7.349E-05 7.120E-05 6.861E-05

HOUR #  1
* * * R E C E P T O R   N U M B E R * * *
            19        20

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  119.   2.489E-05 2.389E-05
 2  127.   2.358E-05 2.280E-05
 3   93.   1.738E-05 1.635E-05

            TOTAL CONCENTRATION (G/M**3)

           6.585E-05 6.303E-05


AVERAGE CONCENTRATIONS FOR  1 HOURS.
* * * R E C E P T O R   N U M B E R * * *
             1         2         3         4         5         6

 S           PARTIAL CONCENTRATIONS (G/M**3)

 1          6.512E-22 2.702E-10 1.142E-07 1.186E-06 3.682E-06 6.821E-06
 2          1.725E-22 1.388E-10 7.270E-08 8.397E-07 2.779E-06 5.376E-06
 3          2.165E-14 7.008E-08 1.908E-06 6.428E-06 1.105E-05 1.431E-05

            TOTAL CONCENTRATION (G/M**3)

           2.165E-14 7.049E-08 2.095E-06 8.453E-06 1.751E-05 2.651E-05
```

```
* * * R E C E P T O R   N U M B E R * * *
            7          8          9         10         11         12

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1         9.759E-06 1.260E-05 1.763E-05 2.174E-05 2.472E-05 2.664E-05
 2         7.932E-06 1.006E-05 1.327E-05 1.727E-05 2.046E-05 2.275E-05
 3         1.650E-05 2.097E-05 2.373E-05 2.507E-05 2.537E-05 2.500E-05

            TOTAL CONCENTRATION (G/M**3)

           3.419E-05 4.363E-05 5.464E-05 6.408E-05 7.055E-05 7.438E-05
* * * R E C E P T O R   N U M B E R * * *
           13         14         15         16         17         18

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1         2.768E-05 2.804E-05 2.791E-05 2.743E-05 2.672E-05 2.585E-05
 2         2.424E-05 2.505E-05 2.535E-05 2.525E-05 2.487E-05 2.429E-05
 3         2.420E-05 2.316E-05 2.200E-05 2.081E-05 1.962E-05 1.847E-05

            TOTAL CONCENTRATION (G/M**3)

           7.611E-05 7.626E-05 7.526E-05 7.349E-05 7.120E-05 6.861E-05
* * * R E C E P T O R   N U M B E R * * *
           19         20

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1         2.489E-05 2.389E-05
 2         2.358E-05 2.280E-05
 3         1.738E-05 1.635E-05

            TOTAL CONCENTRATION (G/M**3)

           6.585E-05 6.303E-05
```

BOISE CASCADE
WALLULA PULP MILL
AMBIENT MONITORING PROGRAM

A. INTRODUCTION

With respect to 40 CFR 52.21 Prevention of Significant Deterioration of Air Quality Regulations, Boise Cascade Corporation's Wallula Pulp Mill requests review of their ambient monitoring network for future PSD considerations.

This document describes the existing ambient monitoring program and data base that has been gathered at Wallula. In addition, it will describe the modifications to be made to this monitoring network. We request that this program be reviewed for comparison with state monitoring network requirements and EPA PSD equipment specifications and quality assurance procedures. The data collected in this monitoring program will be used to meet data requirements for future PSD applications.

B. DATA BASE

In early 1978, EPA issued a PSD permit to Boise Cascade for expansion of its Wallula Kraft pulp mill. The PSD permit application was submitted to EPA by Boise Cascade on November 10, 1977. The application described details of the expansion and included an ambient air quality modeling analysis prepared by URS engineers. A technical analysis, including BACT determination and Air Quality Impact analysis, was performed by EPA Region X using information contained in that application.

The existing data base was obtained from instrumentation installed for purposes of gathering data for the original PSD application. An ambient monitoring station has been

ED_013256A_00000458-00112

operating on the roof of the Wallula Volunteer Fire Station in the town of Wallula approximately 1 mile to the south-southeast of the pulp mill since 1976 (see Figure 1). The roof of the fire station is approximately 12 feet above the ground. The monitoring network consists of a meteorological monitor (measuring wind speed, wind direction, and temperature), an SO_2 analyzer, and a high-volume particulate sampler. The meteorological sensor is approximately 12 feet above the roof of the fire station; the SO_2 probe is approximately 10 feet above the roof; and the high-volume sampler is approximately 4 feet above the roof.

The anemometer is an MRI Model 1071 Mechanical Weather Station. It was installed in April 1976. Operation has continued to the present. One year's data from April 1976 to April 1977 were used in the original PSD application.

The SO_2 analyzer has been a Phillips Model 9755/00 with automatic calibration. The unit was installed in February 1977. Data taken from February 1977 through July 1977 were used in the original PSD application. The analyzer was operated until the end of August 1979.

The high-volume particulate sampler was installed in April 1976. It is a General Metals sampler with a constant-flow controller manufactured by Sierra Instruments. Operation has continued on a 5 days per week basis up to the present. Sampling interval is 8:00 a.m. to 8:00 a.m. The flow rate has been calibrated once per month. Data from May 1976 through April 1977 were used in the original PSD application.

C. REVISIONS TO MONITORING PROGRAM

Because of future expansion plans at the Wallula Volunteer Fire Station, Boise Cascade plans to relocate its ambient monitoring network and to upgrade the instrumentation and

ED_013256A_00000458-00113

quality assurance procedures of its program so as to reflect recent environmental regulations and guidelines.

Location of the proposed new monitoring site has been chosen after consideration of factors such as terrain, availability of power and the ambient impact analysis of the original PSD application. This expansion phase is expected to be completed by the end of 1980.

Wind data taken at the Wallula monitoring site from April 1976 through April 1977 show the dominant winds to be blowing from the southwest during all seasons. Figures 2 through 6 are the annual and seasonal wind roses and are taken from the PSD application.

The modeling results for particulates and SO_2 from the PSD application are contained as Figures 7 and 8. The projected maximum impact zones correspond with the dominant wind flow patterns and have similar patterns and orientation.

The location of the proposed new monitoring site is approximately 1.5 km to the north-northeast of the pulp mill and in line with the dominant winds (Figure 1). The site is on a hill approximately 125 feet higher than the pulp mill near a potato warehouse with UTM coordinates of 5109.145N, 352.390E. This location has been chosen for the following reasons:

- Downwind from the mill--Measurements at the Wallula station show the dominant winds to be from the southwest on an annual basis. The proposed monitoring location is to the north-northeast of the mill.

- Unobstructed flow from mill to the site--As Figure 9 shows, the terrain between the proposed monitoring site and the mill is flat with little vegetation.

ED_013256A_00000458-00114

- Location on a hill--Figure 10 shows the hill where the proposed monitoring site is to be located. The monitors will be located near the crest of the hill, the highest terrain feature in the north-northeasterly direction from the mill.

- Availability of power--Figure 10 shows a string of power poles running along the crest of the hill. This power source is essential.

- Security--The proposed monitoring site is within visual range of the mill and can be equipped with adequate lighting for observation.

- Near area of projected maximum impacts--The modeling results from the original PSD application (Figures 7 and 8) show the maximum impact areas to be in a valley slightly to the south of the proposed monitoring site. However, this modeling analysis used the wind data collected at the Wallula fire station. Physical features such as the Wallula Gap, the building, trees, and the accuracy of the wind sensor itself may be different than those affecting the plumes from the mill. In addition, recent modeling using the EPA PTMAX model performed by CH2M HILL shows the maximum impacts from the major point sources to be less than 2 km from the source, as is the proposed monitoring location. Considering these factors and those mentioned above, this site on the hill is the best location available to operate the ambient monitoring program as described.

The proposed new station will monitor meteorology, SO_2, and particulate matter. The following sections will describe the new equipment which will be used to monitor the same parameters as were measured by the original monitoring network.

All of the monitors will be housed in a temperature controlled instrument shelter. The new shelter will be 8 feet wide by 14 feet long by 8 feet high, and the temperature will be maintained between 20°C and 30°C. The temperature will be controlled by a heat pump with a baseboard heater as a backup.

A new meteorological monitoring network will be installed consisting of components manufactured by Climatronics Corporation. The new system will measure wind speed, wind direction and temperature on a 10-meter tower. The system will be continuously recording on a strip chart located in the instrument shelter. The wind system sensors will have a starting threshold of 0.25 mph and a 0° to 560° measurement range for direction. The Climatronics sensors will include a Wind Mark III wind speed and direction sensor (P/N 100108), a dual element thermistor (P/N 100093), a multiplex strip chart recorder (P/N 1000586) and a digital standard deviation computer (P/N 101035). The MRI mechanical weather station will be used as a backup instrument and as a check for the accuracy of the historical data.

A new TECO Model No. 43 SO_2 unit will be installed. The instrument includes a Model No. 143 internal timer and self calibration permeation tube traceable to NBS standards. The instrument uses a designated EPA equivalent method. The probe for the monitor will be 3 to 15 meters above ground level, located in open terrain and more than 1 meter vertically and horizontally away from the instrument shelter and high-volume samplers. The original Phillips unit has been rebuilt and recalibrated and will be installed as a backup.

A second high-volume sampler has been purchased in order to operate collocated samplers. The instruments will be identical and will be installed on the roof of the instrument shelter 3 meters apart from each other.

D. CALIBRATION

The following quality assurance program will be implemented by Boise Cascade for the new monitoring network:

SO_2

Each analyzer will be calibrated as directed by the analyzer's operation or instruction manual at the time of initial installation. Calibration of each analyzer will establish the relationship between actual pollutant concentrations (in ppm, ppb, $\mu g/m^3$, etc.) and the analyzer output (chart reading, output volts, digital readout, etc.). This relationship will be used to convert subsequent analyzer response values to corresponding pollutant concentrations until superseded by a later calibration.

Recalibration of each analyzer will be performed:

- No later than 3 months after the most recent calibration or performance audit
- Following any one of the following:
  - An interruption of a few days in analyzer operation
  - Repairs that might affect the calibration
  - Physical relocation of the analyzer
  - Any other indication (including excessive zero and span drift) of possible inaccuracy

ED_013256A_00000458-00117

Zero and Span Checks

Automated Analyzers

Zero and span checks will be used to:

- Provide data to allow analyzer adjustment for zero and span drift
- Provide a decision point on when to calibrate the analyzer
- Provide a decision point on invalidation of monitoring data

Level 1 and level 2 checks will be used in the following manner.

- Level 2 checks will be performed every 24 hours (automatically) at 70 to 90 percent of full range.
- Level 1 checks will be performed once every 2 weeks. These consist of an artificial test concentration at zero and 70 to 90 percent of the measurement range. These are passed through as much of the sampling train as feasible. Level 1 checks will be used to make zero and span adjustments according to Table 9.1 from Section 2.0.9 (p. 7) of Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, USEPA, July 1979.

High-Volume Sampler

On a schedule of every third day, the high-volume samplers will be operated. The time schedule will be midnight to midnight.

ED_013256A_00000458-00118

The samplers will be calibrated after major maintenance (i.e., replacement of motor or motor brushes), any time the flow rate measuring device has to be replaced or repaired, or any time a one-point audit check deviates more than ±7 percent from the calibration curve. A one point flow rate audit check will be performed once per month.

Filter analysis will be performed by Boise Cascade. All guidelines for balance calibration, filter conditioning, filter reweighing, and TSP recalculation will be followed. The guidelines appear in the EPA document "Quality Assurance for Air Pollution Measurement Systems, Volume II--Ambient Air Specific Methods," EPA-600/4-77-027a.

Meteorology

The meteorological equipment will be calibrated for direction and signal output when installed. Observation of the system, including time marking the chart, chart spanning, and compass check, will be done on a weekly basis.

E. AUDITS

Each sampling quarter the SO_2 analyzer will be independently audited. The audit will be made by challenging the analyzer with a known concentration of audit gas over 4 audit points in addition to zero concentration. The standards and equipment used for auditing will be different from the standards and equipment used for the regular calibration and spanning. The auditing standards and calibration will be traceable to the National Bureau of Standards (NBS) gaseous Standard Reference Materials (SRM).

At the same time, the flow rate of the high-volume sampler will be audited. The device used for auditing will be different from the one used for routine calibration of the sampler being audited.

ED_013256A_00000458-00119

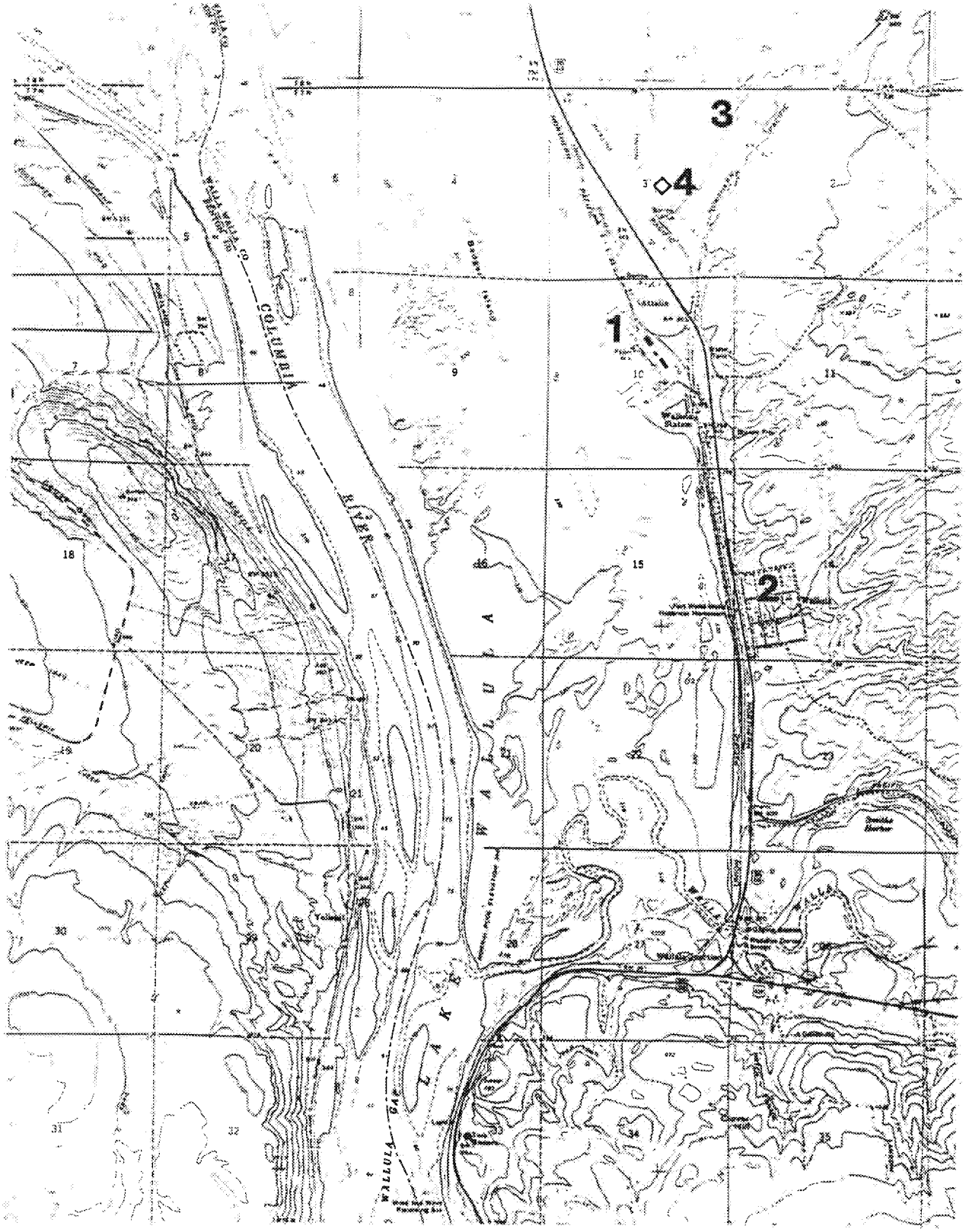
After each quarterly audit, the precision probability interval for each instrument will be calculated.

Every 6 months, the meteorological equipment will undergo independent auditing and calibration. The calibration will involve use of a synchronous motor with a known RPM or a known voltage output. Compass readings will be used to check directional sensor orientation. In addition, the data handling and reduction procedure will be inspected and reviewed.

F. SUMMARY

Boise Cascade believes the monitoring station described in this document to be sufficient to derive significant information on the air quality impacts of TSP and SO_2 from the existing sources at the Wallula Pulp Mill. The network for measuring concentrations of these two pollutants and meteorology has been designed as a basic system capable of accepting additions or modifications as future mill plans and regulations may require. Expansion of this network, which may or may not be at this location, will not be made without DOE and EPA approval prior to installation. Please advise us as to any deficiencies seen in this document so that modifications can be made prior to the implementation of this program.

ED_013256A_00000458-00120



1. Boise Cascade Wallula Pulp Mill
2. Existing Ambient Monitoring Site
3. Proposed Monitoring Site
4. Potato Warehouse

Figure 1
Boise Cascade Ambient Monitoring Sites

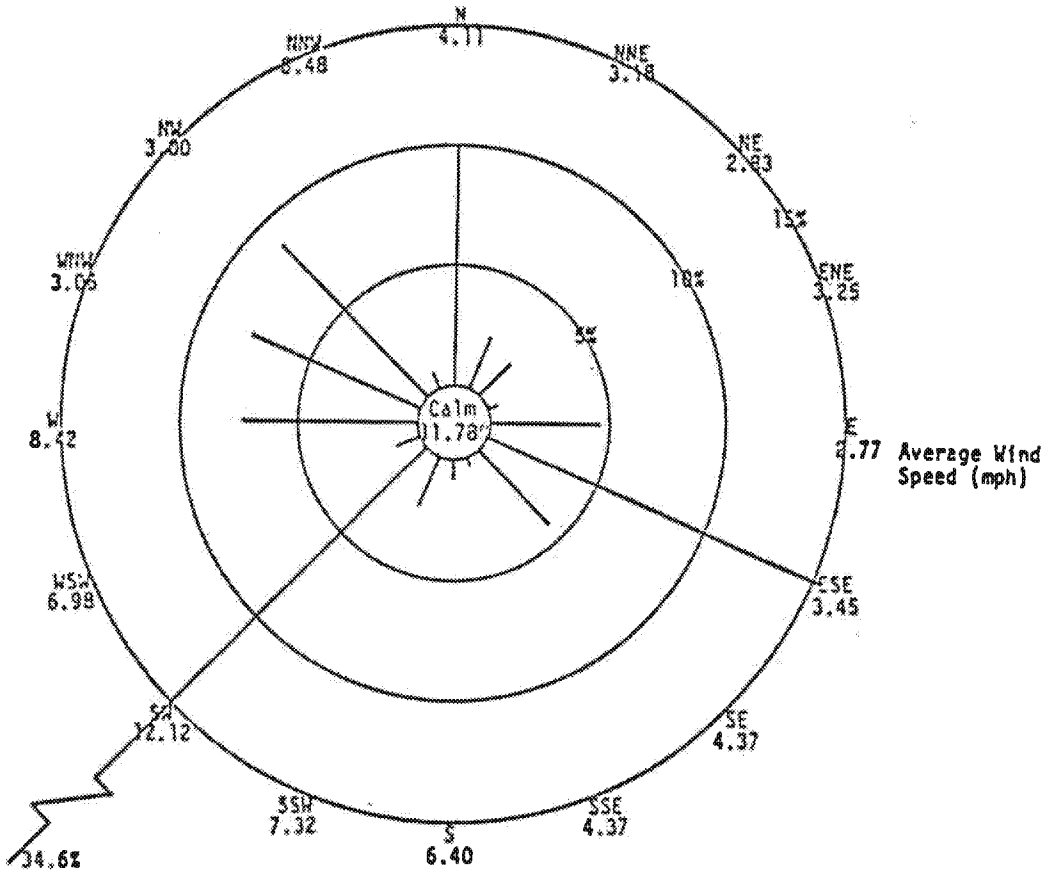


Figure 2
Annual Wind Rose
April 1976 through April 1977
Wallula, Washington

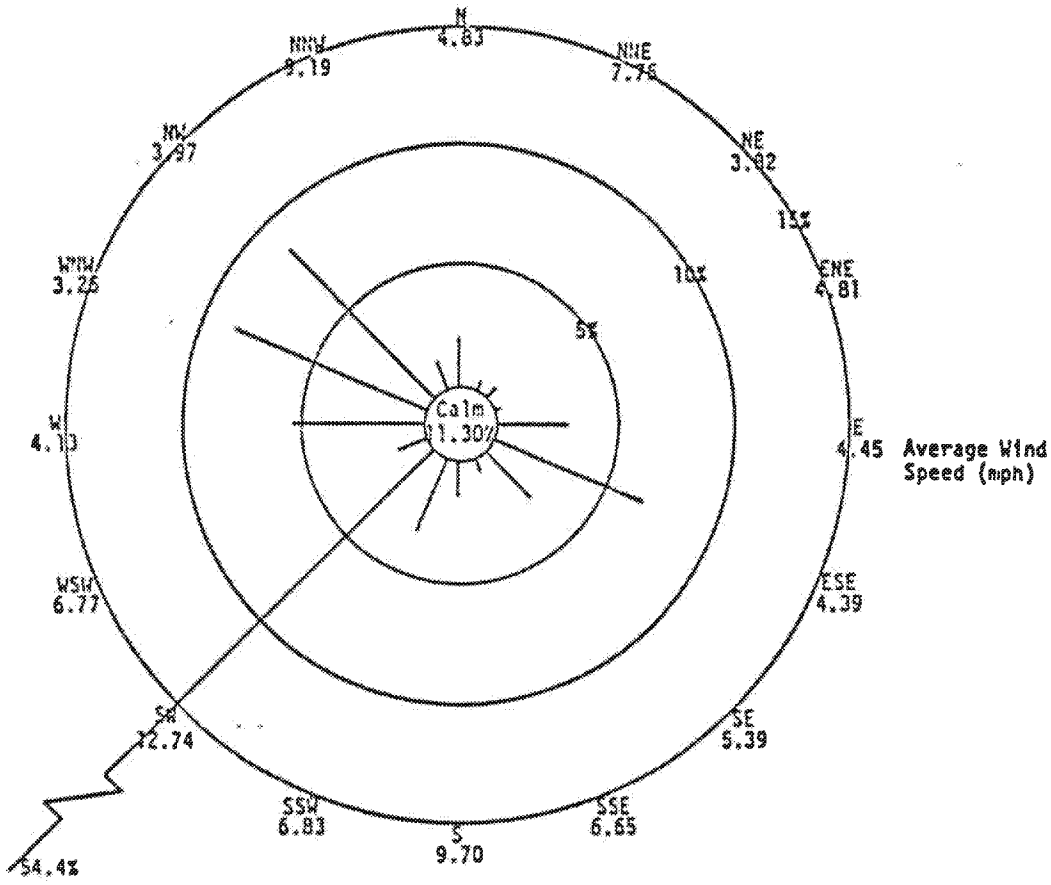


Figure 3
Spring Wind Rose
April through May 1976
March 1977
Wallula, Washington

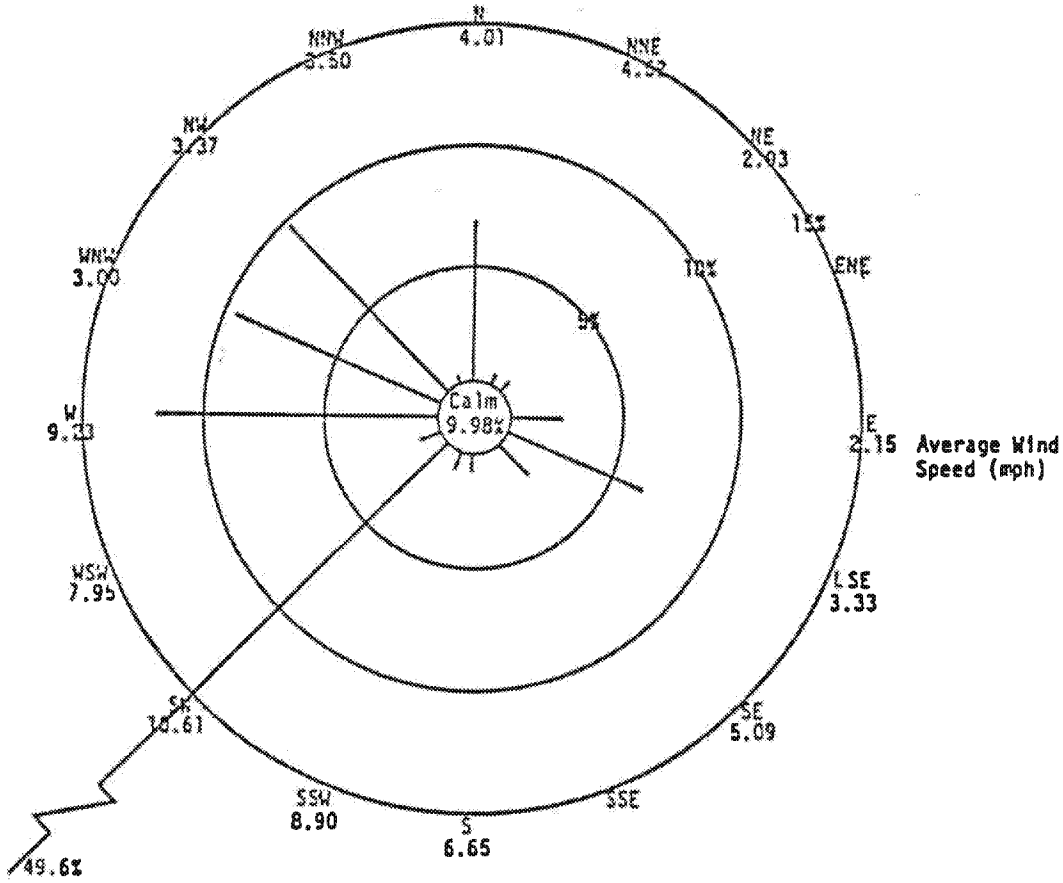


Figure 4
Summer Wind Rose
June through Aug 1976
Wallula, Washington

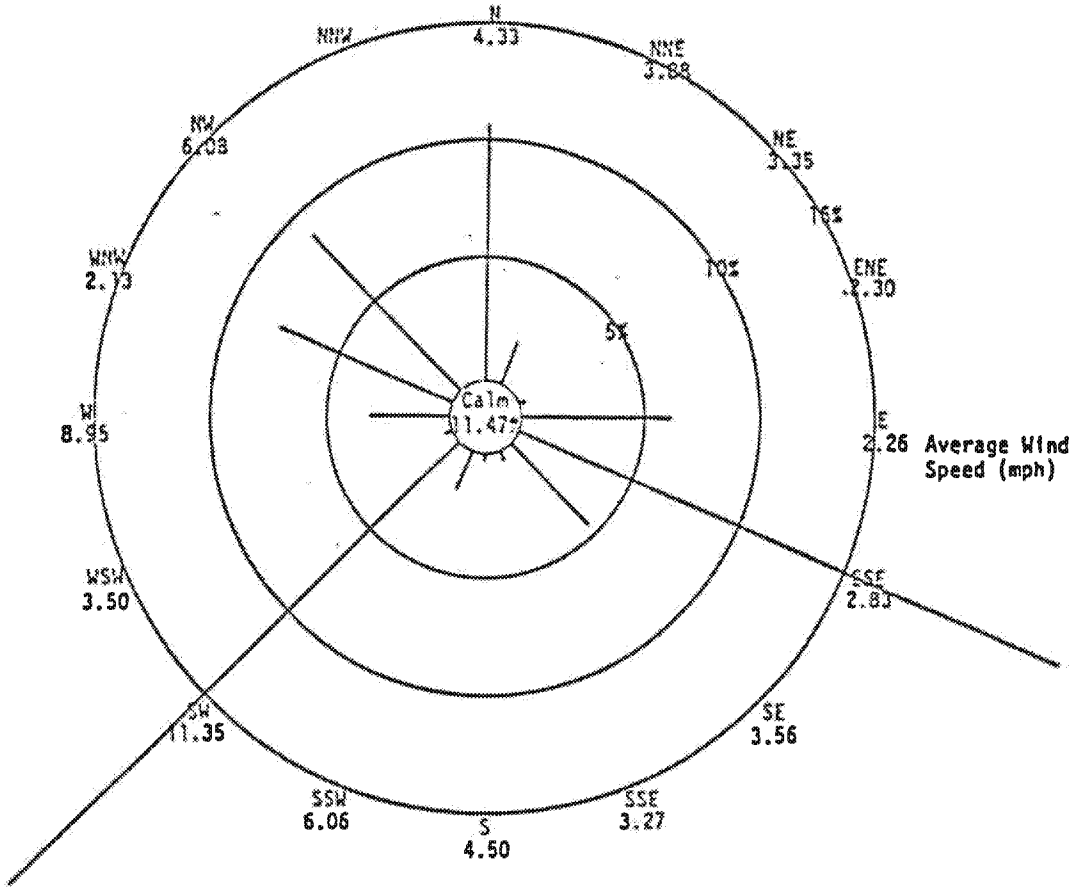


Figure 5
Fall Wind Rose
Sept through Nov 1976
Wallula, Washington

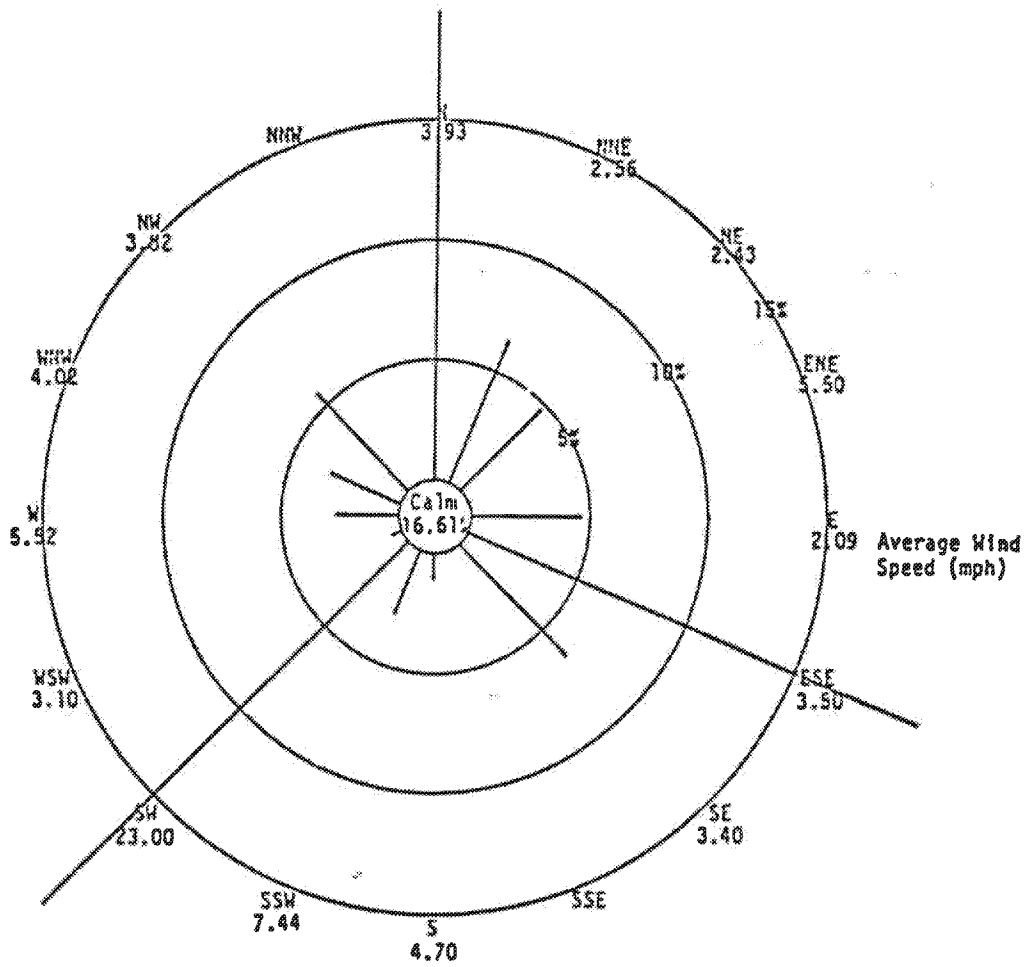
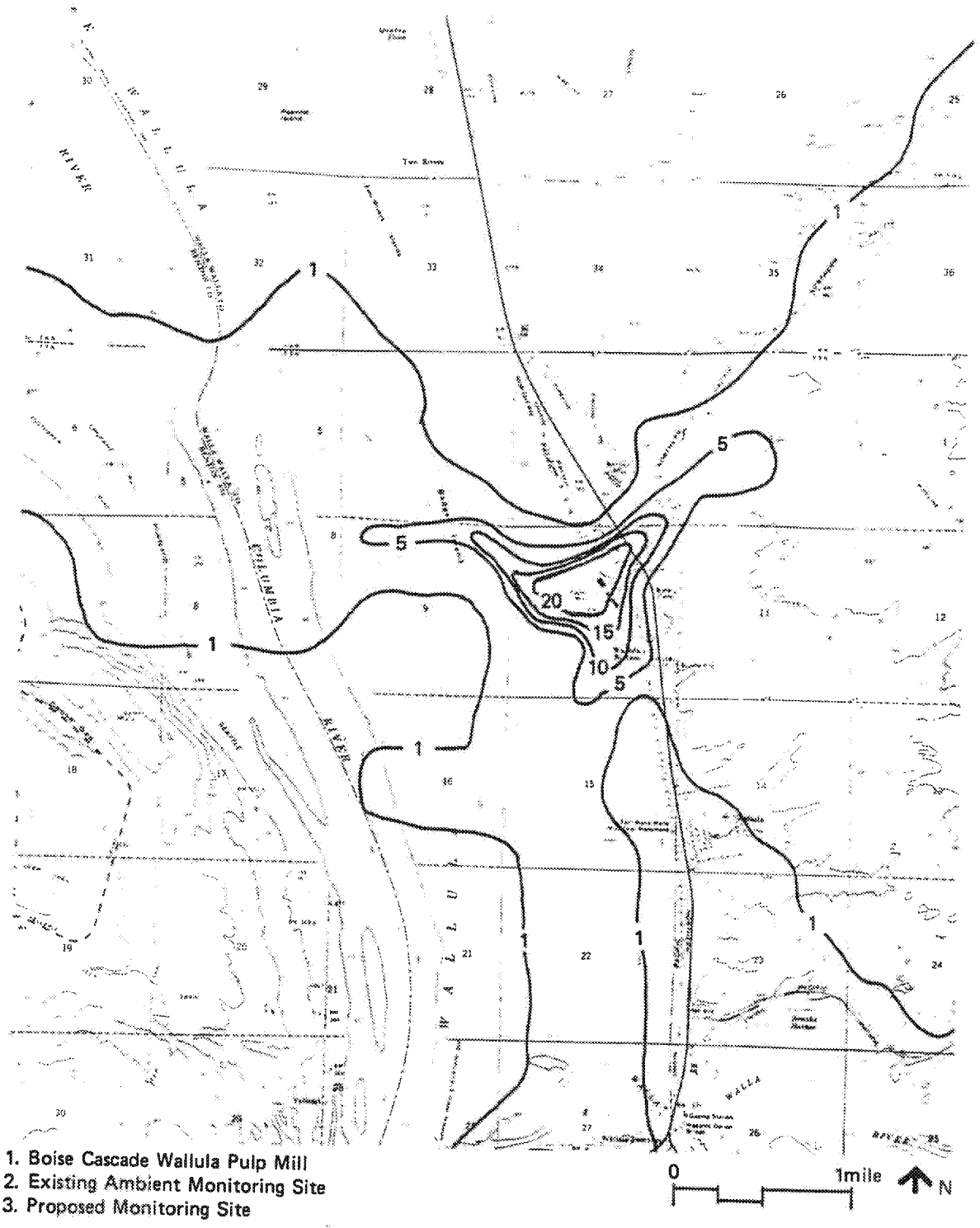
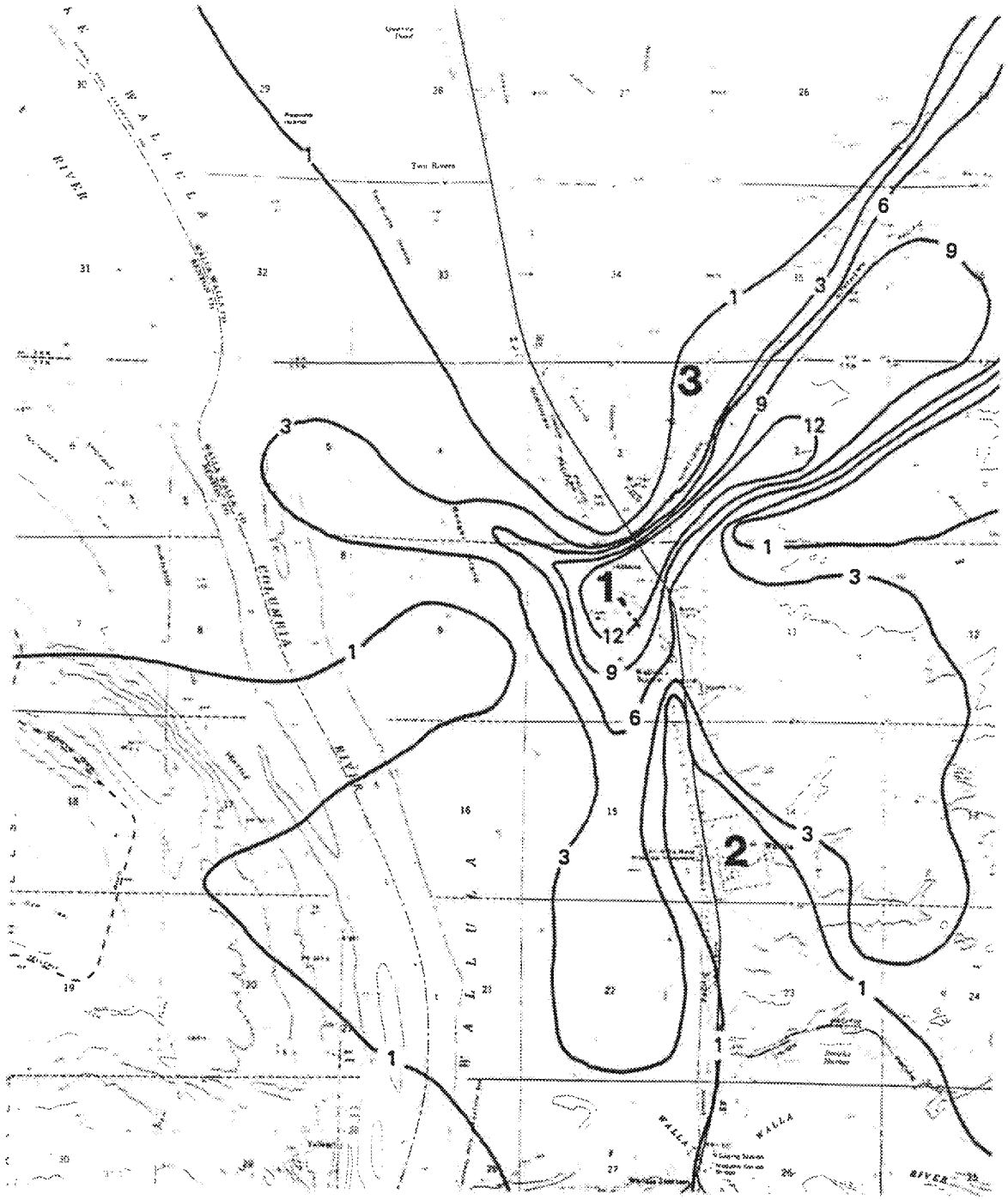


Figure 6
Winter Wind Rose
Dec 1976 through Feb 1977
Wallula, Washington



1. Boise Cascade Wallula Pulp Mill
2. Existing Ambient Monitoring Site
3. Proposed Monitoring Site

Figure 7
Annual Average Particulate Concentrations ($\mu g/m^3$)



1. Boise Cascade Wallula Pulp Mill
2. Existing Ambient Monitoring Site
3. Proposed Monitoring Site

Figure 8
Annual Average Sulfer Dioxide Concentrations($\mu g/m^3$)

APPENDIX A

The EPA approved PTMAX and PTMTP models were run by CH2M HILL to aid in determination of maximum air quality impacts from the existing Wallula pulp mill. All source data inputs and stack characteristics are from the original PSD application.

PTMAX was run for the three largest SO_2 sources and the five largest particulate sources. The results of this model run, shown on the following pages, indicates that most of the individual sources have maximum 1 hour impacts occurring under conditions of A stability and 3.0 m/sec and at distances less than 1 km.

This meteorological condition was then used to run the PTMTP model for the three SO_2 sources. Only these three sources were used since the SO_2 emissions are far greater than the particulate emissions. The model results predict that maximum 1 hour concentrations from the combined sources will occur approximately 0.6 km from the plant site. Since conditions of A stability and 3.0 m/sec are not likely to occur very often or for long time periods, a more likely persistent condition of C stability and 10.0 m/sec was also run. These results predict that maximum 1 hour concentrations from the combined sources will occur approximately 1.6 km from the source. The results of the PTMTP run follows the PTMAX results.

ED_013256A_00000458-00129

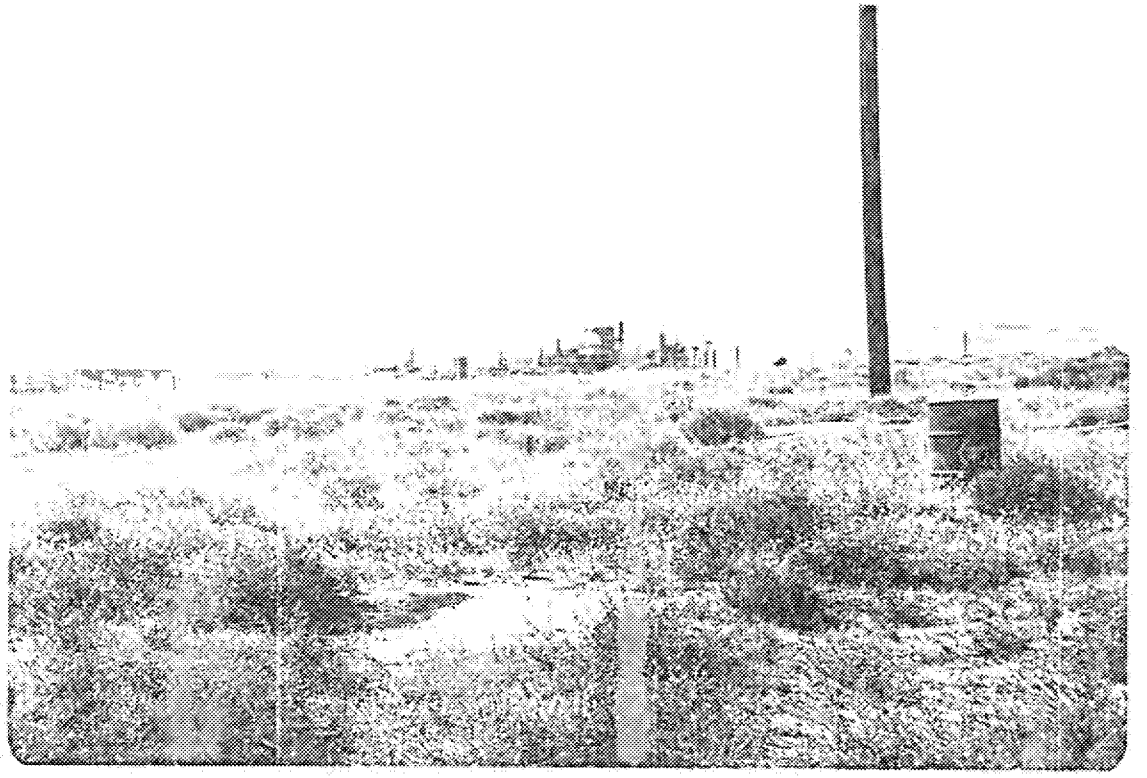


Figure 9. Wallula pulp mill from below the proposed monitoring site.

ED_013256A_00000458-00130

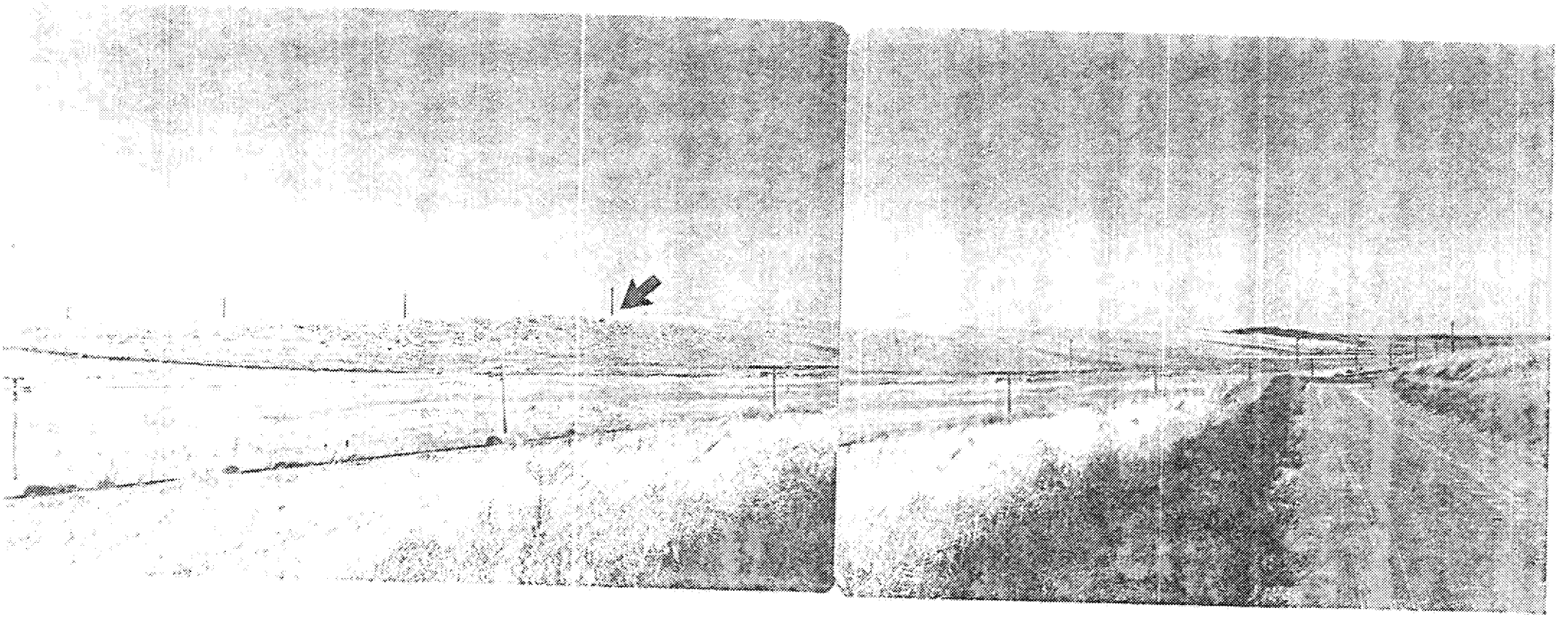


Figure 10. Location of proposed monitoring site (see arrow). Potato warehouse is just to the left of the picture.

ED_013256A_00000458-00131

SO2--NO. 2 RECOVERY BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 28.48
PHYSICAL STACK HEIGHT (M) = 53.34
STACK GAS TEMP (DEG K) = 449.67
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.75
STACK DIAMETER (M) = 3.66
VOLUME FLOW (CU M/SEC) = 102.58

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	2.5417E-05	1.550	1363.6(2)
1	0.8	2.9884E-05	1.254	872.2(2)
1	1.0	3.2107E-05	1.136	708.5(2)
1	1.5	3.6070E-05	0.955	490.1(2)
1	2.0	3.8668E-05	0.848	380.9(2)
1	2.5	4.0422E-05	0.775	315.4(2)
1	3.0	4.1604E-05	0.722	271.7(2)
2	0.5	7.8109E-06	7.653	1363.6(2)
2	0.8	1.0894E-05	5.089	872.2(2)
2	1.0	1.2676E-05	4.203	708.5(2)
2	1.5	1.6416E-05	3.000	490.1(2)
2	2.0	1.9415E-05	2.382	380.9(2)
2	2.5	2.1849E-05	2.005	315.4(2)
2	3.0	2.3844E-05	1.750	271.7(2)
2	4.0	2.6844E-05	1.426	217.1(2)
2	5.0	2.8901E-05	1.228	184.4
3	2.0	1.3875E-05	5.093	380.9(2)
3	2.5	1.6133E-05	4.138	315.4(2)
3	3.0	1.8070E-05	3.513	271.7(2)
3	4.0	2.1154E-05	2.746	217.1(2)
3	5.0	2.3423E-05	2.296	184.4
3	7.0	2.6286E-05	1.791	146.9
3	10.0	2.8065E-05	1.420	118.9
3	12.0	2.8334E-05	1.278	107.9
3	15.0	2.8037E-05	1.136	97.0

4	0.5	9.9000E+01	999.000(1)	1363.6(2)
4	0.8	1.0919E-06	131.575(3)	872.2(2)
4	1.0	1.5204E-06	87.143	708.5(2)
4	1.5	2.7299E-06	42.218	490.1(2)
4	2.0	4.0101E-06	27.446	380.9(2)
4	2.5	5.1954E-06	19.549	315.4(2)
4	3.0	6.3315E-06	15.149	271.7(2)
4	4.0	8.4159E-06	10.417	217.1(2)
4	5.0	1.0161E-05	7.957	184.4
4	7.0	1.2748E-05	5.509	146.9
4	10.0	1.5104E-05	3.908	118.9
4	12.0	1.5987E-05	3.343	107.9
4	15.0	1.6629E-05	2.819	97.0
4	20.0	1.6622E-05	2.340	86.1
5	2.0	2.0255E-05	13.187	158.2
5	2.5	1.8632E-05	12.088	150.7
5	3.0	1.7355E-05	11.277	144.9
5	4.0	1.5439E-05	10.138	136.5
5	5.0	1.4039E-05	9.360	130.6
6	2.0	1.0148E-05	35.053	140.3
6	2.5	9.7723E-06	31.280	134.1
6	3.0	9.4378E-06	28.571	129.3
6	4.0	8.8669E-06	24.879	122.4
6	5.0	8.3946E-06	22.434	117.4

SO2--NO. 3 RECOVERY BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 29.19
PHYSICAL STACK HEIGHT (M) = 53.34
STACK GAS TEMP (DEG K) = 434.67
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.91
STACK DIAMETER (M) = 4.12
VOLUME FLOW (CU M/SEC) = 132.12

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	2.2366E-05	1.630	1518.6(2)
1	0.8	2.6396E-05	1.318	969.1(2)
1	1.0	2.8410E-05	1.194	786.0(2)
1	1.5	3.2072E-05	1.001	541.7(2)
1	2.0	3.4545E-05	0.888	419.6(2)
1	2.5	3.6275E-05	0.811	346.4(2)
1	3.0	3.7488E-05	0.754	297.5(2)
2	0.5	6.5998E-06	8.445	1518.6(2)
2	0.8	9.2390E-06	5.599	969.1(2)
2	1.0	1.0777E-05	4.621	786.0(2)
2	1.5	1.4047E-05	3.288	541.7(2)
2	2.0	1.6700E-05	2.603	419.6(2)
2	2.5	1.8902E-05	2.185	346.4(2)
2	3.0	2.0732E-05	1.902	297.5(2)
2	4.0	2.3568E-05	1.542	236.5(2)
2	5.0	2.5584E-05	1.322	199.9
3	2.0	1.1741E-05	5.665	419.6(2)
3	2.5	1.3732E-05	4.588	346.4(2)
3	3.0	1.5466E-05	3.882	297.5(2)
3	4.0	1.8298E-05	3.016	236.5(2)
3	5.0	2.0443E-05	2.508	199.9
3	7.0	2.3314E-05	1.939	158.0
3	10.0	2.5366E-05	1.521	126.6
3	12.0	2.5867E-05	1.362	114.4
3	15.0	2.5908E-05	1.203	102.2

4	0.5	4.9628E-07	217.343(3)	1124.0(2)
4	0.8	1.0225E-06	89.265	717.1(2)
4	1.0	1.4363E-06	58.914	581.5(2)
4	1.5	2.6107E-06	30.049	400.7(2)
4	2.0	3.7647E-06	18.979	310.2(2)
4	2.5	4.9168E-06	13.713	256.0(2)
4	3.0	6.0434E-06	10.634	219.8(2)
4	4.0	8.0793E-06	7.286	174.6
4	5.0	9.8273E-06	5.543	147.5
4	7.0	1.2608E-05	3.783	116.5
4	10.0	1.5257E-05	2.649	93.2
4	12.0	1.6251E-05	2.259	84.2
4	15.0	1.7087E-05	1.892	75.1
4	20.0	1.7451E-05	1.550	66.1
5	2.0	1.8356E-05	9.722	133.4
5	2.5	1.7049E-05	8.858	126.6
5	3.0	1.6011E-05	8.222	121.4
5	4.0	1.4432E-05	7.331	113.9
5	5.0	1.3261E-05	6.725	108.5
6	2.0	1.1713E-05	22.378	117.3
6	2.5	1.1446E-05	19.790	111.7
6	3.0	1.1190E-05	17.941	107.4
6	4.0	1.0721E-05	15.436	101.2
6	5.0	9.9916E-06	13.962	96.7

SO2--NO. 1 POWER BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 15.88
PHYSICAL STACK HEIGHT (M) = 38.98
STACK GAS TEMP (DEG K) = 616.33
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 10.64
STACK DIAMETER (M) = 2.44
VOLUME FLOW (CU M/SEC) = 49.75

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	1.8626E-05	1.414	1124.0(2)
1	0.8	2.1996E-05	1.143	717.1(2)
1	1.0	2.3674E-05	1.035	581.5(2)
1	1.5	2.6756E-05	0.869	400.7(2)
1	2.0	2.8838E-05	0.769	310.2(2)
1	2.5	3.0293E-05	0.702	256.0(2)
1	3.0	3.1331E-05	0.654	219.8(2)
2	0.5	6.1596E-06	6.411	1124.0(2)
2	0.8	8.6433E-06	4.250	717.1(2)
2	1.0	1.0088E-05	3.507	581.5(2)
2	1.5	1.3170E-05	2.495	400.7(2)
2	2.0	1.5688E-05	1.976	310.2(2)
2	2.5	1.7773E-05	1.658	256.0(2)
2	3.0	1.9516E-05	1.442	219.8(2)
2	4.0	2.2232E-05	1.169	174.6
2	5.0	2.4165E-05	1.001	147.5
3	2.0	1.1617E-05	4.064	310.2(2)
3	2.5	1.3610E-05	3.290	256.0(2)
3	3.0	1.5346E-05	2.783	219.8(2)
3	4.0	1.8191E-05	2.163	174.6
3	5.0	2.0366E-05	1.798	147.5
3	7.0	2.3270E-05	1.389	116.5
3	10.0	2.5387E-05	1.088	93.2
3	12.0	2.5932E-05	0.972	84.2
3	15.0	2.6025E-05	0.858	75.1

4	0.5	4.9784E-07	217.343(3)	1124.0(2)
4	0.8	1.0258E-06	89.265	717.1(2)
4	1.0	1.4408E-06	58.914	581.5(2)
4	1.5	2.6190E-06	30.049	400.7(2)
4	2.0	3.7765E-06	18.979	310.2(2)
4	2.5	4.9323E-06	13.713	256.0(2)
4	3.0	6.0625E-06	10.634	219.8(2)
4	4.0	8.1048E-06	7.286	174.6
4	5.0	9.8583E-06	5.543	147.5
4	7.0	1.2648E-05	3.783	116.5
4	10.0	1.5305E-05	2.649	93.2
4	12.0	1.6302E-05	2.259	84.2
4	15.0	1.7141E-05	1.892	75.1
4	20.0	1.7507E-05	1.550	66.1
5	2.0	1.8414E-05	9.722	133.4
5	2.5	1.7103E-05	8.858	126.6
5	3.0	1.6062E-05	8.222	121.4
5	4.0	1.4477E-05	7.331	113.9
5	5.0	1.3303E-05	6.725	108.5
6	2.0	1.1750E-05	22.378	117.3
6	2.5	1.1482E-05	19.790	111.7
6	3.0	1.1225E-05	17.941	107.4
6	4.0	1.0754E-05	15.436	101.2
6	5.0	1.0023E-05	13.962	96.7

PARTICULATE--NO. 2 RECOVERY BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 2.50
PHYSICAL STACK HEIGHT (M) = 53.34
STACK GAS TEMP (DEG K) = 449.67
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.75
STACK DIAMETER (M) = 1.37
VOLUME FLOW (CU M/SEC) = 14.37

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	1.3121E-05	0.858	390.2(2)
1	0.8	1.4276E-05	0.712	263.9(2)
1	1.0	1.4614E-05	0.656	221.8(2)
1	1.5	1.4834E-05	0.565	165.6
1	2.0	1.4567E-05	0.512	137.6
1	2.5	1.4086E-05	0.478	120.7
1	3.0	1.3526E-05	0.453	109.5
2	0.5	6.5266E-06	2.435	390.2(2)
2	0.8	8.2764E-06	1.704	263.9(2)
2	1.0	9.0713E-06	1.454	221.8(2)
2	1.5	1.0273E-05	1.113	165.6
2	2.0	1.0794E-05	0.940	137.6
2	2.5	1.0946E-05	0.834	120.7
2	3.0	1.0890E-05	0.763	109.5
2	4.0	1.0475E-05	0.673	95.4
2	5.0	9.9134E-06	0.618	87.0
3	2.0	9.2089E-06	1.666	137.6
3	2.5	9.5548E-06	1.444	120.7
3	3.0	9.6705E-06	1.298	109.5
3	4.0	9.5344E-06	1.116	95.4
3	5.0	9.1713E-06	1.008	87.0
3	7.0	8.2770E-06	0.887	77.4
3	10.0	7.0439E-06	0.796	70.2
3	12.0	6.3688E-06	0.761	67.4
3	15.0	5.5473E-06	0.727	64.6

4	0.5	1.3240E-06	28.661	390.2(2)
4	0.8	2.2459E-06	14.426	263.9(2)
4	1.0	2.7997E-06	10.791	221.8(2)
4	1.5	3.8793E-06	6.689	165.6
4	2.0	4.6129E-06	4.951	137.6
4	2.5	5.1032E-06	4.007	120.7
4	3.0	5.4186E-06	3.421	109.5
4	4.0	5.6929E-06	2.748	95.4
4	5.0	5.6877E-06	2.379	87.0
4	7.0	5.3860E-06	1.982	77.4
4	10.0	4.7715E-06	1.701	70.2
4	12.0	4.3874E-06	1.597	67.4
4	15.0	3.8895E-06	1.494	64.6
4	20.0	3.2473E-06	1.395	61.8
5	2.0	5.3405E-06	6.642	107.8
5	2.5	4.7491E-06	6.218	103.9
5	3.0	4.3021E-06	5.903	100.9
5	4.0	3.6388E-06	5.472	96.6
5	5.0	3.1782E-06	5.177	93.5
6	2.0	3.7195E-06	14.530	98.5
6	2.5	3.3061E-06	13.529	95.3
6	3.0	2.9931E-06	12.790	92.8
6	4.0	2.5437E-06	11.751	89.2
6	5.0	2.2314E-06	11.039	86.6

PARTICULATE--NO. 3 RECOVERY BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 4.80
PHYSICAL STACK HEIGHT (M) = 53.34
STACK GAS TEMP (DEG K) = 434.67
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.91
STACK DIAMETER (M) = 4.12
VOLUME FLOW (CU M/SEC) = 132.12

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	3.6778E-06	1.630	1518.6(2)
1	0.8	4.3406E-06	1.318	969.1(2)
1	1.0	4.6717E-06	1.194	786.0(2)
1	1.5	5.2740E-06	1.001	541.7(2)
1	2.0	5.6805E-06	0.888	419.6(2)
1	2.5	5.9650E-06	0.811	346.4(2)
1	3.0	6.1646E-06	0.754	297.5(2)
2	0.5	1.0853E-06	8.445	1518.6(2)
2	0.8	1.5193E-06	5.599	969.1(2)
2	1.0	1.7721E-06	4.621	786.0(2)
2	1.5	2.3099E-06	3.288	541.7(2)
2	2.0	2.7462E-06	2.603	419.6(2)
2	2.5	3.1083E-06	2.185	346.4(2)
2	3.0	3.4091E-06	1.902	297.5(2)
2	4.0	3.8755E-06	1.542	236.5(2)
2	5.0	4.2070E-06	1.322	199.9
3	2.0	1.9308E-06	5.665	419.6(2)
3	2.5	2.2581E-06	4.588	346.4(2)
3	3.0	2.5432E-06	3.882	297.5(2)
3	4.0	3.0089E-06	3.016	236.5(2)
3	5.0	3.3616E-06	2.508	199.9
3	7.0	3.8338E-06	1.939	158.0
3	10.0	4.1712E-06	1.521	126.6
3	12.0	4.2536E-06	1.362	114.4
3	15.0	4.2603E-06	1.203	102.2

4	0.5	9.9000E+01	999.000(1)	1518.6(2)
4	0.8	1.3917E-07	161.921(3)	969.1(2)
4	1.0	1.9419E-07	106.993(3)	786.0(2)
4	1.5	3.5134E-07	51.207	541.7(2)
4	2.0	5.2411E-07	32.491	419.6(2)
4	2.5	6.8916E-07	23.138	346.4(2)
4	3.0	8.4639E-07	17.629	297.5(2)
4	4.0	1.1405E-06	12.015	236.5(2)
4	5.0	1.4017E-06	9.068	199.9
4	7.0	1.7941E-06	6.197	158.0
4	10.0	2.1763E-06	4.329	126.6
4	12.0	2.3326E-06	3.673	114.4
4	15.0	2.4694E-06	3.059	102.2
4	20.0	2.5200E-06	2.506	90.0
5	2.0	3.0299E-06	14.205	164.9
5	2.5	2.7953E-06	12.997	156.9
5	3.0	2.6103E-06	12.107	150.8
5	4.0	2.3314E-06	10.857	141.9
5	5.0	2.1267E-06	10.004	135.5
6	2.0	1.4590E-06	38.648	145.9
6	2.5	1.4113E-06	34.393	139.3
6	3.0	1.3680E-06	31.343	134.2
6	4.0	1.2929E-06	27.194	126.8
6	5.0	1.2297E-06	24.452	121.5

4	0.5	9.9000E+01	999.000(1)	1518.6(2)
4	0.8	1.3917E-07	161.921(3)	969.1(2)
4	1.0	1.9419E-07	106.993(3)	786.0(2)
4	1.5	3.5134E-07	51.207	541.7(2)
4	2.0	5.2411E-07	32.491	419.6(2)
4	2.5	6.8916E-07	23.138	346.4(2)
4	3.0	8.4639E-07	17.629	297.5(2)
4	4.0	1.1405E-06	12.015	236.5(2)
4	5.0	1.4017E-06	9.068	199.9
4	7.0	1.7941E-06	6.197	158.0
4	10.0	2.1763E-06	4.329	126.6
4	12.0	2.3326E-06	3.673	114.4
4	15.0	2.4694E-06	3.059	102.2
4	20.0	2.5200E-06	2.506	90.0
5	2.0	3.0299E-06	14.205	164.9
5	2.5	2.7953E-06	12.997	156.9
5	3.0	2.6103E-06	12.107	150.8
5	4.0	2.3314E-06	10.857	141.9
5	5.0	2.1267E-06	10.004	135.5
6	2.0	1.4590E-06	38.648	145.9
6	2.5	1.4113E-06	34.393	139.3
6	3.0	1.3680E-06	31.343	134.2
6	4.0	1.2929E-06	27.194	126.8
6	5.0	1.2297E-06	24.452	121.5

PARTICULATE--NO. 1 POWER BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 1.20
PHYSICAL STACK HEIGHT (M) = 38.98
STACK GAS TEMP (DEG K) = 616.33
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 10.63
STACK DIAMETER (M) = 2.43
VOLUME FLOW (CU M/SEC) = 49.30

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	1.4181E-06	1.411	1118.1(2)
1	0.8	1.6744E-06	1.140	713.4(2)
1	1.0	1.8020E-06	1.033	578.5(2)
1	1.5	2.0363E-06	0.867	398.7(2)
1	2.0	2.1941E-06	0.767	308.8(2)
1	2.5	2.3043E-06	0.701	254.8(2)
1	3.0	2.3828E-06	0.652	218.8(2)
2	0.5	4.6992E-07	6.380	1118.1(2)
2	0.8	6.5928E-07	4.230	713.4(2)
2	1.0	7.6942E-07	3.491	578.5(2)
2	1.5	1.0044E-06	2.483	398.7(2)
2	2.0	1.1959E-06	1.967	308.8(2)
2	2.5	1.3544E-06	1.650	254.8(2)
2	3.0	1.4868E-06	1.436	218.8(2)
2	4.0	1.6931E-06	1.164	173.9
2	5.0	1.8395E-06	0.998	146.9
3	2.0	8.8624E-07	4.043	308.8(2)
3	2.5	1.0380E-06	3.274	254.8(2)
3	3.0	1.1701E-06	2.770	218.8(2)
3	4.0	1.3863E-06	2.153	173.9
3	5.0	1.5514E-06	1.790	146.9
3	7.0	1.7712E-06	1.383	116.1
3	10.0	1.9306E-06	1.084	92.9
3	12.0	1.9711E-06	0.969	83.9
3	15.0	1.9770E-06	0.856	74.9

4	0.5	3.8150E-08	215.064(3)	1118.1(2)
4	0.8	7.8597E-08	88.353	713.4(2)
4	1.0	1.1039E-07	58.320	578.5(2)
4	1.5	2.0050E-07	29.792	398.7(2)
4	2.0	2.8890E-07	18.816	308.8(2)
4	2.5	3.7717E-07	13.607	254.8(2)
4	3.0	4.6343E-07	10.554	218.8(2)
4	4.0	6.1897E-07	7.236	173.9
4	5.0	7.5246E-07	5.507	146.9
4	7.0	9.6443E-07	3.760	116.1
4	10.0	1.1655E-06	2.636	92.9
4	12.0	1.2406E-06	2.249	83.9
4	15.0	1.3036E-06	1.885	74.9
4	20.0	1.3301E-06	1.545	66.0
5	2.0	1.4001E-06	9.685	133.1
5	2.5	1.3003E-06	8.825	126.3
5	3.0	1.2210E-06	8.192	121.2
5	4.0	1.1003E-06	7.305	113.7
5	5.0	1.0109E-06	6.701	108.3
6	2.0	8.9530E-07	22.264	117.1
6	2.5	8.7471E-07	19.691	111.5
6	3.0	8.5499E-07	17.854	107.2
6	4.0	8.1892E-07	15.363	101.0
6	5.0	7.6178E-07	13.908	96.5

PARTICULATE--LIME KILN

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 2.23
PHYSICAL STACK HEIGHT (M) = 22.86
STACK GAS TEMP (DEG K) = 348.55
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.75
STACK DIAMETER (M) = 1.37
VOLUME FLOW (CU M/SEC) = 14.37

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	2.8124E-05	0.640	210.2(2)
1	0.8	3.1677E-05	0.517	140.0
1	1.0	3.3057E-05	0.469	116.5
1	1.5	3.5450E-05	0.384	85.3
1	2.0	3.6705E-05	0.331	69.7
1	2.5	3.7398E-05	0.292	60.3
1	3.0	3.7428E-05	0.265	54.1
2	0.5	1.7828E-05	1.385	210.2(2)
2	0.8	2.3324E-05	0.955	140.0
2	1.0	2.6017E-05	0.807	116.5
2	1.5	3.0560E-05	0.607	85.3
2	2.0	3.3116E-05	0.505	69.7
2	2.5	3.4585E-05	0.436	60.3
2	3.0	3.5266E-05	0.390	54.1
2	4.0	3.5475E-05	0.333	46.3
2	5.0	3.4831E-05	0.298	41.6
3	2.0	3.1852E-05	0.790	69.7
3	2.5	3.4001E-05	0.675	60.3
3	3.0	3.5249E-05	0.598	54.1
3	4.0	3.6111E-05	0.504	46.3
3	5.0	3.5768E-05	0.449	41.6
3	7.0	3.3661E-05	0.386	36.2
3	10.0	2.9805E-05	0.340	32.2
3	12.0	2.7433E-05	0.322	30.7
3	15.0	2.4366E-05	0.304	29.1

4	0.5	5.7245E-06	9.870	210.2(2)
4	0.8	9.8531E-06	5.092	140.0
4	1.0	1.2417E-05	3.786	116.5
4	1.5	1.7739E-05	2.307	85.3
4	2.0	2.1636E-05	1.683	69.7
4	2.5	2.4520E-05	1.345	60.3
4	3.0	2.6598E-05	1.135	54.1
4	4.0	2.8472E-05	0.923	46.3
4	5.0	2.8640E-05	0.822	41.6
4	7.0	2.7494E-05	0.708	36.2
4	10.0	2.4761E-05	0.624	32.2
4	12.0	2.2955E-05	0.591	30.7
4	15.0	2.0534E-05	0.556	29.1
4	20.0	1.7321E-05	0.519	27.5
5	2.0	1.8796E-05	2.806	64.8
5	2.5	1.6980E-05	2.603	61.8
5	3.0	1.5589E-05	2.452	59.5
5	4.0	1.3560E-05	2.238	56.2
5	5.0	1.2122E-05	2.090	53.8
6	2.0	1.7206E-05	4.733	57.7
6	2.5	1.5674E-05	4.328	55.2
6	3.0	1.4482E-05	4.031	53.3
6	4.0	1.2714E-05	3.617	50.5
6	5.0	1.1345E-05	3.390	48.5

PARTICULATE--HOG FUEL BOILER

ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED.
VERSION 75128, D. B. TURNER.

EMISSION RATE (G/SEC) = 3.00
PHYSICAL STACK HEIGHT (M) = 22.40
STACK GAS TEMP (DEG K) = 346.89
AMBIENT AIR TEMPERATURE (DEG K) = 293.
STACK GAS VEL (M/SEC) = 9.78
STACK DIAMETER (M) = 2.10
VOLUME FLOW (CU M/SEC) = 33.87

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HEIGHT (M)
1	0.5	1.6846E-05	0.839	372.0(2)
1	0.8	1.9491E-05	0.682	240.9(2)
1	1.0	2.0726E-05	0.620	197.2
1	1.5	2.2970E-05	0.515	138.9
1	2.0	2.4242E-05	0.454	109.8
1	2.5	2.5229E-05	0.407	92.3
1	3.0	2.6070E-05	0.369	80.7
2	0.5	8.5369E-06	2.332	372.0(2)
2	0.8	1.1711E-05	1.568	240.9(2)
2	1.0	1.3470E-05	1.306	197.2
2	1.5	1.6958E-05	0.948	138.9
2	2.0	1.9497E-05	0.765	109.8
2	2.5	2.1366E-05	0.653	92.3
2	3.0	2.2759E-05	0.577	80.7
2	4.0	2.4565E-05	0.478	66.1
2	5.0	2.5537E-05	0.414	57.4
3	2.0	1.7305E-05	1.302	109.8
3	2.5	1.9562E-05	1.076	92.3
3	3.0	2.1339E-05	0.928	80.7
3	4.0	2.3818E-05	0.746	66.1
3	5.0	2.5298E-05	0.638	57.4
3	7.0	2.6493E-05	0.517	47.4
3	10.0	2.6174E-05	0.429	39.9
3	12.0	2.5389E-05	0.395	37.0
3	15.0	2.3939E-05	0.361	34.1

4	0.5	1.7946E-06	26.307	372.0(2)
4	0.8	3.3995E-06	12.392	240.9(2)
4	1.0	4.5278E-06	8.874	197.2
4	1.5	7.1989E-06	5.032	138.9
4	2.0	9.6821E-06	3.438	109.8
4	2.5	1.1841E-05	2.609	92.3
4	3.0	1.3652E-05	2.114	80.7
4	4.0	1.6538E-05	1.550	66.1
4	5.0	1.8629E-05	1.243	57.4
4	7.0	2.0818E-05	0.947	47.4
4	10.0	2.1086E-05	0.786	39.9
4	12.0	2.0679E-05	0.724	37.0
4	15.0	1.9730E-05	0.662	34.1
4	20.0	1.7929E-05	0.601	31.1
5	2.0	1.5648E-05	3.787	77.8
5	2.5	1.4415E-05	3.464	73.8
5	3.0	1.3449E-05	3.226	70.8
5	4.0	1.1913E-05	2.910	66.3
5	5.0	1.0793E-05	2.695	63.2
6	2.0	1.4064E-05	6.669	68.3
6	2.5	1.3007E-05	6.036	65.0
6	3.0	1.2170E-05	5.573	62.5
6	4.0	1.0902E-05	4.932	58.9
6	5.0	9.9658E-06	4.499	56.2

BOISE CASCADE -WALLULA- SO2 CONCENTRATIONS

MULTIPLE SOURCE MODEL DBT51, VERSION 78010

* * * S O U R C E S * * *

NO	Q (G/SEC)	HP (M)	TS (DEG K)	VS (M/SEC)	D (M)	VF (M**3/SEC)	R (KM)	S (KM)
1	28.5	53.3	449.7	9.8	3.7	102.6	0.000	0.000
2	29.2	53.3	434.7	9.9	4.1	132.1	0.000	0.000
3	15.9	39.0	616.3	10.6	2.4	49.8	0.000	0.000

* * * R E C E P T O R S * * *

NO	RREC (KM)	SREC (KM)	Z (M)
1	0.000	0.100	0.0
2	0.000	0.200	0.0
3	0.000	0.300	0.0
4	0.000	0.400	0.0
5	0.000	0.500	0.0
6	0.000	0.600	0.0
7	0.000	0.700	0.0
8	0.000	0.800	0.0
9	0.000	0.900	0.0
10	0.000	1.000	0.0
11	0.000	1.100	0.0
12	0.000	1.200	0.0
13	0.000	1.300	0.0
14	0.000	1.400	0.0
15	0.000	1.500	0.0
16	0.000	1.600	0.0
17	0.000	1.700	0.0
18	0.000	1.800	0.0
19	0.000	1.900	0.0
20	0.000	2.000	0.0

* * * M E T E O R O L O G Y * * *

NO	THETA (DEG)	U (M/SEC)	KST	HL (M)	T (DEG K)
1	180.0	3.0	1	1000.	293.

HOUR # 1

* * * R E C E P T O R N U M B E R * * *

S	HFIN	PARTIAL CONCENTRATIONS (G/M**3) 1	2	3	4	5	6
1	272.	5.357E-16	1.889E-08	1.630E-06	1.170E-05	3.091E-05	4.562E-05
2	298.	7.341E-17	7.538E-09	9.507E-07	8.472E-06	2.572E-05	4.150E-05
3	220.	7.124E-12	3.439E-07	5.405E-06	1.766E-05	3.004E-05	3.439E-05

TOTAL CONCENTRATION (G/M**3)

7.125E-12	3.703E-07	7.986E-06	3.783E-05	8.667E-05	1.215E-04

HOUR # 1

```
* * * R E C E P T O R   N U M B E R * * *
              7          8          9         10         11         12

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  272.   4.533E-05 3.929E-05 3.307E-05 2.669E-05 2.146E-05 1.771E-05
 2  298.   4.312E-05 3.794E-05 3.206E-05 2.640E-05 2.151E-05 1.792E-05
 3  220.   3.050E-05 2.569E-05 2.031E-05 1.583E-05 1.244E-05 1.009E-05

            TOTAL CONCENTRATION (G/M**3)

           1.189E-04 1.029E-04 8.544E-05 6.892E-05 5.542E-05 4.572E-05
```

HOUR # 1

```
* * * R E C E P T O R   N U M B E R * * *
             13         14         15         16         17         18

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  272.   1.527E-05 1.376E-05 1.276E-05 1.201E-05 1.138E-05 1.083E-05
 2  298.   1.556E-05 1.407E-05 1.307E-05 1.231E-05 1.167E-05 1.110E-05
 3  220.   8.597E-06 7.695E-06 7.121E-06 6.699E-06 6.347E-06 6.036E-06

            TOTAL CONCENTRATION (G/M**3)

           3.943E-05 3.552E-05 3.295E-05 3.102E-05 2.940E-05 2.796E-05
```

HOUR # 1

```
* * * R E C E P T O R   N U M B E R * * *
             19         20

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  272.   1.033E-05 9.873E-06
 2  298.   1.058E-05 1.012E-05
 3  220.   5.757E-06 5.505E-06

            TOTAL CONCENTRATION (G/M**3)

           2.667E-05 2.550E-05
```

AVERAGE CONCENTRATIONS FOR 1 HOURS.

```
* * * R E C E P T O R   N U M B E R * * *
              1          2          3          4          5          6

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1          5.357E-16 1.889E-08 1.630E-06 1.170E-05 3.091E-05 4.562E-05
 2          7.341E-17 7.538E-09 9.507E-07 8.472E-06 2.572E-05 4.150E-05
 3          7.124E-12 3.439E-07 5.405E-06 1.766E-05 3.004E-05 3.439E-05

            TOTAL CONCENTRATION (G/M**3)

           7.125E-12 3.703E-07 7.986E-06 3.783E-05 8.667E-05 1.215E-04
```

* * * R E C E P T O R N U M B E R * * *

S	7	8	9	10	11	12
	PARTIAL CONCENTRATIONS (G/M**3)					
1	4.533E-05	3.929E-05	3.307E-05	2.669E-05	2.146E-05	1.771E-05
2	4.312E-05	3.794E-05	3.206E-05	2.640E-05	2.151E-05	1.792E-05
3	3.050E-05	2.569E-05	2.031E-05	1.583E-05	1.244E-05	1.009E-05
	TOTAL CONCENTRATION (G/M**3)					
	1.189E-04	1.029E-04	8.544E-05	6.892E-05	5.542E-05	4.572E-05

* * * R E C E P T O R N U M B E R * * *

S	13	14	15	16	17	18
	PARTIAL CONCENTRATIONS (G/M**3)					
1	1.527E-05	1.376E-05	1.276E-05	1.201E-05	1.138E-05	1.083E-05
2	1.556E-05	1.407E-05	1.307E-05	1.231E-05	1.167E-05	1.110E-05
3	8.597E-06	7.695E-06	7.121E-06	6.699E-06	6.347E-06	6.036E-06
	TOTAL CONCENTRATION (G/M**3)					
	3.943E-05	3.552E-05	3.295E-05	3.102E-05	2.940E-05	2.796E-05

* * * R E C E P T O R N U M B E R * * *

S	19	20
	PARTIAL CONCENTRATIONS (G/M**3)	
1	1.033E-05	9.873E-06
2	1.058E-05	1.012E-05
3	5.757E-06	5.505E-06
	TOTAL CONCENTRATION (G/M**3)	
	2.667E-05	2.550E-05

BOISE CASCADE -WALLULA- SO2 CONCENTRATIONS

MULTIPLE SOURCE MODEL DBT51, VERSION 78010

* * * S O U R C E S * * *

NO	Q (G/SEC)	HP (M)	TS (DEG K)	VS (M/SEC)	D (M)	VF (M**3/SEC)	R (KM)	S (KM)
1	28.5	53.3	449.7	9.8	3.7	102.6	0.000	0.000
2	29.2	53.3	434.7	9.9	4.1	132.1	0.000	0.000
3	15.9	39.0	616.3	10.6	2.4	49.8	0.000	0.000

* * * R E C E P T O R S * * *

NO	RREC (KM)	SREC (KM)	Z (M)
1	0.000	0.100	0.0
2	0.000	0.200	0.0
3	0.000	0.300	0.0
4	0.000	0.400	0.0
5	0.000	0.500	0.0
6	0.000	0.600	0.0
7	0.000	0.700	0.0
8	0.000	0.800	0.0
9	0.000	0.900	0.0
10	0.000	1.000	0.0
11	0.000	1.100	0.0
12	0.000	1.200	0.0
13	0.000	1.300	0.0
14	0.000	1.400	0.0
15	0.000	1.500	0.0
16	0.000	1.600	0.0
17	0.000	1.700	0.0
18	0.000	1.800	0.0
19	0.000	1.900	0.0
20	0.000	2.000	0.0

* * * M E T E O R O L O G Y * * *

NO	THETA (DEG)	U (M/SEC)	KST	HL (M)	T (DEG K)
1	180.0	10.0	3	1000.	293.

HOUR # 1

* * * R E C E P T O R N U M B E R * * *

S	HFIN	1	2	3	4	5	6
		PARTIAL CONCENTRATIONS (G/M**3)					
1	119.	6.512E-22	2.702E-10	1.142E-07	1.186E-06	3.682E-06	6.821E-06
2	127.	1.725E-22	1.388E-10	7.270E-08	8.397E-07	2.779E-06	5.376E-06
3	93.	2.165E-14	7.008E-08	1.908E-06	6.428E-06	1.105E-05	1.431E-05
		TOTAL CONCENTRATION (G/M**3)					
		2.165E-14	7.049E-08	2.095E-06	8.453E-06	1.751E-05	2.651E-05

HOUR # 1

* * * R E C E P T O R N U M B E R * * *

S	HFIN	7	8	9	10	11	12
		PARTIAL CONCENTRATIONS (G/M**3)					
1	119.	9.759E-06	1.260E-05	1.763E-05	2.174E-05	2.472E-05	2.664E-05
2	127.	7.932E-06	1.006E-05	1.327E-05	1.727E-05	2.046E-05	2.275E-05
3	93.	1.650E-05	2.097E-05	2.373E-05	2.507E-05	2.537E-05	2.500E-05
		TOTAL CONCENTRATION (G/M**3)					
		3.419E-05	4.363E-05	5.464E-05	6.408E-05	7.055E-05	7.438E-05

```
HOUR #  1
* * * R E C E P T O R   N U M B E R * * *
            13        14        15        16        17        18

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  119.   2.768E-05 2.804E-05 2.791E-05 2.743E-05 2.672E-05 2.585E-05
 2  127.   2.424E-05 2.505E-05 2.535E-05 2.525E-05 2.487E-05 2.429E-05
 3   93.   2.420E-05 2.316E-05 2.200E-05 2.081E-05 1.962E-05 1.847E-05

            TOTAL CONCENTRATION (G/M**3)

           7.611E-05 7.626E-05 7.526E-05 7.349E-05 7.120E-05 6.861E-05

HOUR #  1
* * * R E C E P T O R   N U M B E R * * *
            19        20

 S  HFIN    PARTIAL CONCENTRATIONS (G/M**3)

 1  119.   2.489E-05 2.389E-05
 2  127.   2.358E-05 2.280E-05
 3   93.   1.738E-05 1.635E-05

            TOTAL CONCENTRATION (G/M**3)

           6.585E-05 6.303E-05


AVERAGE CONCENTRATIONS FOR  1 HOURS.
* * * R E C E P T O R   N U M B E R * * *
             1         2         3         4         5         6

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1         6.512E-22 2.702E-10 1.142E-07 1.186E-06 3.682E-06 6.821E-06
 2         1.725E-22 1.388E-10 7.270E-08 8.397E-07 2.779E-06 5.376E-06
 3         2.165E-14 7.008E-08 1.908E-06 6.428E-06 1.105E-05 1.431E-05

            TOTAL CONCENTRATION (G/M**3)

           2.165E-14 7.049E-08 2.095E-06 8.453E-06 1.751E-05 2.651E-05
```

```
* * * R E C E P T O R   N U M B E R * * *
            7          8          9         10         11         12

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1         9.759E-06 1.260E-05 1.763E-05 2.174E-05 2.472E-05 2.664E-05
 2         7.932E-06 1.006E-05 1.327E-05 1.727E-05 2.046E-05 2.275E-05
 3         1.650E-05 2.097E-05 2.373E-05 2.507E-05 2.537E-05 2.500E-05

            TOTAL CONCENTRATION (G/M**3)

           3.419E-05 4.363E-05 5.464E-05 6.408E-05 7.055E-05 7.438E-05
* * * R E C E P T O R   N U M B E R * * *
           13         14         15         16         17         18

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1         2.768E-05 2.804E-05 2.791E-05 2.743E-05 2.672E-05 2.585E-05
 2         2.424E-05 2.505E-05 2.535E-05 2.525E-05 2.487E-05 2.429E-05
 3         2.420E-05 2.316E-05 2.200E-05 2.081E-05 1.962E-05 1.847E-05

            TOTAL CONCENTRATION (G/M**3)

           7.611E-05 7.626E-05 7.526E-05 7.349E-05 7.120E-05 6.861E-05
* * * R E C E P T O R   N U M B E R * * *
           19         20

 S          PARTIAL CONCENTRATIONS (G/M**3)

 1         2.489E-05 2.389E-05
 2         2.358E-05 2.280E-05
 3         1.738E-05 1.635E-05

            TOTAL CONCENTRATION (G/M**3)

           6.585E-05 6.303E-05
```

APPENDIX D: SOURCE PARAMETERS

ED_013256A_00000458-00155

Table D-1a. Point Source Parameters

Stack ID	Source Type	Description	Stack Location (NAD83) UTM East (m)	UTM North (m)	Elevation (m)	Height (m)	Temperature (K)	Velocity (m/s)	Diameter (m)	Flow Rate (acfm)
RF2	POINT	No. 2 Recovery Furnace	351,654.2	5,107,466.2	107.81	61.10	436.48	6.49	2.72	79,933.46
RF3	POINT	No. 3 Recovery Furnace	351,617.4	5,107,449.4	107.67	58.10	464.82	13.94	3.96	363,776.33
SDT2	POINT	No. 2 Smelt Dissolving Tank	351,635.7	5,107,433.2	107.67	51.40	342.59	8.13	1.01	13,799.93
SDT3PRE	POINT	No. 3 Smelt Dissolving Tank - Pre Project	351,630.9	5,107,451.7	107.65	51.27	336.72	11.44	1.65	51,831.79
SDT3PST	POINT	No. 3 Smelt Dissolving Tank - Post Project	351,630.9	5,107,451.7	107.65	55.05	336.72	11.44	1.65	51831.79
LK	POINT	Lime Kiln	351,799.8	5,107,350.6	107.87	32.99	337.04	4.44	1.83	24,744.21
743_3632	POINT	No. 3 Paper Machine Roof Vent	351645.19	5107212.52	106.83	24.54	313.15	6.35	1.83	35,370
743_3633	POINT	No. 3 Paper Machine Roof Vent	351663.69	5107241.47	106.83	26.03	346.48	30.48	1.34	91,000
743_3634	POINT	No. 3 Paper Machine Roof Vent	351656.66	5107250.65	106.83	26.22	318.15	30.48	1.42	102,130
743_3635	POINT	No. 3 Paper Machine Roof Vent	351650.89	5107257.29	106.83	24.54	323.15	5.87	1.83	32,650
743_3636	POINT	No. 3 Paper Machine Roof Vent	351642.93	5107270.21	106.83	26.22	327.59	30.48	1.42	102,130
743_3637	POINT	No. 3 Paper Machine Roof Vent	351635.19	5107281.95	106.83	26.15	352.04	25.40	1.42	85,100
743_3638	POINT	No. 3 Paper Machine Roof Vent	351630.47	5107288.32	106.83	26.22	319.26	33.02	1.42	110,640
743_3639	POINT	No. 3 Paper Machine Roof Vent	351625.40	5107295.56	106.83	26.22	326.48	33.02	1.42	110,640
743_3640	POINT	No. 3 Paper Machine Roof Vent	351618.90	5107303.36	106.83	24.54	310.93	5.38	1.83	29,930
743_3641	POINT	No. 3 Paper Machine Roof Vent	351615.58	5107308.10	106.83	24.54	307.59	5.38	1.83	29,930
743_3642	POINT	No. 3 Paper Machine Roof Vent	351611.40	5107317.57	106.83	26.31	307.04	10.16	1.35	30,630
743_3643	POINT	No. 3 Paper Machine Roof Vent	351608.59	5107318.09	106.83	24.54	302.59	5.87	1.83	32,650
743_3644	POINT	No. 3 Paper Machine Roof Vent	351598.32	5107340.78	106.83	24.54	308.71	5.87	1.83	32,650
743_3649	POINT	No. 3 Paper Machine Roof Vent	351650.12	5107263.19	106.83	25.48	307.04	10.16	0.71	8,550
743_3650	POINT	No. 3 Paper Machine Roof Vent	351652.83	5107263.30	106.83	24.81	304.26	10.16	1.05	18,670
743_3656	POINT	No. 3 Paper Machine Roof Vent	351568.98	5107337.72	106.83	19.20	308.15	0.001	0.97	1,800
743_3661	POINT	No. 3 Paper Machine Roof Vent	351629.47	5107305.70	106.83	19.81	322.04	0.001	0.56	10,660
743_3666	POINT	No. 3 Paper Machine Roof Vent	351597.92	5107348.35	106.83	20.48	310.93	0.001	0.41	560

[1] Temperature and exhaust velocity for RF2, RF3, SDT2, SDT3, and LK correspond to stack test data with the maximum flow rate from the last five years.

[2] Stack parameters for Paper Machine #3 building roof vents are based on 1994 site survey.

Table D-1b. Point Source Parameters (unaffected; for Tier 2 NO_2 Analysis)

Stack ID	Source Type	Description	Stack Location (NAD83) UTM East (m)	UTM North (m)	Elevation (m)	Height (m)	Temperature (K)	Velocity (m/s)	Diameter (m)
HFB	POINT	Hog Fuel Boiler	351644.4	5107496.8	107.86	35.27	333.58	8.48	2.96
PB1	POINT	No. 1 Power Boiler	351669.5	5107415.6	107.49	35.84	449.82	11.09	2.44
PB2	POINT	No. 2 Power Boiler	351681.3	5107396.9	107.42	30.18	413.15	10.30	1.68

[1] HFB temperature and exhaust velocity are the average from stack tests conducted for the last five years. HFB height and diameter obtained from 2008 modeling project.

[2] PB1 and PB2 stack parameters obtained from 2008 modeling project.

Table D-2a. Pre-Project NO_x Annual SIL Model Emission Rates

Emission Unit	Model ID	Emission Rate [1] (g/s)
No. 2 Recovery Boiler	RF2	2.092E+00
No. 3 Recovery Boiler	RF3	8.606E+00
Lime Kiln	LK	1.501E+00
Hog Fuel Boiler	HFB	9.139E+00
Power Boiler 1	PB1	8.619E-01
Power Boiler 2	PB2	8.920E-01

[1] Emission rates are calculated using the baseline emissions shown in the PSD applicability calculations.

Table D-2b. Post-Project NO_x Annual SIL Model Emission Rates

Emission Unit	Model ID	Emission Rate (g/s)
No. 2 Recovery Boiler [2]	RF2	2.092E+00
No. 3 Recovery Boiler	RF3	9.535E+00
Lime Kiln	LK	1.902E+00
Hog Fuel Boiler	HFB	9.139E+00
Power Boiler 1	PB1	8.619E-01
Power Boiler 2	PB2	8.920E-01

[1] Emission rates are calculated using the projected maximum emissions provided in the PSD applicability calculations.

[2] The No. 2 Recovery Boiler has a net decrease in NO_x emissions; therefore, an emission increase is not modeled. However, the average emission rate during the baseline is modeled for the use of PVMRM.

Table D-2c. PM_{10} Emission Rate Increases for 24-hour SIL Model

Emission Unit	Model ID	Emission Rate [1] (g/s)
Paper Machine 3 [2]	W3	2.586E-02

[1] Emission rate is calculated based on the maximum 24-hour paper machine throughput and the emission factor used in the PSD applicability calculations. The baseline emissions from the PSD applicability calculations, conservatively converted to a short-term emission rate assuming 8760 hr/yr operation, are subtracted to get a modeled emission increase.

[2] The emission rate for Paper Machine 3 represents the total emission rate from the paper machine. This emission rate is divided proportionally among roof vents based on the flow rate of each roof vent in the model.

Table D-2d. PM_{10} and $PM_{2.5}$ Emission Rate Increases for Annual SIL Model [1,2]

Emission Unit	Model ID	PM_{10} Emission Rate (g/s)	$PM_{2.5}$ Emission Rate (g/s)
No. 2 Recovery Furnace	RF2	0.000E+00	3.279E-03
No. 3 Recovery Furance	RF3	1.826E-01	1.573E-01
No. 2 Smelt Dissolving Tank	SDT2	3.704E-02	2.727E-02
No. 3 Smelt Dissolving Tank (Pre-Project)	SDT3PRE	8.803E-01	6.573E-01
No. 3 Smelt Dissolving Tank (Post-Project)	SDT3PST	1.202E+00	8.944E-01
Lime Kiln	LK	0.000E+00	0.000E+00
Paper Machine 3 [3]	W3	2.586E-02	0.000E+00

[1] PM_{10} and $PM_{2.5}$ emission rates for fugitive emission sources are provided in later tables of this appendix.

[2] The annual emission rates of unmodified units are calculated as the difference between the baseline and projected maximum emissions in the PSD applicability calculations.

[3] For the modified unit (only Paper Machine 3), the annual emission rate is calculated as the future short-term allowable emission rate, assuming continuous operation, minus the baseline annual emission rate (this difference is equal to the short term emission rate increase).
The emission rate for Paper Machine 3 represents the total emission rate from the paper machine. This emission rate is divided proportionally among roof vents based on the flow rate of each roof vent in the model.

Table D-3. No. 3 Paper Machine PM_{10} Emission Rates

Stack ID	Source Type	Description	Stack Location (NAD83) UTM East (m)	UTM North (m)	Elevation (m)	Flow Rate (acfm)	Annual PM_{10} (g/s)	24-Hour PM_{10} (g/s)
743_3632	POINT	No. 3 Paper Machine Roof Vent	351645.19	5107212.52	106.83	35,370	1.057E-03	1.057E-03
743_3633	POINT	No. 3 Paper Machine Roof Vent	351663.69	5107241.47	106.83	91,000	2.718E-03	2.718E-03
743_3634	POINT	No. 3 Paper Machine Roof Vent	351656.66	5107250.65	106.83	102,130	3.051E-03	3.051E-03
743_3635	POINT	No. 3 Paper Machine Roof Vent	351650.89	5107257.29	106.83	32,650	9.754E-04	9.754E-04
743_3636	POINT	No. 3 Paper Machine Roof Vent	351642.93	5107270.21	106.83	102,130	3.051E-03	3.051E-03
743_3637	POINT	No. 3 Paper Machine Roof Vent	351635.19	5107281.95	106.83	85,100	2.542E-03	2.542E-03
743_3638	POINT	No. 3 Paper Machine Roof Vent	351630.47	5107288.32	106.83	110,640	3.305E-03	3.305E-03
743_3639	POINT	No. 3 Paper Machine Roof Vent	351625.40	5107295.56	106.83	110,640	3.305E-03	3.305E-03
743_3640	POINT	No. 3 Paper Machine Roof Vent	351618.90	5107303.36	106.83	29,930	8.941E-04	8.941E-04
743_3641	POINT	No. 3 Paper Machine Roof Vent	351615.58	5107308.10	106.83	29,930	8.941E-04	8.941E-04
743_3642	POINT	No. 3 Paper Machine Roof Vent	351611.40	5107317.57	106.83	30,630	9.150E-04	9.150E-04
743_3643	POINT	No. 3 Paper Machine Roof Vent	351608.59	5107318.09	106.83	32,650	9.754E-04	9.754E-04
743_3644	POINT	No. 3 Paper Machine Roof Vent	351598.32	5107340.78	106.83	32,650	9.754E-04	9.754E-04
743_3649	POINT	No. 3 Paper Machine Roof Vent	351650.12	5107263.19	106.83	8,550	2.554E-04	2.554E-04
743_3650	POINT	No. 3 Paper Machine Roof Vent	351652.83	5107263.30	106.83	18,670	5.577E-04	5.577E-04
743_3656	POINT	No. 3 Paper Machine Roof Vent	351568.98	5107337.72	106.83	1,800	5.377E-05	5.377E-05
743_3661	POINT	No. 3 Paper Machine Roof Vent	351629.47	5107305.70	106.83	10,660	3.185E-04	3.185E-04
743_3666	POINT	No. 3 Paper Machine Roof Vent	351597.92	5107348.35	106.83	560	1.673E-05	1.673E-05

[1] Temperature and exhaust velocity for RF2, RF3, SDT2, SDT3, and LK correspond to stack test data with the maximum flow rate from the last five years.

[2] Stack parameters for Paper Machine #3 building roof vents are based on 1994 site survey.

Table D-4a. SIL Modeling Pile Size Information

Pile Name	Pile ID	Associated Emission Increase?	Actual Exposed Area [1] (ft^2)	Actual Pile Height [1] (ft)	Actual Radius [1] (ft)
Kamyr Chip Pile (softwood)	SW_Pile	Yes	132,756	47	203
M&D Sawdust Pile	SD_Pile2	Yes	54,835	41	129

[1] The parameters for piles are provided by PCA on 11/1/2017. The size of the piles is smaller than the size reported in the Annual Emission Inventories (which is more conservative in terms of modeling). Exposed areas for piles with associated emission increase will be doubled based on PCA's projection. After the completion of the project, sawdust will also be stocked at where the current hardwood pile is. Therefore, for SIL modeling, the emission increase for sawdust pile will be from the new sawdust pile only (SD_Pile2). The new sawdust pile is assumed to have the same footprint as the existing pile based on PCA's projection that the post-project amount of sawdust will be doubled.

Table D-4b. SIL Modeling Pile Model Parameters

Pile ID	Actual Radius (m)	Footprint Area [1] (m^2)	Center UTM (m) X	Center UTM (m) Y	Release Height [2] (m)	Initial Vertical Dimension [3] (m)	Elevation [4] (m)	PM_{10} Emission Increase [5] (tpy)	PM_{10} Emission Increase [5] Annual ($g/s\text{-}m^2$)	PM_{10} Emission Increase [5] 24-hour ($g/s\text{-}m^2$)	$PM_{2.5}$ Emission Increase [5] (tpy)	$PM_{2.5}$ Emission Increase [5] Annual ($g/s\text{-}m^2$)	$PM_{2.5}$ Emission Increase [5] 24-hour ($g/s\text{-}m^2$)
SW_Pile	NA	22580.45	351388.4	5107608	7.21	0	107.29	0.04	5.145E-08	5.145E-08	0.02	2.058E-08	2.058E-08
SD_Pile2	39.33	4,859.40	351471.9	5107668	6.22	0	107.61	0.12	7.099E-07	7.099E-07	0.05	2.840E-07	2.840E-07

[1] For SIL modeling, the new sawdust pile is modeled assuming the new pile will have the same size as the existing sawdust pile. The softwood pile is modeled as a polygon area source due to the irregular shaped footprint. The area of the footprint is approximately twice the size of the current footprint.

[2] According to Section 5.2.7 of "Modeling Fugitive Dust Sources with AERMOD" published by the National Stone, Sand and Gravel Association (NSSGA), release height for each pile is determined to be half of the average height. This assumption takes into considerations that wind speed increases with elevation and leads to greater erosion, and the surface area above a certain height decreases as the give height increases. Therefore, half of the pile height is representative of release height. It is conservatively assumed that the pile height will not increase.

[3] Per AERMOD User's Guide Section 3.3.2.4, the passive emissions from area sources such as wind erosion can omit the input for initial vertical dimension (i.e., initial vertical dimension is zero).

[4] Elevation of the Sawdust Pile is obtained from AERMAP output. Elevation for the Softwood Pile is assumed to be at 352 ft based on Google Earth (which is also consistent with the elevations of the drop points near the pile).

[5] Storage pile wind erosion emissions are unrelated to the number of days of operation. Therefore, storage pile emissions are calculated assuming 365 days of operation per year, and the 24-hour emission rate equals the annual emission rate.

Table D-5a. Chipping Trucks Volume Sources and Annual Emission Rates

Truck Width	2.44	m, provided by PCA on 11/13/2017
Truck Height	2.90	m, provided by PCA on 11/13/2017

ID	Segment	UTM NAD83 10N Easting (m)	UTM NAD83 10N Northing (m)	Elevation (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)	PM_{10} Emission Increase (tpy)	PM_{10} Emission Increase Annual (g/s)	$PM_{2.5}$ Emission Increase (tpy)	$PM_{2.5}$ Emission Increase Annual (g/s)
NA9VO002	Chipping	351,256.6	5,108,765.6	112.05	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO003	Chipping	351,250.9	5,108,759.4	111.76	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO004	Chipping	351,245.2	5,108,753.2	111.34	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO005	Chipping	351,241.8	5,108,746.1	111.03	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO006	Chipping	351,241.8	5,108,737.6	110.62	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO007	Chipping	351,246.0	5,108,730.6	110.07	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO008	Chipping	351,251.0	5,108,723.8	109.77	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO009	Chipping	351,256.0	5,108,717.0	109.65	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00A	Chipping	351,261.1	5,108,710.3	109.58	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00B	Chipping	351,266.1	5,108,703.5	109.44	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00C	Chipping	351,271.1	5,108,696.7	109.26	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00D	Chipping	351,276.2	5,108,689.9	108.98	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00E	Chipping	351,281.2	5,108,683.2	108.9	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00F	Chipping	351,286.3	5,108,676.4	108.82	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00G	Chipping	351,291.3	5,108,669.6	108.81	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00H	Chipping	351,296.3	5,108,662.8	109	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00I	Chipping	351,301.4	5,108,656.1	109.03	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00J	Chipping	351,306.4	5,108,649.3	108.96	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00K	Chipping	351,311.4	5,108,642.5	108.69	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00L	Chipping	351,316.5	5,108,635.7	108.43	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00M	Chipping	351,321.5	5,108,629.0	108.64	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00N	Chipping	351,326.5	5,108,622.2	108.3	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00O	Chipping	351,331.6	5,108,615.4	108.33	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00P	Chipping	351,336.6	5,108,608.6	108.27	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00Q	Chipping	351,341.6	5,108,601.9	108.28	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00R	Chipping	351,346.7	5,108,595.1	108.29	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00S	Chipping	351,351.7	5,108,588.3	108.21	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00T	Chipping	351,356.7	5,108,581.5	108.15	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00U	Chipping	351,361.8	5,108,574.8	108.14	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00V	Chipping	351,366.8	5,108,568.0	108.08	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00W	Chipping	351,371.8	5,108,561.2	108.16	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00X	Chipping	351,376.9	5,108,554.4	108.23	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00Y	Chipping	351,381.9	5,108,547.7	108.28	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO00Z	Chipping	351,386.9	5,108,540.9	108.36	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO010	Chipping	351,392.0	5,108,534.1	108.39	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO011	Chipping	351,397.0	5,108,527.3	108.45	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01O	Chipping	351,505.8	5,108,366.7	111.84	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01P	Chipping	351,507.1	5,108,359.0	111.92	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01Q	Chipping	351,505.8	5,108,350.6	112.04	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01R	Chipping	351,504.4	5,108,342.3	111.84	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01S	Chipping	351,503.1	5,108,334.0	111.55	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01T	Chipping	351,501.8	5,108,325.6	111.31	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01U	Chipping	351,500.4	5,108,317.3	111.1	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01V	Chipping	351,499.1	5,108,309.0	110.91	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01W	Chipping	351,497.7	5,108,300.6	110.75	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01X	Chipping	351,499.4	5,108,292.4	110.57	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01Y	Chipping	351,501.3	5,108,284.2	110.38	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO01Z	Chipping	351,503.2	5,108,276.0	110.18	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO020	Chipping	351,505.1	5,108,267.7	110.01	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO021	Chipping	351,507.0	5,108,259.5	109.84	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO022	Chipping	351,508.9	5,108,251.3	109.68	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO023	Chipping	351,510.9	5,108,243.1	109.47	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO024	Chipping	351,512.6	5,108,234.8	109.31	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO025	Chipping	351,513.4	5,108,226.4	109.26	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9VO026	Chipping	351,514.2	5,108,218.0	109.27	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06

Table D-5a. Chipping Trucks Volume Sources and Annual Emission Rates

Truck Width	2.44 m, provided by PCA on 11/13/2017
Truck Height	2.90 m, provided by PCA on 11/13/2017

ID	Segment	UTM NAD83 10N Easting (m)	UTM NAD83 10N Northing (m)	Elevation (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)	PM_{10} Emission Increase (tpy)	PM_{10} Emission Increase Annual (g/s)	$PM_{2.5}$ Emission Increase (tpy)	$PM_{2.5}$ Emission Increase Annual (g/s)
NA9V0027	Chipping	351,515.1	5,108,209.6	109.28	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0028	Chipping	351,515.9	5,108,201.2	109.28	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0029	Chipping	351,516.7	5,108,192.8	109.28	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002A	Chipping	351,517.5	5,108,184.4	109.27	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002B	Chipping	351,518.4	5,108,176.0	109.27	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002C	Chipping	351,519.2	5,108,167.6	109.3	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002D	Chipping	351,520.0	5,108,159.2	109.32	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002E	Chipping	351,520.9	5,108,150.8	109.33	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002F	Chipping	351,521.7	5,108,142.4	109.31	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002G	Chipping	351,522.5	5,108,134.0	109.25	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002H	Chipping	351,523.4	5,108,125.6	109.13	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002I	Chipping	351,524.2	5,108,117.2	109	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002J	Chipping	351,525.0	5,108,108.8	108.87	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002K	Chipping	351,525.3	5,108,100.5	108.68	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002L	Chipping	351,522.9	5,108,092.4	108.49	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002M	Chipping	351,520.5	5,108,084.3	108.35	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002N	Chipping	351,518.1	5,108,076.2	108.21	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002O	Chipping	351,515.8	5,108,068.1	108.09	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002P	Chipping	351,513.4	5,108,060.0	108	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002Q	Chipping	351,511.0	5,108,051.9	107.95	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002R	Chipping	351,508.6	5,108,043.8	107.9	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002U	Chipping	351,500.0	5,108,020.1	107.93	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002V	Chipping	351,496.0	5,108,012.7	108.01	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002W	Chipping	351,492.0	5,108,005.3	108.17	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002X	Chipping	351,488.0	5,107,997.9	108.39	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002Y	Chipping	351,483.6	5,107,990.7	108.62	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V002Z	Chipping	351,476.2	5,107,986.7	109.14	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0030	Chipping	351,468.8	5,107,982.6	109.17	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0031	Chipping	351,461.4	5,107,978.6	109.43	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0032	Chipping	351,454.0	5,107,974.5	109.45	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0033	Chipping	351,446.6	5,107,970.5	109.49	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0034	Chipping	351,439.2	5,107,966.4	109.32	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0035	Chipping	351,436.8	5,107,960.4	109.28	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0036	Chipping	351,439.5	5,107,952.4	109.25	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0037	Chipping	351,442.2	5,107,944.4	109.09	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0038	Chipping	351,444.8	5,107,936.4	109.03	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0039	Chipping	351,447.5	5,107,928.4	108.93	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003A	Chipping	351,450.2	5,107,920.4	108.74	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003B	Chipping	351,452.9	5,107,912.4	108.96	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003C	Chipping	351,455.5	5,107,904.4	108.98	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003D	Chipping	351,458.2	5,107,896.4	108.96	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003E	Chipping	351,460.9	5,107,888.4	109.03	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003F	Chipping	351,463.5	5,107,880.3	108.88	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003G	Chipping	351,466.2	5,107,872.3	108.89	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003H	Chipping	351,468.9	5,107,864.3	108.79	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003I	Chipping	351,471.5	5,107,856.3	108.64	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003J	Chipping	351,474.2	5,107,848.3	108.68	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003K	Chipping	351,476.9	5,107,840.3	108.52	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003L	Chipping	351,479.6	5,107,832.3	108.48	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003M	Chipping	351,482.2	5,107,824.3	108.37	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003N	Chipping	351,484.9	5,107,816.3	108.28	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003O	Chipping	351,487.6	5,107,808.3	108.27	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003P	Chipping	351,490.2	5,107,800.3	108.17	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003Q	Chipping	351,492.9	5,107,792.3	108.11	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003R	Chipping	351,495.6	5,107,784.3	108.04	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06

Table D-5a. Chipping Trucks Volume Sources and Annual Emission Rates

Truck Width	2.44 m, provided by PCA on 11/13/2017
Truck Height	2.90 m, provided by PCA on 11/13/2017

ID	Segment	UTM NAD83 10N Easting (m)	UTM NAD83 10N Northing (m)	Elevation (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)	PM_{10} Emission Increase (tpy)	PM_{10} Emission Increase Annual (g/s)	$PM_{2.5}$ Emission Increase (tpy)	$PM_{2.5}$ Emission Increase Annual (g/s)
NA9V003S	Chipping	351,498.2	5,107,776.3	108.01	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003T	Chipping	351,493.5	5,107,772.5	107.94	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003U	Chipping	351,485.2	5,107,770.7	107.79	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003V	Chipping	351,477.0	5,107,769.0	107.69	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003W	Chipping	351,468.7	5,107,767.2	107.57	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003X	Chipping	351,460.5	5,107,765.5	107.41	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003Y	Chipping	351,452.2	5,107,763.7	107.23	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V003Z	Chipping	351,444.0	5,107,761.9	107.1	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0040	Chipping	351,435.7	5,107,760.2	106.96	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0041	Chipping	351,427.5	5,107,758.4	106.9	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0042	Chipping	351,419.2	5,107,756.6	106.82	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0043	Chipping	351,410.9	5,107,754.9	106.74	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0044	Chipping	351,402.7	5,107,753.1	106.73	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0045	Chipping	351,394.4	5,107,751.4	106.76	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0046	Chipping	351,386.2	5,107,749.6	106.84	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0047	Chipping	351,377.9	5,107,747.8	106.98	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0048	Chipping	351,369.7	5,107,746.1	107.02	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V0049	Chipping	351,364.1	5,107,740.4	107	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004A	Chipping	351,359.6	5,107,733.3	106.91	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004B	Chipping	351,359.0	5,107,726.1	106.86	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004C	Chipping	351,363.3	5,107,718.8	106.9	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004D	Chipping	351,367.5	5,107,711.5	106.96	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004E	Chipping	351,371.8	5,107,704.2	106.94	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004F	Chipping	351,376.0	5,107,696.9	107	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004G	Chipping	351,380.3	5,107,689.6	107.04	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004H	Chipping	351,384.6	5,107,682.3	107.08	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004I	Chipping	351,389.0	5,107,675.2	107.13	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004J	Chipping	351,394.4	5,107,668.7	107.16	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004K	Chipping	351,399.9	5,107,662.3	107.12	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004L	Chipping	351,405.3	5,107,655.8	107.17	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004M	Chipping	351,410.8	5,107,649.4	107.21	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004N	Chipping	351,416.2	5,107,643.0	107.23	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004O	Chipping	351,421.7	5,107,636.5	107.22	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004P	Chipping	351,427.1	5,107,630.1	107.23	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004Q	Chipping	351,432.6	5,107,623.6	107.25	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004R	Chipping	351,438.0	5,107,617.2	107.29	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004S	Chipping	351,443.5	5,107,610.7	107.34	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004T	Chipping	351,448.9	5,107,604.3	107.41	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004U	Chipping	351,454.4	5,107,597.8	107.4	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004V	Chipping	351,459.8	5,107,591.4	107.39	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004W	Chipping	351,465.3	5,107,584.9	107.41	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004X	Chipping	351,470.7	5,107,578.5	107.41	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06
NA9V004Y	Chipping	351,476.2	5,107,572.1	107.38	2.46	3.92	2.29	2.750E-04	7.910E-06	6.749E-05	1.942E-06

Note: all truck routes are conservatively assumed to be one-lane roads. Adjacent volume sources are used to represent the emissions from the roadways, as recommended in *Haul Road Workgroup Final Report Submission to EPA-OAQPS Memo* by Tyler Fox on March 2, 2012. The release height for each volume source is half of the top of plume height. The top of plume height is the dominant type of truck height times 1.7. Width of plume is vehicle width plus 6 m for single lane roadways since it's not expected that there will be heavy traffic from both directions on mill roads.

Elevations are determined by AERMAP.

Table D-5b. Chipping Trucks Area Sources and Annual Emission Rates

ID	Segment	UTM NAD83 11N Easting (m)	Northing (m)	Elevation (m)	Release Height (m)	Width (m)	Length (m)	Initial Vertical Dimension (m)	Number of Volume Sources Replaced	Area (m^2)	PM_{10} Emission Increase (tpy)	Annual ($g/s\text{-}m^2$)	$PM_{2.5}$ Emission Increase (tpy)	Annual ($g/s\text{-}m^2$)
CPArea1	Chipping	351,396.0	5,108,521.8	108.46	2.46	8.44	185	2.29	22	1561.4	6.049E-03	1.115E-07	1.485E-03	2.736E-08
CPArea2	Chipping	351,502.9	5,108,040.5	108	2.46	8.44	15.6	2.29	2	131.7	5.499E-04	1.201E-07	1.350E-04	2.948E-08

The areas that are in the volume sources' exclusion zone are modeled as area sources versus volume sources, as recommended in *Haul Road Workgroup Final Report Submission to EPA-OAQPS Memo* by Tyler Fox on March 2, 2012. The release height for each area source is half of the top of plume height. The top of plume height is the dominant type of truck height times 1.7. Width of plume is vehicle width plus 6 m for single lane roadways since it's not expected that there will be heavy traffic from both directions on mill roads.

Area of these area sources are copied from AERMOD. Elevations are determined by AERMAP.

Table D-5c. Freight Trucks Volume Sources and Annual Emission Rates

Truck Width	2.59 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017										
Truck Height	4.11 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017										
		UTM NAD83 10N			Release Height	Initial Lateral	Initial Vertical	PM_{10} Emission Increase		$PM_{2.5}$ Emission Increase	
ID	Segment	Easting (m)	Northing (m)	Elevation (m)	(m)	Dimension (m)	Dimension (m)	(tpy)	Annual (g/s)	(tpy)	Annual (g/s)
EDHTY079	Freight	351,580.0	5,107,255.6	106.76	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07A	Freight	351,574.5	5,107,262.2	106.9	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07B	Freight	351,569.0	5,107,268.7	107.03	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07C	Freight	351,563.5	5,107,275.3	107.21	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07D	Freight	351,557.9	5,107,281.9	107.32	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07E	Freight	351,551.7	5,107,283.5	107.35	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07F	Freight	351,544.6	5,107,278.7	107.34	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07G	Freight	351,537.4	5,107,273.9	107.36	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07H	Freight	351,530.3	5,107,269.1	107.32	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07I	Freight	351,523.2	5,107,264.3	107.15	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07J	Freight	351,516.1	5,107,259.6	107.17	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07K	Freight	351,508.9	5,107,254.8	107.1	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07L	Freight	351,510.2	5,107,248.6	107.1	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07M	Freight	351,515.4	5,107,241.8	107.18	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07N	Freight	351,520.7	5,107,235.1	107.25	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07O	Freight	351,526.0	5,107,228.3	107.33	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07P	Freight	351,531.2	5,107,221.5	107.36	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07Q	Freight	351,536.5	5,107,214.7	107.34	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07R	Freight	351,541.8	5,107,207.9	107.26	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07S	Freight	351,547.1	5,107,201.2	107.27	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07T	Freight	351,552.3	5,107,194.4	107.25	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07U	Freight	351,557.6	5,107,187.6	107.22	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07V	Freight	351,562.9	5,107,180.8	107.22	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07W	Freight	351,568.1	5,107,174.0	107.22	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07X	Freight	351,573.4	5,107,167.2	107.24	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07Y	Freight	351,578.7	5,107,160.5	107.27	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY07Z	Freight	351,584.0	5,107,153.7	107.28	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY080	Freight	351,589.2	5,107,146.9	107.24	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY081	Freight	351,594.5	5,107,140.1	107.29	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY082	Freight	351,599.8	5,107,133.3	107.25	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY083	Freight	351,605.2	5,107,126.8	107.24	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY084	Freight	351,613.2	5,107,123.5	107.28	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY085	Freight	351,621.1	5,107,120.3	107.17	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07

Table D-5c. Freight Trucks Volume Sources and Annual Emission Rates

Truck Width	2.59 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017										
Truck Height	4.11 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017										
		UTM NAD83 10N			Release Height	Initial Lateral	Initial Vertical	PM_{10} Emission Increase		$PM_{2.5}$ Emission Increase	
ID	Segment	Easting (m)	Northing (m)	Elevation (m)	(m)	Dimension (m)	Dimension (m)	(tpy)	Annual (g/s)	(tpy)	Annual (g/s)
EDHTY086	Freight	351,629.1	5,107,117.0	107.26	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY087	Freight	351,637.0	5,107,113.8	107.33	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY088	Freight	351,645.0	5,107,110.5	107.28	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY089	Freight	351,652.9	5,107,107.3	107.28	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08A	Freight	351,660.9	5,107,104.0	107.28	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08B	Freight	351,666.6	5,107,097.9	107.22	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08C	Freight	351,671.8	5,107,091.0	107.21	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08D	Freight	351,676.9	5,107,084.2	107.25	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08E	Freight	351,682.1	5,107,077.3	107.27	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08F	Freight	351,687.3	5,107,070.4	107.25	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08G	Freight	351,692.4	5,107,063.6	107.27	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08H	Freight	351,697.6	5,107,056.7	107.3	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08I	Freight	351,702.7	5,107,049.8	107.31	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08J	Freight	351,707.9	5,107,042.9	107.35	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08K	Freight	351,713.0	5,107,036.1	107.34	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08L	Freight	351,718.3	5,107,030.1	107.33	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08M	Freight	351,725.4	5,107,035.0	107.3	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08N	Freight	351,732.4	5,107,039.9	107.33	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08O	Freight	351,739.4	5,107,044.8	107.3	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08P	Freight	351,746.5	5,107,049.7	107.29	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08Q	Freight	351,753.5	5,107,054.6	107.3	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08R	Freight	351,760.6	5,107,059.6	107.29	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08S	Freight	351,767.6	5,107,064.5	107.26	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08T	Freight	351,774.7	5,107,069.4	107.26	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08U	Freight	351,781.7	5,107,074.3	107.24	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08V	Freight	351,788.7	5,107,079.2	107.25	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08W	Freight	351,795.8	5,107,084.2	107.21	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08X	Freight	351,802.8	5,107,089.1	107.23	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08Y	Freight	351,809.9	5,107,094.0	107.28	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY08Z	Freight	351,816.9	5,107,098.9	107.32	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY090	Freight	351,824.0	5,107,103.8	107.28	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY091	Freight	351,831.0	5,107,108.7	107.3	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY092	Freight	351,838.0	5,107,113.7	107.31	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY093	Freight	351,845.1	5,107,118.6	107.36	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY094	Freight	351,852.1	5,107,123.5	107.39	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY095	Freight	351,859.2	5,107,128.4	107.42	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY096	Freight	351,866.2	5,107,133.3	107.39	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY097	Freight	351,873.3	5,107,138.2	107.38	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY098	Freight	351,880.3	5,107,143.2	107.41	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY099	Freight	351,887.3	5,107,148.1	107.43	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09A	Freight	351,894.4	5,107,153.0	107.44	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09B	Freight	351,901.4	5,107,157.9	107.46	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09C	Freight	351,908.5	5,107,162.8	107.36	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07

Table D-5c. Freight Trucks Volume Sources and Annual Emission Rates

Truck Width	2.59 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017										
Truck Height	4.11 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017										
		UTM NAD83 10N			Release Height	Initial Lateral	Initial Vertical	PM_{10} Emission Increase		$PM_{2.5}$ Emission Increase	
ID	Segment	Easting (m)	Northing (m)	Elevation (m)	(m)	Dimension (m)	Dimension (m)	(tpy)	Annual (g/s)	(tpy)	Annual (g/s)
EDHTY09D	Freight	351,915.5	5,107,167.7	107.37	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09E	Freight	351,921.7	5,107,166.2	107.43	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09F	Freight	351,927.2	5,107,159.6	107.46	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09G	Freight	351,932.6	5,107,152.9	107.59	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09H	Freight	351,938.1	5,107,146.3	107.61	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09I	Freight	351,943.6	5,107,139.7	107.59	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09J	Freight	351,950.1	5,107,134.2	107.59	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09K	Freight	351,956.8	5,107,128.7	107.67	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09L	Freight	351,963.4	5,107,123.2	107.94	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09M	Freight	351,970.0	5,107,117.8	108.33	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09N	Freight	351,976.7	5,107,112.3	108.99	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09O	Freight	351,983.3	5,107,106.9	109.45	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09P	Freight	351,989.9	5,107,101.4	109.46	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09Q	Freight	351,996.6	5,107,095.9	109.68	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09R	Freight	352,003.7	5,107,091.2	109.8	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09S	Freight	352,011.1	5,107,086.8	109.88	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09T	Freight	352,018.5	5,107,082.4	109.85	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09U	Freight	352,025.8	5,107,078.0	109.95	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09V	Freight	352,033.2	5,107,073.6	110.04	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09W	Freight	352,040.6	5,107,069.2	110.27	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09X	Freight	352,047.0	5,107,063.6	110.38	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09Y	Freight	352,053.3	5,107,057.7	110.42	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY09Z	Freight	352,059.5	5,107,051.7	110.49	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A0	Freight	352,064.2	5,107,044.6	110.75	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A1	Freight	352,068.5	5,107,037.2	110.96	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A2	Freight	352,072.8	5,107,029.7	111.05	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A3	Freight	352,077.1	5,107,022.3	111.3	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A4	Freight	352,081.4	5,107,014.9	111.59	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A5	Freight	352,085.8	5,107,007.5	111.78	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A6	Freight	352,090.1	5,107,000.1	112.1	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A7	Freight	352,094.4	5,106,992.6	112.59	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A8	Freight	352,098.7	5,106,985.2	113.14	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0A9	Freight	352,103.1	5,106,977.8	113.55	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AA	Freight	352,107.4	5,106,970.4	113.99	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AB	Freight	352,111.7	5,106,962.9	114.39	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AC	Freight	352,116.0	5,106,955.5	114.81	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AD	Freight	352,120.3	5,106,948.1	115.31	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AE	Freight	352,124.7	5,106,940.7	115.65	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AF	Freight	352,132.0	5,106,936.6	116.02	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AG	Freight	352,139.9	5,106,933.3	116.37	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AH	Freight	352,147.8	5,106,930.0	116.73	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07
EDHTY0AI	Freight	352,153.8	5,106,927.7	116.98	3.50	4.00	3.25	2.921E-05	8.403E-07	7.170E-06	2.063E-07

Note: all truck routes are conservatively assumed to be one-lane roads. Adjacent volume sources are used to represent the emissions from the roadways, as recommended in Haul Road Workgroup Final Report Submission to EPA-OAQPS Memo by Tyler Fox on March 2, 2012. The release height for each volume source is half of the top of plume height. The top of plume height is the dominant type of truck height times 1.7. Width of plume is vehicle width plus 6 m for single lane roadways since it's not expected that there will be heavy traffic from both directions on mill roads.

Elevations are determined by AERMAP.

Table D-6a. Chipping Trucks Volume Sources and 24-Hour Emission Rates

Truck Width	2.44 m, provided by PCA on 11/13/2017
Truck Height	2.90 m, provided by PCA on 11/13/2017

ID	Segment	UTM NAD83 10N Easting (m)	UTM NAD83 10N Northing (m)	Elevation (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)	PM_{10} Emission Increase 24-hour (g/s)	$PM_{2.5}$ Emission Increase 24-hour (g/s)
NA9V0002	Chipping	351,256.6	5,108,765.6	112.05	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0003	Chipping	351,250.9	5,108,759.4	111.76	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0004	Chipping	351,245.2	5,108,753.2	111.34	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0005	Chipping	351,241.8	5,108,746.1	111.03	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0006	Chipping	351,241.8	5,108,737.6	110.62	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0007	Chipping	351,246.0	5,108,730.6	110.07	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0008	Chipping	351,251.0	5,108,723.8	109.77	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0009	Chipping	351,256.0	5,108,717.0	109.65	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000A	Chipping	351,261.1	5,108,710.3	109.58	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000B	Chipping	351,266.1	5,108,703.5	109.44	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000C	Chipping	351,271.1	5,108,696.7	109.26	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000D	Chipping	351,276.2	5,108,689.9	108.98	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000E	Chipping	351,281.2	5,108,683.2	108.9	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000F	Chipping	351,286.3	5,108,676.4	108.82	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000G	Chipping	351,291.3	5,108,669.6	108.81	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000H	Chipping	351,296.3	5,108,662.8	109	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000I	Chipping	351,301.4	5,108,656.1	109.03	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000J	Chipping	351,306.4	5,108,649.3	108.96	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000K	Chipping	351,311.4	5,108,642.5	108.69	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000L	Chipping	351,316.5	5,108,635.7	108.43	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000M	Chipping	351,321.5	5,108,629.0	108.64	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000N	Chipping	351,326.5	5,108,622.2	108.3	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000O	Chipping	351,331.6	5,108,615.4	108.33	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000P	Chipping	351,336.6	5,108,608.6	108.27	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000Q	Chipping	351,341.6	5,108,601.9	108.28	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000R	Chipping	351,346.7	5,108,595.1	108.29	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000S	Chipping	351,351.7	5,108,588.3	108.21	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000T	Chipping	351,356.7	5,108,581.5	108.15	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000U	Chipping	351,361.8	5,108,574.8	108.14	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000V	Chipping	351,366.8	5,108,568.0	108.08	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000W	Chipping	351,371.8	5,108,561.2	108.16	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000X	Chipping	351,376.9	5,108,554.4	108.23	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000Y	Chipping	351,381.9	5,108,547.7	108.28	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V000Z	Chipping	351,386.9	5,108,540.9	108.36	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0010	Chipping	351,392.0	5,108,534.1	108.39	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0011	Chipping	351,397.0	5,108,527.3	108.45	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001O	Chipping	351,505.8	5,108,366.7	111.84	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001P	Chipping	351,507.1	5,108,359.0	111.92	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001Q	Chipping	351,505.8	5,108,350.6	112.04	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001R	Chipping	351,504.4	5,108,342.3	111.84	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001S	Chipping	351,503.1	5,108,334.0	111.55	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001T	Chipping	351,501.8	5,108,325.6	111.31	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001U	Chipping	351,500.4	5,108,317.3	111.1	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001V	Chipping	351,499.1	5,108,309.0	110.91	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001W	Chipping	351,497.7	5,108,300.6	110.75	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001X	Chipping	351,499.4	5,108,292.4	110.57	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001Y	Chipping	351,501.3	5,108,284.2	110.38	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V001Z	Chipping	351,503.2	5,108,276.0	110.18	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0020	Chipping	351,505.1	5,108,267.7	110.01	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0021	Chipping	351,507.0	5,108,259.5	109.84	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0022	Chipping	351,508.9	5,108,251.3	109.68	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0023	Chipping	351,510.9	5,108,243.1	109.47	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0024	Chipping	351,512.6	5,108,234.8	109.31	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0025	Chipping	351,513.4	5,108,226.4	109.26	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0026	Chipping	351,514.2	5,108,218.0	109.27	2.46	3.92	2.29	8.110E-06	1.991E-06

Table D-6a. Chipping Trucks Volume Sources and 24-Hour Emission Rates

Truck Width	2.44 m, provided by PCA on 11/13/2017
Truck Height	2.90 m, provided by PCA on 11/13/2017

ID	Segment	UTM NAD83 10N Easting (m)	UTM NAD83 10N Northing (m)	Elevation (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)	PM_{10} Emission Increase 24-hour (g/s)	$PM_{2.5}$ Emission Increase 24-hour (g/s)
NA9V0027	Chipping	351,515.1	5,108,209.6	109.28	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0028	Chipping	351,515.9	5,108,201.2	109.28	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0029	Chipping	351,516.7	5,108,192.8	109.28	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002A	Chipping	351,517.5	5,108,184.4	109.27	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002B	Chipping	351,518.4	5,108,176.0	109.27	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002C	Chipping	351,519.2	5,108,167.6	109.3	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002D	Chipping	351,520.0	5,108,159.2	109.32	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002E	Chipping	351,520.9	5,108,150.8	109.33	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002F	Chipping	351,521.7	5,108,142.4	109.31	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002G	Chipping	351,522.5	5,108,134.0	109.25	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002H	Chipping	351,523.4	5,108,125.6	109.13	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002I	Chipping	351,524.2	5,108,117.2	109	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002J	Chipping	351,525.0	5,108,108.8	108.87	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002K	Chipping	351,525.3	5,108,100.5	108.68	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002L	Chipping	351,522.9	5,108,092.4	108.49	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002M	Chipping	351,520.5	5,108,084.3	108.35	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002N	Chipping	351,518.1	5,108,076.2	108.21	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002O	Chipping	351,515.8	5,108,068.1	108.09	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002P	Chipping	351,513.4	5,108,060.0	108	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002Q	Chipping	351,511.0	5,108,051.9	107.95	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002R	Chipping	351,508.6	5,108,043.8	107.9	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002U	Chipping	351,500.0	5,108,020.1	107.93	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002V	Chipping	351,496.0	5,108,012.7	108.01	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002W	Chipping	351,492.0	5,108,005.3	108.17	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002X	Chipping	351,488.0	5,107,997.9	108.39	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002Y	Chipping	351,483.6	5,107,990.7	108.62	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V002Z	Chipping	351,476.2	5,107,986.7	109.14	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0030	Chipping	351,468.8	5,107,982.6	109.17	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0031	Chipping	351,461.4	5,107,978.6	109.43	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0032	Chipping	351,454.0	5,107,974.5	109.45	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003I	Chipping	351,471.5	5,107,856.3	108.64	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003J	Chipping	351,474.2	5,107,848.3	108.68	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003K	Chipping	351,476.9	5,107,840.3	108.52	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003L	Chipping	351,479.6	5,107,832.3	108.48	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003M	Chipping	351,482.2	5,107,824.3	108.37	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003N	Chipping	351,484.9	5,107,816.3	108.28	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003O	Chipping	351,487.6	5,107,808.3	108.27	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003P	Chipping	351,490.2	5,107,800.3	108.17	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003Q	Chipping	351,492.9	5,107,792.3	108.11	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003R	Chipping	351,495.6	5,107,784.3	108.04	2.46	3.92	2.29	8.110E-06	1.991E-06

Table D-6a. Chipping Trucks Volume Sources and 24-Hour Emission Rates

Truck Width	2.44 m, provided by PCA on 11/13/2017
Truck Height	2.90 m, provided by PCA on 11/13/2017

ID	Segment	UTM NAD83 10N Easting (m)	UTM NAD83 10N Northing (m)	Elevation (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)	PM_{10} Emission Increase 24-hour (g/s)	$PM_{2.5}$ Emission Increase 24-hour (g/s)
NA9V003S	Chipping	351,498.2	5,107,776.3	108.01	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003T	Chipping	351,493.5	5,107,772.5	107.94	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003U	Chipping	351,485.2	5,107,770.7	107.79	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003V	Chipping	351,477.0	5,107,769.0	107.69	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003W	Chipping	351,468.7	5,107,767.2	107.57	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003X	Chipping	351,460.5	5,107,765.5	107.41	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003Y	Chipping	351,452.2	5,107,763.7	107.23	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V003Z	Chipping	351,444.0	5,107,761.9	107.1	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0040	Chipping	351,435.7	5,107,760.2	106.96	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0041	Chipping	351,427.5	5,107,758.4	106.9	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0042	Chipping	351,419.2	5,107,756.6	106.82	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0043	Chipping	351,410.9	5,107,754.9	106.74	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0044	Chipping	351,402.7	5,107,753.1	106.73	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0045	Chipping	351,394.4	5,107,751.4	106.76	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0046	Chipping	351,386.2	5,107,749.6	106.84	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0047	Chipping	351,377.9	5,107,747.8	106.98	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0048	Chipping	351,369.7	5,107,746.1	107.02	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V0049	Chipping	351,364.1	5,107,740.4	107	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004A	Chipping	351,359.6	5,107,733.3	106.91	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004B	Chipping	351,359.0	5,107,726.1	106.86	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004C	Chipping	351,363.3	5,107,718.8	106.9	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004D	Chipping	351,367.5	5,107,711.5	106.96	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004E	Chipping	351,371.8	5,107,704.2	106.94	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004F	Chipping	351,376.0	5,107,696.9	107	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004G	Chipping	351,380.3	5,107,689.6	107.04	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004H	Chipping	351,384.6	5,107,682.3	107.08	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004I	Chipping	351,389.0	5,107,675.2	107.13	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004J	Chipping	351,394.4	5,107,668.7	107.16	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004K	Chipping	351,399.9	5,107,662.3	107.12	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004L	Chipping	351,405.3	5,107,655.8	107.17	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004M	Chipping	351,410.8	5,107,649.4	107.21	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004N	Chipping	351,416.2	5,107,643.0	107.23	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004O	Chipping	351,421.7	5,107,636.5	107.22	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004P	Chipping	351,427.1	5,107,630.1	107.23	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004Q	Chipping	351,432.6	5,107,623.6	107.25	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004R	Chipping	351,438.0	5,107,617.2	107.29	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004S	Chipping	351,443.5	5,107,610.7	107.34	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004T	Chipping	351,448.9	5,107,604.3	107.41	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004U	Chipping	351,454.4	5,107,597.8	107.4	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004V	Chipping	351,459.8	5,107,591.4	107.39	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004W	Chipping	351,465.3	5,107,584.9	107.41	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004X	Chipping	351,470.7	5,107,578.5	107.41	2.46	3.92	2.29	8.110E-06	1.991E-06
NA9V004Y	Chipping	351,476.2	5,107,572.1	107.38	2.46	3.92	2.29	8.110E-06	1.991E-06

Note: all truck routes are conservatively assumed to be one-lane roads. Adjacent volume sources are used to represent the emissions from the roadways, as recommended in *Haul Road Workgroup Final Report Submission to EPA-OAQPS Memo* by Tyler Fox on March 2, 2012. The release height for each volume source is half of the top of plume height. The top of plume height is the dominant type of truck height times 1.7. Width of plume is vehicle width plus 6 m for single lane roadways since it's not expected that there will be heavy traffic from both directions on mill roads.

Elevations are determined by AERMAP.

Emission increases resulting from increased chipping truck traffic are estimated using the total number of trucks per year and scaling that value based on the increased pulp production from the project. To calculate a 24-hour emission rate, the annual truck throughput is divided by 356 days of operation per year.

Table D-6b. Short Term PM Model Area Sources and 24-Hour Emission Rates

ID	Segment	UTM NAD83 11N Easting (m)	Northing (m)	Elevation (m)	Release Height (m)	Width (m)	Length (m)	Initial Vertical Dimension (m)	Number of Volume Sources Replaced	Area (m^2)	PM_{10} Emission Increase 24-hour (g/s-m^2)	$PM_{2.5}$ Emission Increase 24-hour (g/s-m^2)
CPArea1	Chipping	351,396.0	5,108,521.8	108.46	2.46	8.44	185	2.29	22	1561.4	1.143E-07	2.805E-08
CPArea2	Chipping	351,502.9	5,108,040.5	108	2.46	8.44	15.6	2.29	2	131.7	1.232E-07	3.023E-08
CPArea3	Chipping	351,465.3	5,107,858.2	108.73	2.46	8.44	109.1	2.29	13	920.8	1.145E-07	2.810E-08
CPArea4	Chipping	351,434.3	5,107,969.4	109.14	2.46	8.44	14.7	2.29	2	124.1	1.307E-07	3.208E-08
FRArea1	Freight	352,018.4	5,107,087.7	109.74	3.50	8.59	14.4	3.25	2	123.7	1.359E-08	3.335E-09

The areas that are in the volume sources' exclusion zone are modeled as area sources versus volume sources, as recommended in *Haul Road Workgroup Final Report Submission to EPA-OAQPS Memo* by Tyler Fox on March 2, 2012. The release height for each area source is half of the top of plume height. The top of plume height is the dominant type of truck height times 1.7. Width of plume is vehicle width plus 6 m for single lane roadways since it's not expected that there will be heavy traffic from both directions on mill roads.

Area of these area sources are copied from AERMOD. Elevations are determined by AERMAP.

Emission increases resulting from increased chipping truck traffic are estimated using the total number of trucks per year and scaling that value based on the increased pulp production from the project. To calculate a 24-hour emission rate, the annual truck throughput is divided by 356 days of operation per year.

Table D-6c. Freight Trucks Volume Sources and 24-Hour Emission Rates

Truck Width	2.59 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017
Truck Height	4.11 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017

ID	Segment	UTM NAD83 10N Easting (m)	Northing (m)	Elevation (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)	PM_{10} Emission Increase 24-hour (g/s)	$PM_{2.5}$ Emission Increase 24-hour (g/s)
EDHTY079	Freight	351,580.0	5,107,255.6	106.76	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07A	Freight	351,574.5	5,107,262.2	106.9	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07B	Freight	351,569.0	5,107,268.7	107.03	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07C	Freight	351,563.5	5,107,275.3	107.21	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07D	Freight	351,557.9	5,107,281.9	107.32	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07E	Freight	351,551.7	5,107,283.5	107.35	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07F	Freight	351,544.6	5,107,278.7	107.34	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07G	Freight	351,537.4	5,107,273.9	107.36	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07H	Freight	351,530.3	5,107,269.1	107.32	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07I	Freight	351,523.2	5,107,264.3	107.15	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07J	Freight	351,516.1	5,107,259.6	107.17	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07K	Freight	351,508.9	5,107,254.8	107.1	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07L	Freight	351,510.2	5,107,248.6	107.1	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07M	Freight	351,515.4	5,107,241.8	107.18	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07N	Freight	351,520.7	5,107,235.1	107.25	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07O	Freight	351,526.0	5,107,228.3	107.33	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07P	Freight	351,531.2	5,107,221.5	107.36	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07Q	Freight	351,536.5	5,107,214.7	107.34	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07R	Freight	351,541.8	5,107,207.9	107.26	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07S	Freight	351,547.1	5,107,201.2	107.27	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07T	Freight	351,552.3	5,107,194.4	107.25	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07U	Freight	351,557.6	5,107,187.6	107.22	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07V	Freight	351,562.9	5,107,180.8	107.22	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07W	Freight	351,568.1	5,107,174.0	107.22	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07X	Freight	351,573.4	5,107,167.2	107.24	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07Y	Freight	351,578.7	5,107,160.5	107.27	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY07Z	Freight	351,584.0	5,107,153.7	107.28	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY080	Freight	351,589.2	5,107,146.9	107.24	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY081	Freight	351,594.5	5,107,140.1	107.29	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY082	Freight	351,599.8	5,107,133.3	107.25	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY083	Freight	351,605.2	5,107,126.8	107.24	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY084	Freight	351,613.2	5,107,123.5	107.28	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY085	Freight	351,621.1	5,107,120.3	107.17	3.50	4.00	3.25	8.403E-07	2.063E-07

Table D-6c. Freight Trucks Volume Sources and 24-Hour Emission Rates

Truck Width	2.59 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017								
Truck Height	4.11 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017								
		UTM NAD83 10N			Release Height	Initial Lateral	Initial Vertical	PM_{10} Emission Increase	$PM_{2.5}$ Emission Increase
ID	Segment	Easting (m)	Northing (m)	Elevation (m)	(m)	Dimension (m)	Dimension (m)	24-hour (g/s)	24-hour (g/s)
EDHTY086	Freight	351,629.1	5,107,117.0	107.26	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY087	Freight	351,637.0	5,107,113.8	107.33	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY088	Freight	351,645.0	5,107,110.5	107.28	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY089	Freight	351,652.9	5,107,107.3	107.28	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08A	Freight	351,660.9	5,107,104.0	107.28	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08B	Freight	351,666.6	5,107,097.9	107.22	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08C	Freight	351,671.8	5,107,091.0	107.21	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08D	Freight	351,676.9	5,107,084.2	107.25	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08E	Freight	351,682.1	5,107,077.3	107.27	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08F	Freight	351,687.3	5,107,070.4	107.25	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08G	Freight	351,692.4	5,107,063.6	107.27	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08H	Freight	351,697.6	5,107,056.7	107.3	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08I	Freight	351,702.7	5,107,049.8	107.31	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08J	Freight	351,707.9	5,107,042.9	107.35	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08K	Freight	351,713.0	5,107,036.1	107.34	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08L	Freight	351,718.3	5,107,030.1	107.33	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08M	Freight	351,725.4	5,107,035.0	107.3	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08N	Freight	351,732.4	5,107,039.9	107.33	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08O	Freight	351,739.4	5,107,044.8	107.3	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08P	Freight	351,746.5	5,107,049.7	107.29	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08Q	Freight	351,753.5	5,107,054.6	107.3	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08R	Freight	351,760.6	5,107,059.6	107.29	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08S	Freight	351,767.6	5,107,064.5	107.26	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08T	Freight	351,774.7	5,107,069.4	107.26	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08U	Freight	351,781.7	5,107,074.3	107.24	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08V	Freight	351,788.7	5,107,079.2	107.25	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08W	Freight	351,795.8	5,107,084.2	107.21	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08X	Freight	351,802.8	5,107,089.1	107.23	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08Y	Freight	351,809.9	5,107,094.0	107.28	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY08Z	Freight	351,816.9	5,107,098.9	107.32	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY090	Freight	351,824.0	5,107,103.8	107.28	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY091	Freight	351,831.0	5,107,108.7	107.3	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY092	Freight	351,838.0	5,107,113.7	107.31	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY093	Freight	351,845.1	5,107,118.6	107.36	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY094	Freight	351,852.1	5,107,123.5	107.39	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY095	Freight	351,859.2	5,107,128.4	107.42	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY096	Freight	351,866.2	5,107,133.3	107.39	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY097	Freight	351,873.3	5,107,138.2	107.38	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY098	Freight	351,880.3	5,107,143.2	107.41	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY099	Freight	351,887.3	5,107,148.1	107.43	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09A	Freight	351,894.4	5,107,153.0	107.44	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09B	Freight	351,901.4	5,107,157.9	107.46	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09C	Freight	351,908.5	5,107,162.8	107.36	3.50	4.00	3.25	8.403E-07	2.063E-07

Table D-6c. Freight Trucks Volume Sources and 24-Hour Emission Rates

Truck Width	2.59 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017								
Truck Height	4.11 m, based on PCA's typical trucking dimensions per John Piotrowski on 11/8/2017								
		UTM NAD83 10N			Release Height	Initial Lateral	Initial Vertical	PM_{10} Emission Increase	$PM_{2.5}$ Emission Increase
ID	Segment	Easting (m)	Northing (m)	Elevation (m)	(m)	Dimension (m)	Dimension (m)	24-hour (g/s)	24-hour (g/s)
EDHTY09D	Freight	351,915.5	5,107,167.7	107.37	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09E	Freight	351,921.7	5,107,166.2	107.43	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09F	Freight	351,927.2	5,107,159.6	107.46	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09G	Freight	351,932.6	5,107,152.9	107.59	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09H	Freight	351,938.1	5,107,146.3	107.61	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09I	Freight	351,943.6	5,107,139.7	107.59	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09J	Freight	351,950.1	5,107,134.2	107.59	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09K	Freight	351,956.8	5,107,128.7	107.67	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09L	Freight	351,963.4	5,107,123.2	107.94	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09M	Freight	351,970.0	5,107,117.8	108.33	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09N	Freight	351,976.7	5,107,112.3	108.99	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09O	Freight	351,983.3	5,107,106.9	109.45	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09P	Freight	351,989.9	5,107,101.4	109.46	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09Q	Freight	351,996.6	5,107,095.9	109.68	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09R	Freight	352,003.7	5,107,091.2	109.8	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09S	Freight	352,011.1	5,107,086.8	109.88	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09V	Freight	352,033.2	5,107,073.6	110.04	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09W	Freight	352,040.6	5,107,069.2	110.27	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09X	Freight	352,047.0	5,107,063.6	110.38	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09Y	Freight	352,053.3	5,107,057.7	110.42	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY09Z	Freight	352,059.5	5,107,051.7	110.49	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A0	Freight	352,064.2	5,107,044.6	110.75	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A1	Freight	352,068.5	5,107,037.2	110.96	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A2	Freight	352,072.8	5,107,029.7	111.05	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A3	Freight	352,077.1	5,107,022.3	111.3	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A4	Freight	352,081.4	5,107,014.9	111.59	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A5	Freight	352,085.8	5,107,007.5	111.78	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A6	Freight	352,090.1	5,107,000.1	112.1	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A7	Freight	352,094.4	5,106,992.6	112.59	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A8	Freight	352,098.7	5,106,985.2	113.14	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0A9	Freight	352,103.1	5,106,977.8	113.55	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AA	Freight	352,107.4	5,106,970.4	113.99	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AB	Freight	352,111.7	5,106,962.9	114.39	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AC	Freight	352,116.0	5,106,955.5	114.81	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AD	Freight	352,120.3	5,106,948.1	115.31	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AE	Freight	352,124.7	5,106,940.7	115.65	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AF	Freight	352,132.0	5,106,936.6	116.02	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AG	Freight	352,139.9	5,106,933.3	116.37	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AH	Freight	352,147.8	5,106,930.0	116.73	3.50	4.00	3.25	8.403E-07	2.063E-07
EDHTY0AI	Freight	352,153.8	5,106,927.7	116.98	3.50	4.00	3.25	8.403E-07	2.063E-07

Note: all truck routes are conservatively assumed to be one-lane roads. Adjacent volume sources are used to represent the emissions from the roadways, as recommended in Haul Road Workgroup Final Report Submission to EPA-OAQPS Memo by Tyler Fox on March 2, 2012. The release height for each volume source is half of the top of plume height. The top of plume height is the dominant type of truck height times 1.7. Width of plume is vehicle width plus 6 m for single lane roadways since it's not expected that there will be heavy traffic from both directions on mill roads.

Elevations are determined by AERMAP.

Since the emission increase from increased freight truck traffic was calculated using a maximum daily truck throughput and assuming 365 days per year, the 24-hour emission rate is equal to the annual emission rate.

Table D-7a. Fugitive Material Handling Point Sources

Transfer Point No.	Description	NAD 83 UTM Easting (m)	NAD 83 UTM Northing (m)	Elevation (m)	Stack Height [1] (m)	Diameter [1] (m)	Temperature [1] (K)	Exit Velocity [1] (m/s)	PM_{10} Emission Increase [3] (tpy)	PM_{10} Emission Increase [3] Annual (g/s)	PM_{10} Emission Increase [3] 24-hr (g/s)	$PM_{2.5}$ Emission Increase [3] (tpy)	$PM_{2.5}$ Emission Increase [3] Annual (g/s)	$PM_{2.5}$ Emission Increase [3] 24-hr (g/s)
340-3633	Kraft Tunnel Exhaust Fan	351516.17	5107435.32	106.68	1.04	0.92	290.93	10.22	8.026E-03	2.309E-04	2.341E-04	1.215E-03	3.496E-05	3.545E-05
341-3631	M&D Tunnel Exhaust Fan	351499.38	5107399.80	106.28	4.45	0.69	284.26	20.32	8.026E-03	2.309E-04	2.341E-04	1.215E-03	3.496E-05	3.545E-05

[1] Stack height, temperature, and flow rates are obtained from the survey. The exhaust outlets are square-shaped; therefore, the diameter is the calculated equivalent diameter for the outlet. Exit velocity is converted based on the flow rate provided in CFM.

[2] Elevations are determined based on the survey results as the difference of the elevation above sea level and the elevation above the closest structure (in this case the ground).

[3] Projected and baseline annual emissions are calculated assuming 360 days of operation per year. To calculate a 24-hour emission rate, the annual throughput is divided by 360 days of operation per year.

Table D-7b. Fugitive Material Handling Volume Sources

Transfer Point No.	Description	NAD 83 UTM Easting (m)	NAD 83 UTM Northing (m)	Elevation [4] (m)	Release Height [1] (m)	Initial Lateral Dimension [2] (m)	Initial Vertical Dimension [3] (m)	PM_{10} Emission Increase [5] (tpy)	PM_{10} Emission Increase [5] Annual (g/s)	PM_{10} Emission Increase [5] 24-hr (g/s)	$PM_{2.5}$ Emission Increase [5] (tpy)	$PM_{2.5}$ Emission Increase [5] Annual (g/s)	$PM_{2.5}$ Emission Increase [5] 24-hr (g/s)
340-7101	Chip Handling	351492.32	5107455.12	105.31	1.22	0.50	1.13	9.19E-04	2.643E-05	2.680E-05	1.39E-04	4.002E-06	4.058E-06
340-7102	Chip Handling	351501.73	5107460.49	107.29	4.04	0.31	16.30	9.19E-06	2.643E-07	2.680E-07	1.39E-06	4.002E-08	4.058E-08
340-7103	Chip Handling	351535.74	5107475.89	107.77	12.90	0.25	0.35	9.19E-04	2.643E-05	2.680E-05	1.39E-04	4.002E-06	4.058E-06
340-7104	Chip Handling	351534.03	5107483.76	107.28	12.51	0.25	0.43	9.19E-04	2.643E-05	2.680E-05	1.39E-04	4.002E-06	4.058E-06
340-7107	Chip Handling	351525.46	5107477.59	107.88	10.29	0.79	16.30	9.19E-06	2.643E-07	2.680E-07	1.39E-06	4.002E-08	4.058E-08
340-7108	Chip Handling	351523.44	5107482.25	107.5	10.67	0.79	0.14	9.19E-06	2.643E-07	2.680E-07	1.39E-06	4.002E-08	4.058E-08
340-7109	Chip Handling	351526.57	5107477.95	107.9	9.20	0.79	0.35	4.13E-04	1.189E-05	1.206E-05	6.26E-05	1.801E-06	1.826E-06
340-7110	Chip Handling	351524.57	5107482.71	107.48	9.62	0.79	0.35	4.13E-04	1.189E-05	1.206E-05	6.26E-05	1.801E-06	1.826E-06
340-7111	Chip Handling	351530.64	5107490.57	107.06	9.30	0.39	0.11	6.43E-05	1.850E-06	1.876E-06	9.74E-06	2.802E-07	2.841E-07
340-7112	Chip Handling	351532.60	5107480.59	107.52	8.30	0.41	0.14	6.43E-05	1.850E-06	1.876E-06	9.74E-06	2.802E-07	2.841E-07
340-7113	Chip Handling	351532.52	5107486.15	107.15	8.67	0.41	0.14	6.43E-05	1.850E-06	1.876E-06	9.74E-06	2.802E-07	2.841E-07
340-7114	Chip Handling	351528.20	5107474.72	107.91	9.22	0.18	0.07	9.19E-05	2.643E-06	2.680E-06	1.39E-05	4.002E-07	4.058E-07
340-7115	Chip Handling	351529.76	5107471.19	107.88	7.36	0.07	16.30	6.43E-05	1.850E-06	1.876E-06	9.74E-06	2.802E-07	2.841E-07
340-7116	Chip Handling	351530.93	5107485.48	107.21	8.19	0.71	1.15	4.59E-04	1.322E-05	1.340E-05	6.96E-05	2.001E-06	2.029E-06
340-7117	Chip Handling	351532.93	5107480.72	107.5	7.90	0.71	1.15	4.59E-04	1.322E-05	1.340E-05	6.96E-05	2.001E-06	2.029E-06
340-7118	Chip Handling	351525.02	5107482.91	107.47	7.55	0.71	1.33	6.43E-05	1.850E-06	1.876E-06	9.74E-06	2.802E-07	2.841E-07
340-7119	Chip Handling	351527.03	5107478.16	107.87	7.15	0.71	1.33	6.43E-05	1.850E-06	1.876E-06	9.74E-06	2.802E-07	2.841E-07
340-7120	Chip Handling	351523.56	5107482.32	107.5	3.55	0.09	0.42	4.13E-04	1.189E-05	1.206E-05	6.26E-05	1.801E-06	1.826E-06
340-7121	Chip Handling	351525.56	5107477.57	107.89	3.16	0.09	0.42	4.13E-04	1.189E-05	1.206E-05	6.26E-05	1.801E-06	1.826E-06
340-7122	Chip Handling	351530.52	5107473.17	107.85	2.34	0.11	0.47	6.43E-05	1.850E-06	1.876E-06	9.74E-06	2.802E-07	2.841E-07
340-7123	Chip Handling	351531.65	5107473.63	107.83	2.51	0.18	0.40	1.38E-04	3.965E-06	4.020E-06	2.09E-05	6.004E-07	6.087E-07
340-7124	Chip Handling	351530.37	5107471.15	107.87	0.14	0.11	1.09	4.02E-05	1.155E-06	1.171E-06	6.08E-06	1.749E-07	1.774E-07
340-7125	Chip Handling	351533.82	5107475.09	107.75	0.41	0.18	1.23	4.02E-05	1.155E-06	1.171E-06	6.08E-06	1.749E-07	1.774E-07
340-7126	Chip Handling	351526.97	5107474.27	107.94	2.26	0.08	16.30	9.19E-08	2.643E-09	2.680E-09	1.39E-08	4.002E-10	4.058E-10
340-7127	Chip Handling	351528.20	5107475.64	107.91	1.70	0.21	0.14	1.38E-04	3.965E-06	4.020E-06	2.09E-05	6.004E-07	6.087E-07
340-7128	Chip Handling	351527.41	5107473.05	107.92	1.93	0.21	16.30	8.27E-04	2.379E-05	2.412E-05	1.25E-04	3.602E-06	3.652E-06
340-7129	Chip Handling	351526.79	5107478.01	107.89	2.69	0.08	0.31	1.38E-04	3.965E-06	4.020E-06	2.09E-05	6.004E-07	6.087E-07
340-7130	Chip Handling	351524.71	5107482.88	107.47	3.11	0.08	0.31	1.38E-04	3.965E-06	4.020E-06	2.09E-05	6.004E-07	6.087E-07
340-7131	Chip Handling	351528.71	5107476.55	107.89	2.45	0.07	0.14	9.19E-06	2.643E-07	2.680E-07	1.39E-06	4.002E-08	4.058E-08
340-7132	Chip Handling	351526.69	5107481.21	107.63	2.71	0.07	0.14	9.19E-06	2.643E-07	2.680E-07	1.39E-06	4.002E-08	4.058E-08
340-7133	Chip Handling	351522.02	5107485.95	107.27	2.05	0.09	0.45	8.27E-04	2.379E-05	2.412E-05	1.25E-04	3.602E-06	3.652E-06
340-7134	Chip Handling	351543.63	5107462.96	107.73	1.48	0.07	5.39	9.19E-06	2.643E-07	2.680E-07	1.39E-06	4.002E-08	4.058E-08
340-7135	Chip Handling	351522.61	5107484.48	107.36	1.61	0.08	0.43	9.19E-08	2.643E-09	2.680E-09	1.39E-08	4.002E-10	4.058E-10
340-7136	Chip Handling	351521.79	5107484.05	107.38	1.75	0.23	0.25	9.19E-08	2.643E-09	2.680E-09	1.39E-08	4.002E-10	4.058E-10
340-7137	Chip Handling	351502.71	5107468.05	107.29	3.05	0.14	2.84	8.03E-07	2.310E-08	2.342E-08	1.22E-07	3.499E-09	3.547E-09
340-7138	Chip Handling	351555.41	5107467.66	107.53	6.53	0.14	5.39	8.27E-04	2.379E-05	2.412E-05	1.25E-04	3.602E-06	3.652E-06
341-7101	Kamyr and M&D	351467.88	5107432.64	107.29	2.44	0.17	0.43	1.53E-04	4.405E-06	4.466E-06	2.32E-05	6.671E-07	6.763E-07
341-7103	Kamyr and M&D	351475.34	5107439.37	107.29	0.73	0.15	0.68	1.53E-04	4.405E-06	4.466E-06	2.32E-05	6.671E-07	6.763E-07

Table D-7b. Fugitive Material Handling Volume Sources

Transfer Point No.	Description	NAD 83 UTM Easting (m)	NAD 83 UTM Northing (m)	Elevation [4] (m)	Release Height [1] (m)	Initial Lateral Dimension [2] (m)	Initial Vertical Dimension [3] (m)	PM_{10} Emission Increase [5] (tpy)	PM_{10} Emission Increase [5] Annual (g/s)	PM_{10} Emission Increase [5] 24-hr (g/s)	$PM_{2.5}$ Emission Increase [5] (tpy)	$PM_{2.5}$ Emission Increase [5] Annual (g/s)	$PM_{2.5}$ Emission Increase [5] 24-hr (g/s)
341-7104	Kamyr and M&D	351466.05	5107430.90	107.29	0.66	0.28	1.03	1.34E-05	3.851E-07	3.904E-07	2.03E-06	5.831E-08	5.912E-08
341-7105	Kamyr and M&D	351467.30	5107433.70	107.29	4.95	0.14	4.61	1.34E-03	3.851E-05	3.904E-05	2.03E-04	5.831E-06	5.912E-06
324-7142	Chip Unloading and Blowers	351609.31	5107513.54	107.52	0.27	0.14	0.25	1.27E-03	3.660E-05	3.710E-05	1.926E-04	5.542E-06	5.619E-06
340-7141	Chip Unloading and Blowers	351522.31	5107572.81	107.34	0.58	0.57	0.54	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05
340-7142	Chip Unloading and Blowers	351515.30	5107569.88	107.35	0.58	0.57	0.54	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05
340-7143	Chip Unloading and Blowers	351507.01	5107566.31	107.36	0.57	0.57	0.53	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05
340-7144	Chip Unloading and Blowers	351333.96	5107406.03	106.42	1.50	0.57	1.40	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05
340-7151	Chip Unloading and Blowers	351452.29	5107570.03	107.29	3.05	0.09	2.84	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05
340-7152	Chip Unloading and Blowers	351481.02	5107526.04	107.29	3.35	0.09	3.12	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05
340-7153	Chip Unloading and Blowers	351458.88	5107500.07	107.29	3.35	0.09	3.12	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05
340-7154	Chip Unloading and Blowers	351383.59	5107391.56	106.23	3.88	0.09	3.61	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05
340-7156	Chip Unloading and Blowers	351383.93	5107390.77	106.26	3.56	0.07	3.31	1.16E-02	3.327E-04	3.373E-04	1.751E-03	5.038E-05	5.108E-05

[1] Release height is determined as the center of the elevation of the drop based on the elevation from the survey results, which refer to the elevation from sea level. Therefore, the release height calculated as the input to the model is the elevation of the center of the drop minus the elevation for the volume source which is determined by AERMAP.

[2] Initial lateral dimension is determined based on the shorter width of the "drop from" point and "drop to" point from the survey results, and then divided by 4.3 for single volume source, per Table 3-2 of AERMOD User's Guide, EPA-454/B-16-011, December 2016.

[3] Initial vertical dimension is determined based on the drop height from the survey results or building height where applicable per Table 3-2 of AERMOD User's Guide, EPA-454/B-16-011, December 2016. If the drop is to the ground, the initial vertical dimension is determined as the drop height divided by 2.15. If the drop point is close to or on the building structure, the height of the building divided by 2.15 is used (i.e., chip handling drop points 340-7102, 340-7107, 340-7115, 340-7126 and 340-7128 are on or near the M&D building and drop points 340-7134 and 340-7138 are on the Chip Screening building). Otherwise the initial vertical dimension is determined to be the drop height divided by 4.3. All drop points for Chip Unloading and Blowers are assumed to be dumped to the ground.

[4] Elevations are obtained from AERMAP outputs. Drop points with elevations higher than 108 m (354 ft) are reviewed and corrected based on the sources nearby and base elevation on the ground according to Google Earth, because AERMAP outputs may include the chip pile height as base elevations. For example, the elevations for drop points for Kamyr and M&D handling are assumed to be at 352 ft. For drop point 340-7101 which is a transfer point to the Kamyr Tunnel, the base elevation is determined as the "drop to" point sea level elevation since it's below the ground level.

[5] Projected and baseline annual emissions are calculated assuming 360 days of operation per year. To calculate a 24-hour emission rate, the annual throughput is divided by 360 days of operation per year.

Message

From: McAlpine, Jerrold [McAlpine.Jay@epa.gov]
Sent: 8/6/2018 8:58:51 PM
To: Misenis, Chris [Misenis.Chris@epa.gov]
CC: Bridgers, George [Bridgers.George@epa.gov]; Bray, Dave [Bray.Dave@epa.gov]
Subject: Washington State PacWest smelter WRF-MMIF proposal
Attachments: PacWest_Newport_PSD_Modeling_Protocol.pdf; PacWest_WRF+MMIF_MPE.PDF

Chris,

We chatted some time ago about the proposed controversial PSD project in Washington State – development of a silicon smelter in rural eastern WA. Region 10 is providing technical assistance to WA Dept. Ecology.

The project is controversial because it involves heavy industrial development in a remote and fairly-pristine rural region of the state with no previous industrial development, adjacent to a small town and Tribal lands. Several community groups and the Kalispel and Kootenai Tribal Governments have submitted letters of opposition to the project. Region 10 provided technical consultation with the Tribes during the initial modeling protocol review, and we will continue to provide technical consult as needed. The Tribes have expressed concern and opposition to the use of the WRF-MMIF approach, instead asking the state to consider requiring the collection of site-specific meteorological data.

The applicant is proposing to use WRF-MMIF to provide meteorological inputs to AERMET. We have been awaiting a revised modeling protocol and it has arrived, complete with a WRF model performance analysis (attached). In our previous talks, OAQPS offered to provide technical assistance to Region 10 and Ecology and help alleviate some of the anxiety of a general first-of-its-kind regulatory use of WRF-MMIF for PSD.

I wanted to alert you of the status of the project and share the protocol and MPE with you (attached). I will be having a conversation with the WA State Ecology modeler (Ranil Dhammapala), USFS (Bret Anderson), and Park Service (John Notar) later this week to begin coordinating the review and response to the WRF MPE. Depending on Ecology's needs and timing, I may be reaching out to OAQPS soon for assistance or to at least keep you apprised of project status.

Thank you,
Jay

Jay McAlpine, PhD
Atmospheric Scientist, Regional Modeling Contact
Office of Air and Waste
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 155, OAW-150
Seattle, WA 98101
206.553.0094
McAlpine.Jay@epa.gov

Prepared for:

PacWest Silicon
Edmonton, Alberta

Prepared by:

Ramboll US Corporation
Lynnwood, Washington

July 2018

Project Number:
1690002828

PACWEST SILICON NEWPORT

REVISED PSD MODELING PROTOCOL

RAMBOLL

CONTENTS

Acronyms and Abbreviations iii

1. Introduction 1
1.1 Project Emissions and Regulatory Analysis 2
1.1.1 Criteria Pollutant Emissions 3
1.1.2 Toxic Pollutant Emissions 3

2. Class II Modeling Methodology 6
2.1 Dispersion Model Selection 6
2.2 Modeling Methodology 7
2.2.1 Model Setup 7
2.2.2 Meteorology 7
2.2.3 Receptor Network and Terrain 8
2.2.4 Emission Unit Parameters 8
2.2.5 Good Engineering Practice Analysis 9
2.2.6 NO to NO_2 Chemical Transformations 11
2.3 Criteria Pollutant Significant Impact Level Assessment 11
2.4 Significant Impact Area Determination 14
2.5 Preconstruction Monitoring Analysis 14
2.6 PSD Class II Increment Consumption 14
2.7 Criteria Pollutant Ambient Air Quality Standards Assessment 15
2.8 Toxic Air Pollutant Small Quantity Emission Rate Assessment 16
2.9 Ozone and Secondary $PM_{2.5}$ Assessment 17

3. CLASS I Modeling Methodology 24
3.1 Class I PSD Increment Assessment Methodology 24
3.2 Class I Air Quality Related Values Methodology 26
3.2.1 Dispersion Model Selection 31
3.2.2 Modeling Methodology Summary 31
3.2.3 Characterization of Emissions 32
3.2.4 Chemical Transformations 33
3.2.5 Meteorological Data 33
3.2.6 Receptors and Terrain 34
3.2.7 Post-Processing Procedures 34

4. References 38

ED_013256A_00000460-00002

TABLES

Table 1. Preliminary Project Emissions Increases 5
Table 2. Applicable Class II PSD Air Quality Standards 13
Table 3. Background Concentrations 17
Table 4. Most Conservative Illustrative MERP Values (TPY) 18
Table 5. MERP analysis results for $PM_{2.5}$ and ozone. 19
Table 6. Ozone Design Values at Green Bluff, WA 22
Table 7. Class I Area Significant Levels and Increments 26
Table 8. Mandatory Class I Areas Within 300 km, with initial Q/D 29

FIGURES

Figure 1. PacWest Facility Location and Property Boundary 4
Figure 2. 20 km by 20 km Receptor Grid 10
Figure 3. Location of Green Bluff AQS Monitoring Site 21
Figure 4. Class I Areas within 300 km of the proposed facility 28
Figure 5. Proposed CALPUFF Modeling Domain 30
Figure 6. Proposed Domain with 4 km Resolution Terrain 30

ED_013256A_00000460-00003

ACRONYMS AND ABBREVIATIONS

AERMOD ..... Air quality dispersion modeling system used in this analysis. The AERMOD modeling system consists of two pre-processors and a dispersion model. The meteorological preprocessor (AERMET) provides meteorological information, and a terrain pre-processor (AERMAP) characterizes terrain, and generates receptor grids for the dispersion model (AERMOD)

Ambient air quality standard... Health-based standard representing a pollutant concentration in the ambient air usually over some averaging period like 1-hour, intended to protect the health and welfare of people with a margin of safety

Ambient air ..... The air in outdoor locations to which the public has access, e.g., outside the property boundary of the emissions source

Attainment/Nonattainment..... A determination and classification made by EPA indicating whether ambient air quality in an area complies with (i.e., attains) or fails to meet (i.e., nonattainment) the requirements of one or more NAAQS

Averaging time ..... A specific length of time (e.g., 1 hour, 24-hours, 1 year) over which measured or model-calculated concentrations of an air pollutant are averaged for comparison with the NAAQS based on the same averaging period. Note that some NAAQSs are also based on multi-year averages of certain percentiles of measured or calculated concentrations.

AQIA ..... Air quality impact assessment

AQRV..... Air quality related values: acid deposition flux and visibility impairment

ARM/ARM2 ..... Ambient Ratio Method/Ambient Ratio Method 2; Tier 2 NO-to-NO_2 chemical transformation methods

ASIL ..... Acceptable Source Impact Level

BACT ..... Best available control technology

BART ..... Best available retrofit technology

BPIP PRIME ..... EPA's Prime version of the Building Profile Input Program

CALPUFF ..... Air quality dispersion modeling system typically used for long-range (greater than 50 km) transport assessments. The meteorological preprocessor (CALMET) provides meteorological information for the dispersion model (CALPUFF). The CALPOST post-processor can be used in conjunction with the CALPUFF utility POSTUTIL to summarize modeling results

CO ..... Carbon monoxide, a criteria air pollutant

ED_013256A_00000460-00004

CO_2	Carbon dioxide
Criteria air pollutant	An air pollutant specifically governed by the Federal Clean Air Act for which ambient air quality standards have been set. Criteria air pollutants include carbon monoxide, particulate matter, sulfur dioxide, nitrogen dioxide, ozone, and lead
DAT	Deposition Analysis Threshold, typically in units of kilograms per hectare per year
Dispersion model	A computerized calculation tool used to estimate pollutant concentrations in the ambient air based on numeric simulations that consider the locations and rates of pollutant emissions and the effects of meteorological conditions, usually over specific averaging times (e.g., 8-hours)
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FLAG	Federal Land Managers' Air Quality Related Workgroup
FLMs	Federal Land Managers
Fugitive dust	Potential air pollutant in the form of dust (or other pollutant) emitted from a non-point or non-mobile source such as dust from a road or from a storage pile caused by wind
GEP stack height	Good engineering practice stack height; the height at which a stack must be to avoid building wake effects on emissions during dispersion analysis
H1H, H2H	Highest first-high, highest second-high. The first "highest" is over time, the second over space
IDAPA	Idaho Administrative Code
IWAQM	Interagency Workgroup on Air Quality Modeling
MERP	Modeled emission rates for precursors
Meteorological data set	A compilation of meteorological data representing conditions over some period of time and including such things as wind speed and wind direction, and formatted as required by the dispersion model being used. This analysis used a meteorological data set covering 5 years
Micrometer/Micron	One millionth of a meter; typically used to distinguish particle size; a typical human hair is 100 about microns in diameter
MMIF	Mesoscale model interface program, which converts meteorological model outputs to dispersion model inputs
Modeling domain	The area included in the dispersion-modeling analysis
Modeling receptor	A theoretical (i.e., often non-specific) location used in computer modeling at which air pollutant concentrations are

ED_013256A_00000460-00005

	calculated. Modeling may also use site-specific receptors representing individual locations
MPE	Model Performance Evaluation
NAAQS	National Ambient Air Quality Standard
NED	National Elevation Dataset
NO_2	nitrogen dioxide, a criteria air pollutant
Nonattainment area	An area delineated by regulatory agencies including US EPA and the Washington Department of Ecology in which an ambient air quality standard has been violated and where there is a program in place designed to reduce air pollution so that the standard can be attained
NOx	Oxides of nitrogen, a general class of air pollutant without a specific air quality standard but used in monitoring air quality
NPDES	National Pollutant Discharge Elimination System
NPS/FS	National Park Service/Forest Service
NWS	National Weather Service
O_3	ozone
OLM	Ozone Limiting Method; Tier 3 NO-to-NO_2 chemical transformation method
Particulate matter (PM)	Air pollutant comprised of solid or liquid particles; PM is usually characterized based on the particle size. See also PM_{10} and $PM_{2.5}$
PM_{10}	"Coarse" inhalable particulate matter with an aerodynamic size less than or equal to 10 micrometers (microns)
$PM_{2.5}$	"Fine" inhalable particulate matter with an aerodynamic size less than or equal to 2.5 micrometers (microns)
ppb	Parts per billion
PSD	Prevention of Significant Deterioration
PVMRM	Plume Volume Molar Ratio Method; Tier 3 NO-to-NO_2 chemical transformation method
RAWS	Remote Automated Weather Stations
SCC	Source Classification Code
SCR	Selective Catalytic Reduction
SER	Significant Emission Rate
SIA	Significant Impact Area
SIC	Standard Industrial Classification
SIL	Significant Impact Level

ED_013256A_00000460-00006

SMC ..... Significant Monitoring Concentration

SO_2 ..... Sulfur dioxide, a criteria air pollutant

SPECIATE..... A database giving fractions of particulate matter sub-species

SQER..... Small Quantity Emission Rate

TAP ..... Toxic Air Pollutant

T-BACT ..... Best available control technology for toxic air pollutants

tpy ..... Tons per year, an estimate of annual emissions

$\mu g/m^3$ ..... Micrograms per cubic meter (a metric used in quantifying concentrations of air pollutants)

USFS ..... U.S. Forest Service

USFWS ..... U.S. Fish and Wildlife Service

USGS..... U.S. Geological Survey

VOC..... Volatile organic compound

Volume source..... An emission source type defined in AERMOD. Volume sources emit diffuse air pollutants from a three-dimensional area. Line sources, such as emissions from transiting trains, can be simulated using multiple, adjacent volume sources

WAAQS..... Washington Ambient Air Quality Standards

WAC..... Washington Administrative Code

WRF ..... The Weather Research and Forecast model, a meteorological model

ED_013256A_00000460-00007

1. INTRODUCTION

PacWest Silicon, Inc. (PacWest, formerly called HiTest Silicon) proposes to construct a facility near Newport, Washington to produce very high-quality silicon. The proposed facility boundary would be adjacent to the Washington-Idaho border, as shown in Figure 1. Primary access for both employees and truck deliveries would be via a road to be constructed under or near the electric lines that run east-to-west along the north boundary of the property, out to Washington Highway 2 west of the property. A rail loop would also be constructed to the west of the main facility, to facilitate the delivery of certain raw materials. The details of the road and rail lines are not final at this time, but will be presented in the Prevention of Significant Deterioration (PSD) application.

PacWest owns and operates a mine east of Golden, British Columbia (BC) Canada, but can only process about one third of the annual permitted production rate. The deposit being mined contains very high purity quartz (silicon dioxide) in the form of sand, with nearly no other minerals or organic matter mixed in.

The sand/quartz would be brought by rail from the mine in BC to the rail loop adjacent to the proposed facility, as would low-sulfur coal, and would be unloaded and moved via conveyor belt to storage on-site. Local wood chips and charcoal would be brought to the facility by truck and stored on-site. All raw materials would be stored in enclosed sheds, not open piles, to reduce fugitive emissions.

An electric submerged arc furnace process would then be used to reduce the silica in the quartz, essentially removing the O_2 from each SiO_2 atom to create CO_2, leaving solid Si as the main product. SiO gas formed in the process sublimates to produce SiO_2 in the form of amorphous silica fume, releasing oxygen-free radicals which, given the high temperatures, react with atmospheric nitrogen to form NOx. The sulfur in the coal reacts to form SO_2, and particulate matter (PM) is also produced as a by-product.

A large baghouse would be used to reduce PM from the furnaces and from the refining/casting room. Because most of this PM is actually high-grade silica fume, the main baghouse filtrate would be bagged and sold as a product. Smaller bag houses would control PM from the crushing/screening operation, and from material handling (moving materials from the storage sheds to the furnaces). All conveyance

ED_013256A_00000460-00008

systems would be covered, as would the rail and truck offload stations. PM emissions would be controlled by misting.

Other emission units planned for the facility include an emergency generator, and an emergency water pump.

The common methods to control NOx and SO_2 have never been implemented in the silicon smelting industry. Traditional wet scrubber systems to control SO_2 would produce more wastewater than the Newport wastewater treatment plant National Pollutant Discharge Elimination System (NPDES) permit allows and would require more water be input than is available. Traditional selective catalytic reduction (SCR) can control NOx but produces ammonium nitrate as a byproduct which must be filtered via a baghouse. Because PacWest does not want ammonium nitrate mixed with their silicon dust product, SCR would have to be introduced into the flue gas stream after the main baghouse, where the temperature of the flue gas makes SCR much less efficient. A Best Available Control Technology (BACT) analysis will be presented that details each of these possible control methods.

Current plans call for construction of two furnaces, but the proposed facility layout would leave room for two additional furnaces to potentially be constructed in the future. Future market forces and availability of capital will control whether the two additional furnace lines will ever be built.

PacWest intends to submit a permit application to obtain an Order of Approval to Construct, and a PSD permit from the Washington Department of Ecology (Ecology).

1.1 Project Emissions and Regulatory Analysis

The facility will fall under Standard Industrial Classification (SIC) code 3339, "Primary Smelting and Refining of Nonferrous Metals, Except Copper and Aluminum."[1] As such, it will not be one of the 28 named sources found at 40 CFR 51.166(b)(1).

The proposed project area is either in attainment or unclassifiable for all National Ambient Air Quality Standards (NAAQS).

[1] https://www.osha.gov/pls/imis/sic_manual.display?id=304&tab=description

ED_013256A_00000460-00009

Emission calculations for the proposed facility will be based on BACT, engineering calculations, fuel usage, and operating hours. Potential emission calculations for the two furnaces are based on continuous operation (24 hours per day, 365 days per year). PacWest has invested considerable effort in a refined design of the furnaces and hoods, using detailed computational fluid dynamics modeling. The results indicate a considerable reduction in the emission factor for NOx (lb. per ton Si produced) compared to the most recent similar facility constructed in the United States. By blending the use of charcoal with coal as the source of carbon, the SO_2 emission factor can also be reduced – as well as reducing the CO_2 from fossil fuels (as opposed to carbon already in the biosphere).

Emission calculations for the emergency generators are based on weekly test runs of no more than one hour per run (up to 100 hours per year of operation). PacWest plans to use water misting technology for dust containment at all partially enclosed discharge and drop points, and to keep the wood chips saturated with moisture. Covered storage will be used for quartz, coal, and charcoal. Baghouses would control fugitive dust from material handling.

1.1.1 Criteria Pollutant Emissions

Preliminary calculations of the PSD pollutant emissions attributable to the proposed project are presented in Table 1, and compared to the applicable Significant Emission Rates (SERs). These preliminary calculations indicate the project's NO_X, CO, SO_2, PM_{10}, $PM_{2.5}$, and greenhouse gas emission increases are expected to be greater than the applicable SERs. Because NO_X and SO_2 emission increases are above the SERs, an analysis of the proposed source contribution to secondary $PM_{2.5}$ and ozone increases will be required.

1.1.2 Toxic Pollutant Emissions

Washington Administrative Code (WAC) 173-460 requires the evaluation Toxic Air Pollutant (TAP) emission increases from new and modified sources. Preliminary estimates indicate that the new furnaces will emit small quantities of TAPs. Emissions of TAPs will be estimated based on the BACT for Toxics (T-BACT) analysis, emission factors from the U.S. Environmental Protection Agency's (EPA's) AP-42 reference guide, and publicly available source tests from other similar silicon smelters.

ED_013256A_00000460-00010

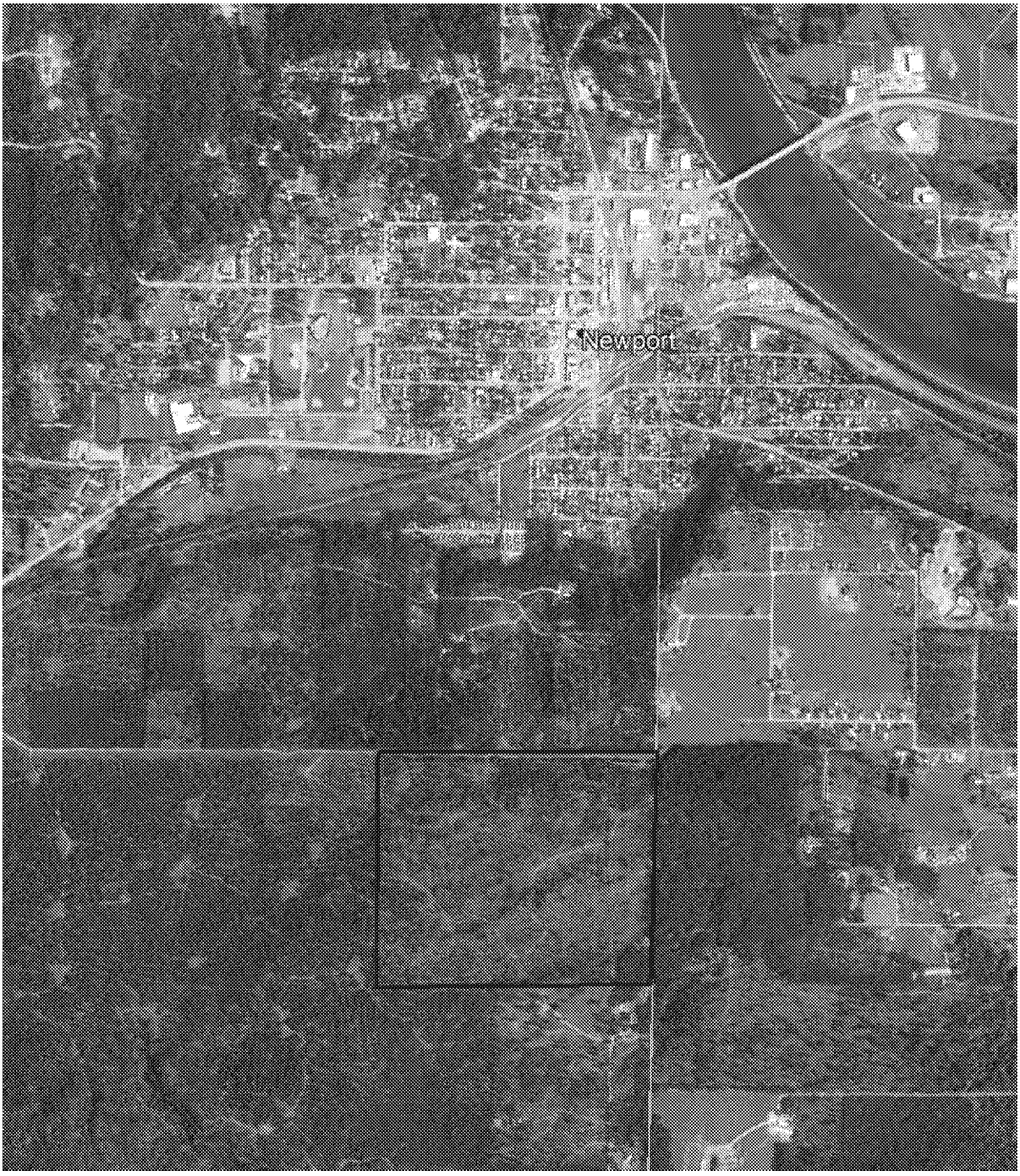


Figure 1. PacWest Facility Location and Property Boundary

Table 1. Preliminary Project Emissions Increases

PSD Pollutant	Preliminary Project Emission Increases (tpy)	PSD Significant Emission Rate (tpy)	Triggers PSD?
NOx	935	40	Yes
CO	307	100	Yes
SO_2	649	40	Yes
PM	45	25	Yes
PM_{10}	36	15	Yes
$PM_{2.5}$	34	10	Yes
VOC	90	40	Yes
Pb	0.1	0.6	No
Fluorides	1	3	No
H_2SO_4	1	7	No
Greenhouse Gases	766,131	75,000	Yes
Total HAPs	23	25	No
Max of any HAP	8	10	No

ED_013256A_00000460-00012

2. CLASS II MODELING METHODOLOGY

Air quality impact assessments (AQIAs) are performed using dispersion modeling techniques in accordance with the EPA's Guideline on Air Quality Models (codified as Appendix W to 40 CFR Part 51, hereafter referred to as the Guideline). The results of a modeling analysis can exempt the applicant from ambient air monitoring or cumulative source modeling.

The local AQIA will include emissions attributable to the proposed emission units. The purpose of the AQIA is to assess potential impacts of the proposed project on air quality in the area surrounding the proposed site. Computer-based dispersion modeling techniques will be applied to simulate criteria and toxic air pollutant releases from the facility to assess compliance with PSD Increments, the NAAQS the Washington Ambient Air Quality Standards (WAAQS), and Ecology's Acceptable Source Impact Levels (ASILs) for toxic air pollutants. This section describes the techniques for the AQIA. This analysis will focus on the prediction of concentrations of pollutants directly emitted by the proposed and affected emission units, but also addresses near-field secondary pollutants.

Dispersion modeling techniques are also used to assess potential impacts to Class I areas, including degradation of visibility and other air-quality-related values (AQRVs). The "regional" AQRV analysis is described in Section 3 of this modeling protocol.

2.1 Dispersion Model Selection

The rationale for the dispersion modeling approach is based on the Guideline, considerations of the local terrain, and the emission units' characteristics. AERMOD is currently the preferred dispersion model recommended by the Guideline for complex source configurations, emission units subject to exhaust plume downwash, and situations where there is the potential for exhaust plumes to interact with complex terrain.

AERMOD is proposed for the modeling analysis primarily because it is the most up-to-date near-field dispersion model currently available. Additionally, the modeling domain and source configuration suggests the potential for exhaust plume downwash and plume impacts on intermediate and complex terrain.

ED_013256A_00000460-00013

2.2 Modeling Methodology

AERMOD will be applied to calculated emissions using regulatory defaults, in addition to the options and data discussed in this section.

2.2.1 Model Setup

The most recent version of AERMOD (currently version 18081) will be applied with the default options for dispersion that depend on representative meteorological data, regional upper air data, and the local physical characteristics of land-use. AERMOD contains several options for urban dispersion that were not selected for these analyses due to the rural characteristics of the area in which the facility is proposed.

2.2.2 Meteorology

A 10-meter meteorological (MET) tower operated by the Idaho Department of Transportation (ID41, mesowest ITDA8, Old Town[2]) is located just east of the site. However, the Idaho Department of Transportation does not perform any audits or other quality control on their meteorological towers. This precludes its use in a PSD permit. Additionally, there appear to be significant obstructions within 10 times the mast height (100 m).

A Remote Automated Weather Station (RAWS) station is located approximately 24 km southeast of the site (HOOI1, Blanchard - Hoodoo[3]). The site is located in a small circular clearing within a stand of trees, with a radius of approximately 35 m. Many RAWS meteorological sites use a 3 m mast, so the nearest obstruction (a tree) is not within 10 times the height of the mast. Furthermore, RAWS sites are typically audited/calibrated only every few years.

The closest National Weather Service (NWS) meteorological station is at Deer Park (KDEW), approximately 36 km southwest of the proposed site. The Deer Park airport is known as a haven for glider plane enthusiasts, due to the relatively higher wind speeds in the region. This region of high wind speeds does not extend to the Newport area, such that KDEW would not be a "representative" site in the terms discussed in Appendix W, Section 8.3.

---

[2] http://lb.511.idaho.gov/idlb/cameras/camera.jsf?id=122&view=state&text=m&textOnly=false
[3] http://mesowest.utah.edu/cgi-bin/droman/station_total.cgi?stn=HOOI1&unit=0

ED_013256A_00000460-00014

PacWest did not install its own meteorological tower in anticipation, so no on-site data exists. With no nearby representative meteorology of suitable quality for a PSD permit available, we propose to follow Appendix W and rely on meteorological data produced by a prognostic weather model.

A three-year meteorological database will be constructed using the Weather Research and Forecasting (WRF) model. WRF outputs will be processed using the Mesoscale Model Interface (MMIF) processor to create an ONSITE datafile and a file that mimics the output of AERSURFACE. The AERMOD meteorological preprocessor, AERMET (version 18081) will be used to process these files.

A WRF Model Performance Evaluation (MPE) and justification of the use of WRF data for the situation was submitted with this Protocol.

2.2.3 Receptor Network and Terrain

The 20 km by 20 km modeling domain proposed for the AQIA is shown in Figure 2. Terrain elevations for receptors and emission units will be prepared using available 1/3 arc-second (~10m) data from the National Elevation Dataset (NED) developed by the United States Geological Survey (USGS).

An initial receptor set has been developed to be used for the AQIA. The initial receptor set includes receptors spaced 500 m apart covering the outermost portion of the simulation domain. Nested grids of 50-m and 250-m spaced receptors will cover 2-km and 6-km square areas centered on the facility. Maximum AERMOD-predicted concentrations located in coarse receptor areas (i.e., receptor spacing greater than 50 m) will be further investigated using a localized fine receptor grid. Receptors will also be located at 10 m intervals along the facility property boundaries. The initial receptor locations are shown in Figure 2. The base elevation and hill height scale for each receptor will be determined using AERMAP (version 18081).

2.2.4 Emission Unit Parameters

The AQIA requires estimates of the stack heights and other stack exit parameters to characterize the exhaust flow from the emission units. Stack parameters for the proposed facility will be obtained from vendors and included in the permit application.

ED_013256A_00000460-00015

In addition, the stack locations and building locations with dimensions will be provided to AERMOD to assess potential downwash effects. Wind direction-specific building profiles will be prepared by using the EPA's Prime version of the Building Profile Input Program (BPIP PRIME). The base elevation of each emission unit will be estimated using AERMAP.

2.2.5 Good Engineering Practice Analysis

A good engineering practice (GEP) stack height design analysis will be conducted based on the specifications of the buildings according to EPA procedures (EPA 1985a). Releases below the GEP stack height are potentially subject to building wake effects that can result in relatively high ground level predictions from the EPA's regulatory models. For the purposes of PSD review, the EPA does not allow credit for the added dispersion associated with releases above the GEP stack height and restricts the simulated heights in the modeling to the GEP stack height.

ED_013256A_00000460-00016

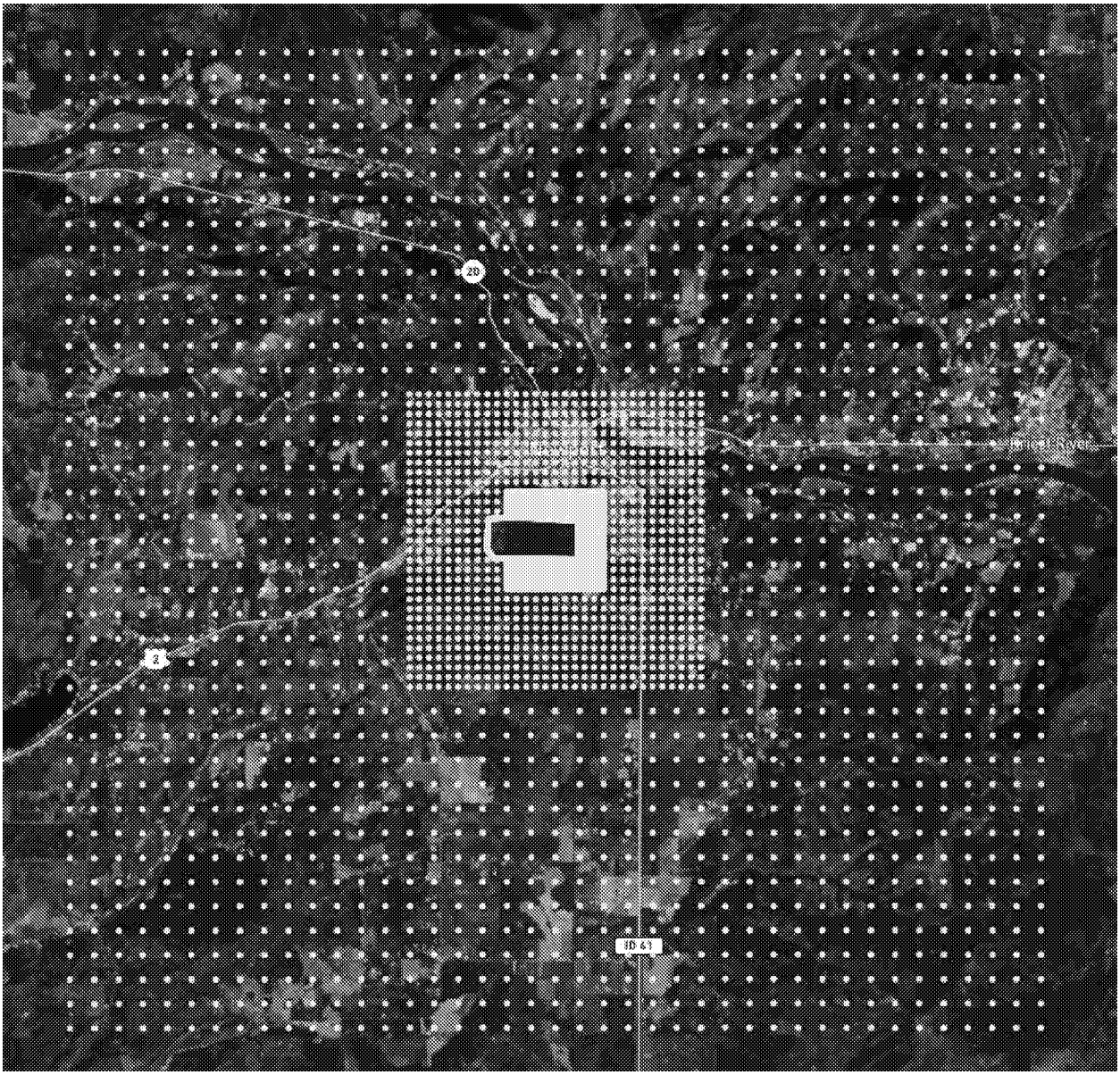


Figure 2. 20 km by 20 km Receptor Grid

A GEP stack height determination will be made for the proposed exhaust stacks for each new emission unit. GEP stack height is equal to the height of the building which has the dominant wake effect ("zone of influence") on the stack plume plus 1.5 times the lesser of (1) that building's maximum projected width, or (2) the building height. This GEP stack height is expressed in the following equation:

$$Hg = H + 1.5\ L \qquad \text{(Equation 1)}$$

Hg is the GEP stack height, H is the building height, and L is the lesser of the maximum projected building width or height.

Use of a stack with the GEP stack height removes the plume completely from the building wake zone.

The cavity height is the stack height required to prevent the stack plume from entering the cavity region of the building. Pollutant plumes which are entrained into the cavity region of a building often produce extremely high concentrations. EPA defines cavity height by the following equation:

$$Hc = H + 0.5\ L \qquad \text{(Equation 2)}$$

Hc is the Cavity height, H is the building height, and L is the lesser of the maximum projected building width or height.

EPA's BPIP PRIME program will be used for the GEP analysis once the final building and stack locations for the new facility are available.

2.2.6 NO to NO_2 Chemical Transformations

We will follow EPA Guidance[4] for NO-to-NO_2 transformations. Initially, the Tier 1 approach of full conversion will be assumed. If the predicted NO_2 concentrations exceed the Significant Impact Level (SIL) or NAAQS, the Tier 2 Ambient Ratio Method 2 (ARM2) will be applied to predict the percentage of NOx that is NO_2 (equivalently, the percentage of NO converted to NO_2). At this time, we do not anticipate needing to use a Tier 3 method (Plume Volume Molar Ratio [PVMRM] or Ozone Limiting Method [OLM]).

2.3 Criteria Pollutant Significant Impact Level Assessment

Ambient concentrations of criteria pollutants due to emission releases from the proposed project will be predicted using AERMOD. Maximum short-term concentrations and annual average concentrations will be obtained for comparison with SILs.

---

[4] Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard, EPA/OAQPS, September 30, 2014. https://www3.epa.gov/scram001/guidance/clarification/NO2_Clarification_Memo-20140930.pdf

ED_013256A_00000460-00018

SILs have been established for various criteria pollutants, and are listed in Table 2. If pollutant concentrations exceed the SILs, then further evaluation is required to compare the project's concentrations to the Class II PSD Increments, the NAAQS, and the WAAQS. However, if all modeled ambient impact concentrations modeled for facility operations are less than the SILs then no further analysis will be required. Additionally, under PSD regulations, only facilities with impacts in excess of SILs are required to include the impacts of other facilities or consider collecting background ambient air quality information.

For 1-hour NO_2 and 1-hour SO_2 EPA's interim SIL (4 percent of the NAAQS) has been assumed to apply.[5] On January 22, 2013, the $PM_{2.5}$ SILs and Significant Monitoring Concentration (SMC) were vacated by the United States Court of Appeals for the District of Columbia Circuit. On August 1, 2016, EPA issued for public comment some draft guidance for $PM_{2.5}$, justifying suggested replacement SILs and SMC. That guidance was finalized on April 17, 2018, and we propose to use the SILs it suggests.

On December 2, 2016, EPA issued draft guidance on the use of Model Emission Rates for Precursors (MERPs) to estimate near-field secondary PM, and updated the guidance on February 23, 2017. Using the same reference source as will be used for the ozone analysis discussed in Section 2.9, we will calculate the contribution to near-field total $PM_{2.5}$ from primary NO_X (converted to ammonium nitrate) and primary SO_2 (converted to ammonium sulfate). This MERP contribution will be applied to all Class II receptors, but not to the Class I receptors discussed in Section 3.1. This methodology follows the 2017 updates to the Guideline, which we believe is more relevant than the guidance on air quality impact assessments issued on May 20, 2014.[6]

---

[5] General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO_2 Significant Impact Level. June 28, 2010 EPA Memorandum.
General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level. August 23, 2010 EPA Memorandum
[6] Available at
https://www3.epa.gov/scram001/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf

Table 2. Applicable Class II PSD Air Quality Standards

Pollutant	Significant Impact Levels (µg/m³)	Monitoring De Minimus Conc. (µg/m³)	PSD Class II Increment (µg/m³)	NAAQS / WAAQS [a] (µg/m³)
CO 8-hour	500	575	None	10,000
CO 1-hour	2,000	None	None	40,000
NO_2 annual	1	14	25	100
NO_2 1-hour [b]	7.5	None	None	188
SO_2 Annual	1	None	20	52
SO_2 24-hour	5	13	91	365
SO_2 3-hour	25	None	512	1300
SO_2 1-hour [c]	7.8	None	None	196
$PM_{2.5}$ annual [d]	0.2	None	4	12
$PM_{2.5}$ 24-hour [d]	1.2	4	9	35
PM_{10} 24-hour	5	10	30	150
O_3 8-hour [e]	2 (1 ppb)	None	None	137 (70 ppb)

Notes:

a The ambient air quality standards shown are the most stringent of the WAAQS and NAAQS. EPA has revoked the annual PM_{10}, annual SO_2, and 24-hour SO_2 standards.

b For the 1-hour NO_2 standard (188 µg/m^3, or 100 ppb), EPA provided an interim SIL of 7.5 µg/m³ (1-hr)

c For the 1-hour SO_2 standard (196 µg/m^3, or 75 ppb), EPA provided an interim SIL of 7.8 µg/m³ (1-hr)

d The $PM_{2.5}$ significance and monitoring de minimus levels were vacated on January 22, 2013 from the Federal PSD regulations. Draft SILs were released on August 1, 2016

e For the 8-hour O_3 standard (137 µg/m^3, or 70 ppb), EPA proposed a draft SIL of 1 ppb (1.96 µg/m^3) on August 1, 2016

ED_013256A_00000460-00020

2.4 Significant Impact Area Determination

If modeling results exceed the significance levels, the Significant Impact Area (SIA) will be determined for that pollutant and averaging period. The SIA is a circular area around the source with a radius equal to the distance to the farthest receptor with a concentration exceeding the significance level. It should be noted that the SIA will not exceed 50 km due to constraints of the dispersion model. The SIA is utilized to define the inventory for the full impact analysis. If required, inventory data will be gathered for all sources within up to 50 km of the SIA.

Only those receptors within the SIA where significance results are predicted to exceed the relevant SIL will be used in any full impact analysis. Only at those receptors could the facility potentially significantly contribute to a modeled NAAQS exceedance.

2.5 Preconstruction Monitoring Analysis

Pre-construction ambient monitoring may be required for any regulated pollutant that triggers PSD review. If the AERMOD-predicted maximum concentration for the project exceeds a monitoring de minimus concentration, ambient monitoring may be required unless existing ambient monitoring data are deemed representative of local conditions. The applicable monitoring de minimus concentration values are presented in Table 2.

2.6 PSD Class II Increment Consumption

For any pollutant/averaging time with a significant impact analysis concentration above the SIL, a Class II increment consumption analysis will be performed if an increment has been established for that pollutant/averaging time. The modeling assessment would normally include other sources with the potential to significantly consume increment within the SIA plus up to 50 km. Should such an analysis be required, Ramboll proposes to use data from Washington State University's Northwest International Air Quality Environmental Science and Technology Consortium's NW-AIRQUEST online tool (see Table 3) as a surrogate. The emissions inventory in the NW-AIRQUEST tool includes all increment-consuming and non-increment-consuming sources, and summing it with PacWest's predicted impacts would be a conservative demonstration of compliance with the Class II PSD increments.

ED_013256A_00000460-00021

Should such an analysis prove to be too conservative for some species, Ramboll will obtain off-property emission sources from Ecology and Idaho Department of Environmental Quality. The appropriate baseline date for the pollutant will be established and actual emissions changes from the baseline date will be estimated for offsite sources. The proposed facility will be modeled using potential emissions as they will be new emission units.

According to data available on Ecology's website[7] for Pend Oreille county, the minor source baseline dates are:

- SO_2 June 28, 1981
- TSP/PM_{10} March 20, 1979
- $PM_{2.5}$ None (not yet triggered)
- NOx None (not yet triggered)

This PSD permit will likely establish the minor source baseline dates for $PM_{2.5}$ and NOx. Any PSD increment consumption analysis should consider emissions increases from all major and minor new or modified sources permitted after the major and minor source baseline dates, respectively.

For increments with an annual averaging period, the highest model prediction will be compared to the applicable PSD increment. For shorter averaging periods, the highest second-high model-prediction will be compared to the applicable PSD increment.

2.7 Criteria Pollutant Ambient Air Quality Standards Assessment

NAAQS have been established by EPA and are presented in Table 2. Some of the criteria pollutants are subject to both "primary" and "secondary" federal standards. Primary standards are designed to protect human health with a margin of safety. Secondary standards are established to protect the public welfare from any known or anticipated adverse effects associated with these pollutants, such as soiling, corrosion, or damage to vegetation.

A NAAQS assessment will be based on AERMOD simulations of PacWest emissions and other industrial sources with the potential to significantly impact the same

[7] https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Air-emissions-inventory

receptors as the proposed facility. As with the Class II increment analysis, Ramboll will obtain emission inventory data from Ecology for other industrial sources. Emissions from all sources may be based on allowable emissions or maximum potential to emit estimates, or may be based on 2-year average actual/representative emissions. Data will be verified as necessary with other public records and any refinements will be documented in the modeling report. Only those receptors inside the SIA that exceed the SILs will be used in the NAAQS analysis, and only those averaging periods whose concentrations exceed the SILs will be considered.

If a NAAQS compliance demonstration is required, we will include applicable background pollutant concentrations from the nearest monitoring stations or from Washington State University's Northwest International Air Quality Environmental Science and Technology Consortium's NW-AIRQUEST online tool[8]. Table 3 contains preliminary background concentrations, obtained from the NW-AIRQUEST site. This online application provides spatially interpolated design values of criteria pollutants for the years of 2009-2011 for Idaho, Washington and Oregon. Ramboll may also develop seasonal or hour-of-day background values for the NAAQS assessment.

2.8 Toxic Air Pollutant Small Quantity Emission Rate Assessment

New and modified sources of TAPs are regulated on the state level by WAC 173-460. Under these regulations, emissions of TAPs from new emission units must be evaluated to ensure compliance with WAC 173-460-070. Additionally, new emission units must use T-BACT. T-BACT applies to each TAP or a mixture of TAPs that is discharged, taking into account the potency, quantity, and toxicity of each TAP.

Under these air toxic regulations, an initial evaluation is conducted and the results are compared to the Small Quantity Emission Rates. TAP emissions exceeding the corresponding Small Quantity Emission Rates (SQER) are then required to undergo air dispersion modeling for an ASIL analysis following WAC 173-460.

---

[8] Washington State University. NW AIRQUEST Design Value Lookup Tool. Available at http://www.lar.wsu.edu/nw-airquest/lookup.html

ED_013256A_00000460-00023

Because the facility borders the State of Idaho, an analysis using Idaho Administrative Code (IDAPA) 58.01.01.585 and 58.01.01.586 will also be performed, to insure compliance with both State's toxics programs.

The full TAPs assessment will be included in the PSD Application.

Table 3. Background Concentrations

Pollutant	Averaging Time	Averaging Method	NW-AIRQUEST Background Value
NO_2	1-hour	3-year avg. of 98th percentile of daily maxes.	10 µg/m^3
	Annual	Annual mean	1.7 µg/m^3
$PM_{2.5}$	24-hour	3-year average of the 98th percentile 24-hr averages.	14 µg/m^3
	Annual	3-year avg. of annual mean	4.6 µg/m^3
PM_{10}	24-hour	3-year avg. of 2nd highs	100 µg/m^3
SO_2	1-hour	3-year avg. of 99th percentile of daily max. 1-hour averages.	1.2 µg/m^3
	3-hour	2nd high	1.2 µg/m^3
	24-hour	2nd high	0.83 µg/m^3
	Annual	Annual mean	0.3 µg/m^3

2.9 Ozone and Secondary $PM_{2.5}$ Assessment

Initial proposed NO_X and SO_2 emission increases from the facility are above the SERs, triggering an analysis of the facility's potential contribution to ozone (O_3) and secondary $PM_{2.5}$ formation. Although proposed VOC emission increases are not above the SER, VOC emissions are incorporated into ozone MERP calculations as a conservative approach.

Following the draft Guidance on the use of MERPs for PSD permitting, Tier I methodologies were used to calculate the contributions to ozone and $PM_{2.5}$ associated with preliminary facility emission increases. Table 4 presents the most conservative MERP values for highest maximum daily 8-hour ozone, daily maximum

$PM_{2.5}$, and annual average $PM_{2.5}$ in the eastern, central, and western United States (adapted from Table 7-1 in the draft MERP guidance). If proposed emission increases are below the most conservative MERP values, no additional calculations are required to demonstrate that proposed emissions will result in ozone and $PM_{2.5}$ increases below the critical air quality threshold (SILs). For $PM_{2.5}$, NOx and SO_2 emissions must be considered together, along with NOx and VOC emissions for ozone.

The conservative Western US NOx and SO_2 MERP values for 8-hr ozone and daily $PM_{2.5}$, respectively, are lower than proposed NOx and SO_2 emissions so further analysis is required to estimate the impact of proposed emissions on 8-hr O_3 and daily $PM_{2.5}$. When proposed NOx and SO_2 emissions are considered together, the combined emissions are well below (58%) the combination of conservative NOx and SO_2 MERP values for annual average $PM_{2.5}$ in the Western US. Therefore, no further analysis is required to demonstrate that the proposed emissions will not increase annual average $PM_{2.5}$ concentrations by more than the SIL (0.2 μg/m^3).

Table 4. Most Conservative Illustrative MERP Values (TPY)

Precursor	Area	8-hr O_3	Daily $PM_{2.5}$	Annual $PM_{2.5}$
NO_X	CUS	126	1693	5496
	EUS	170	2295	10144
	WUS	184	1075	3184
SO_2	CUS	-	238	839
	EUS	-	628	4013
	WUS	-	210	2289
VOC	CUS	948	-	-
	EUS	1159	-	-
	WUS	1049	-	-

Notes:
"CUS" = Central United States, "EUS" = Eastern United States, "WUS" = Western United States
Source: Adapted from Table 7-1 in the draft MERP guidance

For 8-hr ozone and daily $PM_{2.5}$, the relationship between precursor emissions and secondary chemistry formation from a modeled hypothetical source in Morrow, OR

ED_013256A_00000460-00025

(source 18) with a high stack height (90 m) and 500 tpy emission rates was used in Tier I calculations. Figure A-3 in the draft Guidance shows the locations of modeled hypothetical sources. Modeled hypothetical sources in Yellowstone County, MT (source 11) and Klickitat County, WA (source 23) were also considered and source 18 was chosen to be conservative, as it resulted in the highest estimated ozone and $PM_{2.5}$ increases.

Table 5 shows the ozone and $PM_{2.5}$ increases associated with the hypothetical source in Morrow, OR.

The daily maximum $PM_{2.5}$ increases from NO_X and SO_2 emissions associated with source 18 are used to calculate the daily maximum secondary $PM_{2.5}$ increase from the proposed facility in the following equation:

$$\frac{935\ TPY\ NOx\ from\ proposed\ facility}{500\ TPY\ NOx\ from\ source\ 18} \cdot 0.15\,\frac{\mu g}{m^3} + \frac{649\ TPY\ SO_2\ from\ proposed\ facility}{500\ TPY\ SO_2\ from\ source\ 18} \cdot 0.19\,\frac{\mu g}{m^3} = 0.53\ \frac{\mu g}{m^3}$$

Table 5. MERP analysis results for $PM_{2.5}$ and ozone.

Precursor	Daily $PM_{2.5}$ ($\mu g/m^3$)	8-hr O_3 (ppb)
NO_X	0.15	1.94
SO_2	0.19	-
VOC	-	0.46
Sum	0.34	2.40

It is estimated that the NO_X and SO_2 emissions from the proposed facility will lead to a 0.5 $\mu g/m^3$ increase in daily maximum secondary $PM_{2.5}$. Although not described in detail here, a similar approach was used to estimate an annual average secondary $PM_{2.5}$ increase of 0.02 $\mu g/m^3$ from the proposed facility. Estimated total (primary + secondary) $PM_{2.5}$ increases associated with the facility will be compared to the SIL.

The daily maximum 8-hour ozone increases from NO_X and VOC emissions associated with source 18 are used to calculate the daily maximum 8-hour ozone increase from the proposed facility in the equation below:

$$\frac{935\ TPY\ NOx\ from\ proposed\ facility}{500\ TPY\ NOx\ from\ source\ 18} \cdot 1.94\ ppb + \frac{90\ TPY\ VOC\ from\ proposed\ facility}{500\ TPY\ VOC\ from\ source\ 18} \cdot 0.46\ ppb = 3.7\ ppb$$

ED_013256A_00000460-00026

This calculation suggests that the proposed facility will increase daily maximum 8-hour ozone by 3.7 parts per billion (ppb), which is above the proposed SIL (1 ppb). This increase is largely driven by proposed NOx emissions, which are over an order of magnitude higher than proposed VOC emissions.

Because the Tier 1 methodology of using the MERP guidance did not predict an ozone concentration below the proposed SIL, further analysis is needed to ensure that facility ozone increases do not lead to ozone NAAQS exceedances. Estimated ozone contributions associated with the proposed facility (3.7 ppb) are roughly 4 times the proposed ozone SIL (1 ppb). In accordance with recent EPA guidance[9], the estimated ozone contribution is close enough to the proposed ozone SIL to allow for a qualitative assessment of the cumulative impacts of ozone in the region surrounding the proposed facility.

In this assessment, the estimated ozone contribution from the proposed facility is added to representative regional background ozone concentrations and compared to the difference between the ozone NAAQS and SIL (i.e., 75 ppb – 1 ppb = 74 ppb).

The closest EPA Air Quality System (AQS) monitoring site to the proposed PacWest facility is located in Green Bluff, Washington, roughly 40 kilometers southwest of Newport. Figure 3 shows the location of the Green Bluff AQS monitoring site.

[9] Presentation by Tyler Fox at AWMA Specialty Modeling Conference (November 14, 2017, Research Triangle Park, NC).

ED_013256A_00000460-00027

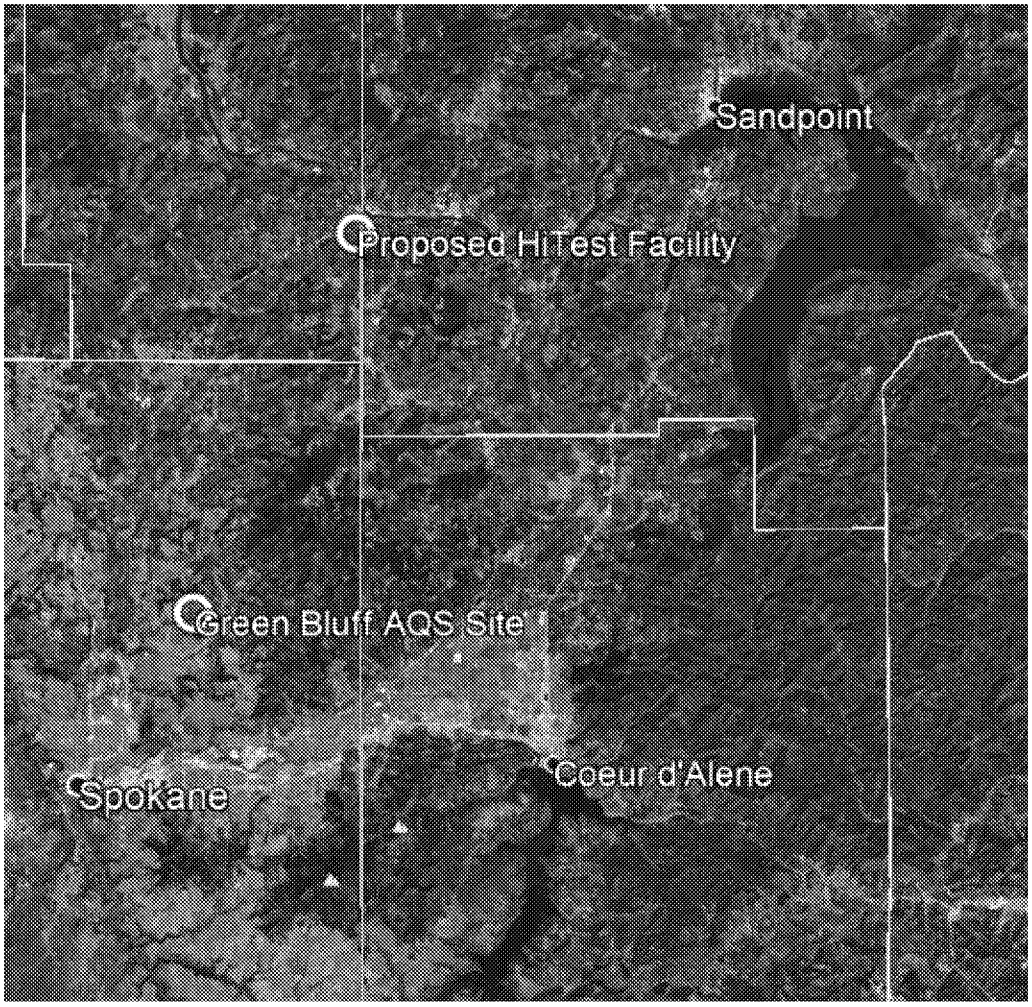


Figure 3. Location of Green Bluff AQS Monitoring Site

The ozone design values (3-year average of 4th highest daily 8-hour maximum ozone concentrations) from 2009 to 2016 range from 57 to 62 ppb, as shown in Table 6.

ED_013256A_00000460-00028

Table 6. Ozone Design Values at Green Bluff, WA

Years	Ozone Design Value (ppb)
2007-2009	60
2008-2010	58
2009-2011	57
2010-2012	59
2011-2013	60
2012-2014	62
2013-2015	62
2014-2016	60

The AQS ozone design values at Green Bluff, WA are generally consistent with the 2009-2011 ozone design values (55 ppb) from the NW-AIRQUEST[10] website for the coordinates of the proposed Facility (48.162584°, -117.046194°).

If the maximum ozone design value (62 ppb) from Table 6 is used to represent recent background ozone concentrations in the region, the combination of background ozone and predicted Facility ozone increases (65.7 ppb) is still well below the difference between the current ozone NAAQS and proposed SIL (74 ppb).

2.10 Additional Impact Analysis

40 CFR 51.21(o) requires an analysis of the impairment to visibility, soils and vegetation that would occur as a result of the project, as well as other residential/industrial growth that the project may trigger.

A qualitative analysis will be presented in the PSD application to address most of these topics, with the exception of visibility in the Kalispel Reservation (which has been explicitly requested). For the latter, a model such as VISCREEN, PLUVUE II, or CALPUFF will be used. Class I settings will taken from those of the Cabinet

[10] NW-AIRQUEST daily 8-hr maximum ozone Design Values from 2009-2011 at coordinates 48.162584°, -117.046194° were obtained from: http://lar.wsu.edu/nw-airquest/lookup.html

Mountains, the closest and probably climatically most similar mandatory Class I area.

ED_013256A_00000460-00030

3. CLASS I MODELING METHODOLOGY

PSD regulations require an analysis to address both Class I PSD increments, and Class I AQRVs. Ecology is responsible for reviewing the former, while the Federal Land Managers (FLMs) are responsible for reviewing the latter.

3.1 Class I PSD Increment Assessment Methodology

The Spokane Indian Reservation has been redesignated a Class I area under the PSD program but has not requested AQRV protections, only the added protection of the Class I PSD increments. Similarly, the Kalispel Tribe of Indians sent a letter to EPA (on May 11, 2017) proposing to redesignate the Kalispel Indian Reservation a Class I area under the PSD program. Like the Spokane Tribe, the Kalispel Tribe has not requested AQRV protections, only the added protection of the Class I PSD increments. We assume that EPA will act to redesignate the Kalispel Indian Reservation before this PSD permit is granted, and will treat it as a Class I area.

The Kalispel Indian Reservation is approximately 22 km from the proposed site, while the distance to the Spokane Indian Reservation is approximately 53 km (Figure 4). Additionally, as shown in Section 3.2, there is one federally mandated Class I area within 100 km of the facility (the Cabinet Mountain Wilderness Area at approximately 94 km) and ten federally mandated Class I areas within 300 km of the facility. See Section 3.2 for a "Q/D" screening methodology following the Federal Land Managers' (FLMs) Air Quality Related Workgroup (FLAG) 2010 guidance to select which Class I areas must be included in the assessment.

Table 7 summarizes the applicable Class I PSD increments and proposed Class I SILs. At this point, there are two sets of Class I SILs, those proposed by EPA and those recommended by the FLMs. These proposed and recommended SILs were obtained from the Federal Register, Vol. 61, No. 143, p. 38292, July 23, 1996, and from the draft guidance of August 1, 2016 (revised August 18, 2016), respectively.

Because the distance is less than 50 km, we will perform the Class I PSD increment analysis for the Kalispel Indian Reservation using AERMOD. We will follow the modeling methodology detailed in Section 2, and include the MERP-predicted contributions for $PM_{2.5}$. Modeling receptors will be placed at 200 m intervals within the boundaries of the Kalispel Indian Reservation with additional receptors placed along the perimeter at 100 m spacing, resulting in 1363 receptors. If initial

ED_013256A_00000460-00031

modeling results show a steep gradient, then a nest of finer receptors will be added and the model re-run to insure the model is not "missing" the highest value.

Initially, an AERMOD technique will be applied to assess Class I PSD increments at the Spokane Indian Reservation (SPOK) and the Cabinet Mountains WA (CAMO). A series of arcs of receptors will be placed at 50 km radius from the proposed facility, using the minimum and maximum angles between the facility and the Class I receptors, plus 20°. The receptor arc will use elevations and hill heights set at ten (10) equal intervals between the minimum and maximum elevations within the Class I area. Each Class I area will have its own set of receptors, specific to the range of elevations found within it.

Should the respective AERMOD analyses for the Kalispel and Spokane Indian Reservations predict highest second high (H2H) values that exceed the Class I SILs, then we propose adding model predictions to the design values from the NW-AIRQUEST design value Lookup Tool[11] to address the Class I PSD increment.

The NW-AIRQUEST tool uses a 2009 emissions inventory. We will use EPA State-wide inventories of SO_2 to show the decrease in SO_2 emissions since 2009, indicating that using the Lookup Tool without scaling is conservative. The 2009 emissions inventory contains all other nearby sources of SO_2, both increment-consuming sources and those built before the baseline trigger date. Therefore, adding the concentrations from the Lookup Tool to the predicted concentrations will be a conservative over-estimate of the Class I PSD increment consumption. If the sum is below the increment, that will indicate compliance.

Should the AERMOD-with-arcs technique for CAMO predict H2H values that exceed the Class I SILs, CALPUFF will be used in screening mode. The CALPUFF modeling will mostly follow the modeling methodology detailed in Section 3.2, with the exception of turning "off" the chemistry and deposition schemes which have never been officially accepted by EPA. The FLM-specified receptors will be used for CAMO for the CALPUFF screening run.

[11] Available at http://lar.wsu.edu/nw-airquest/lookup.html

ED_013256A_00000460-00032

Table 7. Class I Area Significant Levels and Increments

Pollutant	Averaging Period	PSD Class I Increment	EPA SIL [a]	FLM SIL [a]
PM_{10}	Annual	4	0.2	0.08
	24-hour	8	0.3	0.27
$PM_{2.5}$	Annual	1	0.05 [b]	--
	24-hour	2	0.27 [b]	--
SO_2	Annual	2	0.1	0.03
	24-hour	5	0.2	0.07
	3-hour	25	1	0.48
NO_2	Annual	2.5	0.1	0.03

Notes:

a – SIL = Significant Impact Level; EPA proposed and FLM recommended from the Federal Register, Vol. 61, No. 142, p. 38292, July 23, 1996.

b – The Class I $PM_{2.5}$ SILs were vacated on January 22, 2013. New SILs have been circulated for public comment, which we propose to use.

3.2 Class I Air Quality Related Values Methodology

PSD guidance requires an analysis of potential impacts to AQRVs in Federal Class I areas within 100 km of the project. However, the FLMs have in the past requested analyses of AQRV impacts for additional Class I areas within 300 km of the site. Starting with FLAG (2010), there is no maximum distance when considering which Class I areas to include – inclusion is triggered by having a "Q/D" screening value that exceeds 10. There are ten federally mandated Class I areas with 300 km of the proposed facility. Figure 4 displays the location of the site with a 300-km ring encircling it, and shows the closest Class I areas along with the two relevant Reservations.

The "Q/D" screening method is used to choose which Class I areas should be included in the modeling. Because neither the Kalispel Tribe nor the Spokane Tribe of Indians has requested AQRV protections, their reservations will not be included in the AQRV analysis, regardless of their Q/D values. Note however visibility in the

Kalispel Indian Reservation will be address in the Additional Impact Analysis, see Section 2.10.

Table 8 lists the approximate distance between the site and the Class I areas, as well as the initial Q/D values (total emissions in tons per year, divided by the distance in km). The preliminary net emission increase (Q) is based on the sum of the maximum 24-hour NO_X, SO_2, PM_{10}, and H_2SO_4 emissions from the proposed facility, expressed in tons per year. Note that a Q/D screening value of 10 is the screening threshold currently under consideration by the FLMs. With such a low potential for Class I impacts, we believe an AQRV analyses other than for the Cabinet Mountains WA may not be required. In the event that FLMs still require an AQRV assessment, we are providing this protocol to define our assessment methodology.

At the request of the National Park Service, we will include Glacier NP in the analysis.

ED_013256A_00000460-00034

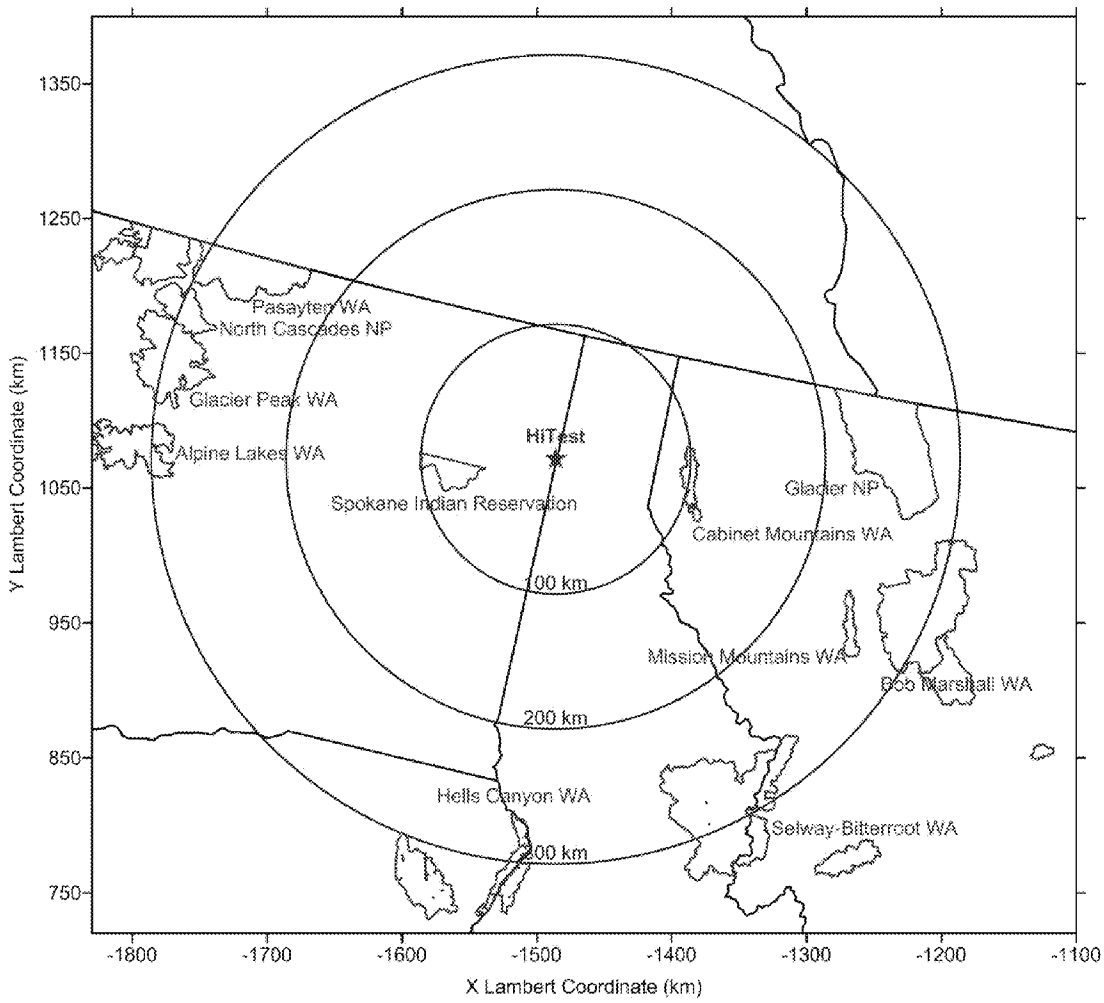


Figure 4. Class I Areas within 300 km of the proposed facility

The proposed modeling domain shown in Figure 5 includes a buffer of at least 50 km around the Glacier NP boundary and a buffer of at least 100 km around the proposed facility. If any FLM requests that another Class I area be included in the analysis, the modeling domain will be expanded using the same 50 km buffer criteria.

The proposed modeling domain also includes the Spokane Indian Reservation, to allow for the possibility of using CALPUFF as a screening model to address Class I PSD increments there.

Table 8. Mandatory Class I Areas Within 300 km, with initial Q/D

ID	Name	Approximate distance to closest part of Class I area (km)	Preliminary Q/D Value (tpy/km)
CAMO	**Cabinet Mountains WA**	**90**	**17.22**
GLAC	Glacier NP	205	7.56
PASA	Pasayten WA	217	7.14
MIMO	Mission Mountains WA	229	6.77
SELW	Selway-Bitterroot WA	235	6.59
BOMA	Bob Marshall WA	248	6.25
GLPE	Glacier Peak WA	251	6.17
HECA	Hells Canyon WA	255	6.08
NOCA	North Cascades NP	259	5.98
ALLA	Alpine Lakes WA	272	5.70
EACA	Eagle Cap WA	289	5.36

Note:
Bolded areas indicate required AQRV analysis based on Q/D value

ED_013256A_00000460-00036

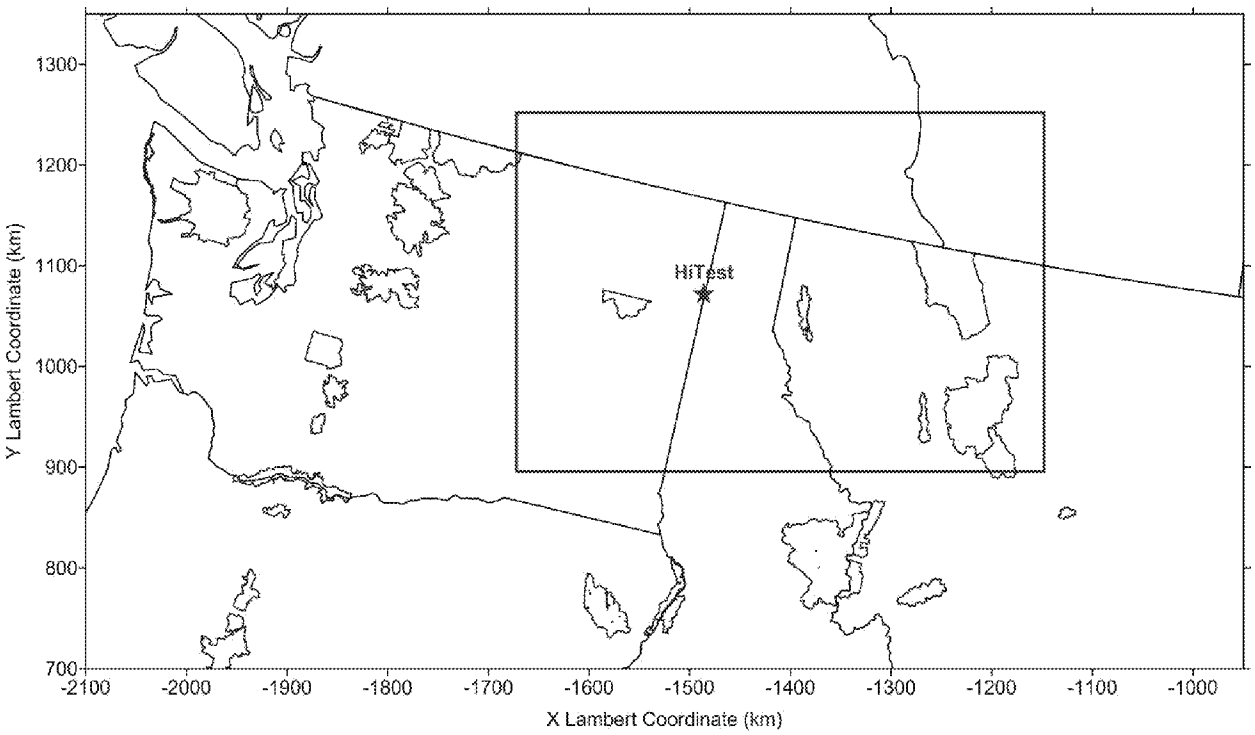


Figure 5. Proposed CALPUFF Modeling Domain

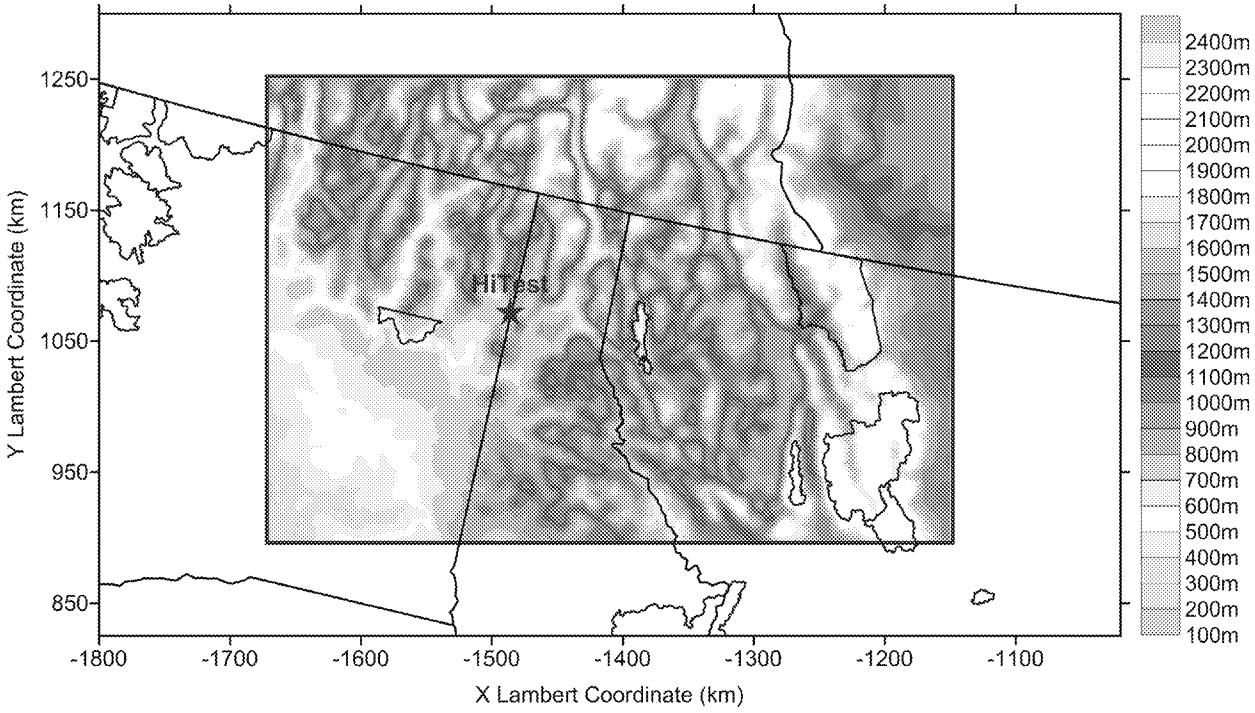


Figure 6. Proposed Domain with 4 km Resolution Terrain

3.2.1 Dispersion Model Selection

On April 15, 2003, EPA adopted the CALPUFF modeling system as the EPA's preferred model for long-range transport assessments and for evaluating potential impacts to Class I areas by including CALPUFF in Appendix A of the EPA's Guideline on Air Quality Models (codified as Appendix W to 40 CFR Part 51). Features of the CALPUFF modeling system include the ability to consider secondary aerosol formation, gaseous and particle deposition, wet and dry deposition processes, and complex three-dimensional wind regimes.

On May 22, 2017, revisions to the Guideline became effective that (among other changes) removed CALPUFF from Appendix A. However, as detailed in the preamble of the proposed rulemaking, this action does not affect the use of CALPUFF under the FLM's guidance regarding AQRV assessments (FLAG 2010).

Ramboll will use CALPUFF version 5.8.5, dated December 14, 2015. This is the most recent "official" EPA version of CALPUFF, and corrects several errors present in the previous versions of CALPUFF, as detailed in Model Change Bulletins E, F, G, and H. CALPOST version 6.221, level 080724 will be used for post processing. As detailed in Section 3.2.5, we will use the latest version of Mesoscale Model Interface program (MMIF) in place of CALMET.

3.2.2 Modeling Methodology Summary

The modeling procedures will follow FLAG and Interagency Workgroup on Air Quality Modeling (IWAQM) recommendations, in particular, FLAG (2000, revised October 2010)[12] and IWAQM (1998) guidance documents. FLAG (2010) revises some procedures in the FLAG (2000) report, the most significant revisions are related to visibility impact calculations. The general CALPUFF modeling approach is summarized here:

- Regulatory Options: CALPUFF will be run in the regulatory mode (MREG =1).
- Modeling Period: Three years will be modeled (2014, 2015, and 2016) using 4 km resolution output from the WRF meteorological model, processed by MMIF.

[12] The FLAG 2000 and 2010 documents are available at http://www.nature.nps.gov/air/Permits/flag/.

ED_013256A_00000460-00038

- Modeling Domain: The modeling domain will include each of the Class I areas for which Q/D exceeds 10, in their entireties, and extend 50 km beyond the far edge of each Class I area.
- Background Ammonia: Past AQRV studies of other regional sources have used a conservative 17 ppb ammonia concentration.
- Background Ozone: Hourly surface ozone will be extracted from the USEPA's AQS database, using all stations within 50km of the modeling domain. A conservative value of 60 ppb will be used when none of the supplied ozone stations have valid data.
- Receptors: High spatial density National Park Service/Forest Service (NPS/FS) receptors[13] in the Class I areas will be used. High spatial density receptors will also be placed inside the Spokane Indian Reservation.
- Visibility Impact Assessment: Visibility impacts will be calculated using the FLAG (2010) recommended Method 8, sub-mode 5 included as the default option in CALPOST. We propose to use the annual average natural conditions tables in FLAG (2010) for monthly species background concentrations and relative humidity adjustment factors.

3.2.3 Characterization of Emissions

The Class I AQRV modeling analysis includes incremental increases in NOx, PM_{10}, $PM_{2.5}$, and SO_2 emissions. There are no Class I area deposition flux thresholds associated with CO or VOCs, and neither CO nor VOCs contribute to visibility impairment in CALPUFF. Therefore, CO and VOCs are not included in any of the AQRV analyses.

Data characterizing the chemical composition and size distribution of the PM_{10} and $PM_{2.5}$ emissions are needed for the AQRV analysis using the CALPUFF modeling system. Particulate emissions must be divided into these six species:

- Soot or elemental carbon (EC)
- Organic carbon (OC)
- Fine soil particles (PMF)
- Coarse particles (PMC)
- Sulfate (SO_4)
- Nitrate (NO_3)

[13] Class I receptors are available at http://www.nature.nps.gov/air/maps/Receptors/index.cfm.

ED_013256A_00000460-00039

At the request of USFS' Bret Anderson, rather than using the SPECIATE database to speciate PM into the above components, Ramboll will speciate PM into only PMC and PMF, where PMF = $PM_{2.5}$ and PMC = PM_{10} – $PM_{2.5}$.

3.2.4 Chemical Transformations

The NOx chemistry in CALPUFF depends on the ambient ammonia concentration to establish the equilibrium between gaseous nitric acid and ammonium nitrate. However, ambient ammonia concentrations are not explicitly simulated by CALPUFF and the user must select an appropriate background concentration. The IWAQM Phase II Recommendations suggest typical ammonia concentrations are: 10 ppb for grasslands, 0.5 ppb for forests, and 1 ppb for arid lands during warmer weather.

For the current analysis, we propose to use 17 ppb for the background ammonia concentration. This conservative concentration was recommended for Pacific Northwest BART simulations and is based on measurements in southern British Columbia. It has been used for most, if not all, PSD modeling in the region since then. This relatively high background ensures the conversion of NOx to ammonium nitrate is not limited by a lack of ammonia for the range of NOx concentrations predicted in this study.

Reaction rates in the CALPUFF chemistry algorithms are also influenced by background ozone concentrations. Hourly ozone monitoring data will be extracted from the USEPA's AQS database and formatted for use in this analysis. A background of 60 ppb will be used during periods of missing data.

3.2.5 Meteorological Data

The AQRV analysis will use three years of hourly 4 km horizontal mesh size prognostic WRF model output data from January 2014 through December 2016. This is the 4 km domain from the same WRF simulation whose 1.33 km domain will supply the meteorology for the Class II modeling analysis presented in Section 2.2.2.

A Model Performance Evaluation justifying its use for the AQRV analysis has been submitted simultaneously with this Modeling Protocol.

Based on recent communication with Tim Allen (USFWS), we propose to use the most recent version of the EPA's MMIF version 3.4 in place of the meteorological pre-processor CALMET. In addition to specifying the three-dimensional wind field,

ED_013256A_00000460-00040

MMIF also estimates the boundary layer parameters used to characterize diffusion and deposition by the dispersion model. The proposed MMIF application setup and input data preparation are as follows:

- The proposed model domain is shown in Figure 5. The horizontal mesh size will be 4 km and the domain will cover an area of 524 km by 356 km.
- There will be ten vertical levels, ranging geometrically from the surface to 4,000 m, using the FLM default layers (MMIF default).
- A Lambert Conformal Conic (LCC) coordinate system will be used with an origin of 40°N, 97°W and standard latitudes of 33°N and 45°N (the so-called Regional Planning Organization or "RPO" projection).
- Land use and terrain data will be inherited (passed through by MMIF) from the USGS-based datasets included in the WRF distribution. Figure 6 shows the 4-km mesh size terrain to be used in the simulations.
- The MMIF-default Golder method for calculating Pasquill-Gifford stability class will be used.
- The MMIF-default WRF-supplied mixing layer heights will be used.

MMIF will be run in monthly segments using the WRF prognostic data.

3.2.6 Receptors and Terrain

The CALPUFF dispersion model simulations will assess AQRVs within each Class I area at discrete receptors obtained from the NPS. In addition to the discrete receptors, a receptor grid with 4-km spacing may also be used throughout the CALPUFF modeling domain to construct plots showing the spatial variation of the calculated parameters. These plots can be used for diagnostic purposes, as well as to develop figures that may be presented in the permit application. Comparisons with AQRV criteria will be based on the discrete receptor locations and elevations rather than the domain-wide gridded receptors.

3.2.7 Post-Processing Procedures

The CALPUFF modeling system will be used to predict criteria pollutant concentrations (if CALPUFF is used in screening mode to address Class I PSD increments), concentrations of PM_{10} species that contribute to regional haze, total deposition fluxes (wet and dry) for nitrogen-containing pollutant species, and total deposition fluxes for sulfur species. For each emission case considered, three annual simulations will be performed in parallel for each of the three modeling years. A sample CALPUFF input file is included with this submittal.

ED_013256A_00000460-00041

The CALPUFF utility POSTUTIL will be used to manipulate the large CALPUFF output files and calculate a number of the parameters needed to assess AQRVs in the areas of interest. Specifically, POSTUTIL will be used to sum the sulfur and nitrogen portions of the deposited gaseous and particle compounds to estimate the total sulfur and nitrogen deposition fluxes. The nitrogen in the ammonium nitrate and ammonium sulfate, including the portion that might be from the background ammonia, will be incorporated in the total.

Following the application of POSTUTIL, the CALPOST post-processor will be used to summarize the modeling results.

Predicted annual sulfur and nitrogen deposition fluxes will be used as a measure to assess potential impacts to soils and vegetation in regional Class I areas. The FLMs have established Deposition Analysis Thresholds (DATs) for nitrogen and sulfur of 0.005 kilograms per hectare per year (kg/ha/yr).[14] These "thresholds" are based on natural background deposition estimates culled from various research efforts, a variability factor, and a safety factor that accounts for cumulative effects. The nitrogen and sulfur DATs are not adverse impact thresholds, but are intended as conservative screening criteria that allow the FLMs to identify potential deposition fluxes that require their consideration on a case-by-case basis.

The FLAG workgroup recommends procedures for estimating the visibility impacts due to proposed new sources at Class I areas using CALPUFF modeling (FLAG, 2010). The FLAG visibility metric is the estimated maximum 24-hour change in extinction (Δb_{ext}) over clean natural visibility conditions (Natural Conditions) at the Class I area. The interpretation of the FLAG thresholds for extinction change over natural background is as follows:

- If the source's visibility impact is < 5% on all days, the FLM will likely not object to the permit.
- If there are days with the source's visibility impact > 10%, the FLM may object to the permit.

[14] *Guidance on Nitrogen and Sulfur Deposition Analysis Thresholds*, available on the FLAG internet site at http://www2.nature.nps.gov/ard/flagfree/NSDATGuidance.htm

ED_013256A_00000460-00042

- If there are days in which the source's visibility impact is above 5%, the frequency, magnitude and duration of the visibility impacts are used to make a significance determination.

If a source exceeds a specific threshold at a Class I area, then the frequency, magnitude and duration of the impacts and the reliability and accuracy of the modeling are examined to interpret the modeling results.

The FLAG (2010) procedures employ the IMPROVE extinction equation to calculate b_{ext} (Method 8, sub-mode 5, invoked with MVISCHECK=1 in CALPOST). This equation for extinction uses monthly relative humidity adjustment factors with relative humidity capped at 95%. It uses annual background aerosol concentrations recommended by the FLMs for the Class I area of concern, and assesses the visibility using the 98th percentile modeled values at each receptor. In order to use Method 8, sub-mode 5, CALPOST version 6.221 (level 080724) will be used to post-process the CALPUFF output files.

For FLAG 2010, a project's extinction is calculated using the revised IMPROVE reconstructed mass extinction equation as follows:

$$
\begin{aligned}
b_{project} = {} & 2.2 \times f_S(RH) \times [\text{Small Sulfate}] + 4.8 \times f_L(RH) \times [\text{Large Sulfate}] \\
& + 2.4 \times f_S(RH) \times [\text{Small Nitrate}] + 5.1 \times f_L(RH) \times [\text{Large Nitrate}] \\
& + 2.8 \times [\text{Small Organic Mass}] + 6.1 \times [\text{Large Organic Mass}] \\
& + 10 \times [\text{Elemental Carbon}] \\
& + 1 \times [\text{Fine Soil}] \\
& + 0.6 \times [\text{Coarse Mass}] \\
& + 1.7 \times f_{SS}(RH) \times [\text{Sea Salt}] \\
& + \text{Rayleigh Scattering (Site Specific)} \\
& + 0.33 \times [NO_2\,(\text{ppb})]\ \{\text{or as: } 0.1755 \times [NO_2\,(\mu g/m^3)]\}
\end{aligned}
$$

Where:

[ ] indicates concentrations in $\mu g/m^3$
$f_S(RH)$ = Relative humidity adjustment factor for small sulfate and nitrate
$f_L(RH)$ = Relative humidity adjustment factor for large sulfate and nitrate
$f_{SS}(RH)$ = Relative humidity adjustment factor for sea salt
For Total Sulfate < 20 $\mu g/m^3$:
[Large Sulfate] = ([Total Sulfate] / 20 $\mu g/m^3$) × [Total Sulfate]
For Total Sulfate ≥ 20 $\mu g/m^3$:
[Large Sulfate] = [Total Sulfate]

And:

[Small Sulfate] = [Total Sulfate] – [Large Sulfate]

To calculate large and small nitrate and organic mass, substitute ({Large, Small, Total} {Nitrate, Organic Mass}) for Sulfate.

The visibility related AQRVs will be summarized for each area of interest in a series of tables showing the number of days the 5 percent change to extinction was exceeded and showing the extinction budgets for the top 8 days in each year of the simulation and any day with a change to extinction greater than 5 percent. Time series plots will be used to display the seasonality of the modeling results and contour plots of the predicted maximum 24-hour extinction coefficients will be used to examine spatial variability.

ED_013256A_00000460-00044

4. REFERENCES

Federal Land Manager Advisory Group (FLAG). 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report - Revised (2010). Available at: http://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf.

ED_013256A_00000460-00045

Prepared for:

PacWest Silicon
Edmonton, Alberta

Prepared by:

Ramboll US Corporation
Lynnwood, Washington

July 2018

Project Number:
1690002828

PACWEST SILICON NEWPORT

METEOROLOGICAL PERFORMANCE EVALUATION

RAMBOLL

CONTENTS

Acronyms and Abbreviations i

1. Introduction 1

2. WRF Modeling Methodology 3

2.1 Model Inputs and Initial Configuration 3

2.1.1 WRF Version and Options 4

2.1.2 Domain Configuration 6

2.1.3 Model Vertical Resolution 8

3. Meteorological Observations 10

4. Meteorological Model Performance Methodology 20

4.1 Quantitative Evaluation Using METSTAT 20

4.1.1 Quantitative Statistics 22

5. Meteorological Model Performance Results 24

5.1 METSTAT Soccer Plots 24

5.2 Qualitative Evaluation Using PRISM Precipitation data 12

5.3 Vertical Temperature and Wind Speed Profile Analysis 26

5.3.1 Winter Vertical Profiles 26

5.3.2 Summer Vertical Profiles 27

5.4 Meteorological Parameter Comparison 34

5.4.1 Wind Roses and Stability Parameters 34

5.4.2 Box and Whisker Plots 34

5.4.3 Meteorological Comparison 35

6. AERMOD-Based Sensitivity Analysis Methodology 71

6.1 Sensitivity Analysis Model Setup 71

6.2 MMIF Extraction Methodology 73

6.3 Averaging Periods 74

7. AERMOD-Based Sensitivity Analysis Results 75

7.1 Sensitivity Analysis Design Value Comparison 76

7.2 Sensitivity Analysis Q-Q Plots 78

8. Conclusions 83

9. References 84

ED_013256A_00000461-00002

TABLES

Table 2-1. Physics Options used in the PacWest WRF Dataset 6
Table 2-2. WRF Domain Specifications 6
Table 2-3. PacWest WRF Dataset Model Levels 9

Table 3-1. Meteorological Observational Sites Considered in Analysis 11

Table 4-1. Meteorological Model Performance Benchmarks for Simple and Complex Conditions 21

FIGURES

Figure 2-1. WRF (36/12/4/1.33 km) Modeling Domains 3
Figure 2-2. WRF grid d04 (1.33 km, red rectangle) centered on the proposed Facility location near Newport. The blue rectangle shows the usable portion of the 1.33 domain 8

Figure 3-1. MADIS meteorological observation sites in 1.33 km domain 12
Figure 3-2. Site layout of RAWS station FRCW1 14
Figure 3-3. Site layout of RAWS station HOOI1 15
Figure 3-4. Site layout of MAEI1 16
Figure 3-5. Site layout of PMFW1 17
Figure 3-6. Site layout of TCFW1 18
Figure 3-7. Wind direction soccer plot for TCFW1 19

Figure 5-1. METSTAT Soccer Plots for all DS3505 sites in the 1.33 km WRF domain i
Figure 5-2. METSTAT Soccer Plots for all MADIS sites in the 1.33 km WRF domain . ii
Figure 5-3. METSTAT Soccer Plots for all DS3505 sites in the 4 km WRF domain iii
Figure 5-4. METSTAT Soccer Plots for all DS3505 sites in the 12 km WRF domain . iv
Figure 5-5. METSTAT Soccer Plots at KCOE (Coeur d'Alene, 50 km S of Newport) .. v
Figure 5-6. METSTAT Soccer Plots at KDEW (Deer Park NWS, 36 km SW of Newport) vi
Figure 5-7. METSTAT Soccer Plots at KGEG (Spokane NWS, 71 km SW of Newport) vii
Figure 5-8. METSTAT Soccer Plots at KSFF (Spokane NWS, 60 km SSW of Newport) viii
Figure 5-9. METSTAT Soccer Plots at KSKA (Fairchild Air Force Base, 77 km SW of Newport) ix
Figure 5-10. METSTAT Soccer Plots at KSZT (Sandpoint, 39 km NE of Newport) x
Figure 5-11. METSTAT Soccer Plots at HOOI1 (24 km SE of Newport) xi

ED_013256A_00000461-00003

Figure 5-12. 3-year average PRISM (top) and WRF (bottom) precipitation for January 14
Figure 5-13. 3-year average PRISM (top) and WRF (bottom) precipitation for February 15
Figure 5-14. 3-year average PRISM (top) and WRF (bottom) precipitation for March 16
Figure 5-15. 3-year average PRISM (top) and WRF (bottom) precipitation for April 17
Figure 5-16. 3-year average PRISM (top) and WRF (bottom) precipitation for May 18
Figure 5-17. 3-year average PRISM (top) and WRF (bottom) precipitation for June 19
Figure 5-18. 3-year average PRISM (top) and WRF (bottom) precipitation for July 20
Figure 5-19. 3-year average PRISM (top) and WRF (bottom) precipitation for August 21
Figure 5-20. 3-year average PRISM (top) and WRF (bottom) precipitation for September 22
Figure 5-21. 3-year average PRISM (top) and WRF (bottom) precipitation for October 23
Figure 5-22. 3-year average PRISM (top) and WRF (bottom) precipitation for November 24
Figure 5-23. 3-year average PRISM (top) and WRF (bottom) precipitation for December 25
Figure 5-24. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on February 1, 2014, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC) 28
Figure 5-25. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on February 1, 2015, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC) 29
Figure 5-26. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on February 1, 2016, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC) 30
Figure 5-27. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on August 1, 2014, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC) 31
Figure 5-28. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on August 1, 2015, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC) 32
Figure 5-29. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on August 1, 2016, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC) 33

ED_013256A_00000461-00004

Figure 5-30. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KCOE 36
Figure 5-31. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) meteorology at KCOE 37
Figure 5-32. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) meteorology at KCOE 38
Figure 5-33. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) meteorology at KCOE 39
Figure 5-34. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) meteorology at KCOE 40
Figure 5-35. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KDEW 41
Figure 5-36. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) meteorology at KDEW 42
Figure 5-37. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) meteorology at KDEW 43
Figure 5-38. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) meteorology at KDEW 44
Figure 5-39. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) meteorology at KDEW 45
Figure 5-40. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KGEG 46
Figure 5-41. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at KGEG 47
Figure 5-42. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at KGEG 48
Figure 5-43. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at KGEG 49
Figure 5-44. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at KGEG 50
Figure 5-45. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KSFF 51
Figure 5-46. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at KSFF 52
Figure 5-47. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at KSFF 53
Figure 5-48. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at KSFF 54
Figure 5-49. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at KSFF 55

ED_013256A_00000461-00005

Figure 5-50. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KSKA..... 56
Figure 5-51. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at KSKA 57
Figure 5-52. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at KSKA 58
Figure 5-53. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at KSKA 59
Figure 5-54. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at KSKA 60
Figure 5-55. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KSZT..... 61
Figure 5-56. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at KSZT..... 62
Figure 5-57. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at KSZT..... 63
Figure 5-58. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at KSZT..... 64
Figure 5-59. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at KSZT..... 65
Figure 5-60. Observed (top) and MMIF (bottom) wind roses and meteorological charts at HOOI1 66
Figure 5-61. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at HOOI1..... 67
Figure 5-62. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at HOOI1..... 68
Figure 5-63. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at HOOI1..... 69
Figure 5-64. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at HOOI1..... 70

ED_013256A_00000461-00006

ACRONYMS AND ABBREVIATIONS

AERMOD ..... Air quality dispersion modeling system used in this analysis. The AERMOD modeling system consists of two pre-processors and a dispersion model. The meteorological preprocessor (AERMET) provides meteorological information, and a terrain pre-processor (AERMAP) characterizes terrain, and generates receptor grids for the dispersion model (AERMOD).

Ambient air quality standard... Health-based standard representing a pollutant concentration in the ambient air usually over some averaging period like 1-hour, intended to protect the health and welfare of people with a margin of safety

Ambient air ..... the air in outdoor locations to which the public has access, e.g., outside the property boundary of the emissions source

Averaging time ..... a specific length of time (e.g., 1 hour, 24-hours, 1 year) over which measured or model-calculated concentrations of an air pollutant are averaged for comparison with the MPE Model Performance Evaluation

NAAQS..... National Ambient Air Quality Standard

NAM ..... North American Mesoscale Forecast System

NCEP ..... National Weather Service's National Centers for Environmental Prediction

NCDC ..... U.S. National Climatic Data Center

NMB ..... Normalized Mean Bias

NO2..... nitrogen dioxide, a criteria air pollutant

NOx..... oxide of nitrogen, a general class of air pollutant without a specific air quality standard but used in monitoring air quality

NOAA ..... National Oceanic and Atmospheric Administration

NOHRSC ..... NOAA National Weather Service's National Operational Hydrologic Remote Sensing Center

NWP ..... Numerical Weather Prediction

NWS..... National Weather Service

based on the same averaging period. Note that some NAAQSs are also based on multi-year averages of certain percentiles of measured or calculated concentrations.

AQRVs ..... Air quality related values: acid deposition flux and visibility impairment

ED_013256A_00000461-00007

CALPUFF	Air quality dispersion modeling system typically used for long-range (greater than 50 km) transport assessments. The meteorological preprocessor (CALMET) provides meteorological information for the dispersion model (CALPUFF). The CALPOST post-processor can be used in conjunction with the CALPUFF utility POSTUTIL to summarize modeling results
CFL	Courant-Friedrichs-Lewy
CONUS	Continental United States
Criteria air pollutant	an air pollutant specifically governed by the Federal Clean Air Act for which ambient air quality standards have been set. Criteria air pollutants include carbon monoxide, particulate matter, sulfur dioxide, nitrogen dioxide, ozone, and lead.
CWOP	Citizen Weather Observer Program
Dispersion model	A computerized calculation tool used to estimate pollutant concentrations in the ambient air based on numeric simulations that consider the locations and rates of pollutant emissions and the effects of meteorological conditions, usually over specific averaging times (e.g., 8-hours)
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FDDA	Four Dimensional Data Assimilation
H1H, H2H	Highest first-high, highest second-high. The first "highest" is over time, the second over space.
IC/BC	Initial Conditions and Boundary Conditions
ISHO	Integrated Surface Hourly Observations
LCC	Lambert Conformal Conic projection
LSM	Land Surface Model
MADIS	NCEP Meteorological Assimilation Data Ingest System, a dataset
Meteorological data set	a compilation of meteorological data representing conditions over some period of time and including such things as wind speed and wind direction, and formatted as required by the dispersion model being used. This analysis used a meteorological data set covering 5 years.
MMIF	Mesoscale model interface program, which converts meteorological model outputs to dispersion model inputs
Modeling domain	the area included in the dispersion-modeling analysis
Modeling receptor	a theoretical (i.e., often non-specific) location used in computer modeling at which air pollutant concentrations are

ED_013256A_00000461-00008

calculated. Modeling may also use site-specific receptors representing individual locations.

MPE ..... Model Performance Evaluation

NAAQS ..... National Ambient Air Quality Standard

NAM ..... North American Mesoscale Forecast System

NCEP ..... National Weather Service's National Centers for Environmental Prediction

NCDC ..... U.S. National Climatic Data Center

NMB ..... Normalized Mean Bias

NO_2 ..... nitrogen dioxide, a criteria air pollutant

NOx ..... oxide of nitrogen, a general class of air pollutant without a specific air quality standard but used in monitoring air quality

NOAA ..... National Oceanic and Atmospheric Administration

NOHRSC ..... NOAA National Weather Service's National Operational Hydrologic Remote Sensing Center

NWP ..... Numerical Weather Prediction

NWS ..... National Weather Service

Particulate matter (PM) ..... air pollutant comprised of solid or liquid particles; PM is usually characterized based on the particle size. See also PM_{10} and $PM_{2.5}$.

PBL ..... Planetary Boundary Layer

PM_{10} ..... "Coarse" inhalable particulate matter with an aerodynamic size less than or equal to 10 micrometers (microns)

$PM_{2.5}$ ..... "Fine" inhalable particulate matter with an aerodynamic size less than or equal to 2.5 micrometers (microns)

PRISM ..... Parameter-elevation Regressions on Independent Slopes Model

QA/QC ..... Quality Assurance/Quality Control

Q-Q plots ..... Quantile-Quantile plots

RAP ..... NOAA's Rapid Refresh assimilation/modeling system

RAWS ..... Remote Automated Weather Station

RMSE ..... Root Mean Squared Error

RPO ..... Regional Planning Organization

RTG ..... Real-Time Global, an SST dataset

SNODAS ..... Snow Data Assimilation System

SO_2 ..... Sulfur dioxide, a criteria air pollutant

ED_013256A_00000461-00009

SST ..... Sea Surface Temperature

WPS ..... WRF Pre-processing System

WRAP ..... Western Regional Air Partnership

WRF ..... The weather research and forecast model, a meteorological model

YSU ..... Yonsei University planetary boundary layer scheme

ED_013256A_00000461-00010

1. INTRODUCTION

PacWest Silicon, Inc. (PacWest, formerly called HiTest Silicon) proposes to construct a silicon manufacturing plant located near the city of Newport, in Pend Oreille County, Washington. The proposed silicon manufacturing plant (hereafter referred to as "the Facility" or "the Plant") would produce revolutionary low-cost, high-quality silicon allowing PacWest to meet ever-increasing demand in North America.

Dispersion modeling platforms, including AERMOD and CALPUFF, are used to estimate pollutant concentrations associated with the proposed facility emissions for permitting purposes. This includes both Class II (in the vicinity immediately surrounding the proposed facility) as well as nearby Class I areas. Dispersion modeling is highly dependent on the meteorological parameters used in the model. Wind speed, wind direction, and vertical stability play key roles in atmospheric dispersion.

AERMOD uses meteorology observed at a single point, usually a meteorological tower. Unfortunately, there is no representative observational meteorology available near the site – the closest National Weather Service (NWS) site is approximately 36 km to the southwest at Deer Park (KDEW). CALPUFF requires a gridded field of meteorology, often supplied by prognostic weather prediction models. 40 CFR 51 Appendix W (the Guideline on Air Quality Modeling) allows for the use of prognostic weather model output, if no on-site meteorology exists and the nearest NWS site is not representative.

The Weather Research and Forecasting (WRF) meteorological model (Shamrock et al., 2008) was selected for high resolution meteorological modeling of the region, and the three most recent years (2014-2016) were simulated. WRF's research and operational application ensures state-of-the-science physics and adaptability to a wide range of environments, through a broad selection of physics options, allowing for the development of the best-performing configuration for simulating meteorology in the region. The Mesoscale Model Interface program (MMIF) was used to convert meteorological fields from WRF into input formats that can be used by AERMOD and CALPUFF. AERMOD modeling will use 1.33 km output, while CALPUFF modeling will use 4 km output from WRF.

ED_013256A_00000461-00011

In this meteorological Model Performance Evaluation (MPE), WRF parameters are compared to observations at a variety of sites near the proposed Facility location to determine how well WRF is able to replicate regional meteorology.

In addition, a variety of sensitivity studies are performed using AERMOD to examine the impact of meteorological parameters and processing methods on modeled pollutant concentrations. These studies are designed to shed light on the impact of meteorology on atmospheric dispersion throughout the region surrounding the proposed Facility location. In order to validate the WRF dataset as a whole, multiple stations are examined. This should indicate whether the meteorological dataset is suited for dispersion modeling techniques in the region near the proposed Facility.

The wide range of AERMOD-predicted concentrations across the sites considered in this study highlights the strong influence of terrain and wind direction on dispersion modeling. Additionally, at each site, there are noticeable concentration differences depending on the meteorological configurations used. However, when averaged across multiple sites, using the modeled meteorology results in predicted concentrations similar to those generated with observed meteorology on an hourly basis, and also results in predicted higher concentrations over a longer (24 hour or annual) averaging period.

ED_013256A_00000461-00012

2. WRF MODELING METHODOLOGY

This section describes the methodology used for conducting the WRF simulation for the three-year modeling period (2014-2016) and describes the model configuration used in the final WRF dataset for the PacWest air dispersion modeling. A nested-grid structure of four grids nested in a 3:1 nesting ratio (36/12/4/1.33 km) is used, as shown in Figure 2-1.

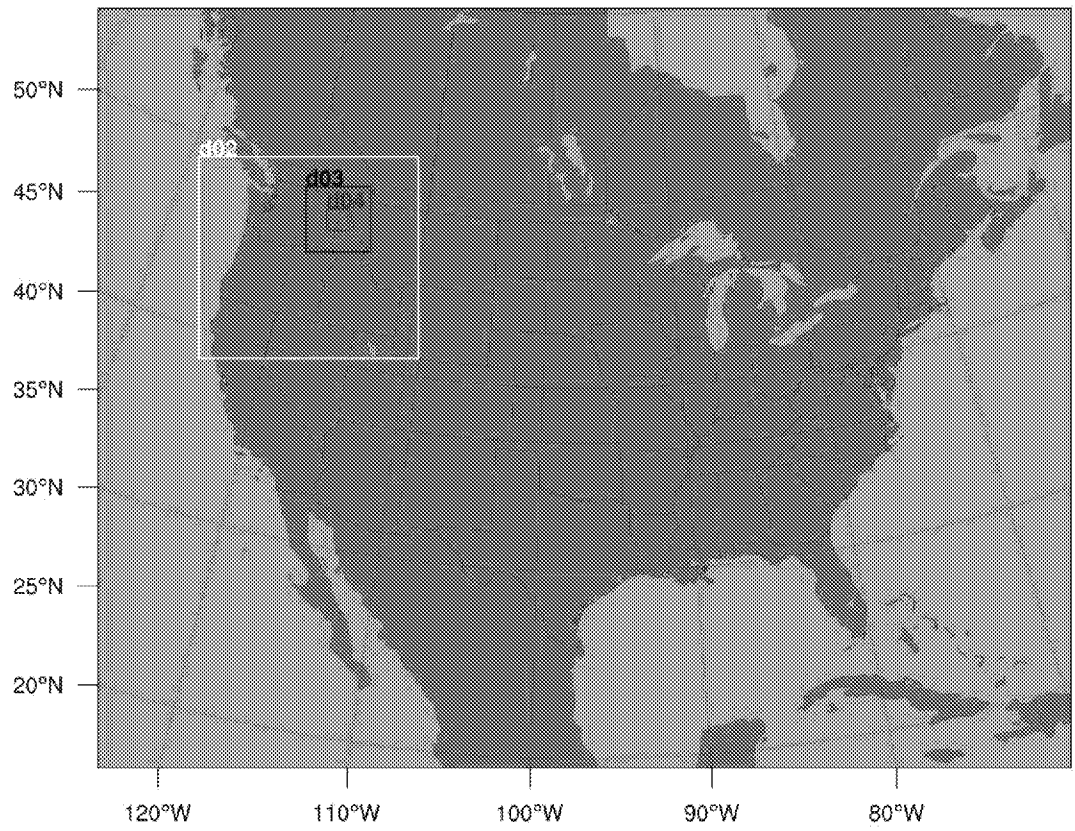


Figure 2-1. WRF (36/12/4/1.33 km) Modeling Domains

2.1 Model Inputs and Initial Configuration

A summary of the WRF configuration and input data used for this MPE is provided below.

2.1.1 WRF Version and Options

Model Selection: The publicly available version of WRF, version 3.9.1.1, was used for the PacWest simulation. The WPS pre-processor programs including GEOGRID, UNGRIB and METGRID were used to develop model inputs.

Topographic Inputs: Topographic information for all domains was developed using the standard WRF terrain databases. The 36 km domain was based on the 10minute global data; the 12 km domain was based on the 2 minute data; and the 4 and 1.33 km domains were based on the 30 second (~900 m) data.

Vegetation Type and Land Use Inputs: Vegetation type and land use information was developed using the most recently-released databases provided with the WRF distribution. Standard WRF surface characteristics corresponding to each land use category were employed.

Atmospheric Data Inputs: WRF relies on other model or re-analysis output to provide initial and boundary conditions (IC/BC). The first guess fields were taken from the 12 km North American Mesoscale Forecast System (NAM) dataset. These were objectively re-analyzed using traditional observational data (meteorological towers) at the higher resolution of each WRF grid, using the OBSGRID program. These fields are used to initialize the model and with analysis nudging (on selected domains) to guide the model to best match the observations.

Time Integration: Adaptive time stepping was used to maximize the time step that the model can use while keeping the model numerically stable. The model time step was adjusted based on the domain-wide horizontal and vertical stability Courant-Friedrichs-Lewy (CFL) target value of 0.8.

Diffusion Options: Horizontal Smagorinsky first-order closure with sixth-order numerical diffusion and suppressed up-gradient diffusion were used.

Lateral Boundary Conditions: Lateral boundary conditions were specified from the initialization dataset on the 36 km CONUS domain with continuous updates nested from each "parent" domain to its "child" domain.

Top and Bottom Boundary Conditions: The top boundary condition was selected as an implicit Rayleigh dampening for the vertical velocity. Consistent with the model

ED_013256A_00000461-00014

application for non-idealized cases, the bottom boundary condition was selected as physical, not free-slip.

Water Temperature Inputs: The water temperature data were taken from the NWS's National Centers for Environmental Protection (NCEP) Real-Time Global (RTG) daily global one-twelfth degree analysis, and was updated every 24 hours (as opposed to fixed for each WRF initialization).

Snow Cover: The model runs used the 1 km resolution snow data from the Snow Data Assimilation System (SNODAS). SNODAS is a modeling and data assimilation system developed by the National Oceanic and Atmospheric Administration (NOAA) NWS's National Operational Hydrologic Remote Sensing Center (NOHRSC) to provide the best possible estimates of snow cover and associated variables to support hydrologic modeling and analysis. SNODAS includes procedures to ingest and downscale output from Numerical Weather Prediction (NWP) models and to simulate snow cover using a physically based, spatially-distributed energy and mass-balance snow model (NOHRSC, 2004). The product used is very similar to that used by NOAA's Rapid Refresh (RAP) assimilation/modeling system.

FDDA Data Assimilation: The WRF model was run with analysis nudging (i.e., Four Dimensional Data Assimilation [FDDA]). At the request of the Washington State Department of Ecology (Ecology) and the U.S. Forest Service, no observational (OBS) nudging was used.

Physics Options: The WRF model contains many different physics options. The physics options chosen for the WRF configuration are presented in Table 2-1.

ED_013256A_00000461-00015

Table 2-1. Physics Options used in the PacWest WRF Dataset

Physics Scheme	Option
Longwave Radiation	RRTMG
Shortwave Radiation	RRTMG
Microphysics	Thompson
Cumulus Parameterization	Multi-scale Kain-Fritsch in 36, 12, 4 and 1.33 km
Planetary Boundary Layer (PBL)	Yonsei University scheme (YSU)
Land Surface Model (LSM)	Noah
Surface Layer	Monin-Obukhov

Application Methodology: The WRF model was executed in 5-day blocks initialized at 12Z every five days. Model results were output every 60 minutes and output files were split at twelve (12) hour intervals. Twelve (12) hours of spin-up were included in each 5-day block before the data were used in the subsequent evaluation. The model was run at the 36, 12, 4, and 1.33 resolution from January, 2014 through December, 2016.

2.1.2 Domain Configuration

The WRF domain configuration is comprised of a system of simultaneous nested grids. Figure 2-1 shows the WRF modeling grids at 36/12/4/1.33 km. All WRF grids are defined on a Lambert Conformal Conic (LCC) projection centered at 40°N, 97°W with true latitudes at 33°N and 45°N (the so-called standard Regional Planning Organization "RPO" projection). The outermost domain with 36 km resolution includes the entire continental United States and parts of Canada and Mexico. The inner 12 km regional grid covers the northwestern portion of the Unites States and parts of southwestern Canada. The 4 km domain covers western Washington, northern Idaho, northeastern Montana, and parts of southwestern Canada. Figure 2-2 pictures the 1.33 km domain with grid cells, which is centered on the proposed Facility location near Newport, WA. Table 2-2 provides the domain specifications used in the modeling study.

Table 2-2. WRF Domain Specifications

ED_013256A_00000461-00016

Grid Spacing (km)	Number of Points (West-East)	Number of Points (South-North)	Starting Point (West-East)	Starting Point (South-North)
36	165	129	-	-
12	115	112	18	70
4	142	100	55	59
1.33	100	100	34	34

ED_013256A_00000461-00017

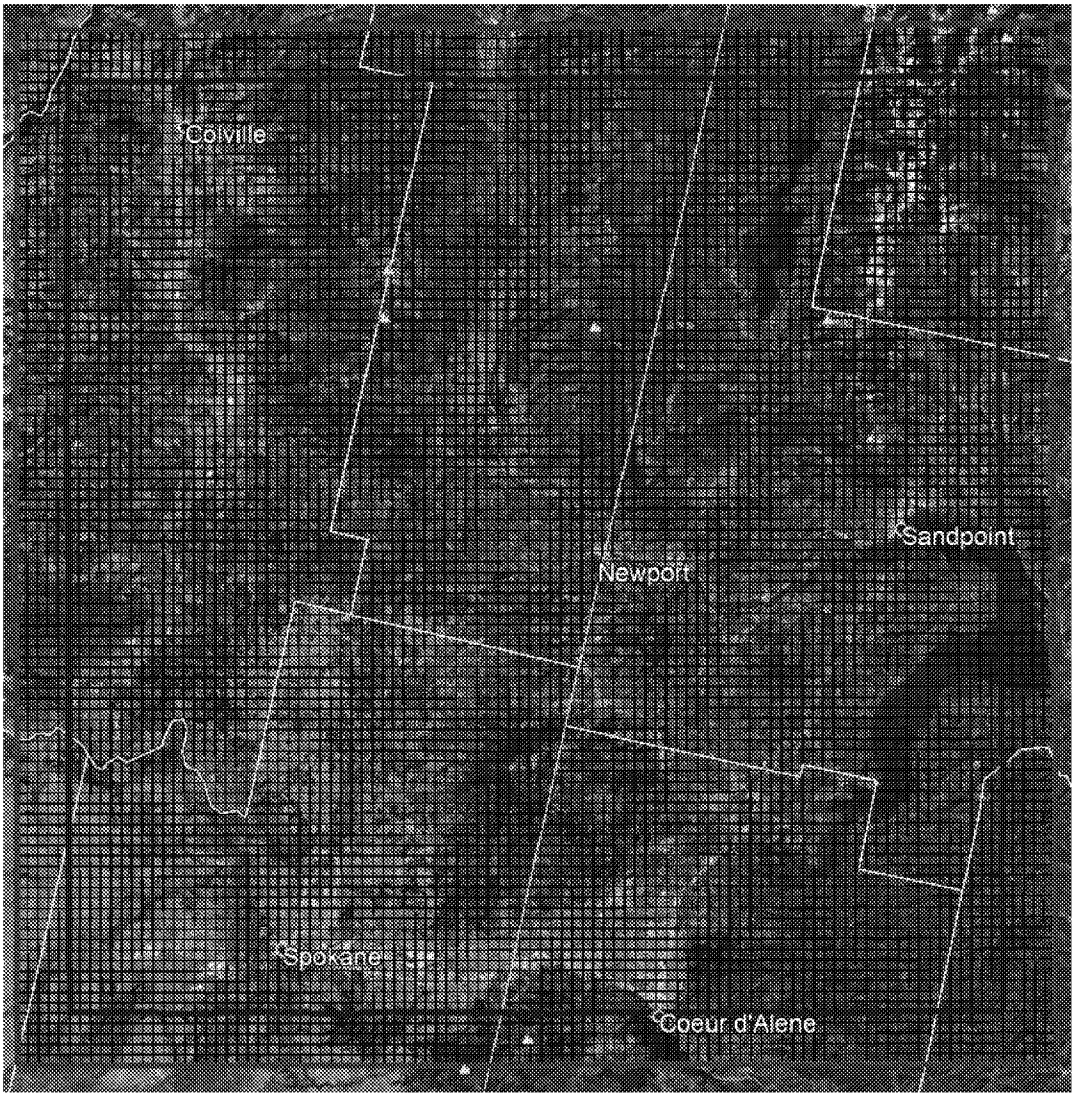


Figure 2-2. WRF grid d04 (1.33 km, red rectangle) centered on the proposed Facility location near Newport. The blue rectangle shows the usable portion of the 1.33 domain

2.1.3 Model Vertical Resolution

High vertical resolution enables the model to more accurately capture the convective updraft velocities in summer and low-level temperature inversions in winter. The PacWest WRF modeling was based on 36 vertical layers with an approximately 11 meter thick lowest layer. Table 2-3 illustrates the vertical layer structure used in this modeling project.

Table 2-3. PacWest WRF Dataset Model Levels

Level	Eta	Pressure (mb)	Height (m)	ΔZ (m)
1	1.0000	1000	0.0	
2	0.9985	999	11.6	11.6
3	0.9970	997	23.2	11.6
4	0.9950	996	38.7	15.5
5	0.9930	994	54.2	15.5
6	0.9900	991	77.5	23.3
7	0.9870	988	100.9	23.4
8	0.9820	984	139.9	39.1
9	0.9770	979	179.1	39.2
10	0.9685	972	246.1	67.0
11	0.9600	964	313.5	67.4
12	0.9500	955	393.4	79.9
13	0.9400	946	473.8	80.5
14	0.9300	937	554.9	81.1
15	0.9150	924	677.8	122.8
16	0.9000	910	802.1	124.3
17	0.8800	892	970.1	168.1
18	0.8500	865	1227.4	257.3
19	0.8200	838	1491.3	263.9
20	0.7800	802	1854.1	362.8
21	0.7400	766	2230.4	376.2
22	0.7000	730	2621.2	390.8
23	0.6400	676	3237.8	616.6
24	0.5800	622	3895.7	657.9
25	0.5200	568	4601.6	705.9
26	0.4550	510	5430.5	828.9
27	0.4000	460	6194.4	763.9
28	0.3500	415	6949.1	754.6
29	0.3000	370	7773.2	824.1
30	0.2500	325	8682.9	909.7
31	0.2000	280	9701.0	1018.1
32	0.1500	235	10861.6	1160.6
33	0.1000	190	12218.6	1357.1
34	0.0600	154	13506.9	1288.3
35	0.0270	124	14768.9	1262.0
36	0.0000	100	15998.6	1229.7

ED_013256A_00000461-00019

3. METEOROLOGICAL OBSERVATIONS

Several different meteorological observation networks were used in this analysis. Observed meteorology is used to evaluate WRF model performance (see Section 5). Additionally, specific observed meteorological parameters, such as cloud cover, are used in some AERMOD runs discussed in Sections 6 and 7 to investigate the impact of meteorology on modeled pollutant concentrations at sites within the 1.33 km modeling domain.

The NCEP MADIS meteorological observation database and data delivery system is used in this MPE. The MADIS system ingests both NOAA and non-NOAA meteorological observations and converts the observations into a common format. In the modeling domain shown in Figure 2-2, several different surface-level observational networks are included in the MADIS database. These networks include DS3505 stations, which are global integrated surface hourly observations (ISHO) archived and quality-controlled by the U.S. National Climatic Data Center (NCDC)[1]. Many DS3505 stations are located at airports. MADIS also includes the Remote Automated Weather Station (RAWS) network, which is a collection of automated weather stations run by the U.S. Forest Service, Bureau of Land Management, and the National Interagency Fire Center[2]. Many RAWS sites are located in remote areas. Additionally, the MADIS database includes observations from Idaho Department of Transportation (Idaho DT) sites as well as various Citizen Weather Observer Program (CWOP) sites. CWOP sites are volunteer-run meteorological sites across the world and are generally located in residential areas.

Table 3-1 presents the meteorological observational sites considered in the dispersion model portion of this MPE, and Figure 3-1 shows the location of these sites within the 1.33 km modeling domain. For the MPE, DS3505 sites alone were used outside of the 1.33 km modeling domain, because there are a sufficient number of stations (far more than six) within the larger domains to obtain statistically strong results. As described in detail below, not all of the meteorological sites included within the MADIS database are used in the dispersion model analysis portion of this MPE.

[1] https://www.ncdc.noaa.gov/isd
[2] https://famit.nwcg.gov/applications/RAWS

ED_013256A_00000461-00020

Table 3-1. Meteorological Observational Sites Considered in Analysis

Site	Network [1]	Location (Lat, Lon)	Included in dispersion model analysis? [2]
AR316	CWOP	48.0853, -117.432	No
AT594	CWOP	47.827, -116.842	No
D8292	CWOP	47.751, -117.456	No
E4312	CWOP	47.699, -117.280	No
FRCW1	RAWS	48.423, -117.363	No
HOOI1	RAWS	48.053, -116.793	Yes
ITD66	Idaho TD	48.574, -116.958	No
ITDA8	Idaho TD	48.171, -117.023	No
KCOE	DS3505	47.770, -116.820	Yes
KDEW	DS3505	47.970, -117.410	Yes
KGEG	DS3505	47.630, -117.530	Yes
KSFF	DS3505	47.680, -117.320	Yes
KSKA	DS3505	47.620, -117.650	Yes
KSZT	DS3505	48.300, -116.560	Yes
MAEI1	RAWS	47.884, -116.299	No
PMFW1	RAWS	48.390, -117.585	No
TCFW1	RAWS	48.490, -117.436	No
TLITT	WA DOT	47.787, -117.407	No

Notes:

[1] Citizen Weather Observer Program (CWOP), Remote Automated Weather Station (RAWS), Integrated hourly surface data (DS3505), Idaho Transportation Department (Idaho DT), and Washington Department of Transportation (WA DOT).

[2] See Section 6

ED_013256A_00000461-00021

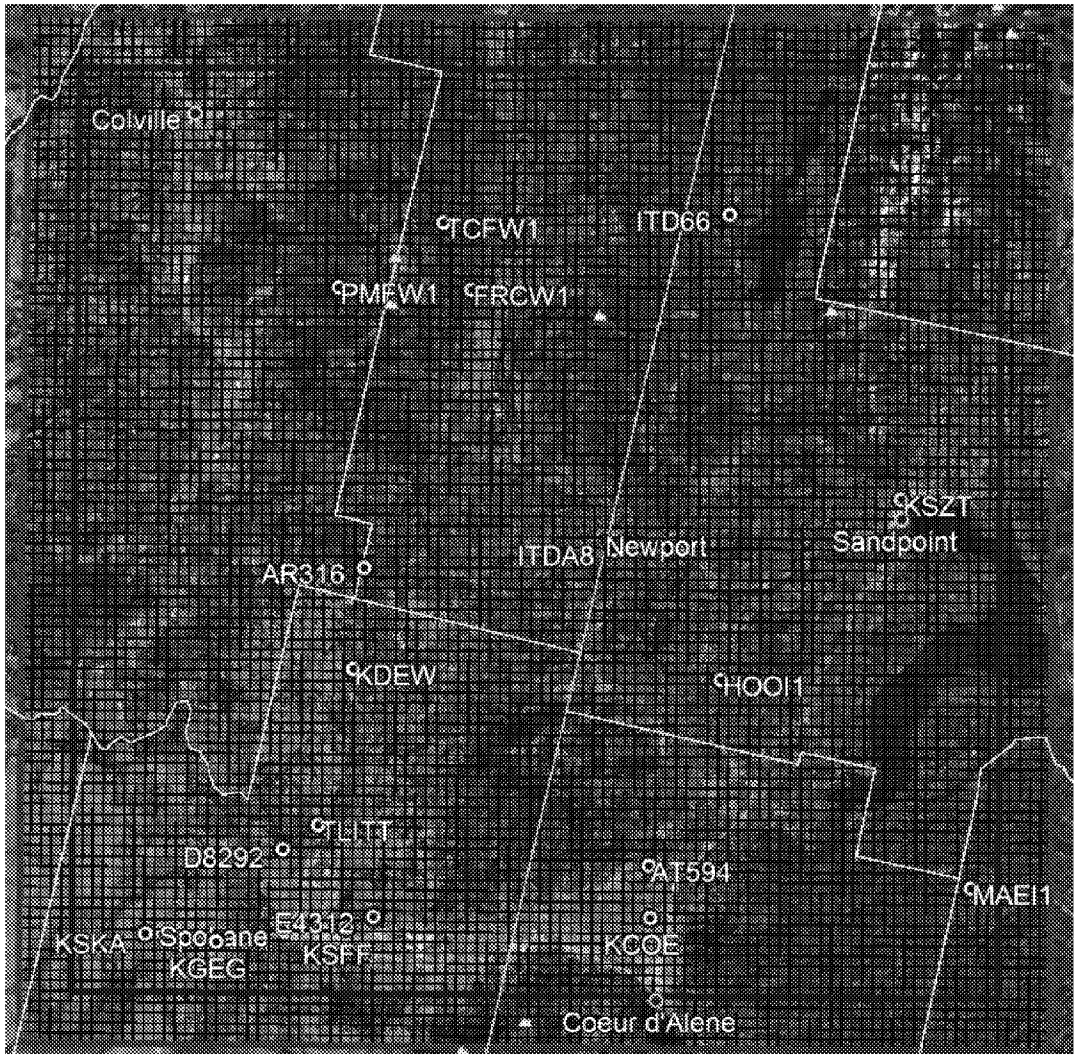


Figure 3-1. MADIS meteorological observation sites in 1.33 km domain

As mentioned above, although several datasets (CWOP, DS3505, RAWS, Washington DOT, and Idaho TD) are included in the MADIS database and used in the meteorological performance evaluation provided in Section 4, the majority of these observational sites are not used in the dispersion model portion of this MPE, on the basis of either poor quality control standards or poor tower siting. Quality control and instrument audits are essential for ensuring that collected data is valid. Electrical issues, uncalibrated instruments, or improperly installed instruments can lead to inaccurate, misleading data. Tower siting is also important, as any tall objects near a meteorological tower can bias wind direction and speed readings by blocking wind flows. As a general rule, any objects should be at least ten times

their height away from the tower. For example, 10 m tall trees should be cleared to at least 100 m from the base of the tower.

DS3505 stations are the "gold standard" for meteorological towers, both in terms of data QC and tower siting. Generally located at airports, these stations follow auditing, data monitoring, and tower siting guidelines. All DS3505 stations were included in the analysis.

CWOP stations are installed and operated by civilians, and therefore not always subject to stringent data quality control standards. Additionally, there is no guarantee that good instrument siting practices were followed when the station was installed or that weather instruments are working properly. Given these considerations, all CWOP stations are excluded from further analysis.

Although meteorological stations run by the Idaho Department of Transportation follow more stringent siting requirements, because there is no record of quality control checks on these stations, these stations are also excluded from further analysis.

RAWS stations do follow stricter siting requirements and quality control procedures, with scheduled audits for all instrumentation. However, instrumentation is not standardized across stations. For example, several monitoring stations do not include relative humidity or barometric pressure measurements. Despite stricter operating standards, RAWS stations are generally located in remote locations with complex terrain, in areas that don't always represent regional meteorology. Therefore, we examined each RAWS station on a case-by-case basis, and excluded any stations with poor tower siting and/or non-representative locations (e.g., mountain tops).

The location of each RAWS station within the 1.3km modeling domain is shown above in Figure 3-1, and a discussion of each of the five stations within the 1.33 km WRF domain (FRCW1, HOOI1, MAEI1, PMFW1, and TCFW1) follows.

FRCW1

Station FRCW1 (48.4233°N, 117.3627°W) is located in a valley oriented northeast to southwest. Nearby terrain is moderately complex and the location of FRCW1 is likely representative of wind directions in the valley. The meteorological tower siting

ED_013256A_00000461-00023

is marginal, with two large buildings located 20 m northeast of the station and about a dozen trees scattered within 10 m of the station. All other vegetation has been cleared to at least 60 m from the station. The site layout of station FRCW1 is shown in Figure 3-2.

Figure 3-2. Site layout of RAWS station FRCW1

HOOI1

Station HOOI1 (48.0533°N, 116.7934°W) is located in a relatively flat forested area. The meteorological tower siting of HOOI1 is reasonable, with all trees and vegetation cleared in a radius of at least 30 m around the tower. Despite lacking relative humidity data, HOOI1 was included in further analyses because of its good tower placement. The site layout of HOOI1 is shown in Figure 3-3.

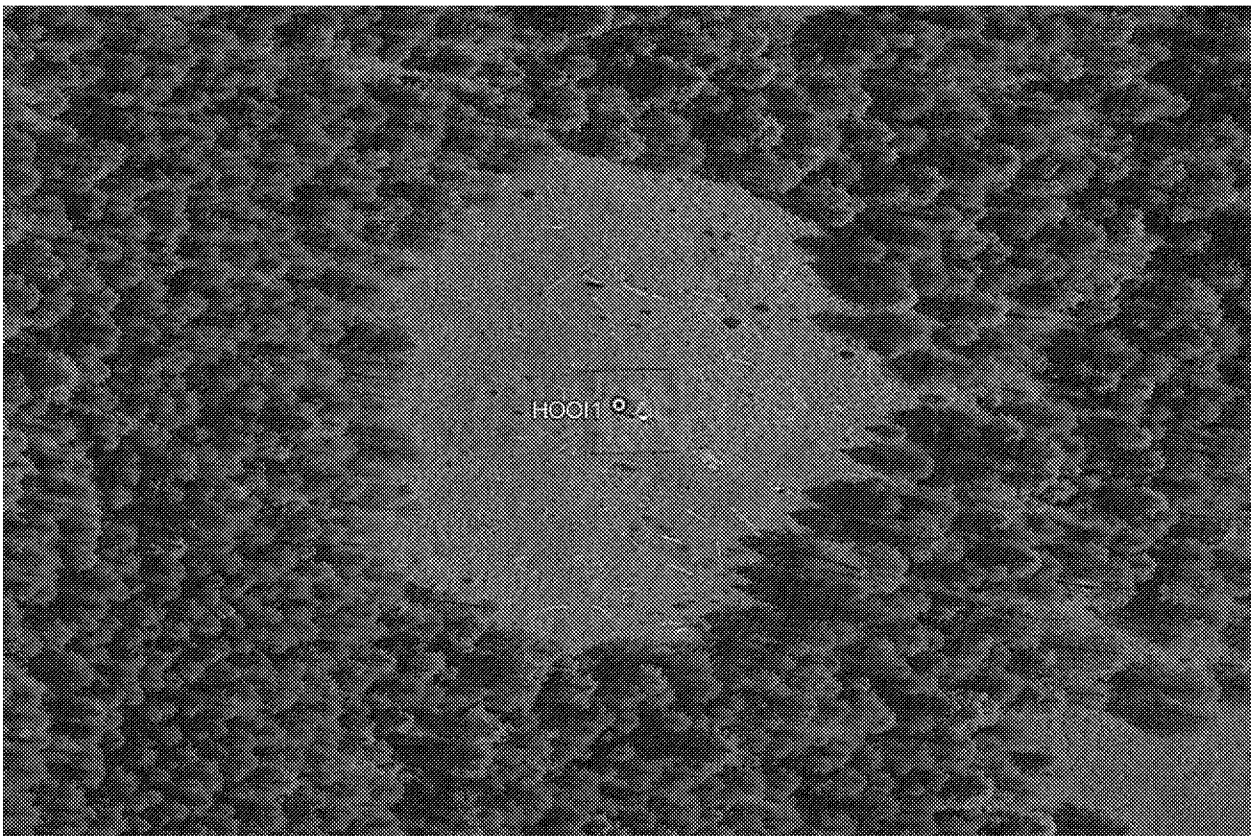


Figure 3-3. Site layout of RAWS station HOOI1

ED_013256A_00000461-00025

MAEI1

Station MAEI1 (47.8837°N, 116.2990°W) is located on top of a mountain and is surrounded by extremely complex terrain. The tower is located at an elevation of approximately 4,700 ft, nearly 1,000 ft higher than the valley floor below.

Because MAEI1 is located on top of a mountain and largely subject to southerly wind flow, it is not representative of the complex terrain (e.g., adjacent mountains and valleys) surrounding the site. Furthermore, it is a difficult to compare this observational data with 1.33 km resolution WRF model output because WRF may not be able fully resolve this complex terrain. For these reasons, MAEI1 was excluded from further analysis. The location of MAEI1 is shown in Figure 3-4.

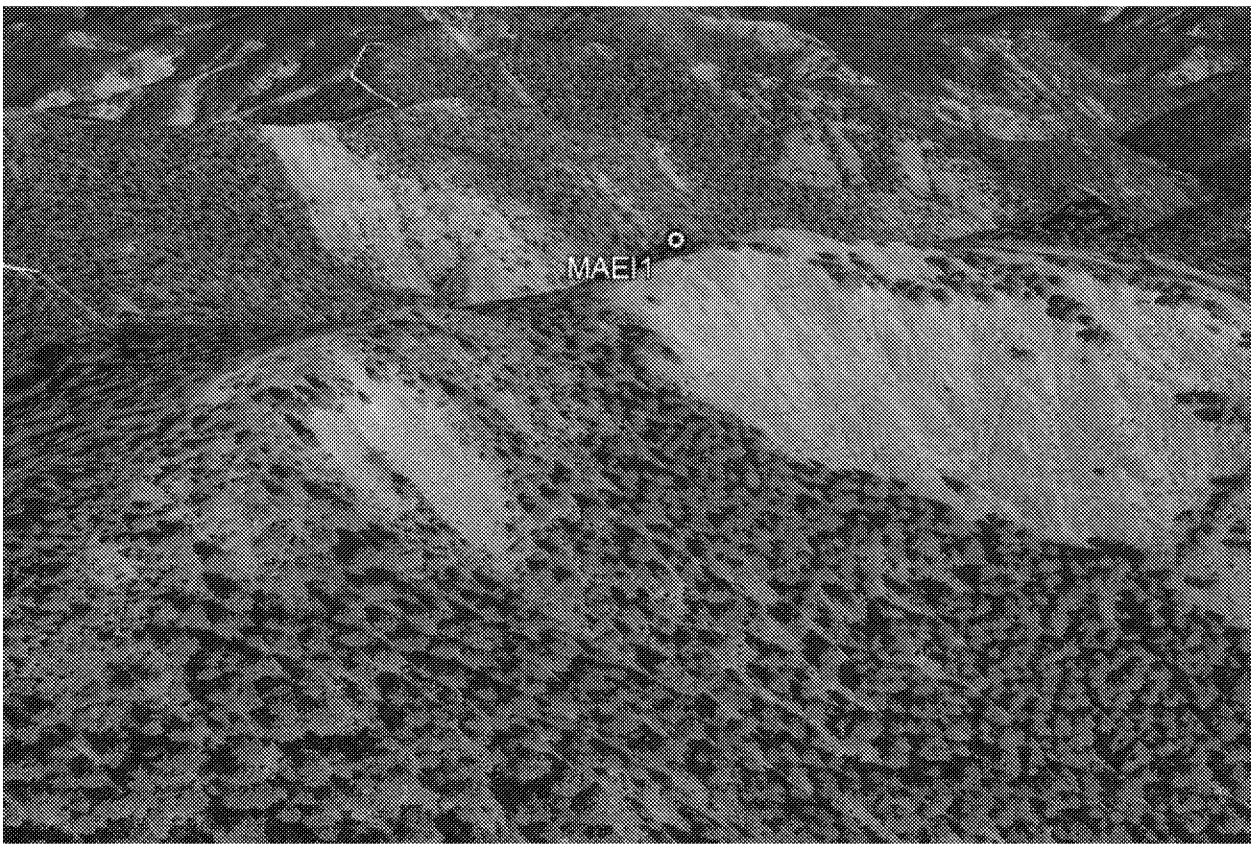


Figure 3-4. Site layout of MAEI1

PMFW1

Station PMFW1 (48.3903°N, 117.5853°W) is located at the bottom of a valley running east to west. The siting of the meteorological tower likely has a large effect on observed wind speeds and directions, as trees are located close to the tower (13 m to the east, 30 m to the west). Additionally, a road runs northeast to southwest near the tower and wind is likely channelled through this corridor. WRF-predicted wind direction generally follows the east-west orientation of the valley and has difficultly simulating the high-resolution wind flow along the nearby road. Due to the poor siting of PMFW1, the station was excluded from further analyses. The site layout of PMFW1 is shown in Figure 3-5.

Figure 3-5. Site layout of PMFW1

ED_013256A_00000461-00027

TCFW1

Station TCFW1 (48.4905°N, 117.4355°W) is located midway up the side of a valley that runs north to south. Vegetation is cleared relatively evenly around the tower, although trees are located as close as 15 m. While the surrounding vegetation likely decreases measured wind speeds, there should not be a wind direction bias due to the even clearing. Figure 3-6 shows the site layout of TCFW1.

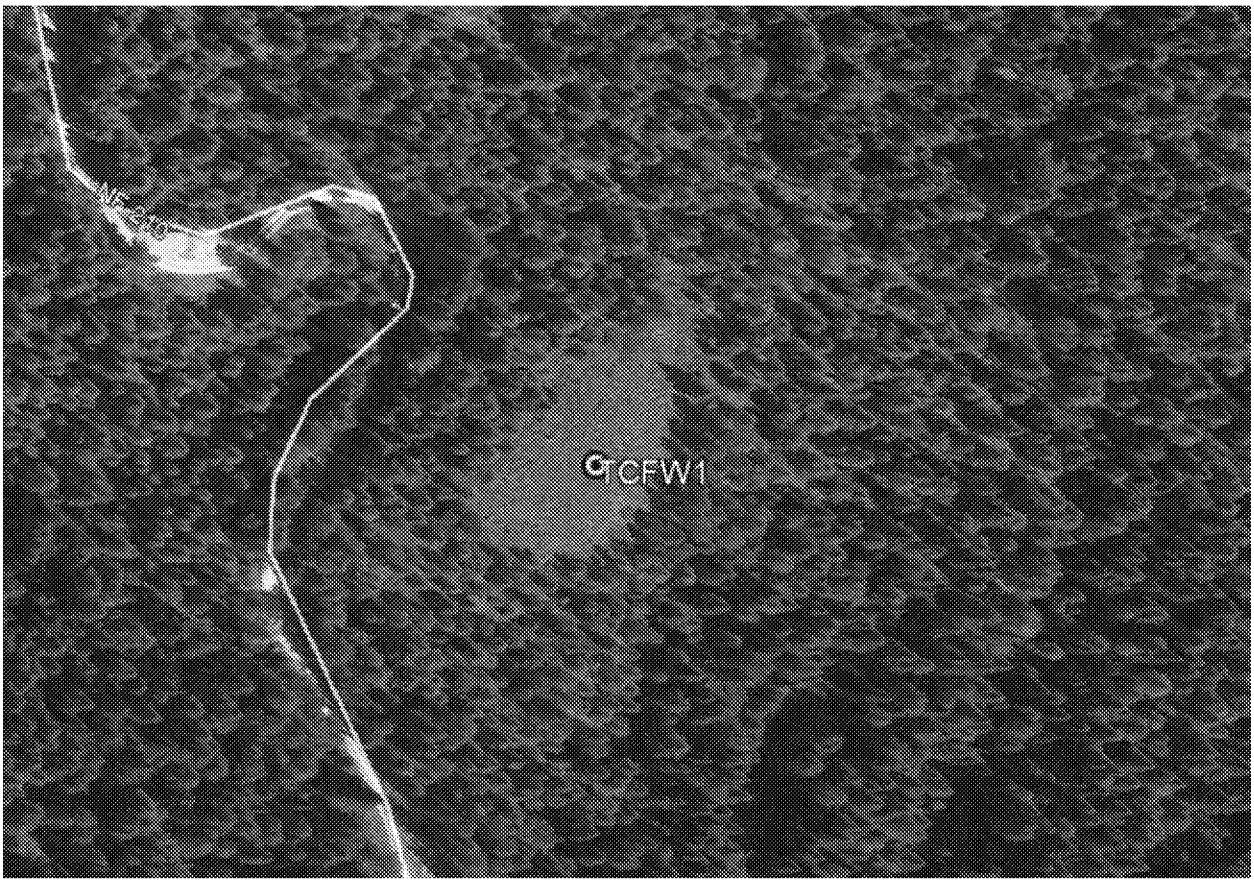


Figure 3-6. Site layout of TCFW1

Measured wind data indicates that there is likely an issue with the wind sensor at TCFW1. From the beginning of 2014 through April 2015, wind direction measurements show a consistent bias of approximately 60 degrees. After April 2015, wind directions show a bias of 0 degrees, on average. This is indicative of an error with the wind sensor; either the sensor base was misaligned with north or there was an electrical error during this period. Figure 3-7 is a soccer plot that

ED_013256A_00000461-00028

shows the shift in wind direction bias at TCFW1. Soccer plots use two performance metrics as X-axis and Y-axis values (e.g., wind direction bias as X, and wind direction error as Y) along with the performance benchmarks. Since the cause of this discrepancy is unknown and the reliability of TCFW1 wind direction data is uncertain, observational data from TCFW1 has been excluded.

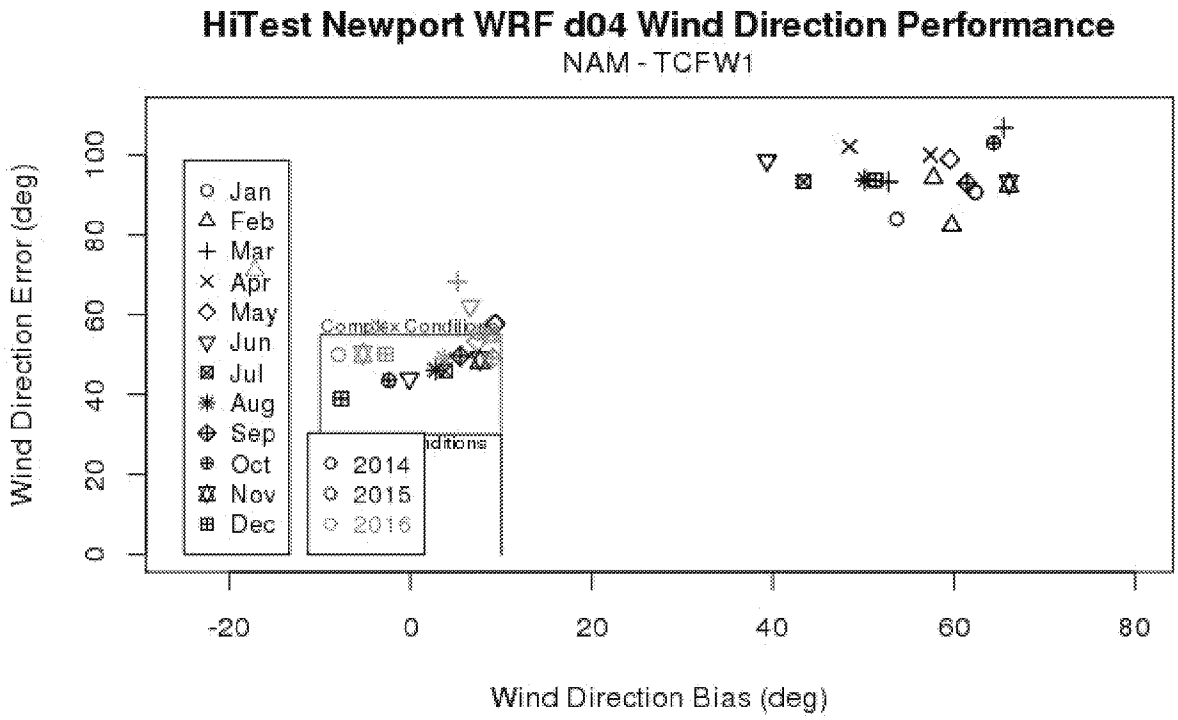


Figure 3-7. Wind direction soccer plot for TCFW1

Given the considerations described above, only one RAWS station, HOOI1, meets the criteria for proper siting and data reliability. The HOOI1 site, along with all DS3505 stations within the 1.33 km WRF modeling domain, is included in the dispersion portion of this report (Section 6).

ED_013256A_00000461-00029

4. METEOROLOGICAL MODEL PERFORMANCE METHODOLOGY

This section describes the statistical metrics used to evaluate the performance of WRF compared to the network of observations described in the previous section.

Both quantitative and qualitative evaluations of the PacWest WRF simulation were conducted and results are presented in Section 5. The quantitative evaluation compares surface-level meteorological observations contained in the DS3505 network with WRF predictions, paired by time and location. Observations from the HOOI1 station (RAWS network), were also used for the evaluation. Data from all other RAWS stations were eliminated from the quantitative meteorological evaluation based on poor quality control or problematic siting, as discussed in Section 3. The qualitative evaluation compares twice daily vertical profiles of upper-air observations from the Spokane International Airport (OTX) with WRF predictions matched by time and location. Additionally, modeled precipitation from WRF is qualitatively compared to precipitation observations from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) datasets. Lastly, wind roses and box and whisker plots are used to qualitatively compare a number of modeled and observed meteorological parameters.

4.1 Quantitative Evaluation Using METSTAT

A quantitative MPE of the PacWest WRF simulation was performed using hourly surface meteorological measurements and the publicly-available METSTAT software (Ramboll Environ, 2015) evaluation tool. METSTAT calculates statistical performance metrics for bias, error and correlation for surface winds, temperature, and mixing ratio (i.e., water vapor or humidity). To evaluate the performance of a meteorological model simulation for air quality model applications, a number of performance benchmarks for comparison are typically used. Table 4-1 lists the meteorological model performance benchmarks for simple (Emery et al., 2001) and complex (Kemball-Cook et al., 2005) situations. The simple benchmarks were developed by analyzing well-performing meteorological model evaluation results for simple, mostly flat terrain conditions and simple meteorological conditions (e.g., stationary high pressure) that were mostly conducted to support air quality modeling studies (e.g., ozone SIP modeling). The complex benchmarks were developed during the Western Regional Air Partnership (WRAP) regional haze modeling and are performance benchmarks for more complex conditions, such as

the complex terrain of the Rocky Mountains and Alaska (Kemball-Cook et al., 2005). McNally (2009) analyzed multiple annual runs that included complex terrain conditions and suggested an alternative set of benchmarks for temperature under more complex conditions. The purpose of the benchmarks is not to assign a "pass/fail" decision, but to understand how good or poor the results are relative to other model applications run for the United States.

In this section, Ramboll compares the WRF meteorological variables to the benchmarks as an indication of WRF model performance. These benchmarks include bias and error in temperature, wind direction and mixing ratio as well as the wind speed bias and Root Mean Squared Error (RMSE) between the model output and observations

Table 4-1. Meteorological Model Performance Benchmarks for Simple and Complex Conditions

Parameter	Emery et al. (2001)	Kemball-Cook et al. (2005)	McNally (2009)	Resulting Criteria
Conditions	Simple	Complex	Complex	Complex
Temperature Bias	≤ ±0.5 K	≤ ±2.0 K	≤ ±1.0 K	≤ ±1.0 K
Temperature Error	≤ 2.0 K	≤ 3.5 K	≤ 3.0 K	≤ 3.0 K
Humidity Bias	≤ ±1.0 g/kg	≤ ±0.8 g/kg	≤ ±1.0 g/kg	≤ ±1.0 g/kg
Humidity Error	≤ 2.0 g/kg	≤ 2.0 g/kg	≤ 2.0 g/kg	≤ 2.0 g/kg
Wind Speed Bias	≤ ±0.5 m/s	≤ ±1.5 m/s	(not addressed)	≤ ±1.5 m/s
Wind Speed RMSE	≤ 2.0 m/s	≤ 2.5 m/s	(not addressed)	≤ 2.5 m/s
Wind Dir. Bias	≤ ±10 degrees	(not addressed)	(not addressed)	≤ ±10 degrees
Wind Dir. Error	≤ 30 degrees	≤ 55 degrees	(not addressed)	≤ 55 degrees

A standard set of statistical metrics from the METSTAT package was used. These metrics were calculated on hourly time frames for wind speed, wind direction, temperature, and humidity at the surface, using observational weather data from the DS3505 network as well as one local site from the RAWS network (HOOI1). The WRF surface meteorological model performance metrics were compared against the

ED_013256A_00000461-00031

simple and complex model performance goals using soccer plots. As mentioned in the previous section, soccer plots use two WRF performance metrics as X-axis and Y-axis values (e.g., temperature bias as X, and temperature error as Y) along with the performance benchmarks. The closer the symbols are to the zero origin, the better the model performance. These plots also make it easy to see when the two WRF performance metrics fall within the benchmark lines.

4.1.1 Quantitative Statistics

The quantitative analysis was conducted using METSTAT. Statistical measures calculated by METSTAT include observation and prediction means, prediction bias, and prediction error that are given as follows.

Mean observation (M_o) is calculated using values from all sites for a given time period by Eq. (1):

$$M_o = \frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I} O_j^i \qquad \textbf{(1)}$$

where O^i_j is the individual observed quantity at site i and time j, and the summations are over all sites (I) and over time periods (J).

Mean Prediction (M_p) is calculated from simulation results that are interpolated to each observation used to calculate the mean observation for a given time period by Eq. (2):

$$M_p = \frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I} P_j^i \qquad \textbf{(2)}$$

where P^i_j is the individual predicted quantity at site i and time j. Note the predicted mean wind speed and mean resultant direction are derived from the vector-average (for east-west component u and north-south component v), from which the mean wind speed and mean resultant direction are derived.

Bias (B) is calculated as the mean difference in prediction-observation pairings with valid data within a given analysis region and for a given time period by Eq. (3):

ED_013256A_00000461-00032

$$B = \frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I}\left(P_j^i - O_j^i\right) \quad \textbf{(3)}$$

Gross Error (E) is calculated as the mean *absolute* difference in prediction-observation pairings with valid data within a given analysis region and for a given time period by Eq. (4):

$$E = \frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I}\left|P_j^i - O_j^i\right| \quad \textbf{(4)}$$

Note that the bias and gross error for winds are calculated from the predicted-observed residuals in speed and direction (not from vector components *u* and *v*). The direction error for a given prediction-observation pairing is limited to range from 0 to ±180°.

Root Mean Square Error (RMSE) is calculated as the square root of the mean squared difference in prediction-observation pairings with valid data within a given analysis region and for a given time period by Eq (5):

$$RMSE = \left[\frac{1}{IJ}\sum_{j=1}^{J}\sum_{i=1}^{I}\left(P_j^i - O_j^i\right)^2\right]^{\frac{1}{2}} \quad \textbf{(5)}$$

The RMSE, as with the gross error, is a good overall measure of model performance. However, since large errors are weighted heavily (due to squaring), large errors in a small sub-region may produce a large RMSE even though the errors may be small and quite acceptable elsewhere.

ED_013256A_00000461-00033

5. METEOROLOGICAL MODEL PERFORMANCE RESULTS

5.1 METSTAT Soccer Plots

Figure 5-1 presents METSTAT soccer plots that show the comparison between observed and modeled wind direction, wind speed, temperature, and humidity for the six DS3505 sites within the 1.33 km modeling domain for 2014-2016. Overall, these plots demonstrate acceptable model performance. Wind speed temperature and humidity statistics all fall within the complex conditions threshold, and majority of the monthly biases and errors are within the threshold for simple conditions. Given the complex terrain of the modeling region, producing statistics within these ranges represents strong performance. Wind direction evaluation is the exception, with most months showing a positive bias just beyond the threshold for complex conditions. Wind direction can be highly affected by the topography near the meteorological station, which makes wind direction biases common amidst complex terrain.

Figure 5-2 presents METSTAT soccer plots with data from all meteorological sites in the MADIS database contained within the 1.33 km WRF modeling domain for 2014-2016. This includes the six DS3505 sites as well as additional meteorological sites described in Section 3 (e.g., CWOP, RAWS, IDT). Model-measurement agreement is similar to the DS3505 evaluation for wind direction, temperature and humidity, but worse for wind speed, which shows a positive bias of over 1 m/s for most months. As mentioned in Section 3, meteorological observations from DS3505 sites are generally considered to be of good quality, while other sites contained in the MADIS database are not necessarily subject to the same level of quality assurance/quality control (QA/QC). Additionally, non-DS3505 sites can be located in remote locations and have sub-optimal monitor placement. Given these considerations, it is not surprising that the inclusion of non-DS3505 sites into the METSTAT analysis results in increased wind speed bias. For the remaining METSTAT analyses, we focus on the comparison of observations from the DS3505 network and HOOI1 RAWS site (see Section 3) to WRF model results.

Figure 5-3 presents METSTAT soccer plots for all DS3505 sites within the 4 km modeling domain for 2014-2016. We expect METSTAT performance to be slightly better when averaged over larger model domains, and indeed WRF shows stronger performances for wind direction, temperature, and humidity over the 4 km domain. Wind speed shows slightly higher error, but less total bias than for the 1.33 km

ED_013256A_00000461-00034

domain. Figure 5-4 presents METSTAT soccer plots for all DS3505 sites within the 12 km modeling domain, which WRF performs well across.

Figure 5-5 through Figure 5-11 present MESTAT soccer plots for the six DS3505 sites in the 1.33 km WRF modeling domain and the HOOI1 RAWS site for 2014-2016. Overall, there is good agreement between observed and modeled temperature, humidity, and wind speed in most cases. There are bigger disagreements between observed and modeled wind directions, with most sites showing high biases. As mentioned above, wind direction is highly dependent on localized terrain and impacted by nearby buildings and other small-scale features. Even with 1.33 km resolution, WRF is not able to capture all of these highly detailed terrain and land use features, which likely contributes to differences between observed and modeled wind direction.

Cumulatively, the results of the quantitative MPE indicate that WRF represented local surface-level meteorological variables with sufficient accuracy for standard Class I CALPUFF and AERMOD dispersion modeling applications. Section 5.4 further examines surface-level winds at specific observations sites, and evaluates stability parameters.

ED_013256A_00000461-00035

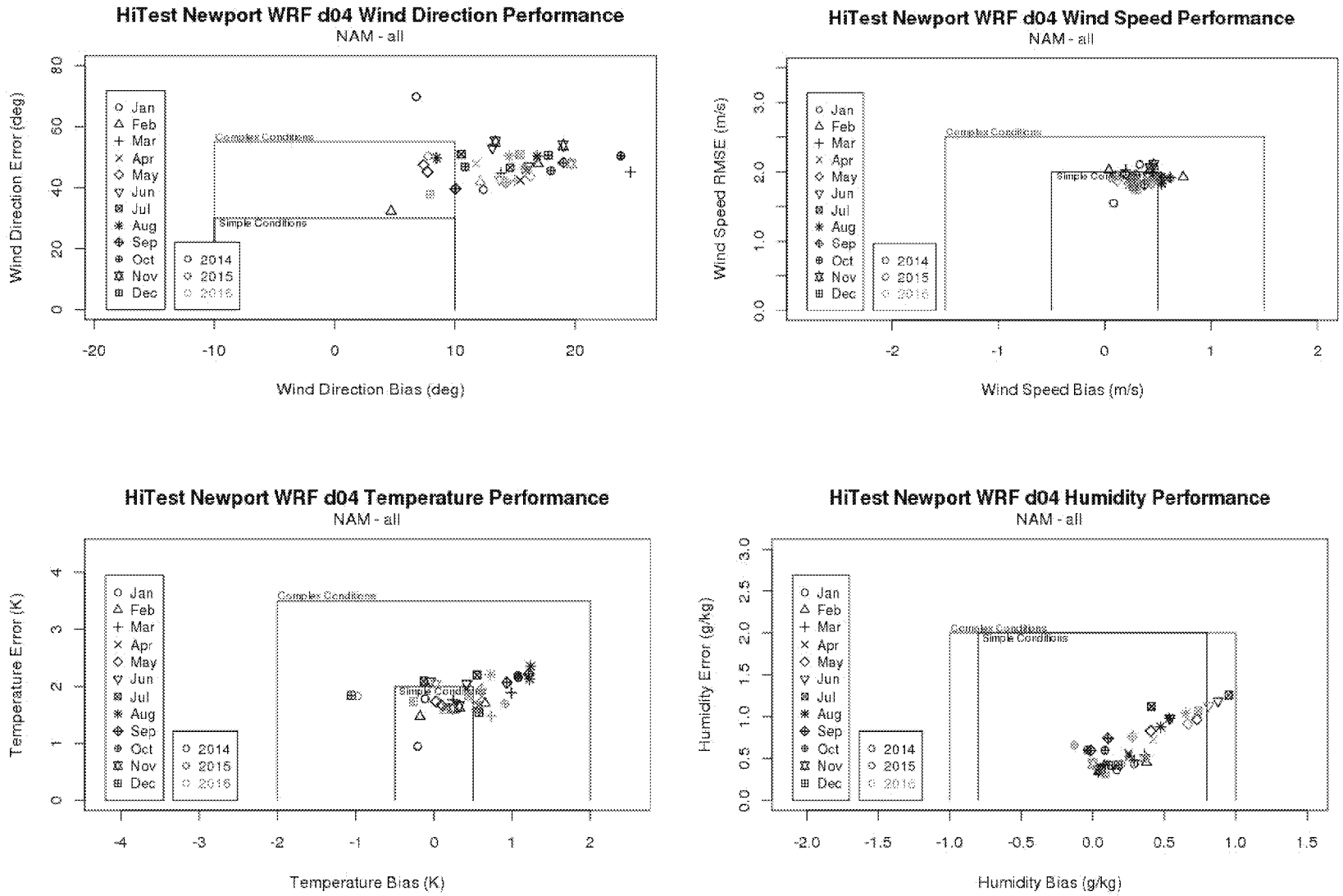


Figure 5-1. METSTAT Soccer Plots for all DS3505 sites in the 1.33 km WRF domain

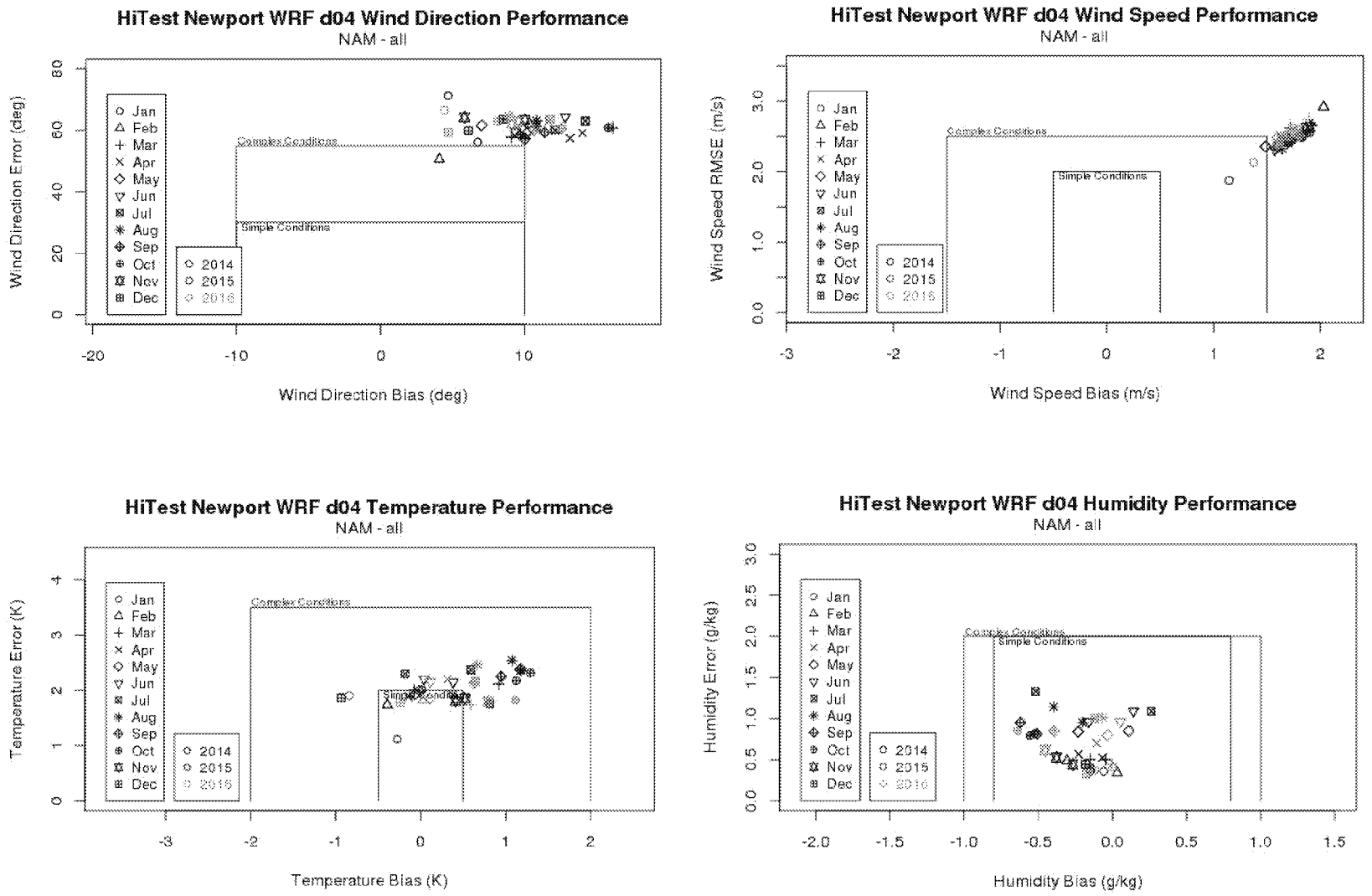


Figure 5-2. METSTAT Soccer Plots for all MADIS sites in the 1.33 km WRF domain

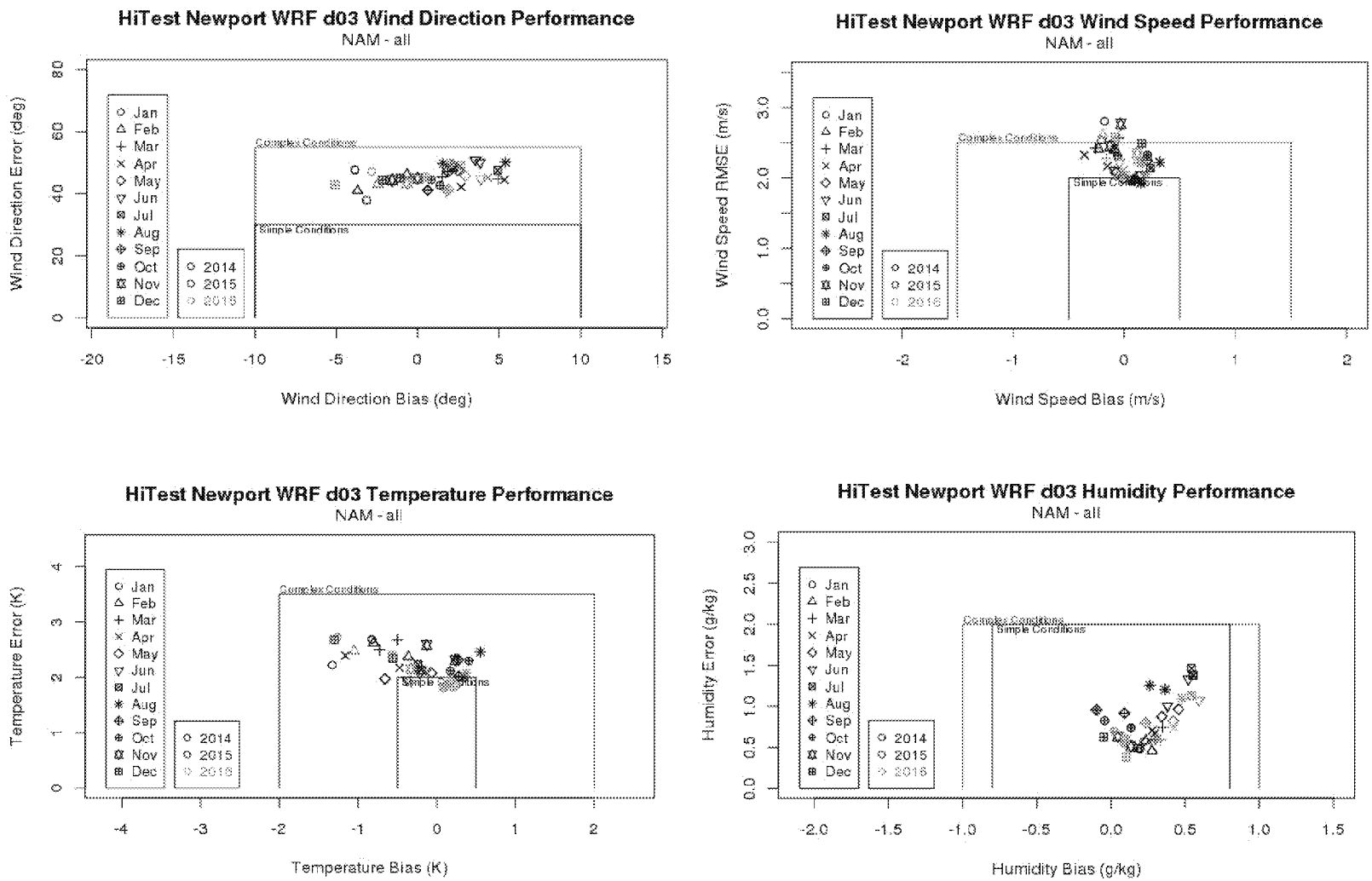


Figure 5-3. METSTAT Soccer Plots for all DS3505 sites in the 4 km WRF domain

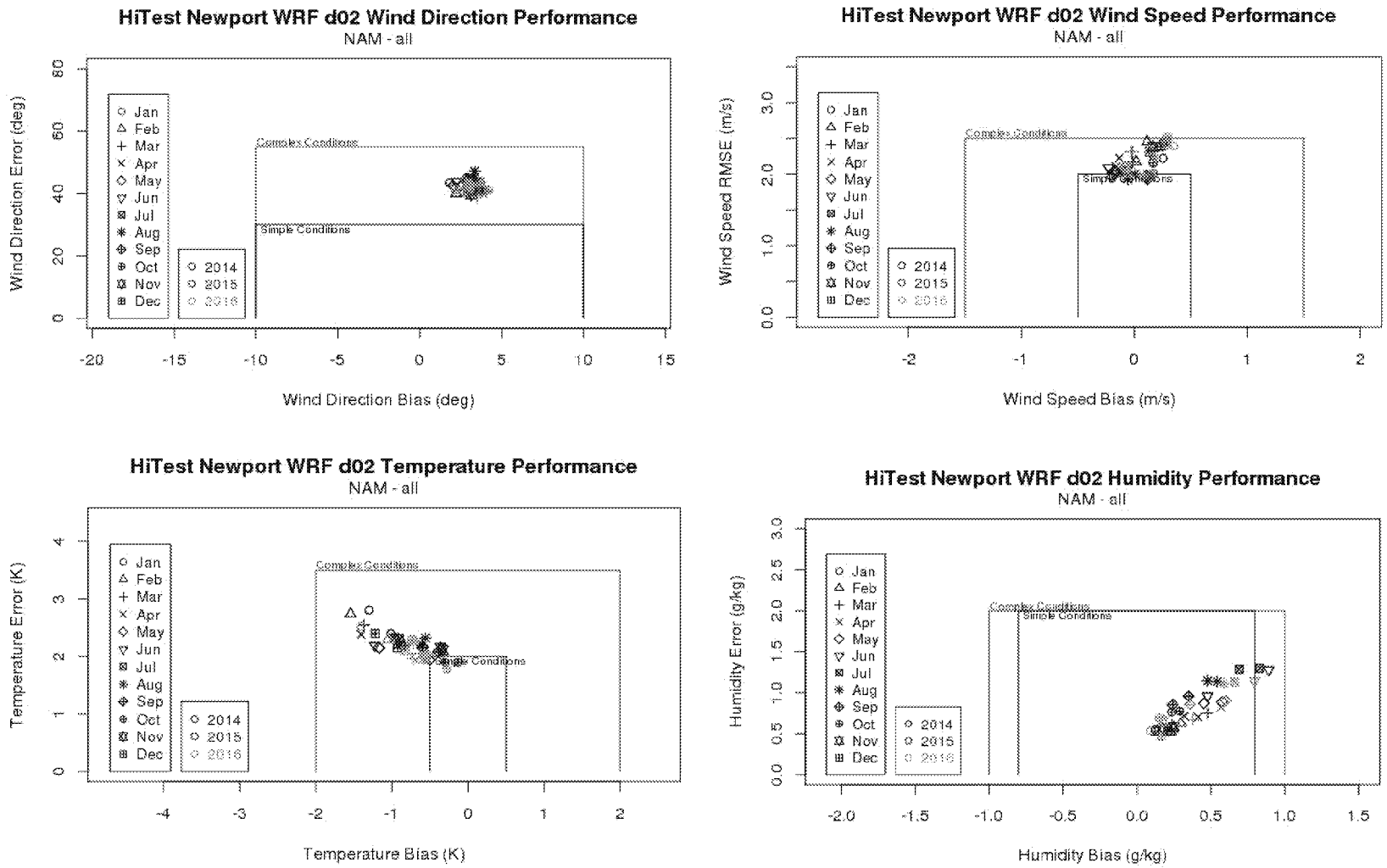


Figure 5-4. METSTAT Soccer Plots for all DS3505 sites in the 12 km WRF domain

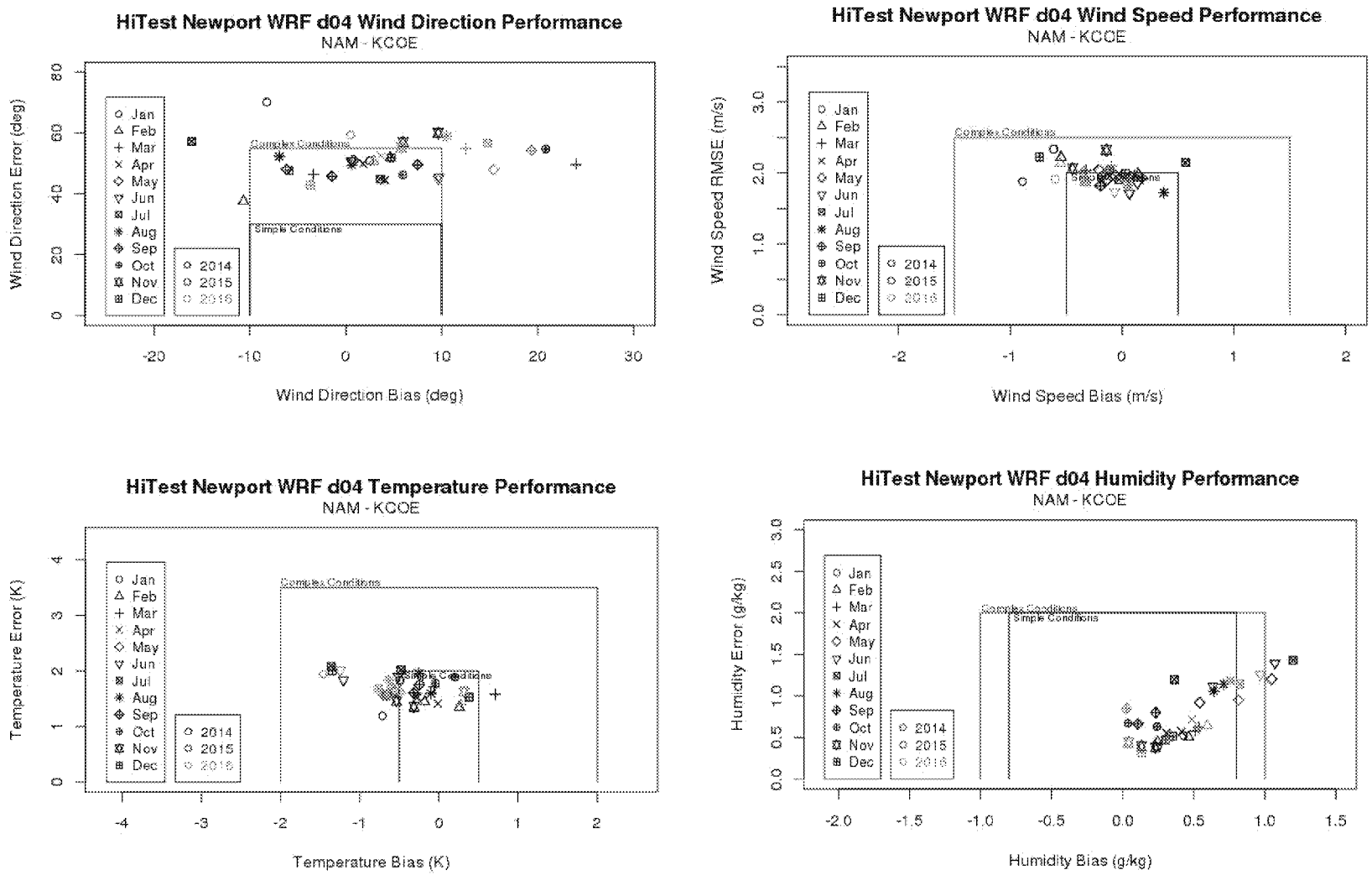


Figure 5-5. METSTAT Soccer Plots at KCOE (Coeur d'Alene, 50 km S of Newport)

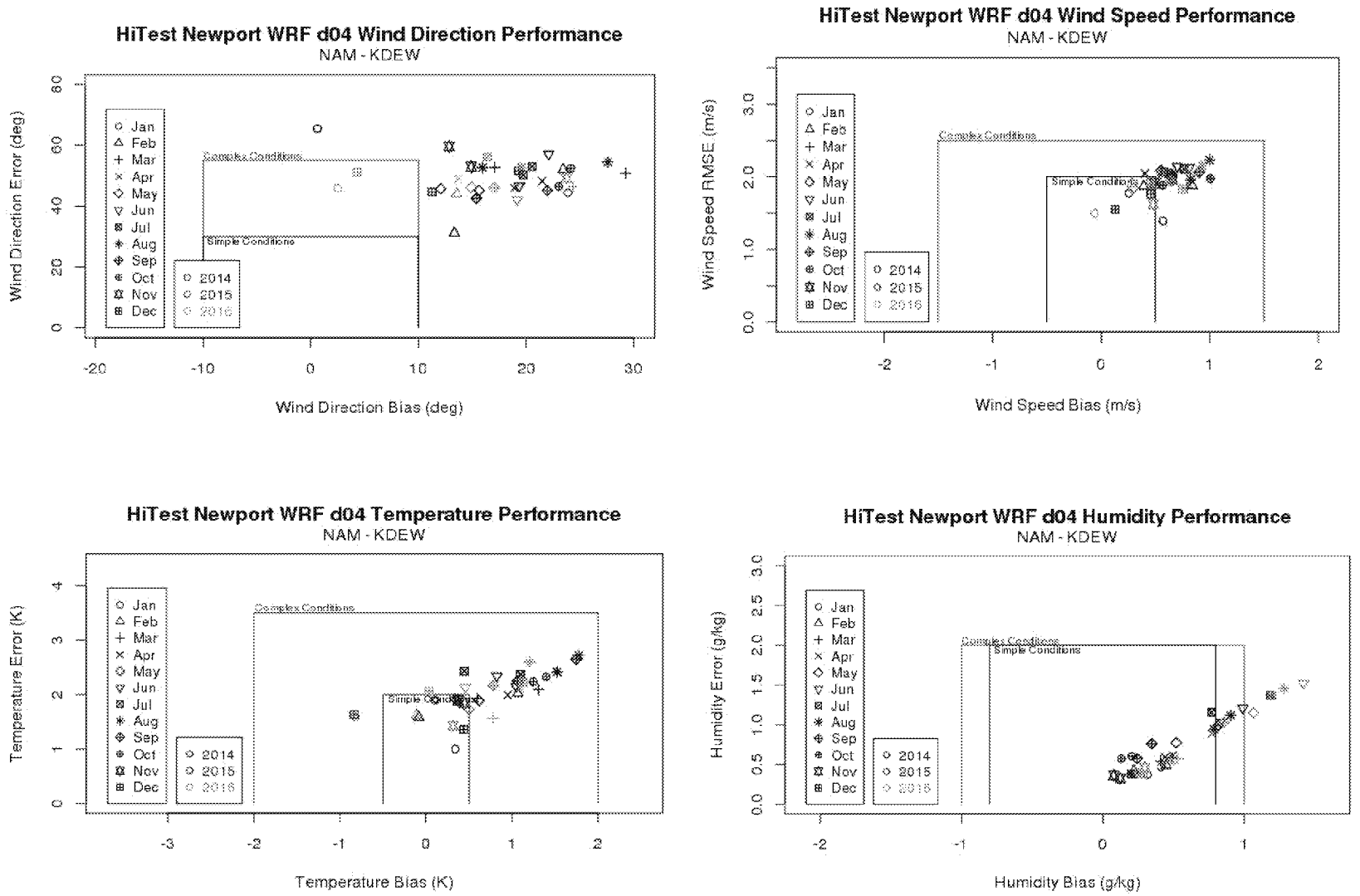


Figure 5-6. METSTAT Soccer Plots at KDEW (Deer Park NWS, 36 km SW of Newport)

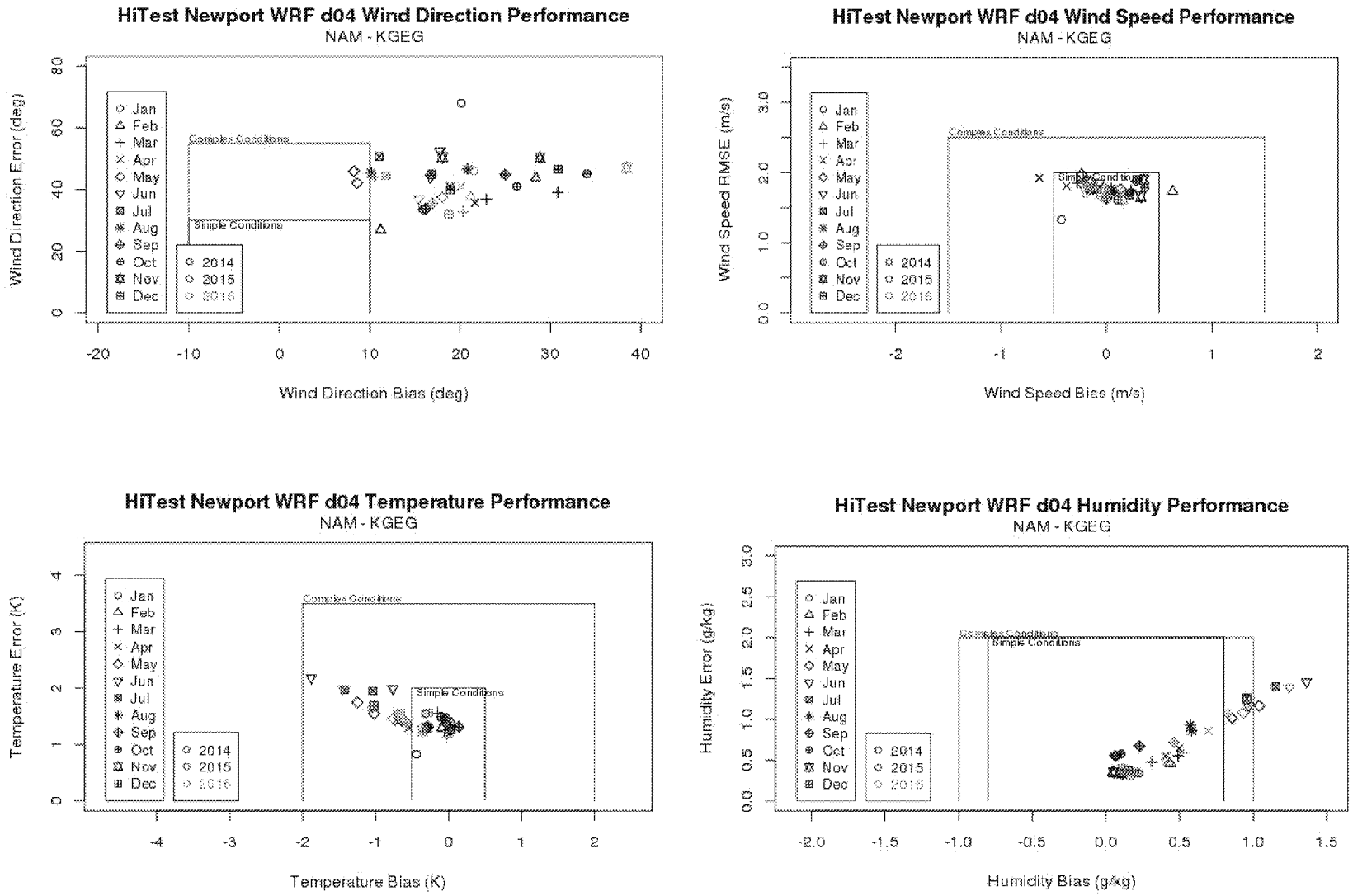


Figure 5-7. METSTAT Soccer Plots at KGEG (Spokane NWS, 71 km SW of Newport)

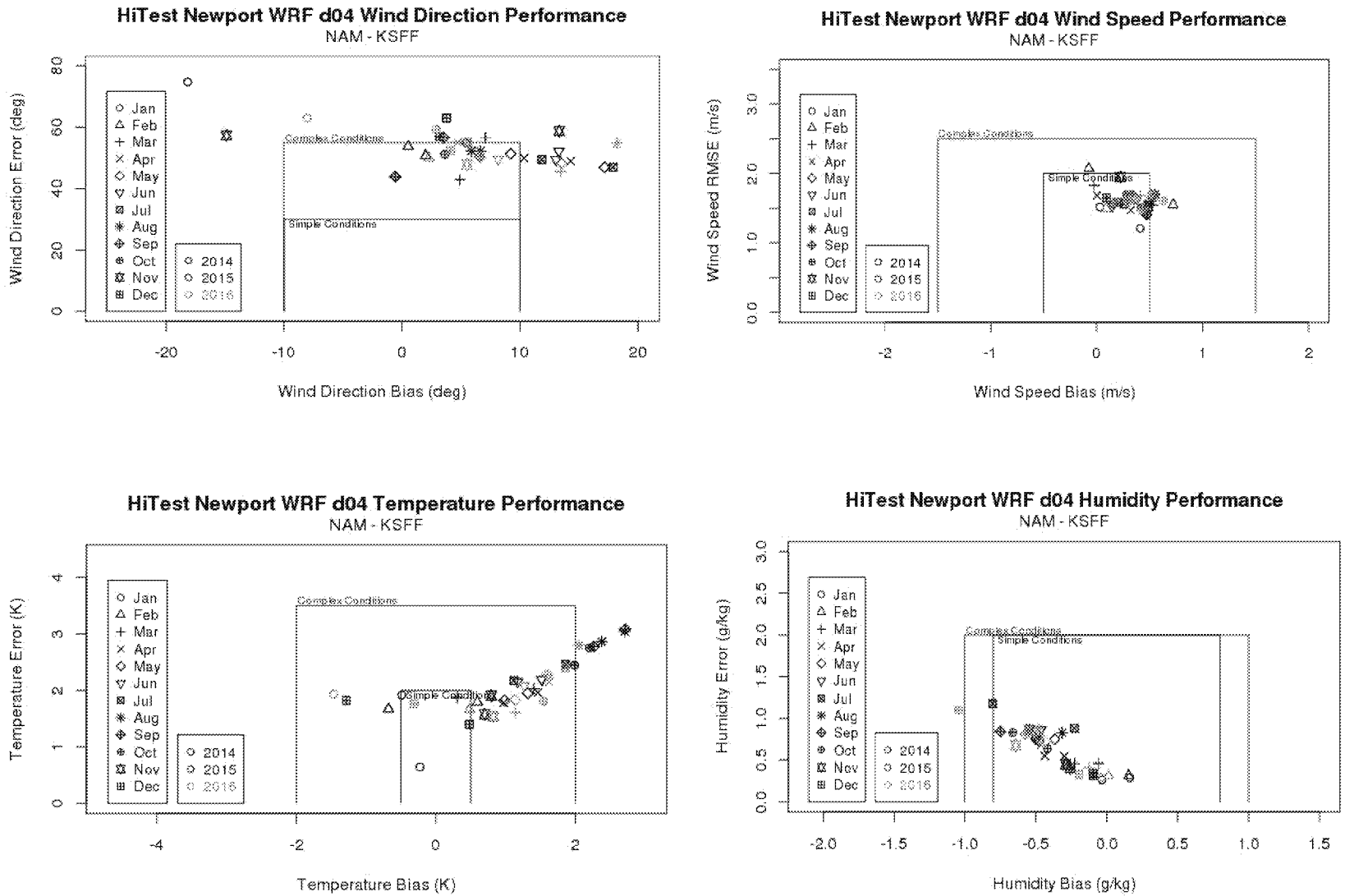


Figure 5-8. METSTAT Soccer Plots at KSFF (Spokane NWS, 60 km SSW of Newport)

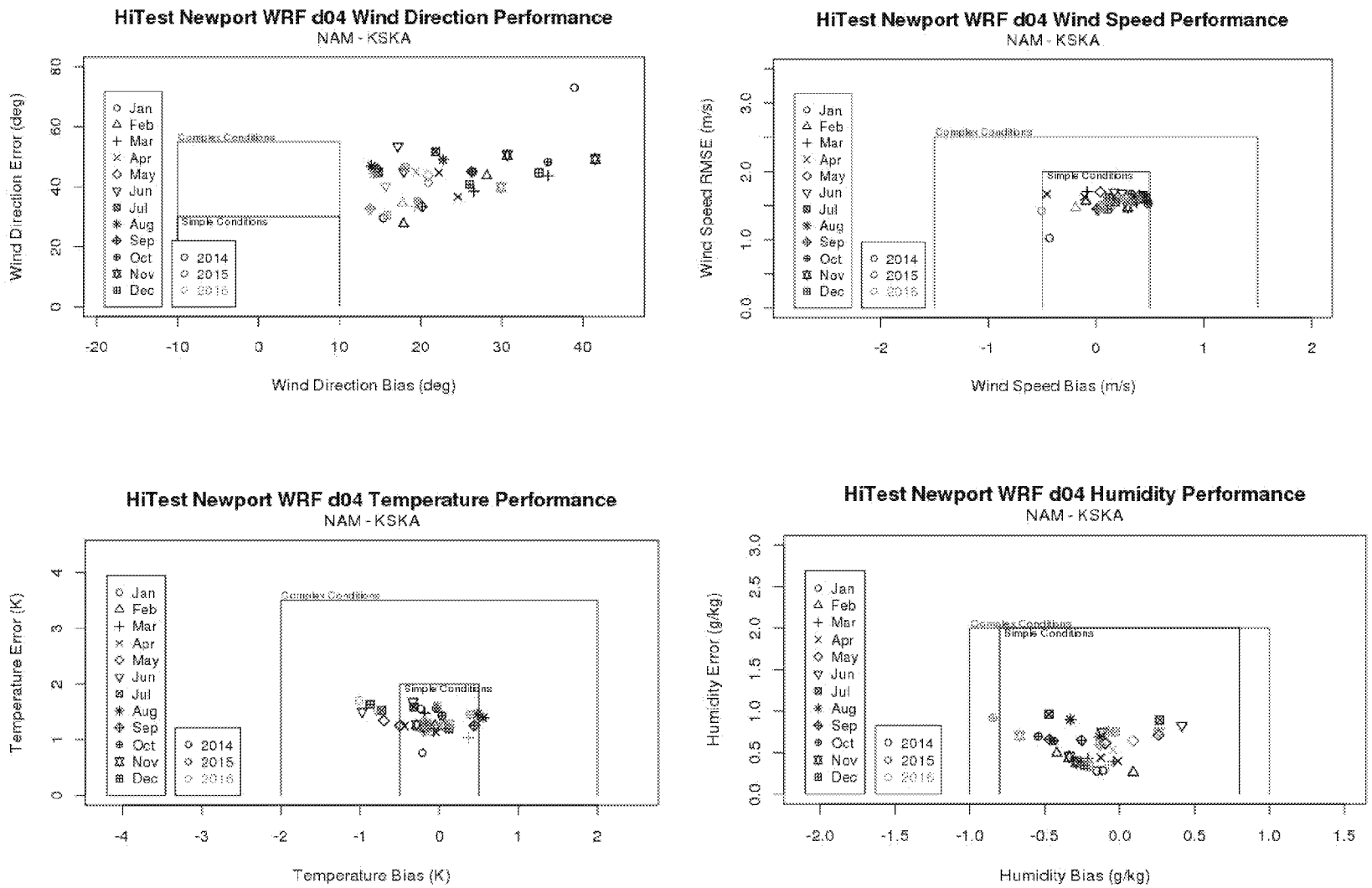


Figure 5-9. METSTAT Soccer Plots at KSKA (Fairchild Air Force Base, 77 km SW of Newport)

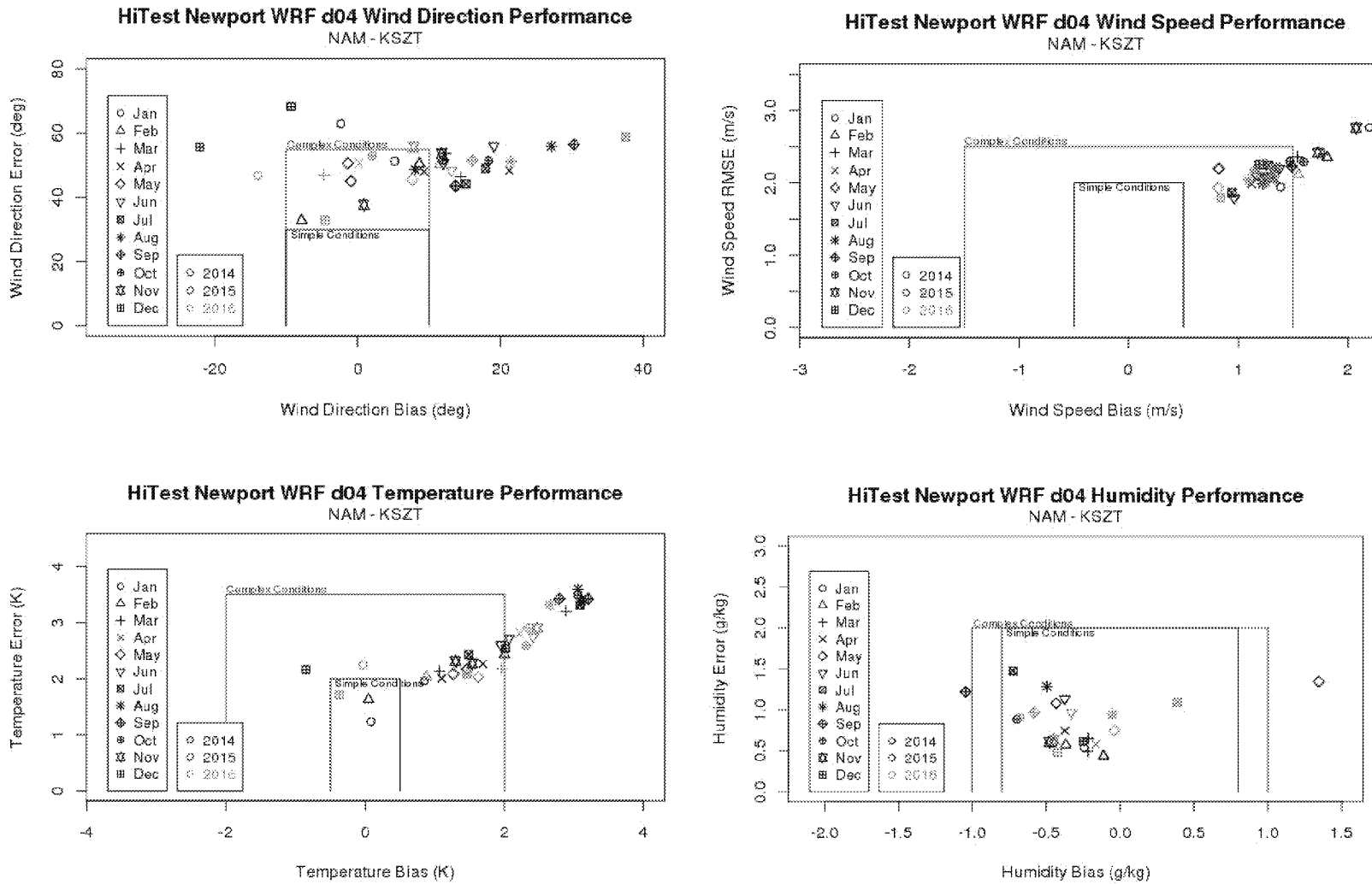
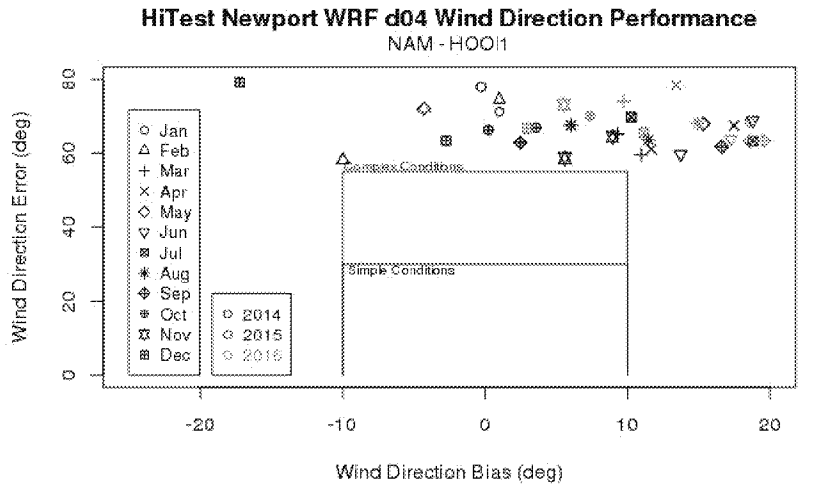
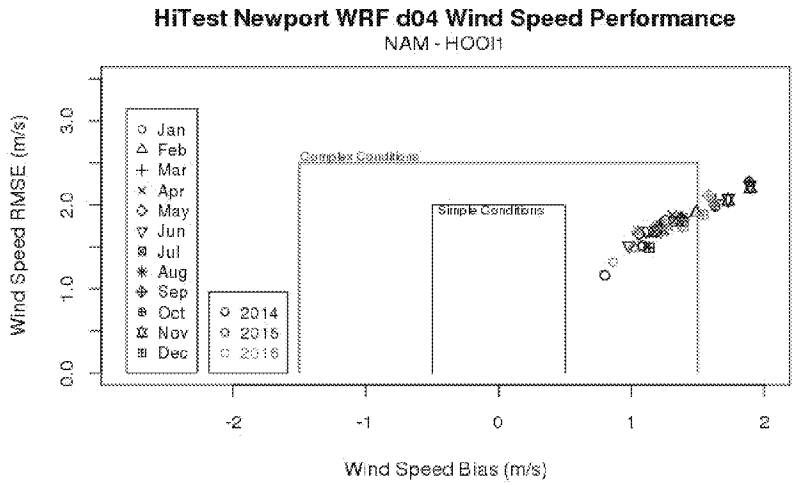


Figure 5-10. METSTAT Soccer Plots at KSZT (Sandpoint, 39 km NE of Newport)





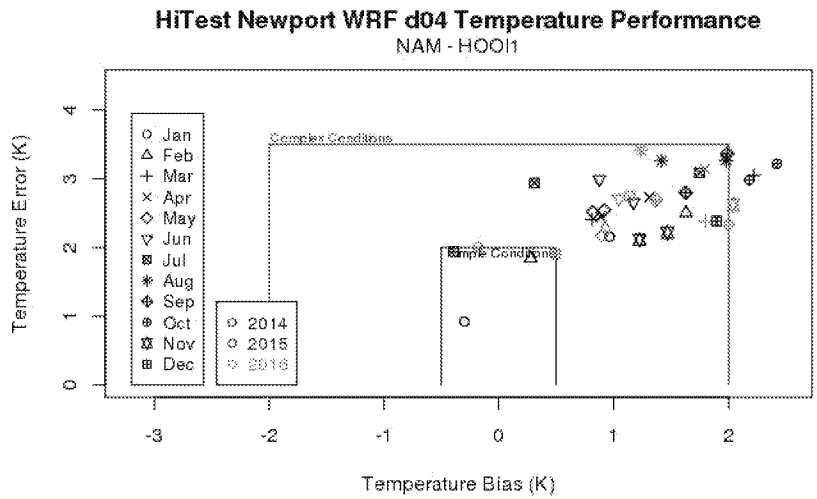


Figure 5-11. METSTAT Soccer Plots at HOOI1 (24 km SE of Newport)

5.2 Qualitative Evaluation Using PRISM Precipitation data

This section presents a qualitative comparison of WRF-simulated quarterly precipitation along with quarterly PRISM (Daly, 2008) analysis fields that are based on observations. The PRISM datasets are spatial maps of climate elements across the United States built by the Spatial Climate Analysis Service at Oregon State University. Gridded maps of mean monthly and annual precipitation and temperature were built using meteorological station measurements and a set of statistical weighting procedures and corrections based on distance, elevation, topographic orientations and influences, and land-surface type (Daly and Bryant, 2013). The process and results have been extensively peer-reviewed and are generally accepted by the climatological community as state-of-the-art representations.

When comparing the WRF and PRISM precipitation data, note that the PRISM analysis fields only cover the continental United States and do not extend into Canada, or any oceanic portions of the domain; the WRF fields, on the other hand, cover the entire domain. To ease visual comparison between the two plots, the WRF precipitation plots are masked to emphasize rainfall over the CONUS. Additionally, as the precipitation monitoring sites tend to be located at lower elevations (e.g., airports), the PRISM observation fields may not fully capture the enhanced precipitation at high elevations due to orographic effects that could be present in the WRF simulations. However, PRISM does include an elevation effect as one of the parameters in its regression model.

PRISM precipitation is generally presented and plotted as monthly totals. For this analysis, PRISM and WRF precipitation monthly totals were averaged over the three analysis years and plotted as 3-year monthly averages. Figure 5-12 through Figure 5-23 compare 2014-2016 average monthly WRF precipitation with corresponding PRISM totals over the 4 km WRF domain covering northeastern Washington, northern Idaho, and northwestern Montana.

Figure 5-12 through Figure 5-14 show average January, February, and March precipitation over 2014-2016 for PRISM and WRF. High monthly precipitation totals are observed along the Bitterroot Mountain range, especially near the southern edge of the 4 km domain. Significant precipitation is also observed along the Lewis and Clark Mountain range in Montana, to the east. Very little precipitation is observed in the flatlands along the western and eastern edges of the domain. WRF represents the spatial extents of these patterns very well, but generally

ED_013256A_00000461-00047

underestimates the high precipitation along the mountain ranges, relative to PRISM totals. The largest discrepancy occurs for March, which includes the highest average precipitation of this quarter.

Figure 5-15 through Figure 5-17 show 3-year average PRISM and WRF monthly precipitation totals for April, May, and June. Significantly less precipitation is observed in these months compared to the previous three, but the spatial distribution remains very similar as the majority of the rainfall occurs over the largest mountain ranges. WRF again represents of the spatial extent of the PRISM observations relatively accurately. The average precipitation totals are also much closer between PRISM and WRF for this quarter. Average WRF precipitation was slightly lower than PRISM totals for April and June, but slightly higher than PRISM totals for May.

Figure 5-18 through Figure 5-20 show 3-year average PRISM and WRF monthly precipitation totals for July, August and September. On average, these months were the three driest of the period. Most of the observed rainfall was limited to the Lewis and Clark Mountain Range in Montana. WRF again represented the spatial extent of the sparse precipitation well. WRF precipitation averages closely matched those of PRISM for July and August, while WRF tended to underestimate PRISM rainfall over the Lewis and Clark mountain range in September.

Figure 5-21 through Figure 5-23 show 3-year average PRISM and WRF monthly precipitation totals for October, November, and December. Heavy precipitation is again observed along the large mountain ranges during these months. The largest discrepancies between PRISM and WRF precipitation also occur during these months, as WRF consistently underestimates average precipitation relative to PRISM. While WRF reproduces the spatial patterns of the precipitation well, the model does not reflect the peak precipitation totals observed over the Bitterroot and Lewis and Clark ranges, particularly in October and November. Given the frequency of WRF under-stating monthly precipitation averages relative to PRISM it is possible that orographic rainfall effects in WRF may not be strong enough for this mountainous domain at the 4 km resolution.

ED_013256A_00000461-00048

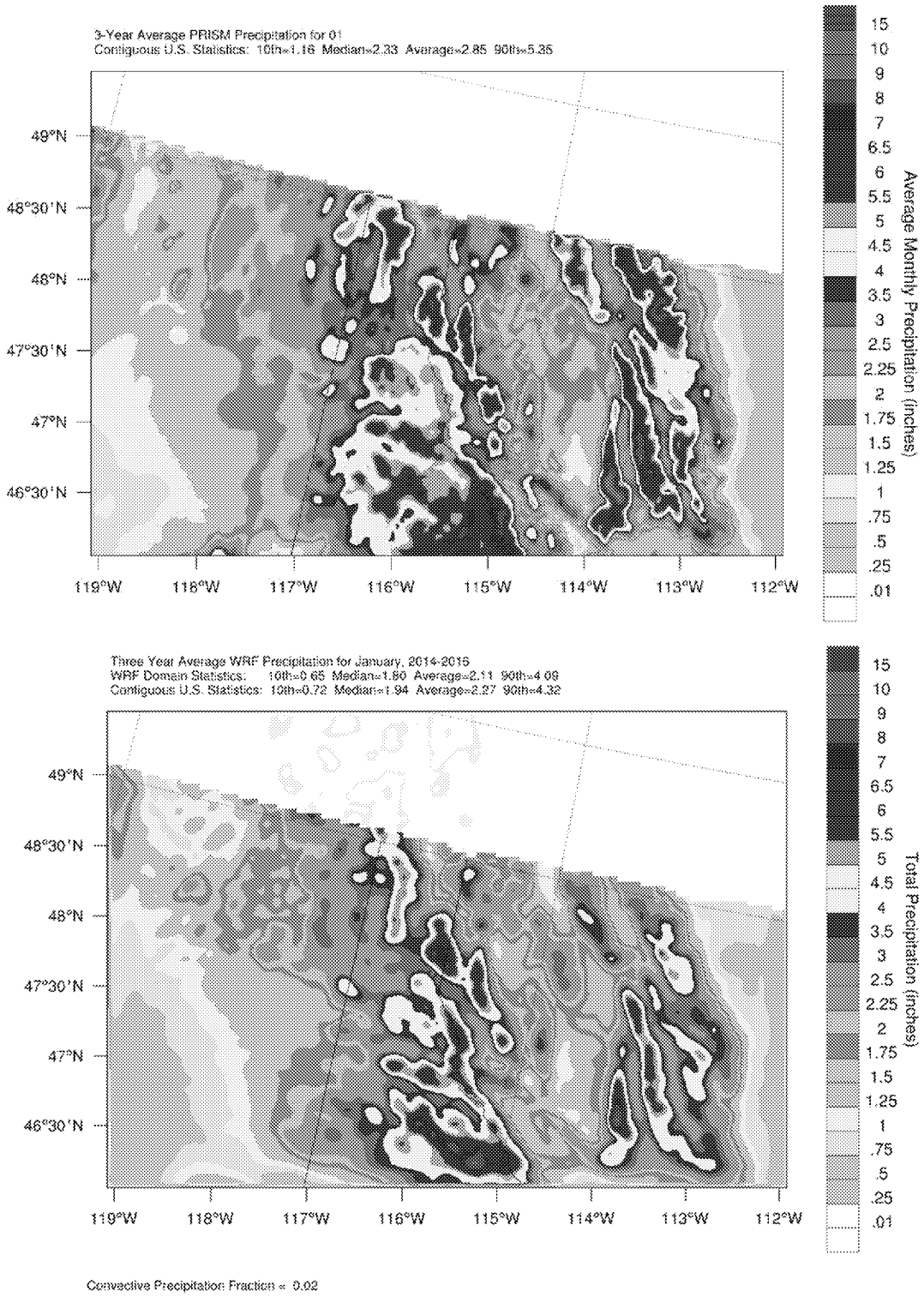


Figure 5-12. 3-year average PRISM (top) and WRF (bottom) precipitation for January

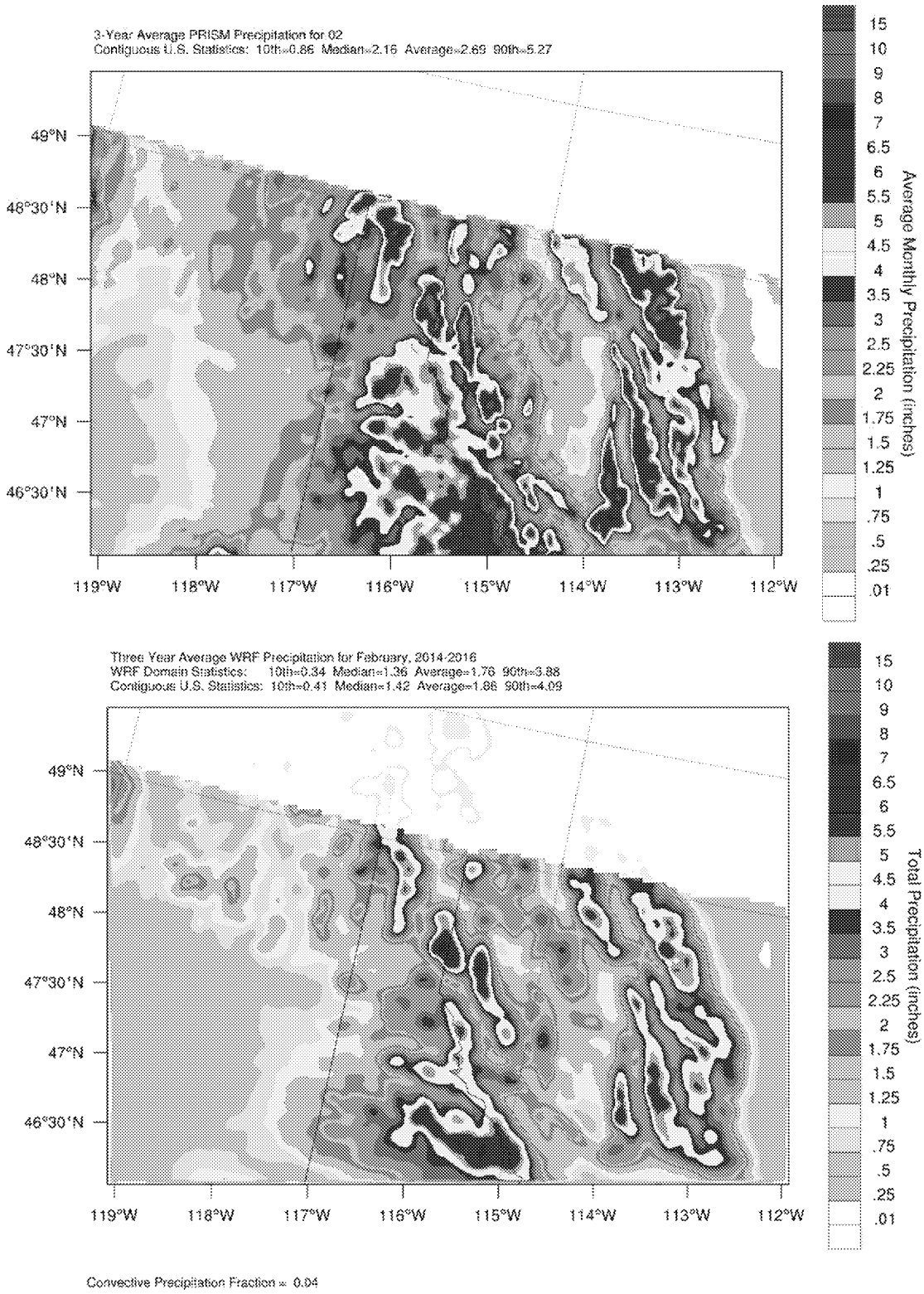


Figure 5-13. 3-year average PRISM (top) and WRF (bottom) precipitation for February

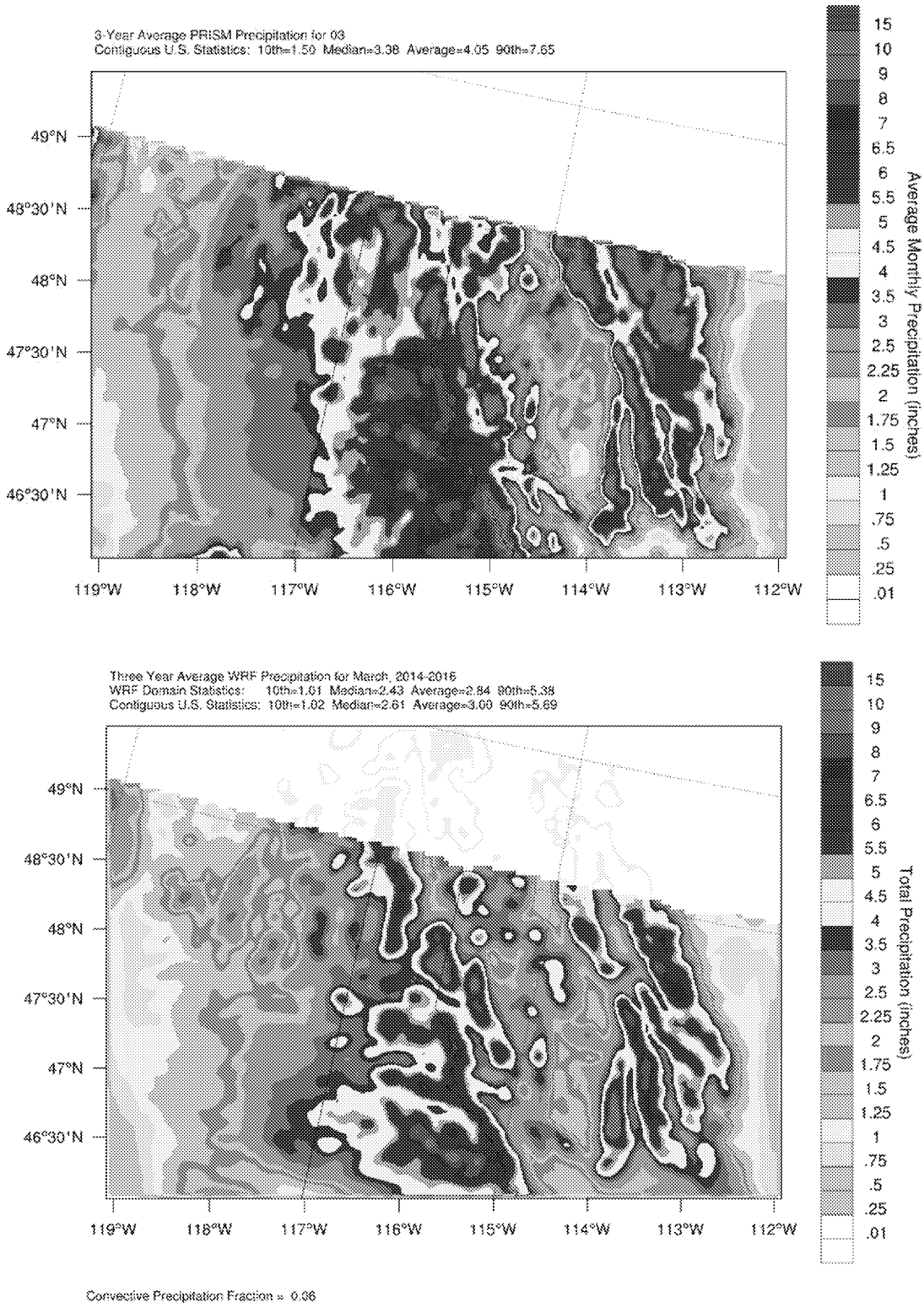


Figure 5-14. 3-year average PRISM (top) and WRF (bottom) precipitation for March

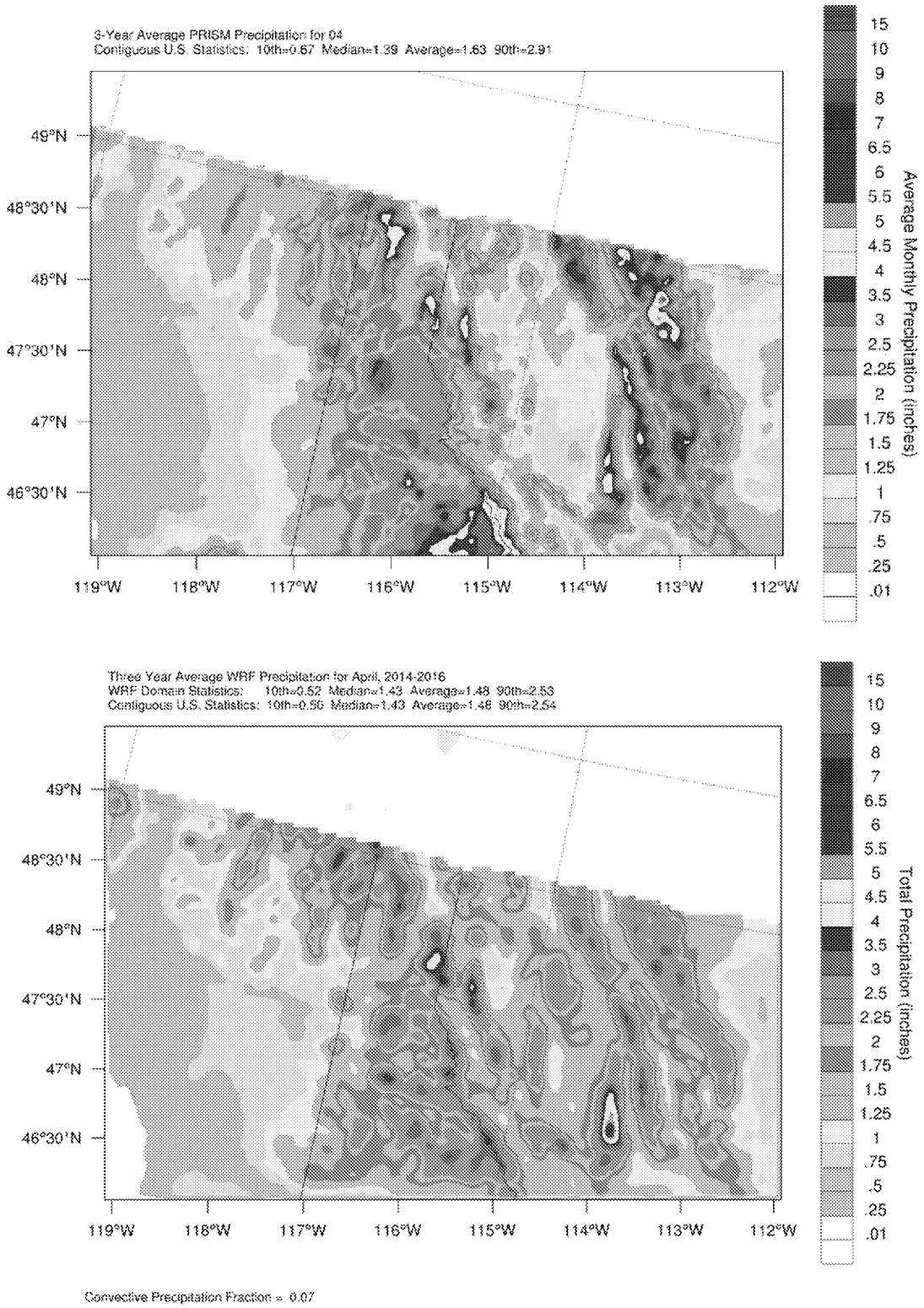


Figure 5-15. 3-year average PRISM (top) and WRF (bottom) precipitation for April

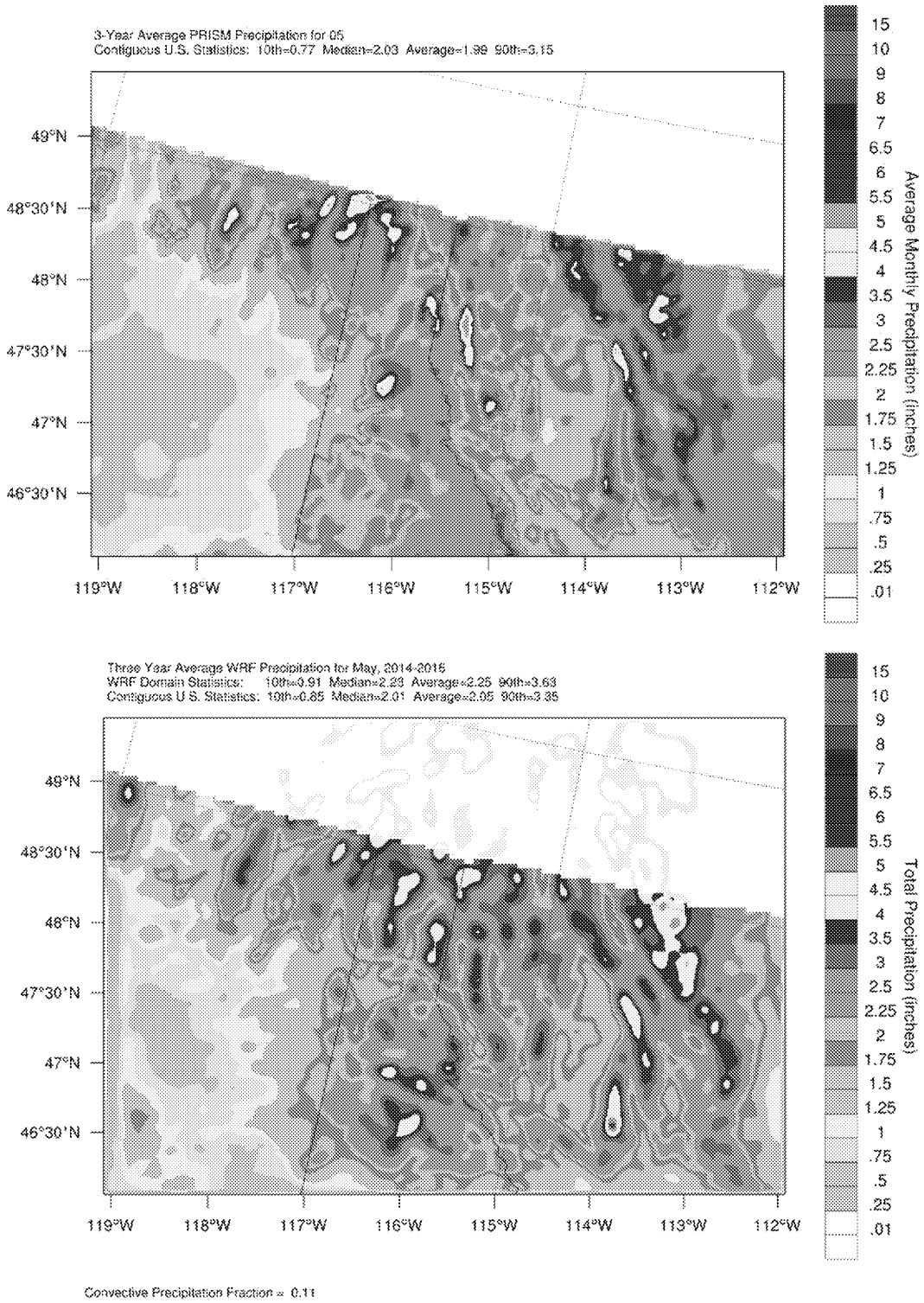


Figure 5-16. 3-year average PRISM (top) and WRF (bottom) precipitation for May

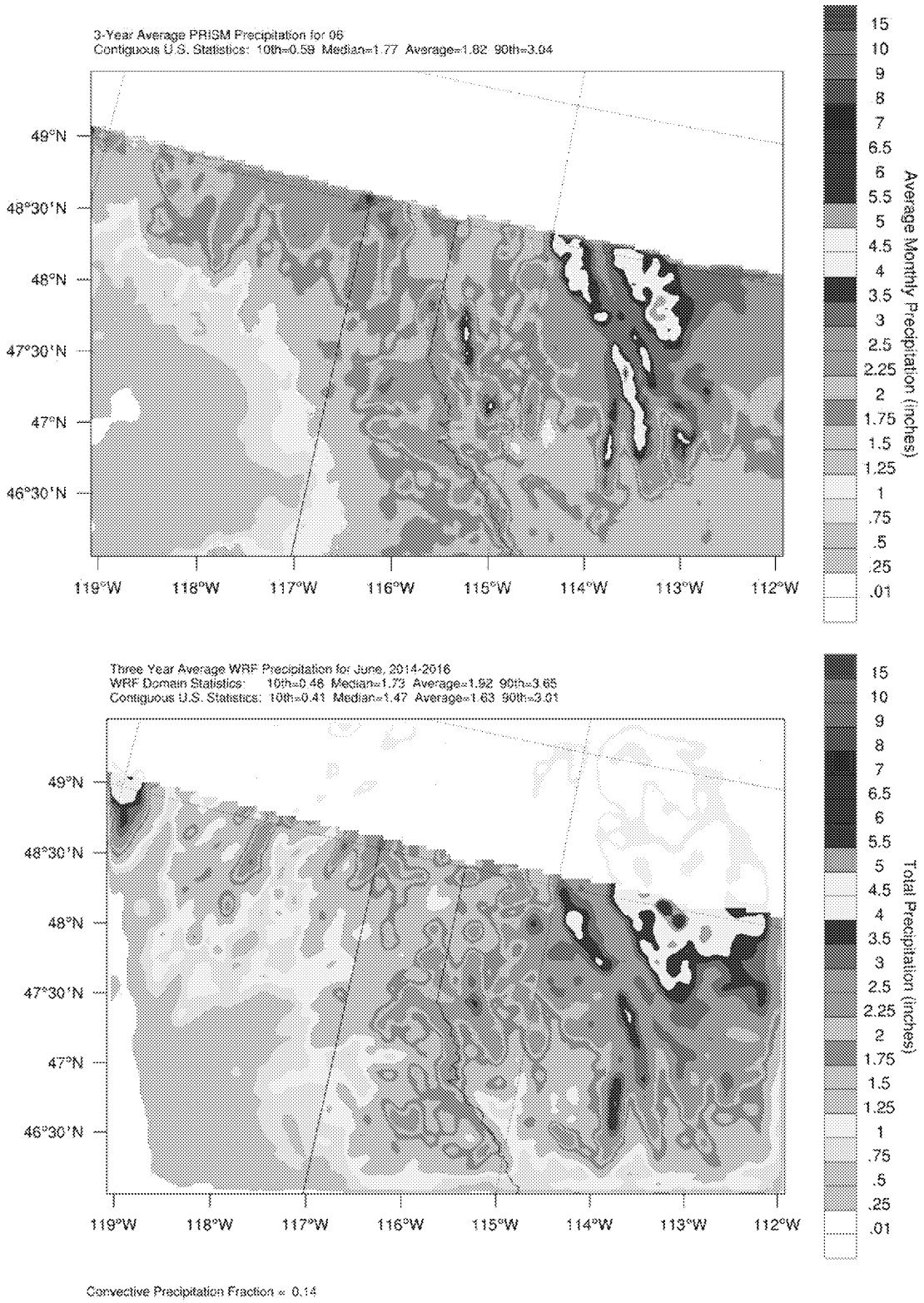


Figure 5-17. 3-year average PRISM (top) and WRF (bottom) precipitation for June

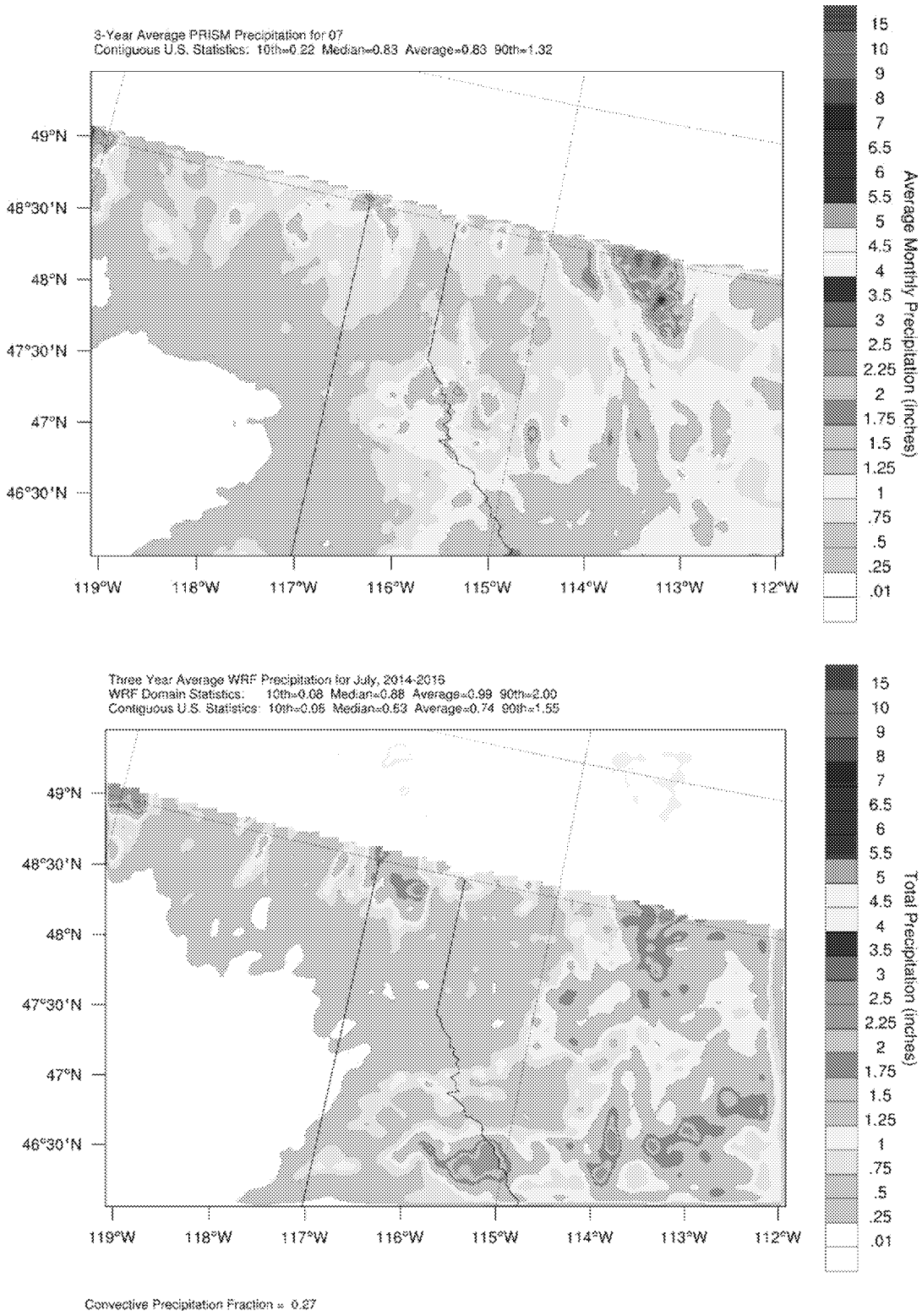


Figure 5-18. 3-year average PRISM (top) and WRF (bottom) precipitation for July

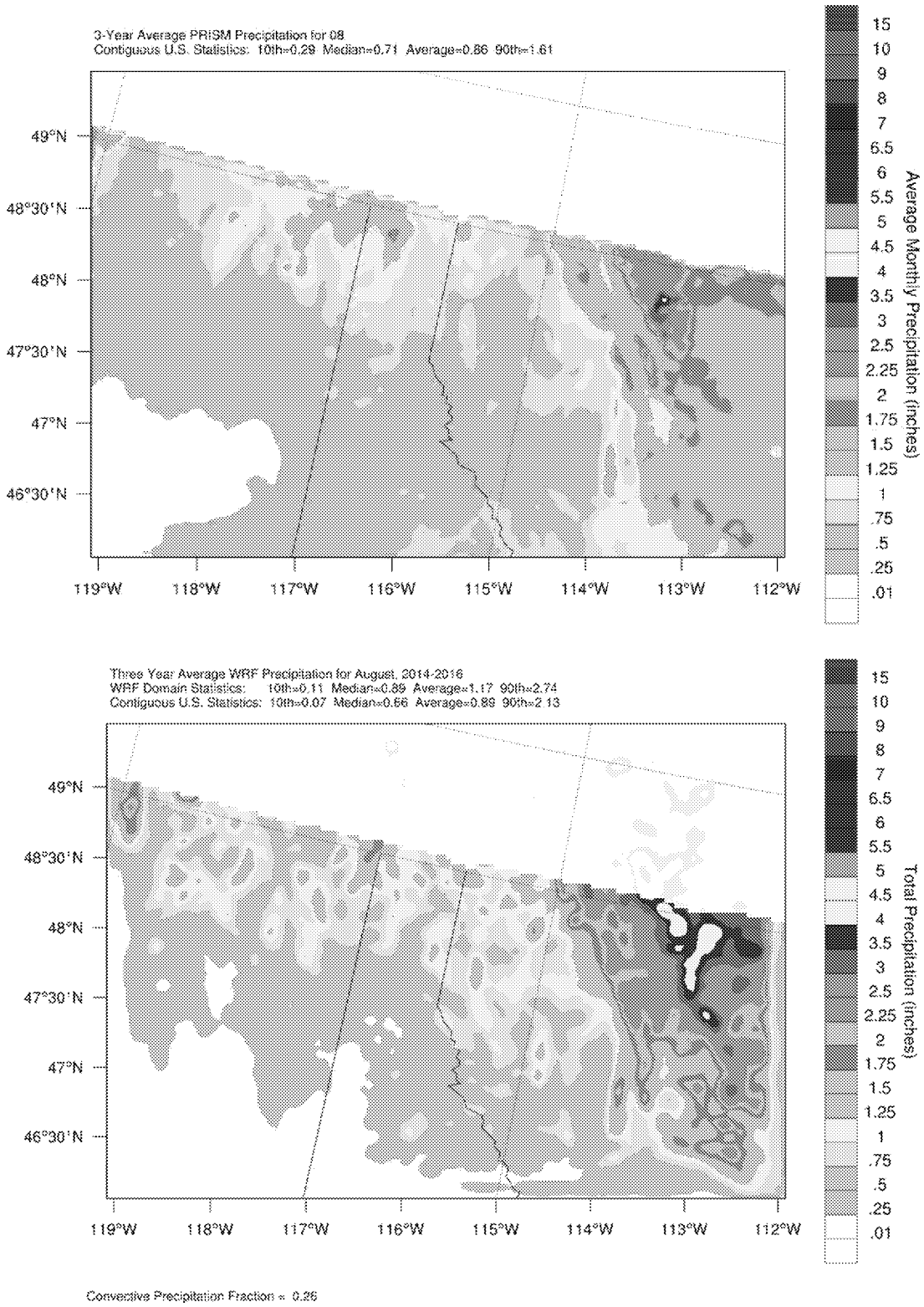


Figure 5-19. 3-year average PRISM (top) and WRF (bottom) precipitation for August

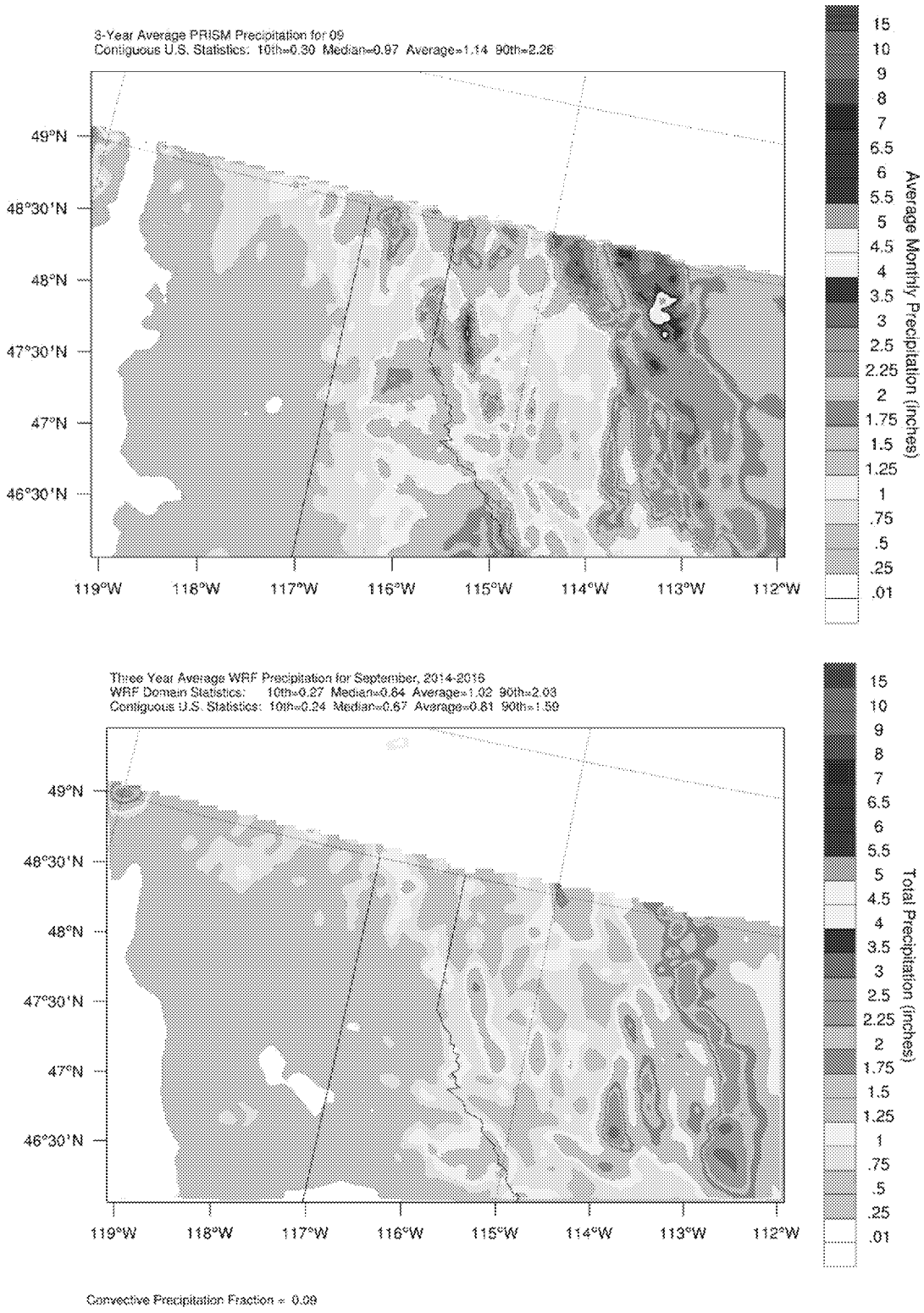


Figure 5-20. 3-year average PRISM (top) and WRF (bottom) precipitation for September

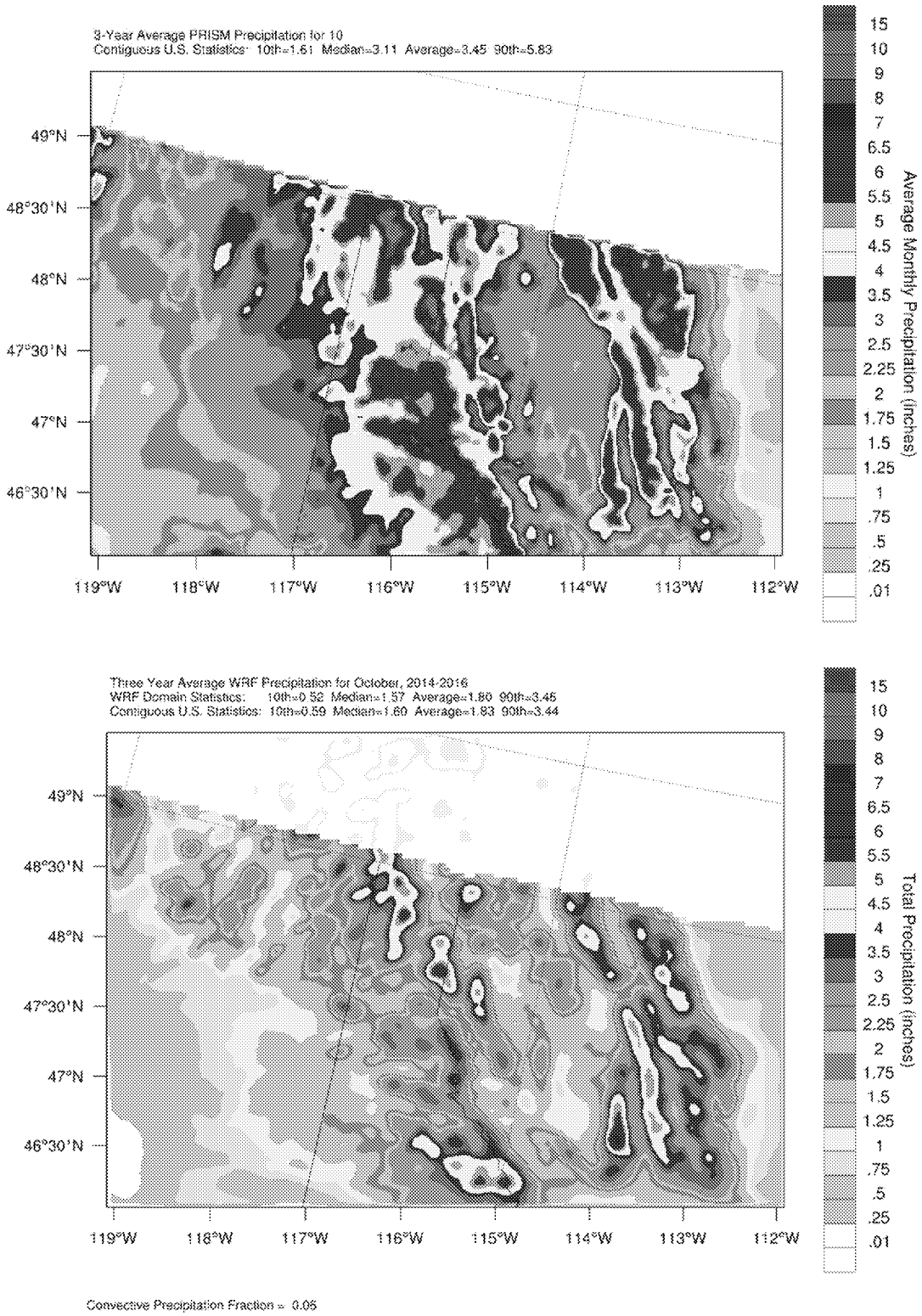


Figure 5-21. 3-year average PRISM (top) and WRF (bottom) precipitation for October

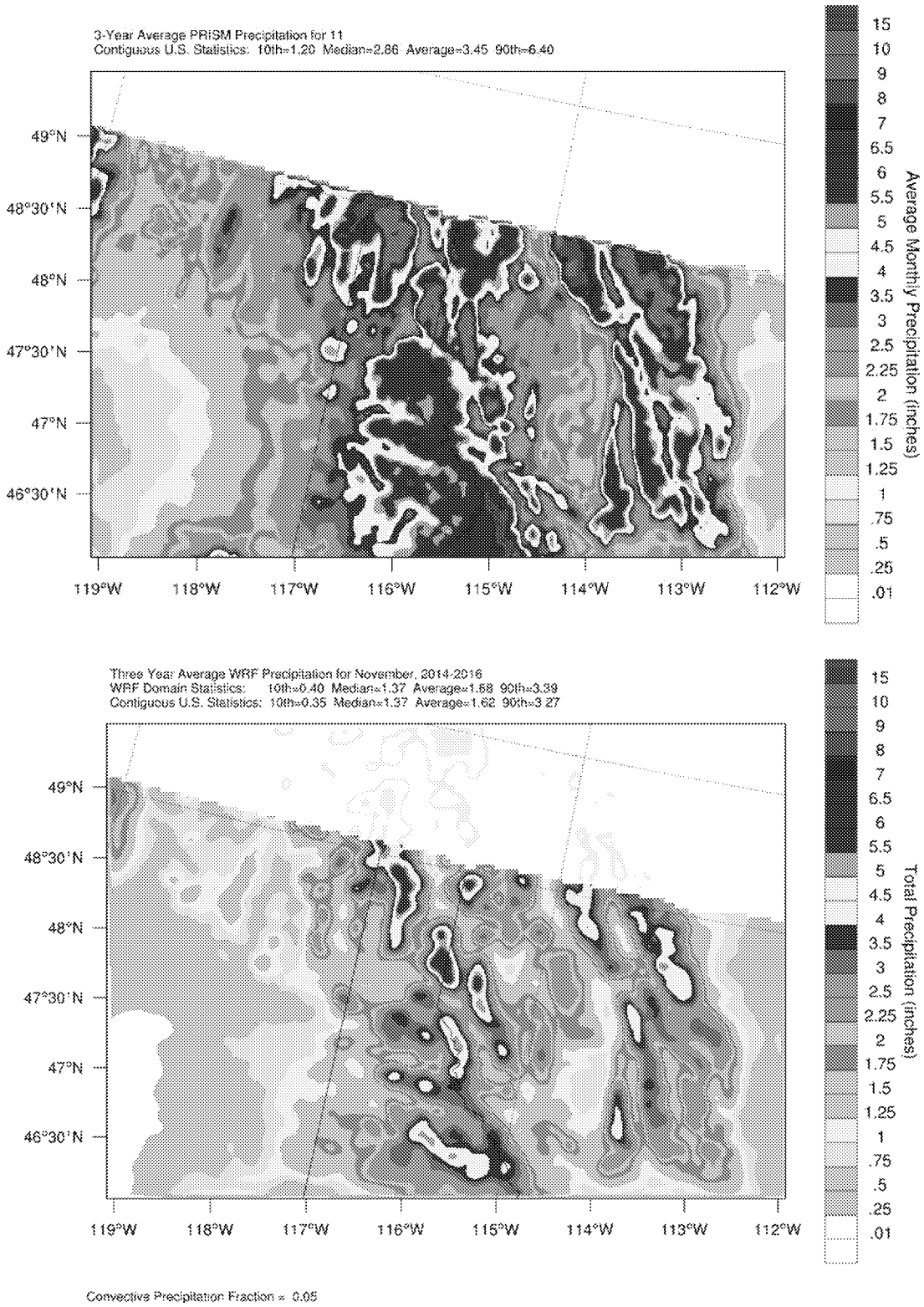


Figure 5-22. 3-year average PRISM (top) and WRF (bottom) precipitation for November

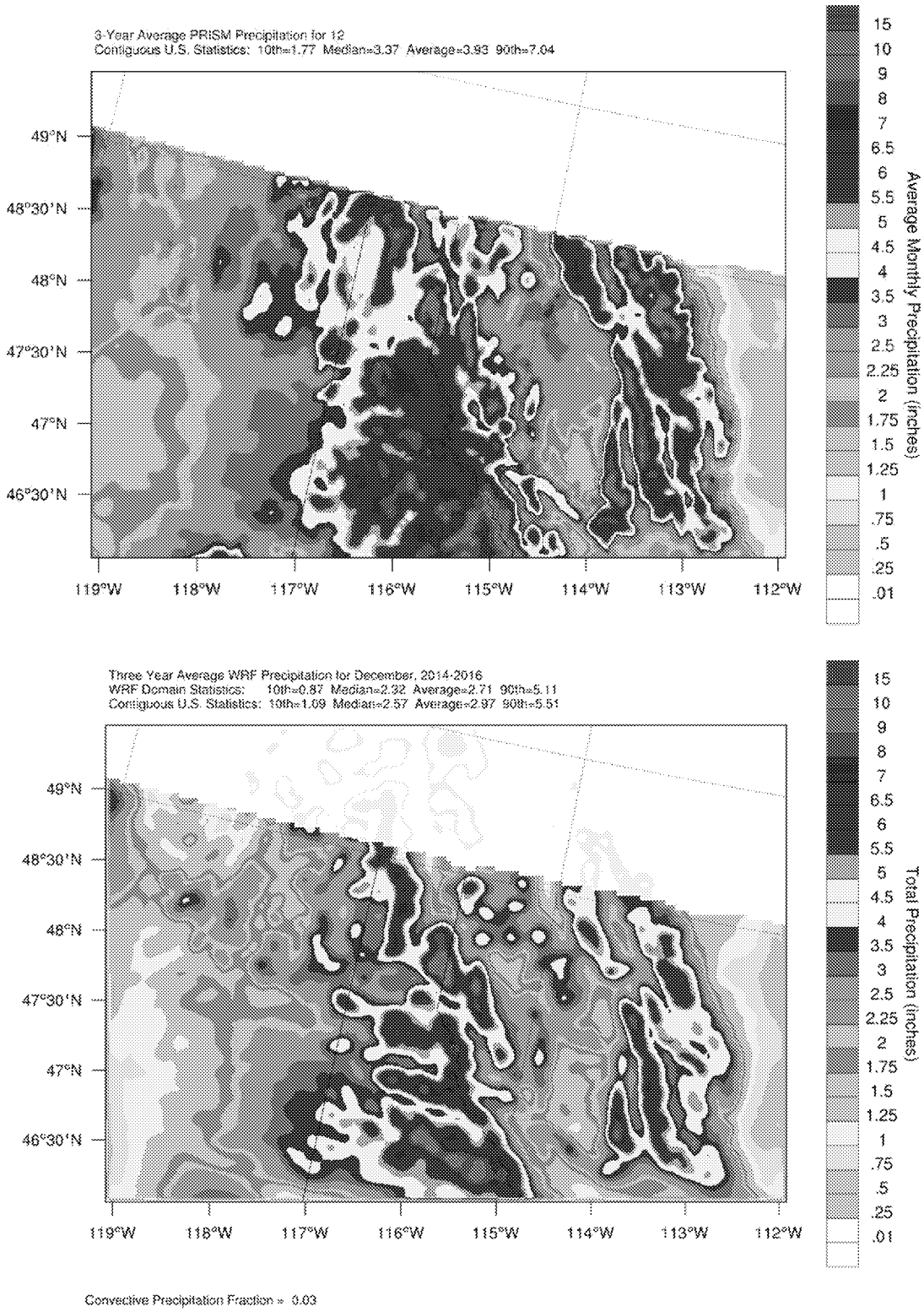


Figure 5-23. 3-year average PRISM (top) and WRF (bottom) precipitation for December

5.3 Vertical Temperature and Wind Speed Profile Analysis

The performance of the WRF vertical atmosphere structure was evaluated qualitatively using upper-air observations. Modeled and observed vertical profiles of temperatures, dew points, and wind speeds were plotted together and analyzed for select days in the 2014-2016 WRF modeling period. Upper-air sounding wind speed observation data were extracted from the OTX radiosonde station east of Spokane near Fairchild Airforce Base. This is the only upper-air station within the 1.33 km WRF domain. Radiosonde data at OTX is compared to 1.33 km WRF output from the model grid cell containing OTX.

Radiosonde measurements are taken at approximately 00:00 and 12:00 UTC, which correspond to 16:00 (previous day) and 04:00 local time. Thus the 12:00 sounding and the following midnight sounding are used to evaluate WRF morning and afternoon vertical profiles, respectively, on a given day. Vertical profile analyses for the first days in February and August of each year are presented below. These days were chosen as representative winter and summer days in terms of typical boundary layer structure. In Figure 5-24 through Figure 5-29. WRF vertical profiles are displayed as blue lines, while sounding observations are shown in red.

5.3.1 Winter Vertical Profiles

Figure 5-24, Figure 5-25, and Figure 5-26 show vertical profile comparisons on February 1st of 2014-2016. These plots represent typical wintertime vertical profiles in the early morning and late afternoon. Overall, WRF upper-air temperature performance is generally very strong for these periods. On the morning of February 1st, 2014, WRF represents the surface-based temperature inversion well although WRF overestimates humidity throughout much of the mid-troposphere. In the afternoon, WRF slightly overestimates surface temperature and matches upper-air temperature observations well. Similar to the morning sounding, WRF overestimates humidity throughout much of the mid-troposphere. No other strong temperature inversions are observed in the remaining February 1st soundings. Modeled and observed temperatures and dew points correspond very well on February 1st of 2015 and 2016, with the slight exception of the 04:00 February 1st 2016 sounding, for which WRF underestimates surface temperature and predicts a slight temperature inversion around 1000 m. In general, WRF represents February wind speeds well at all levels, although there is a tendency for model underestimation near the surface. Slight underestimates in surface wind speed are likely due to small differences between modeled and observed surface roughness at the location of the monitor.

ED_013256A_00000461-00061

5.3.2 Summer Vertical Profiles

Figure 5-27, Figure 5-28, and Figure 5-29 show vertical profile comparisons on August 1st for 2014-2016, which represent typical morning and afternoon summertime profiles. Surface-based temperature inversions are reported in all three morning soundings which WRF is able to reproduce. WRF is able to reproduce observed afternoon temperatures very well in all three cases. The morning and afternoon upper air summer humidity profiles were also modeled with more accuracy compared to the winter days shown above. In most summer soundings, there is strong agreement between observed and modeled surface wind speeds. These summertime soundings show better upper air wind speed model-measurement agreement compared to the winter soundings.

ED_013256A_00000461-00062

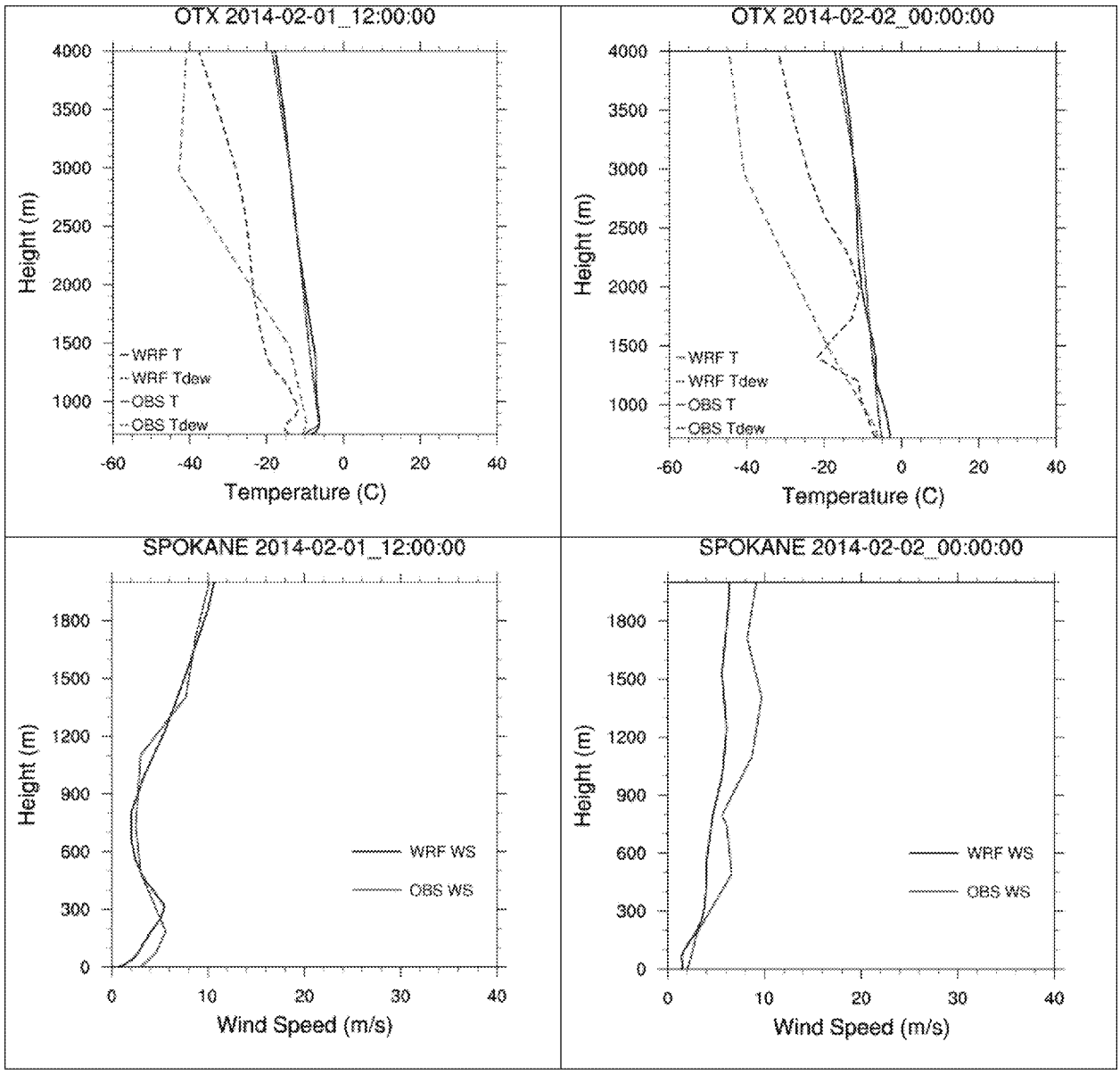


Figure 5-24. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on February 1, 2014, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC)

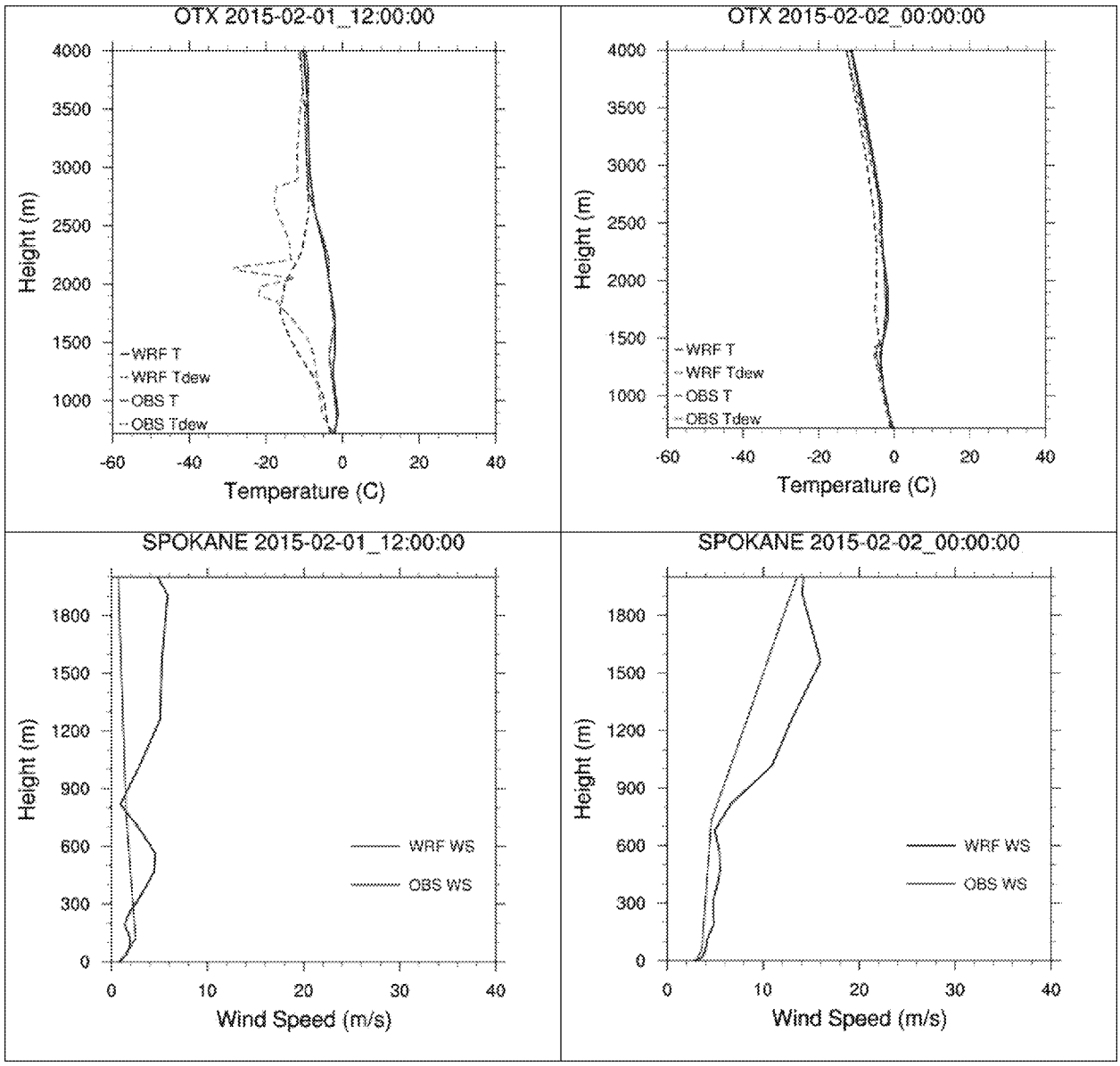


Figure 5-25. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on February 1, 2015, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC)

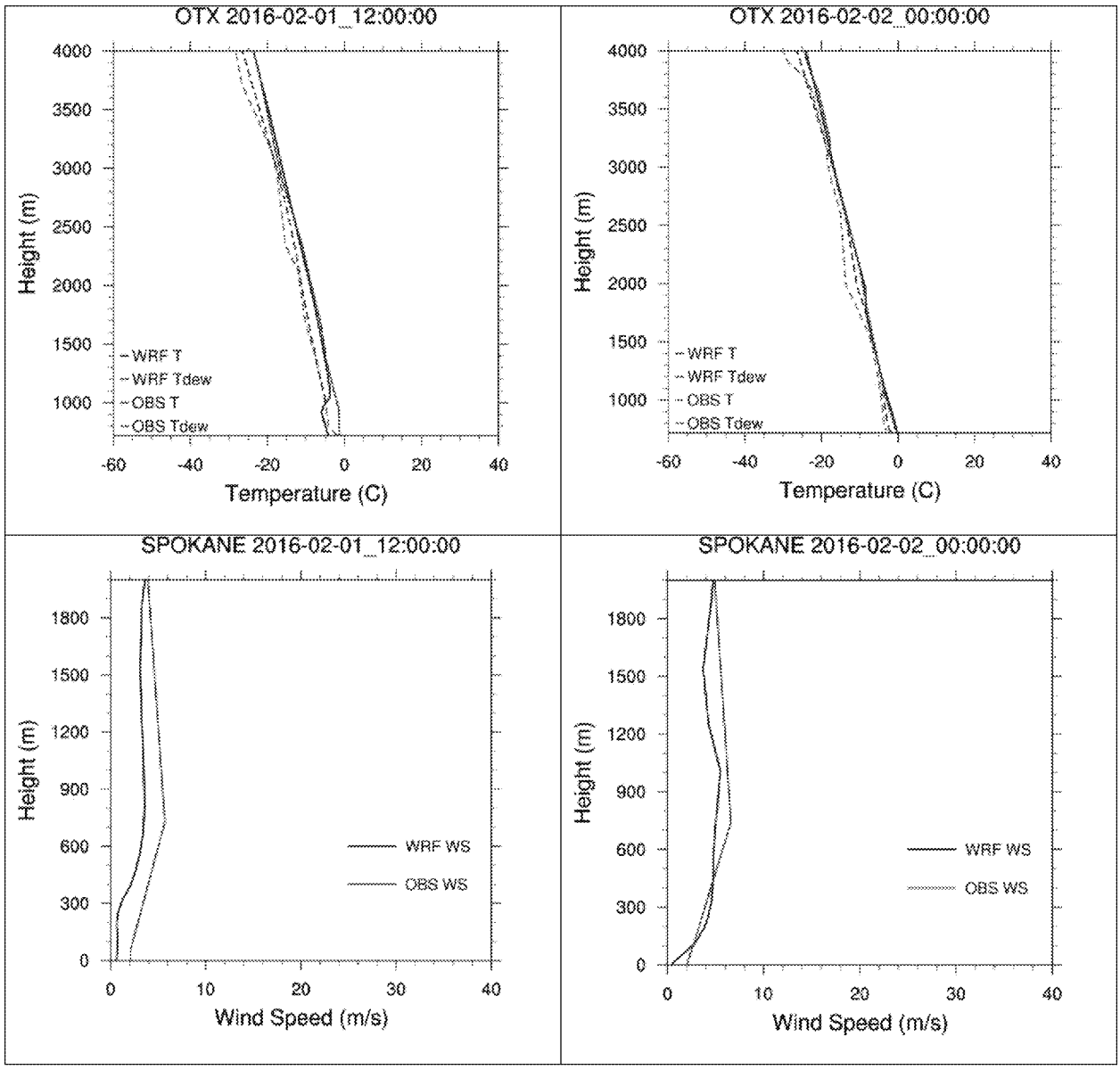


Figure 5-26. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on February 1, 2016, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC)

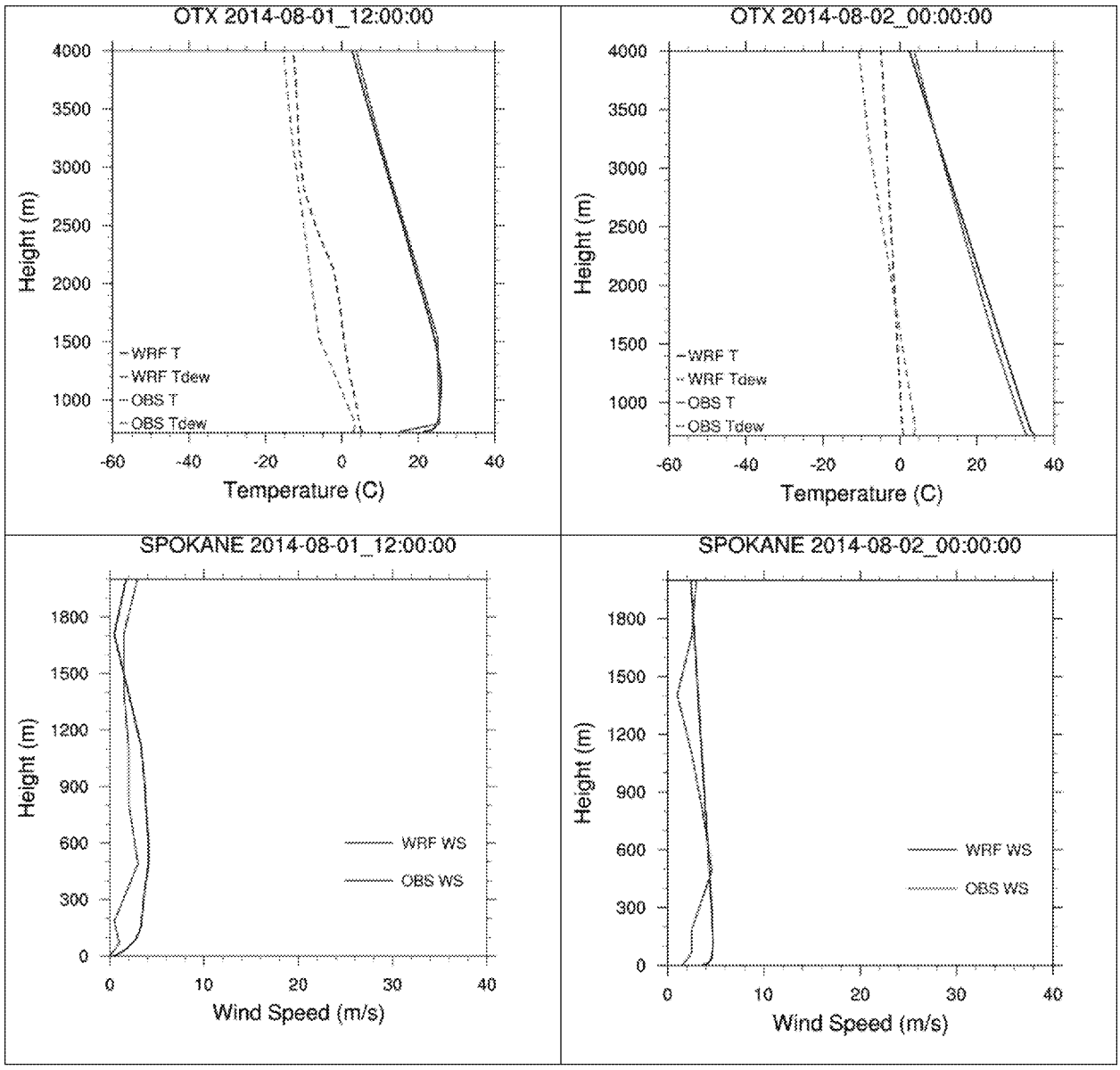


Figure 5-27. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on August 1, 2014, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC)

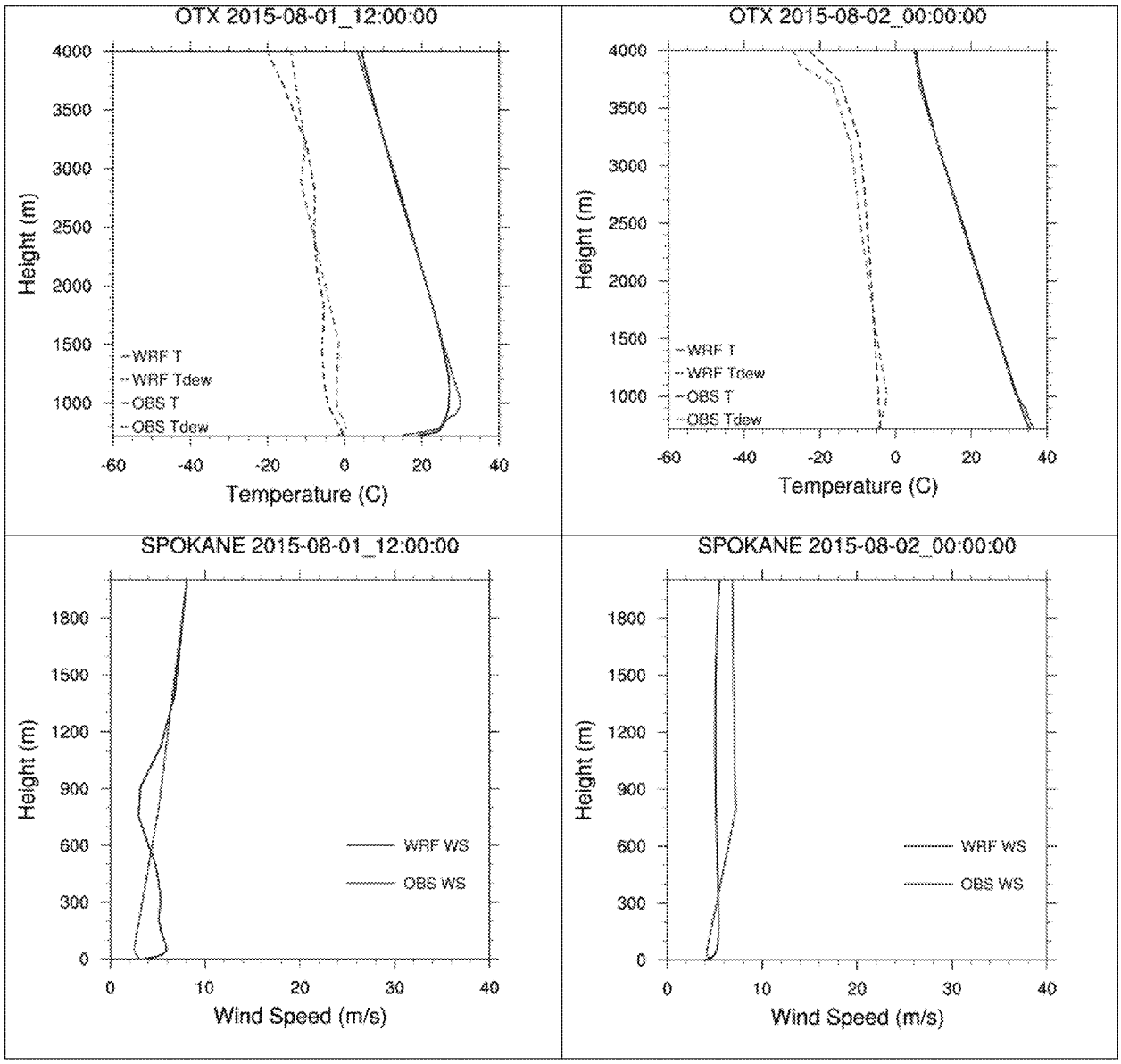


Figure 5-28. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on August 1, 2015, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC)

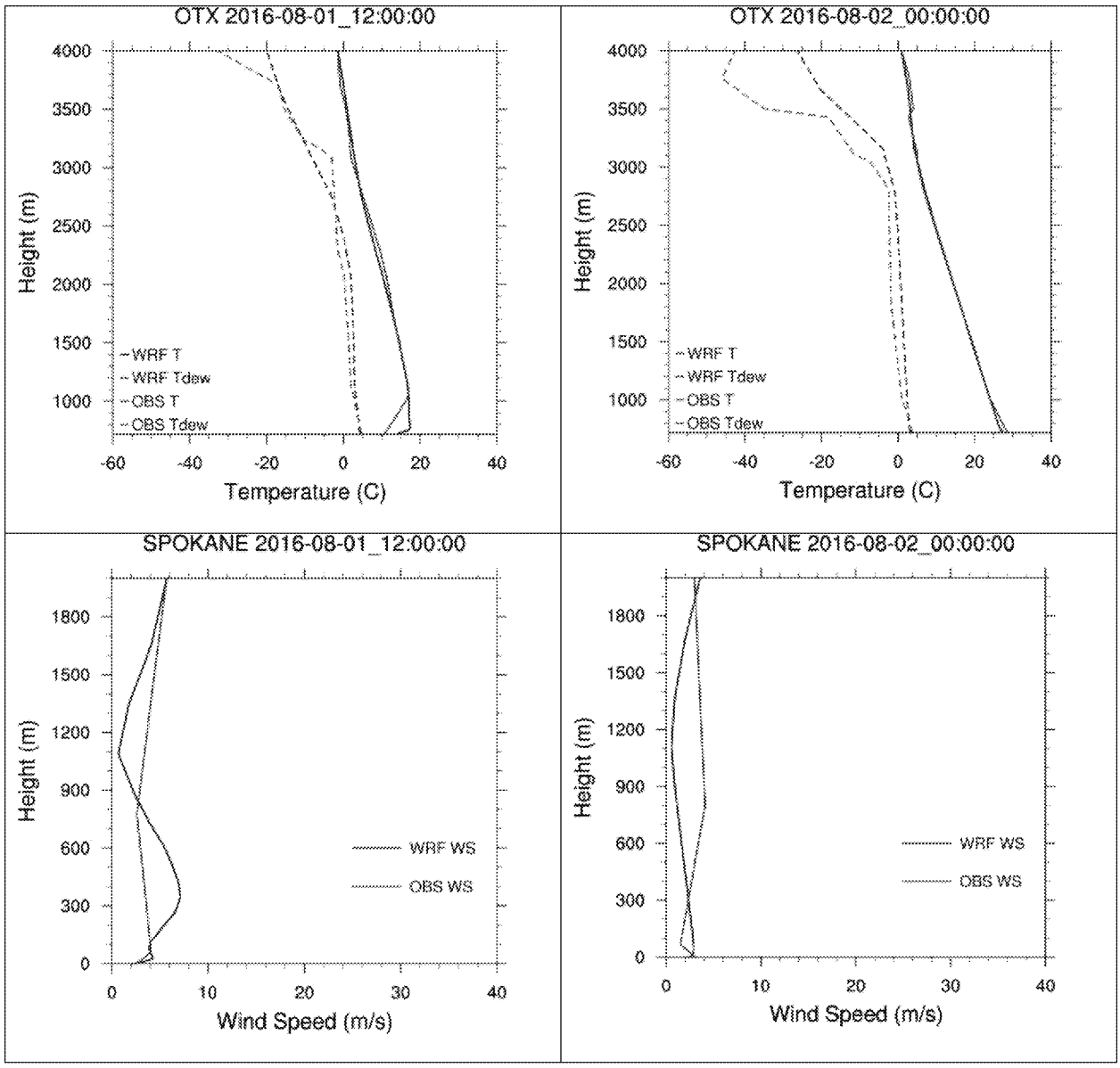


Figure 5-29. Vertical profiles of temperature and dew point (top) and wind speed (bottom) from WRF and observations at Spokane (OTX) on August 1, 2016, 04:00 LST (12:00 UTC) and 16:00 LST (00:00 UTC)

5.4 Meteorological Parameter Comparison

The MPE results presented in Sections 5.1 through 5.3 strictly compare observed and WRF-predicted meteorology at sites within the 1.33 km modeling domain. These analyses reveal that there is good overall agreement between observed and modeled temperature, humidity, precipitation, and wind speed. WRF has difficultly reproducing observed wind direction at some sites, however this is likely at least partially due to WRF's inability to exactly replicate all complex (i.e. sub-grid-scale) terrain and land use features within the modeling domain.

In addition to the METSTAT, PRISM, and upper-air radiosonde analyses, Figure 5-30 through Figure 5-64 show wind roses and box and whisker style plots that compare modeled and observed meteorological parameters within the 1.33 km modeling domain.

5.4.1 Wind Roses and Stability Parameters

A wind rose is a graphical representation of the distribution of hourly wind speeds and directions at a given site. Each hour is grouped by direction around a 360° axis, and then into bins by speed. The total length of each "petal" represents the total percent of hours during which wind was blowing from that direction, and the length of each segment within the petal shows the percentage of hours within a wind speed bin. Additional plots are included to highlight the distribution of other meteorological variables:

- hourly stability class distribution, estimated using the Golder Nomogram method;
- hourly cloud cover distribution;
- total monthly precipitation; and
- average monthly temperature.

These additional plots allow for easy comparison of trends between observed ("OBS") and MMIF-extracted WRF data ("MMIF-extracted data") at each station.

5.4.2 Box and Whisker Plots

Box and whisker plots are also provided to more clearly illustrate the differences between OBS and MMIF-extracted data. Boxes show the median value as the center line, the upper and lower quartiles of the data as the bounds of the box, and the range of the data as whiskers. Outliers are shown as individual points. OBS and MMIF-extracted distributions are plotted side by side for direct comparison. If the median of one dataset is within the quartiles of the other and vice versa, it can be said that the two are agreeable.

ED_013256A_00000461-00069

For each station, the distribution of values of wind speed, temperature, mixing height, and inverse Obukhov length (1/L) were plotted by hour of day, with each quarter plotted separately. Separating each quarter allows comparisons to be made between seasons – a station that shows good agreement during summer may diverge during winter months. Similarly, a station may agree closely during the night time, but diverge during the daylight hours. This format allows conclusions to be drawn about which time periods the model performs best.

5.4.3 Meteorological Comparison

In general, agreement between OBS and MMIF-extracted data was good, although there were some distinct ways the datasets differed. For dispersion modeling applications, the most significant difference is seen in stability characteristics, which can have a large effect on modeled concentrations. Plots of stability class distribution show that MMIF-extracted results in more stable hours than OBS. This can partly be explained by the way that stability class is calculated with each method. MMIF-extracted data processing extrapolates boundary layer conditions based on the difference in temperature between 2 and 10 meters using the Bulk Richardson method. OBS data does not have temperature readings at multiple levels, so cloud cover values are used to estimate stability conditions instead. On average, using cloud cover values results in fewer stable and unstable hours (Class A and F), and more neutral hours (Class C/D). These differences are best illustrated in the box and whisker plots of inverse Monin-Obhukov length (1/L), where the upper and lower quartiles of MMIF-extracted data show significantly more spread. Plots showing the distribution of cloud cover values generally show good agreement. While MMIF-extracted data shows a much more uniform stair-step distribution of cloud cover values, the bimodal nature – it is usually either completely clear or completely overcast - is seen in both MMIF-extracted and OBS data.

Other parameters also showed high agreement, with wind roses looking similar across most sites. Precipitation and temperature showed very high agreement, capturing seasonal changes well. It can also be seen in the box and whisker plots that diurnal changes in both data sets are consistent.

Wind roses and box plots for each station are provided below in Figures 5-30 through 5-64.

ED_013256A_00000461-00070

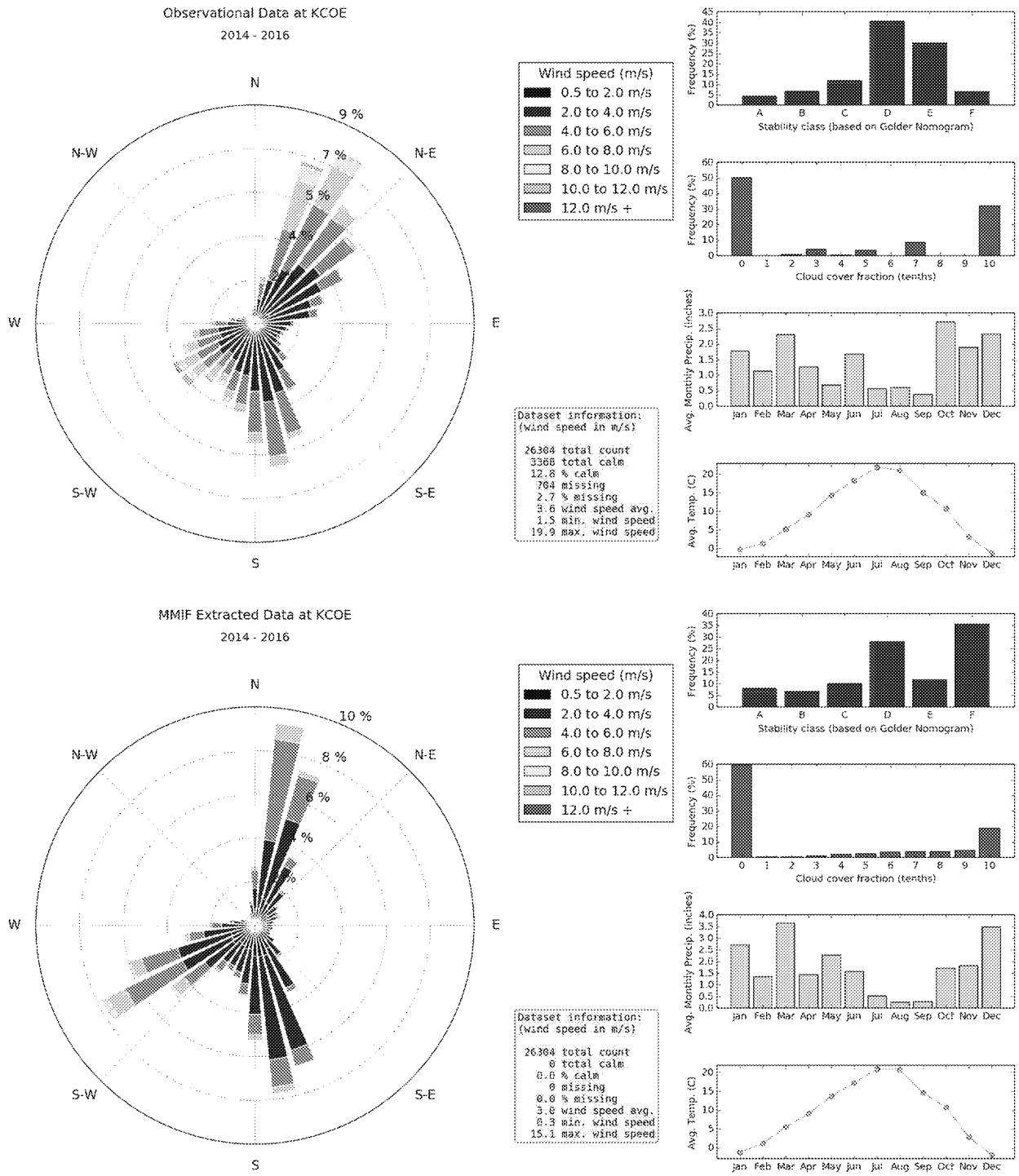


Figure 5-30. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KCOE

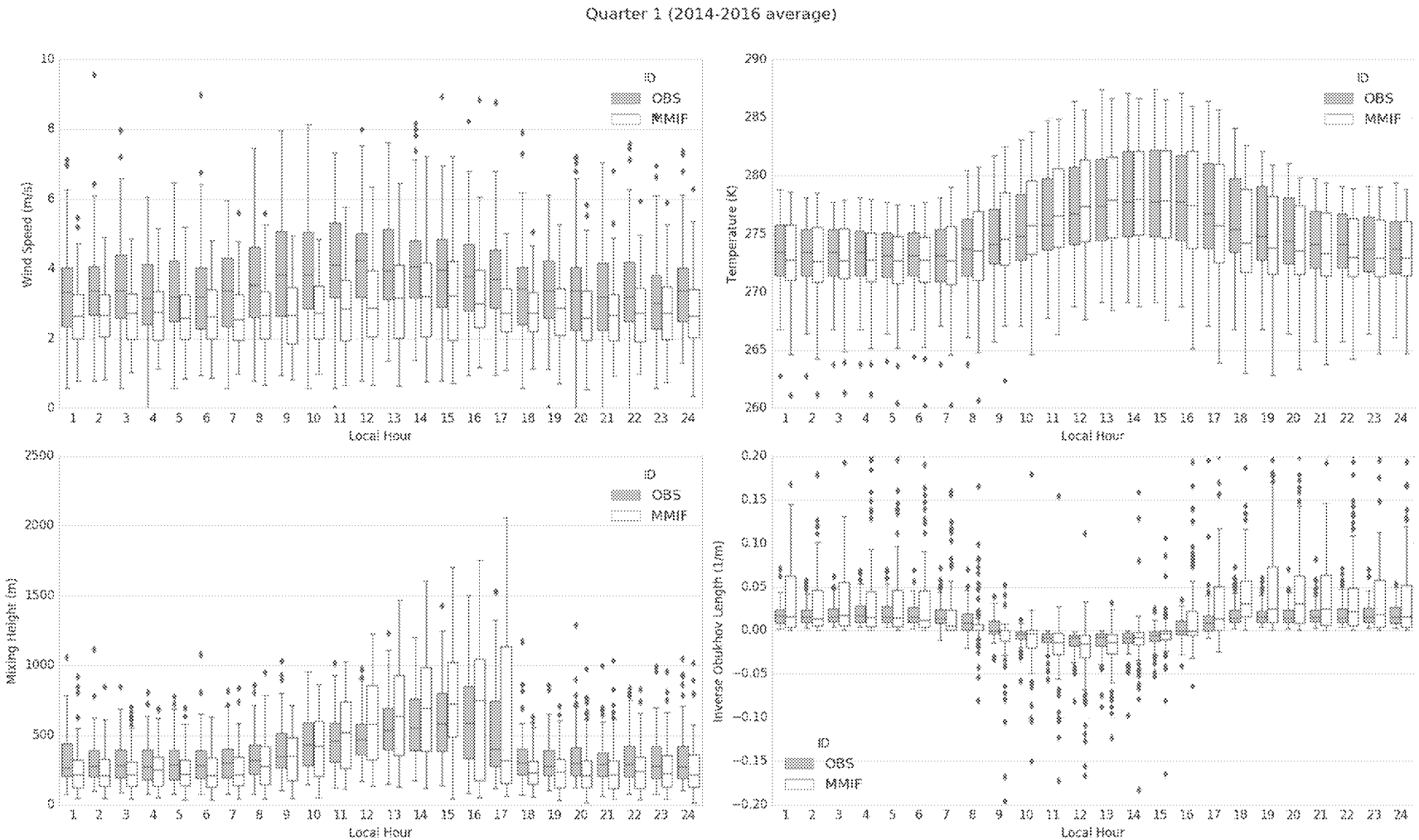


Figure 5-31. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) meteorology at KCOE

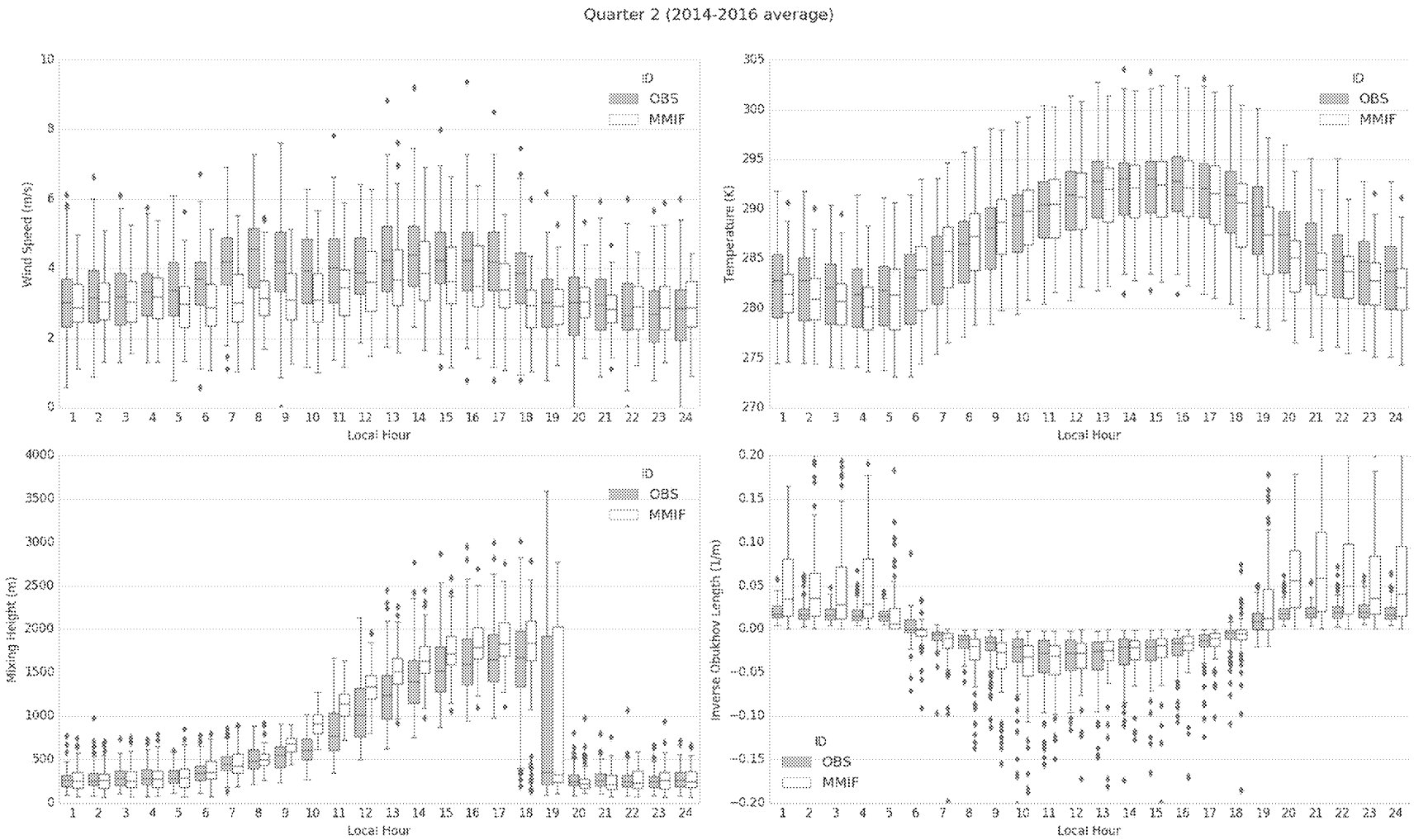


Figure 5-32. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) meteorology at KCOE

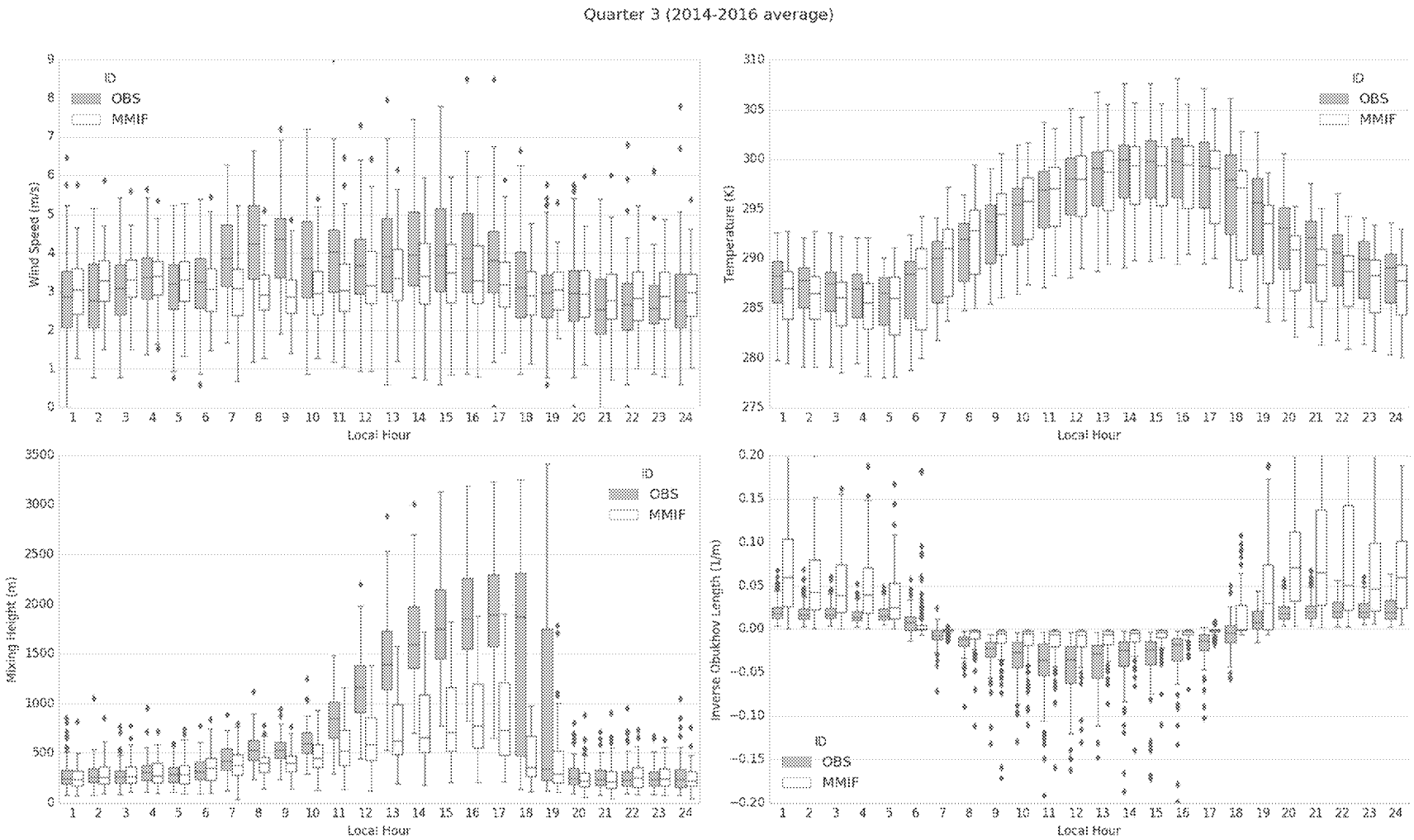


Figure 5-33. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) meteorology at KCOE

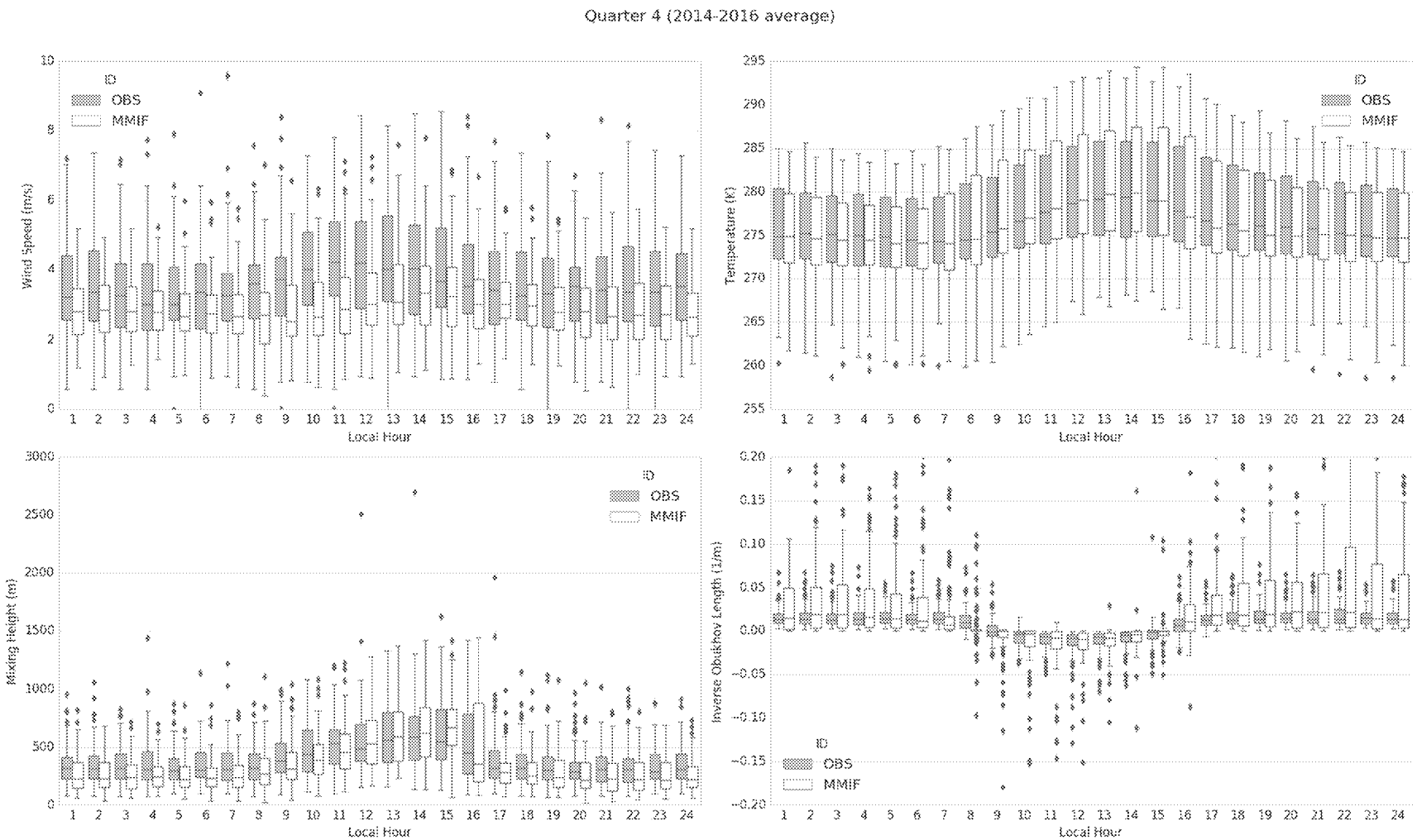


Figure 5-34. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) meteorology at KCOE

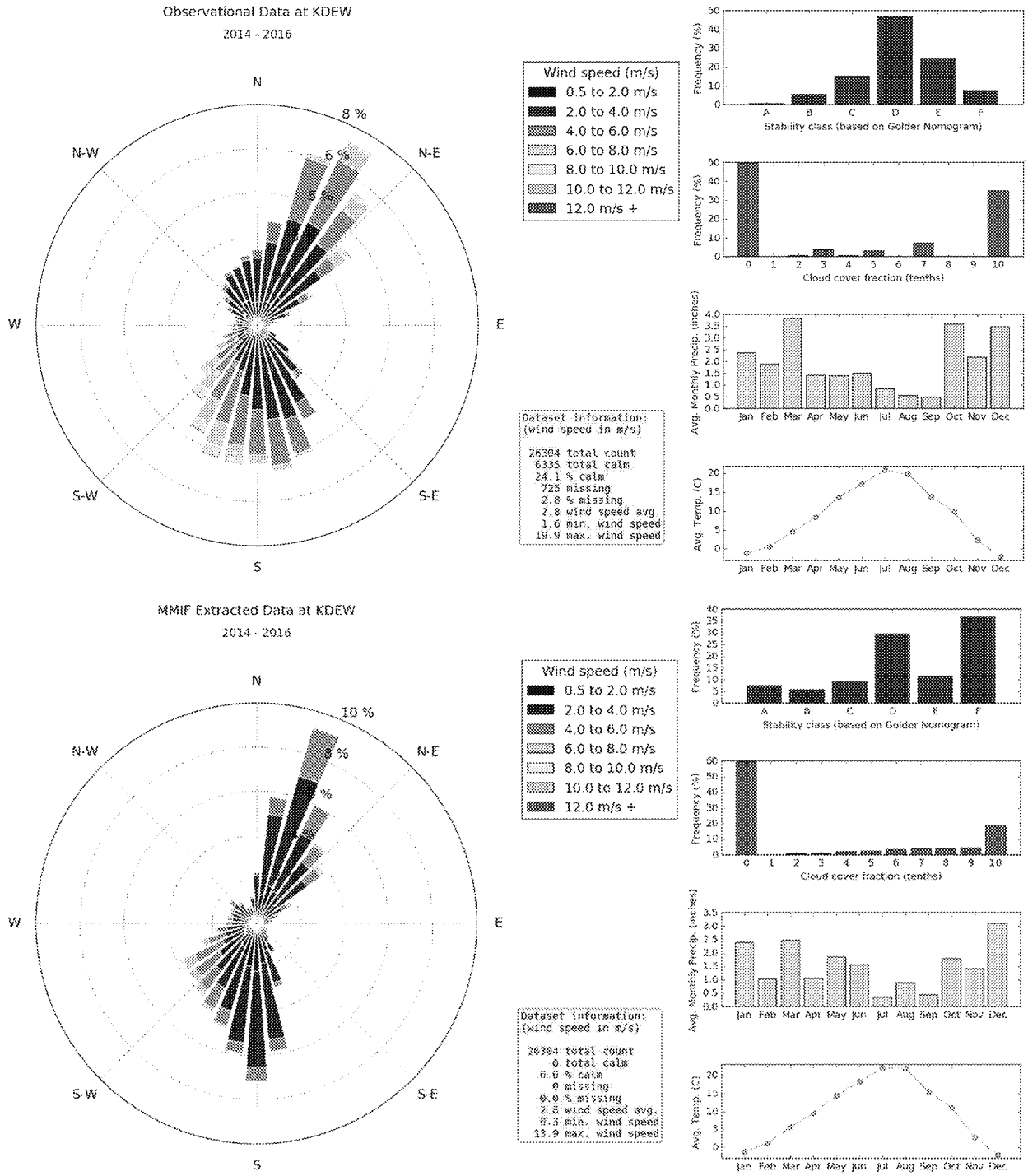


Figure 5-35. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KDEW

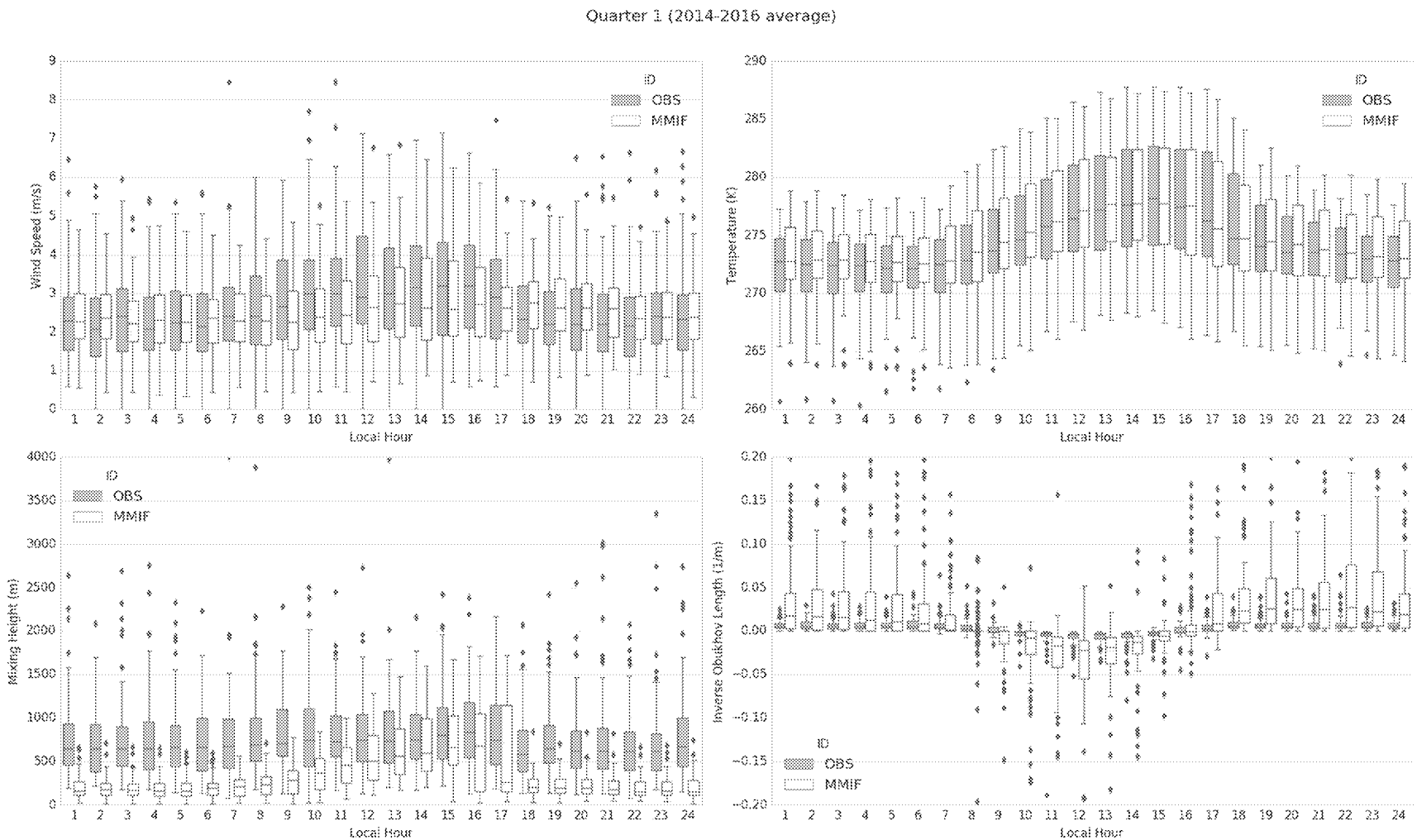


Figure 5-36. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) meteorology at KDEW

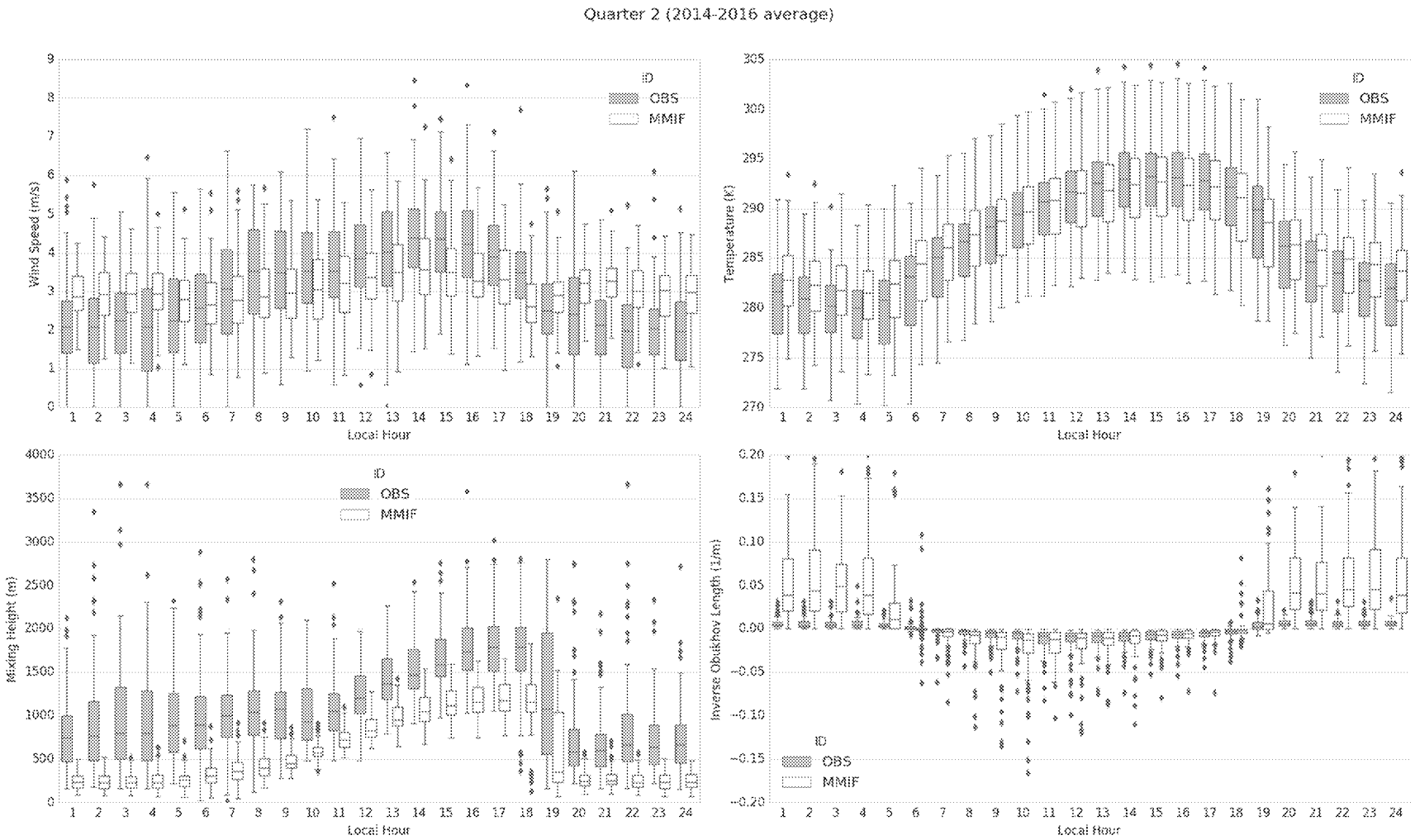


Figure 5-37. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) meteorology at KDEW

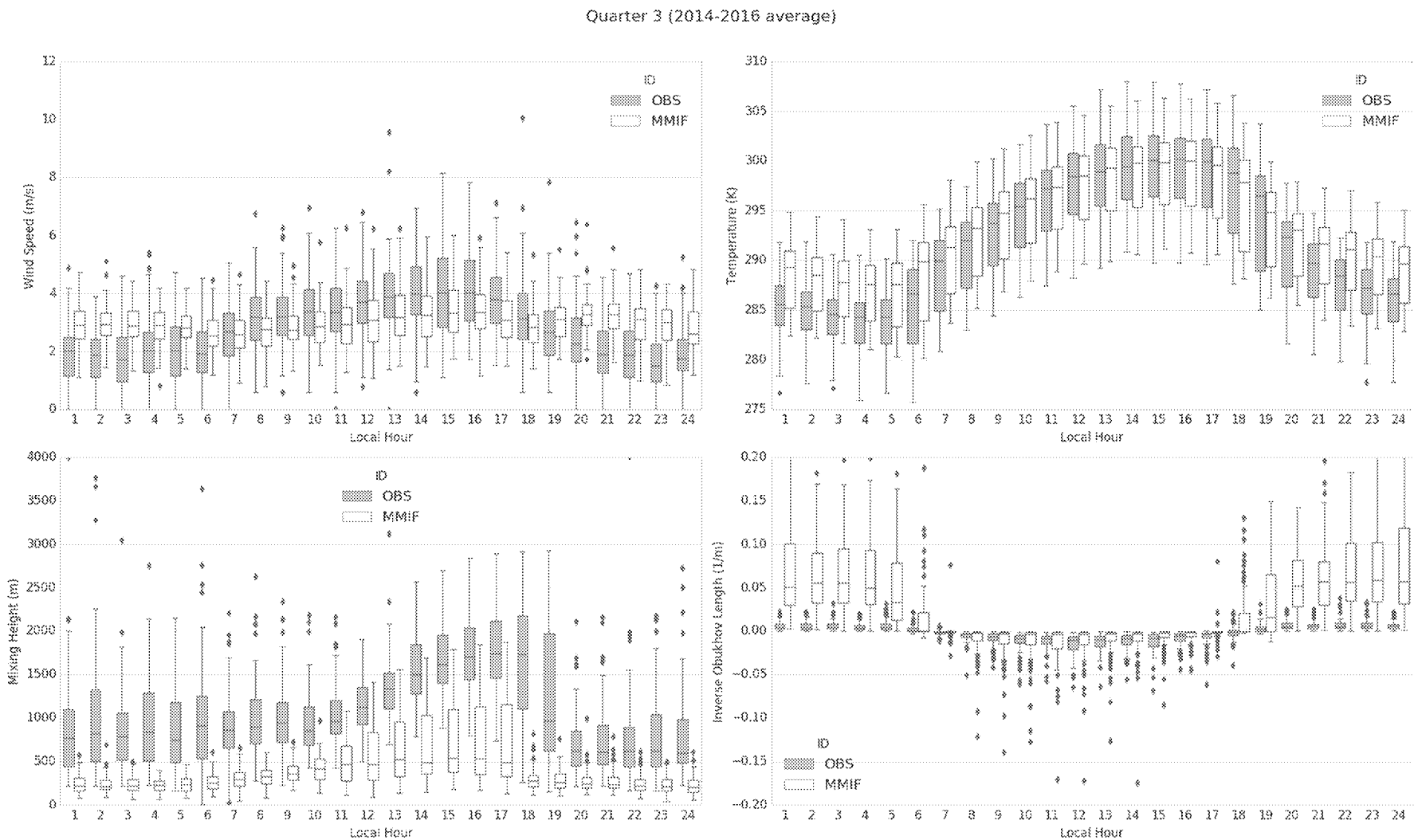


Figure 5-38. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) meteorology at KDEW

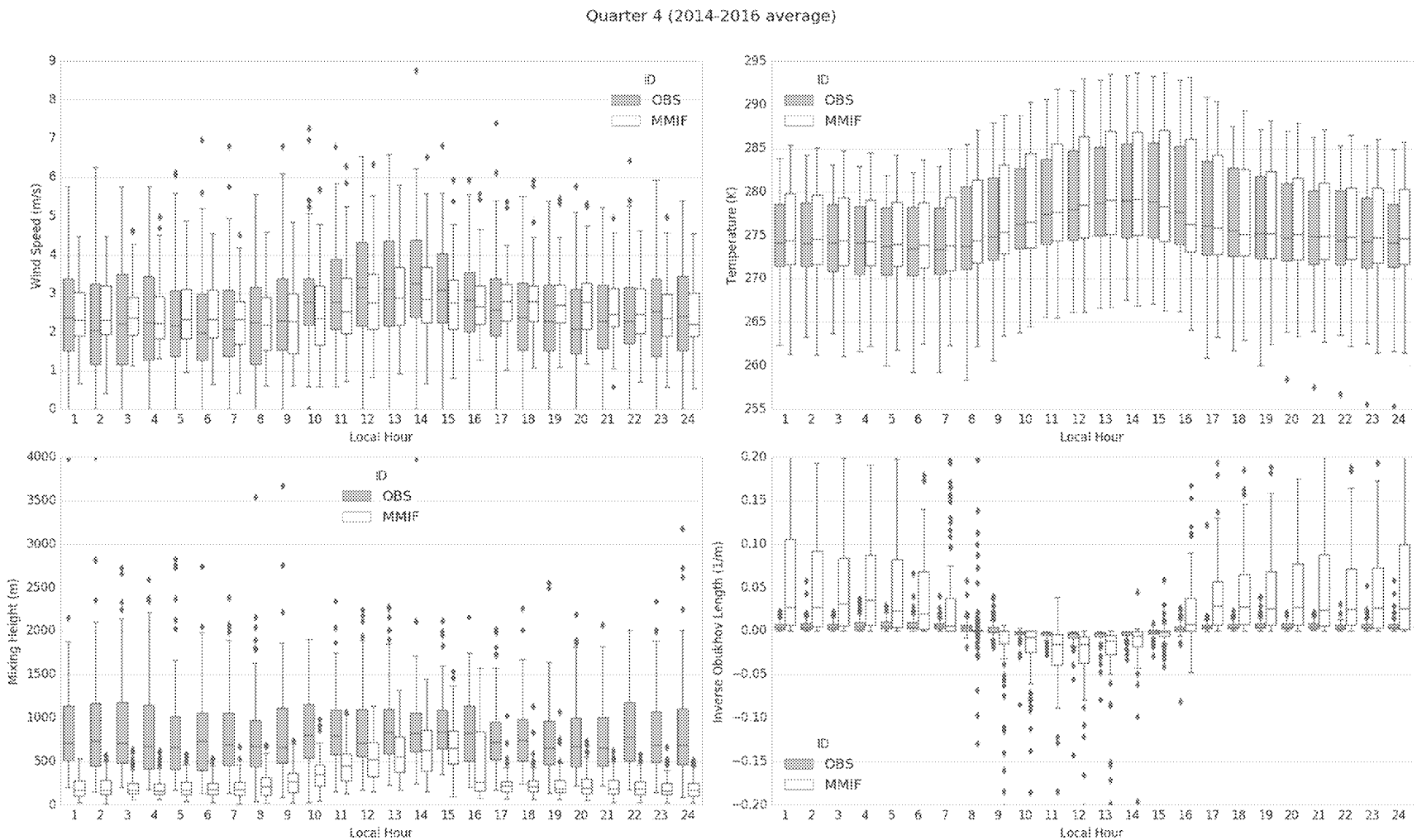


Figure 5-39. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) meteorology at KDEW

ED_013256A_00000461-00080

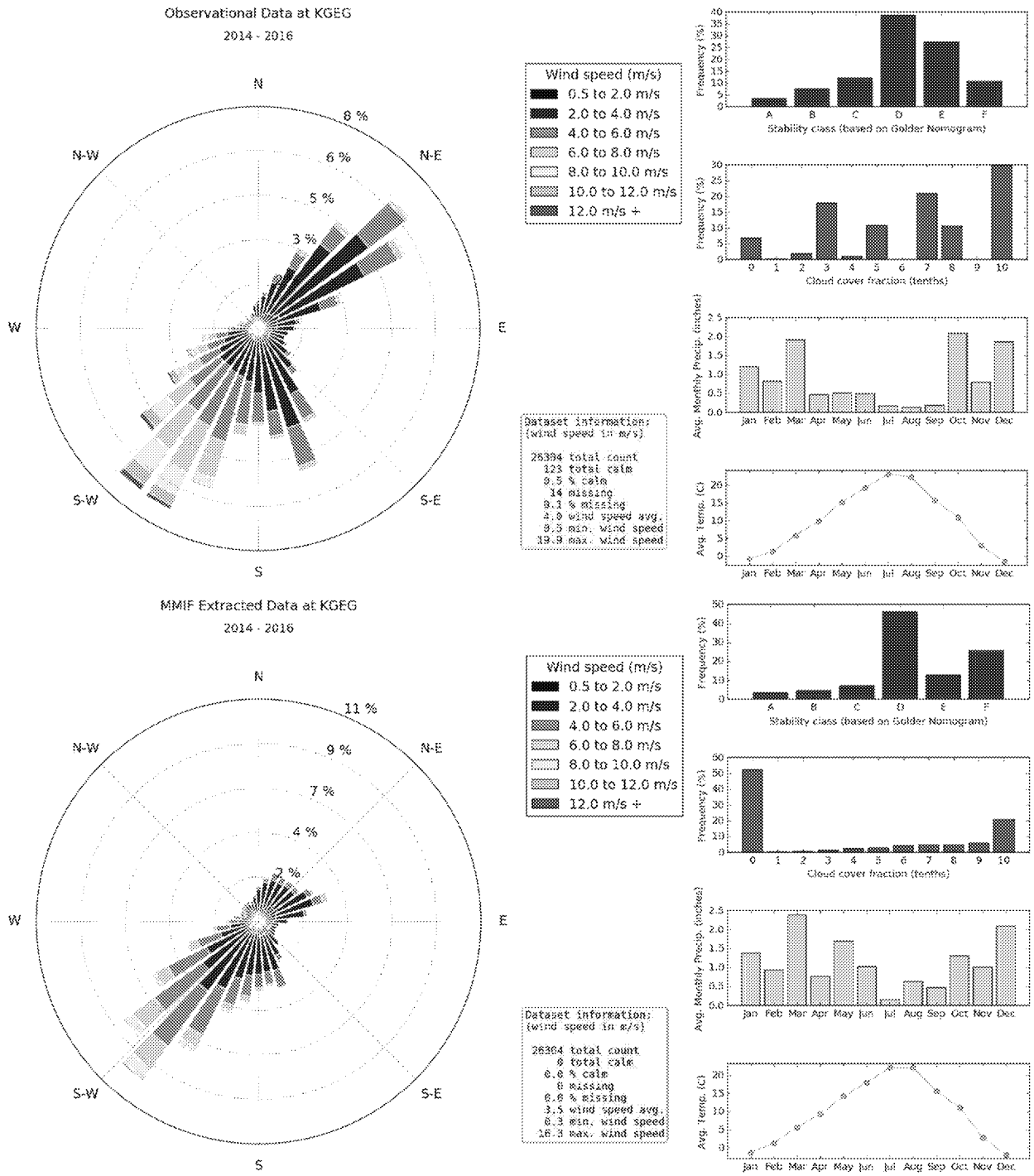


Figure 5-40. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KGEG

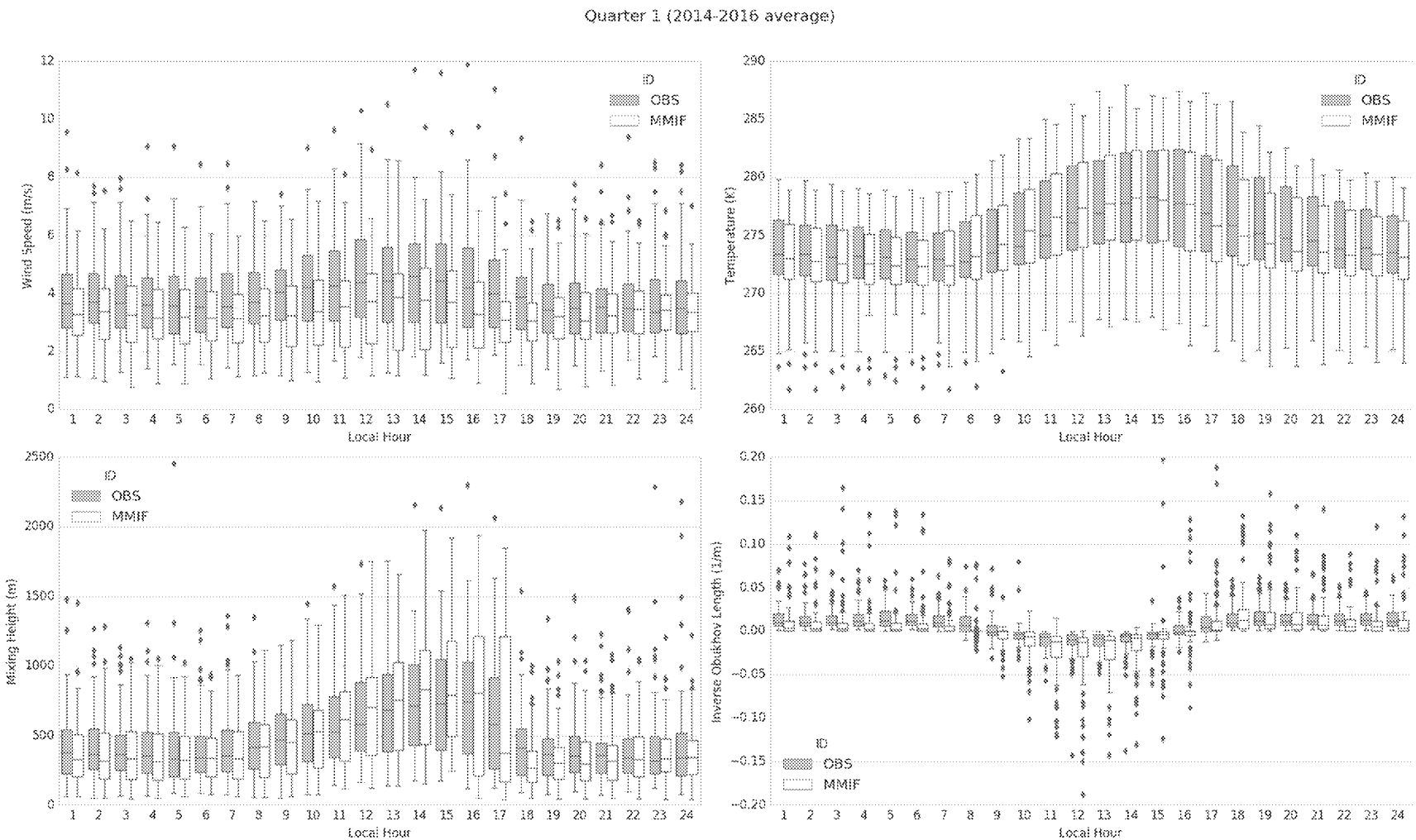


Figure 5-41. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at KGEG

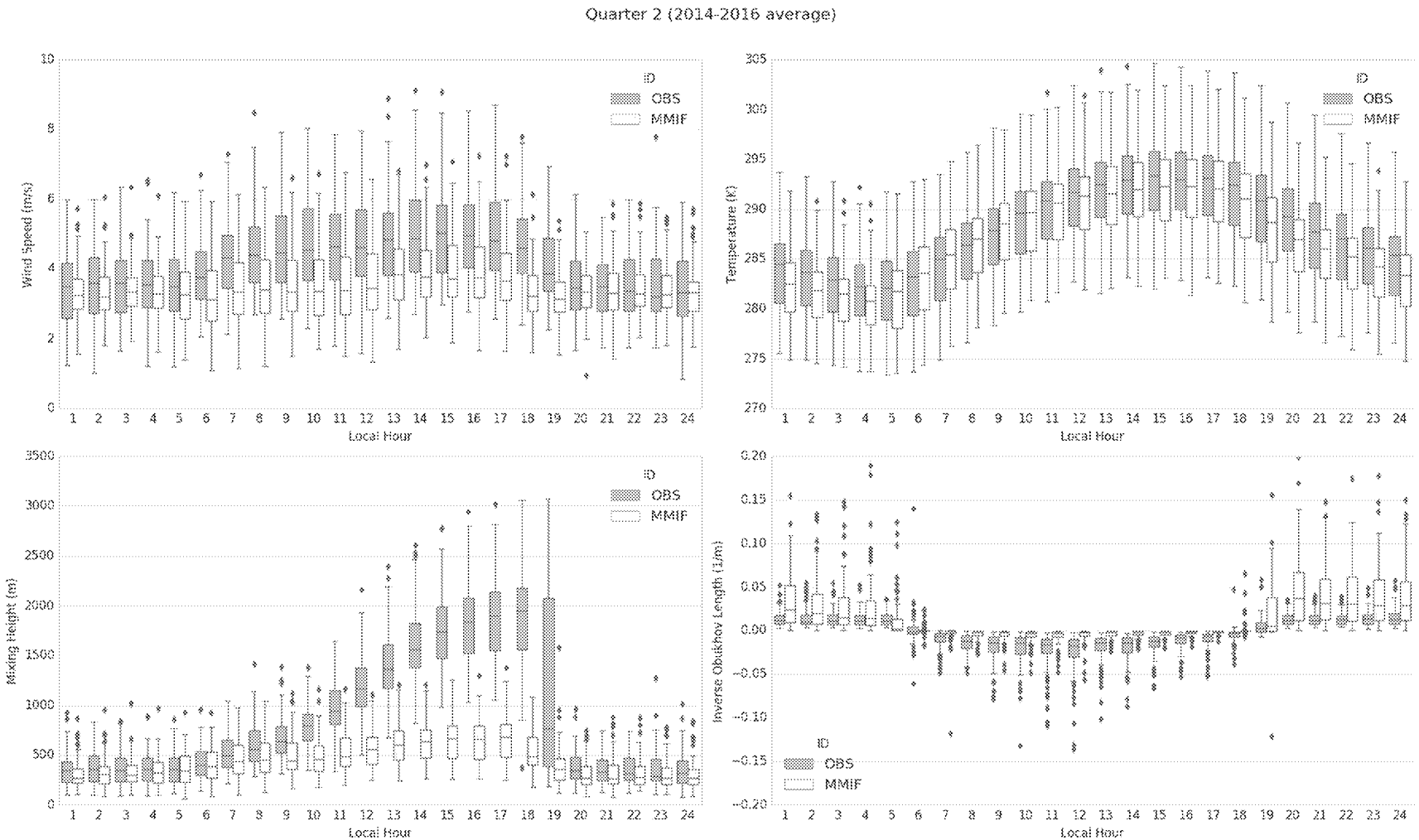


Figure 5-42. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at KGEG

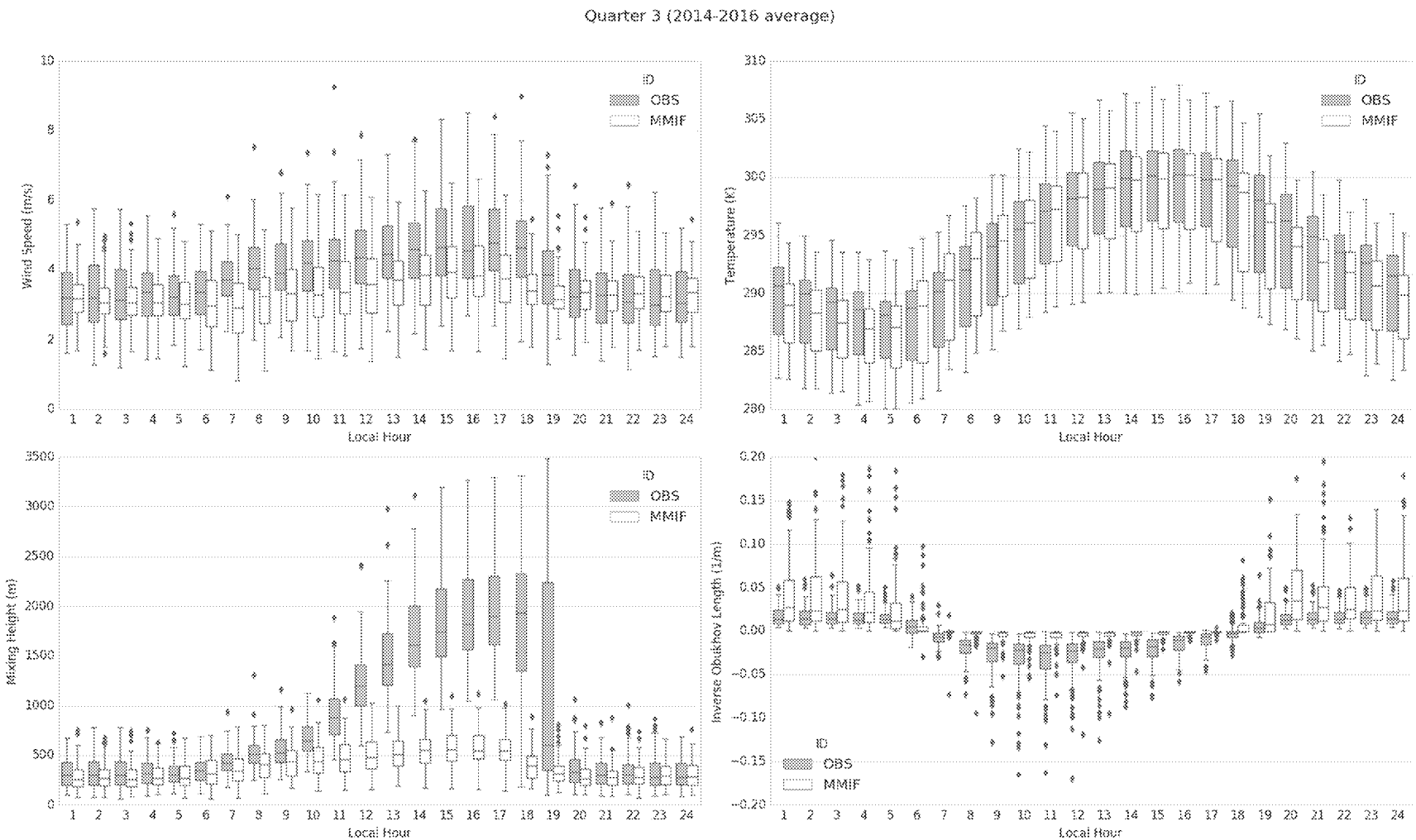


Figure 5-43. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at KGEG

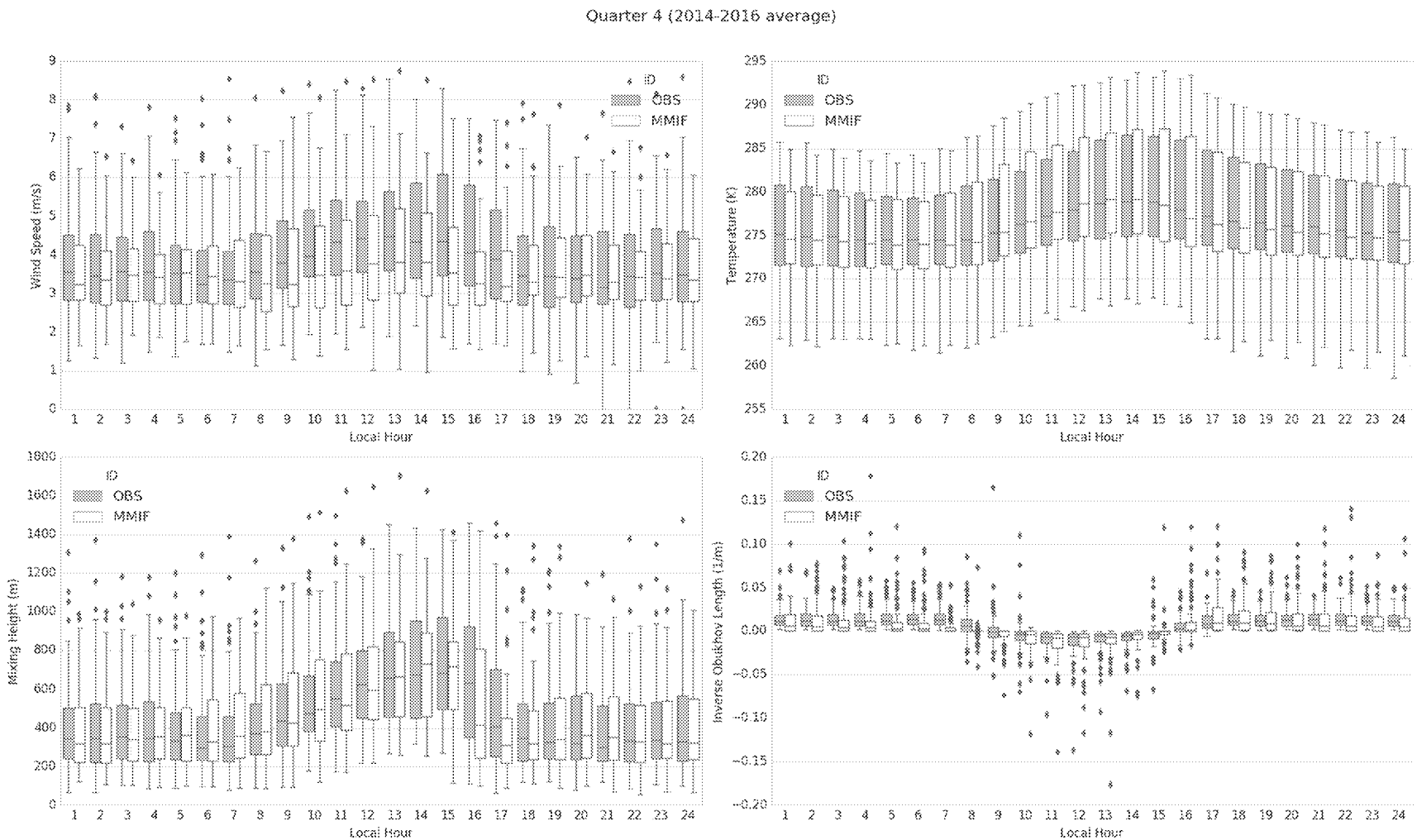


Figure 5-44. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at KGEG

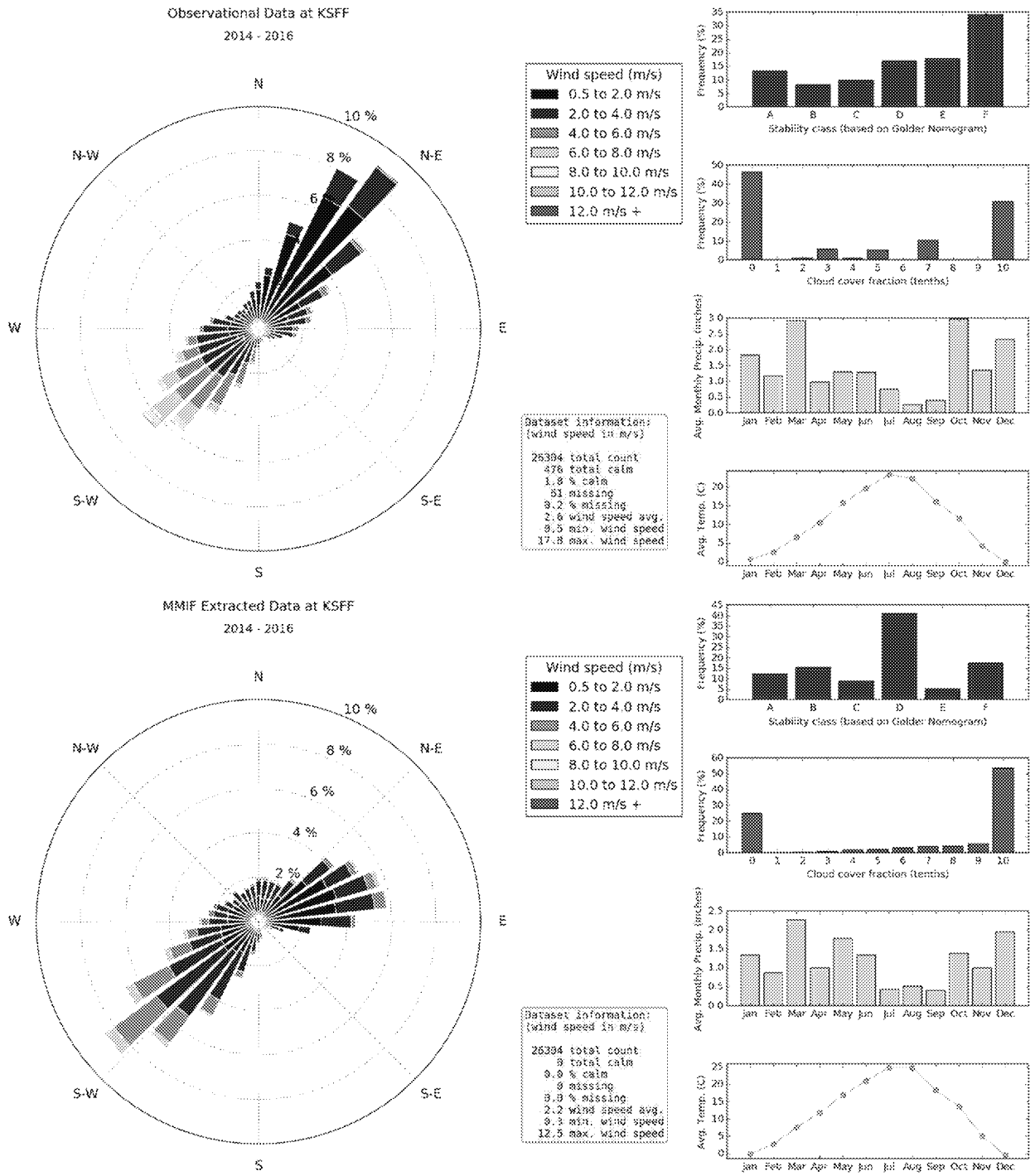


Figure 5-45. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KSFF

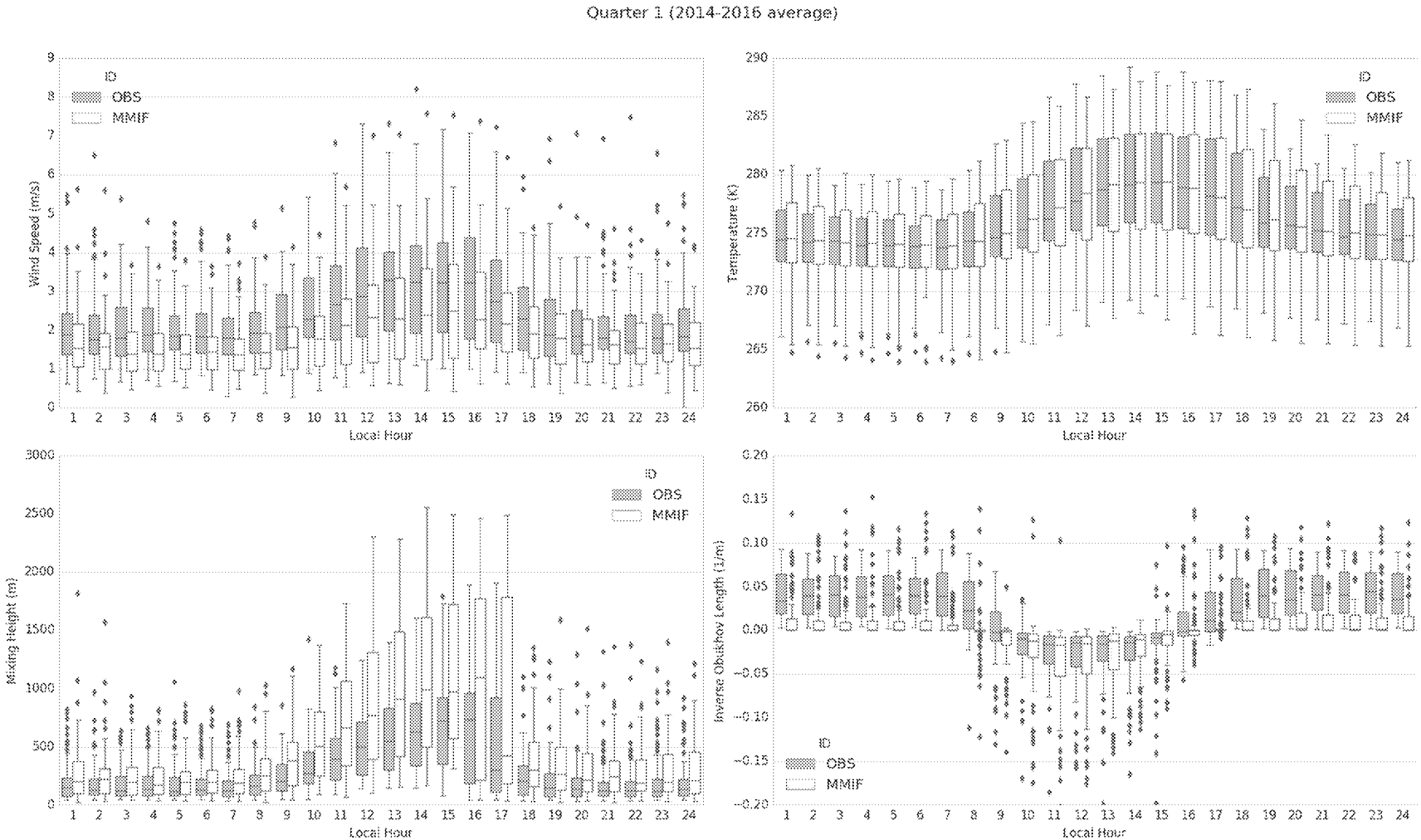


Figure 5-46. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at KSFF

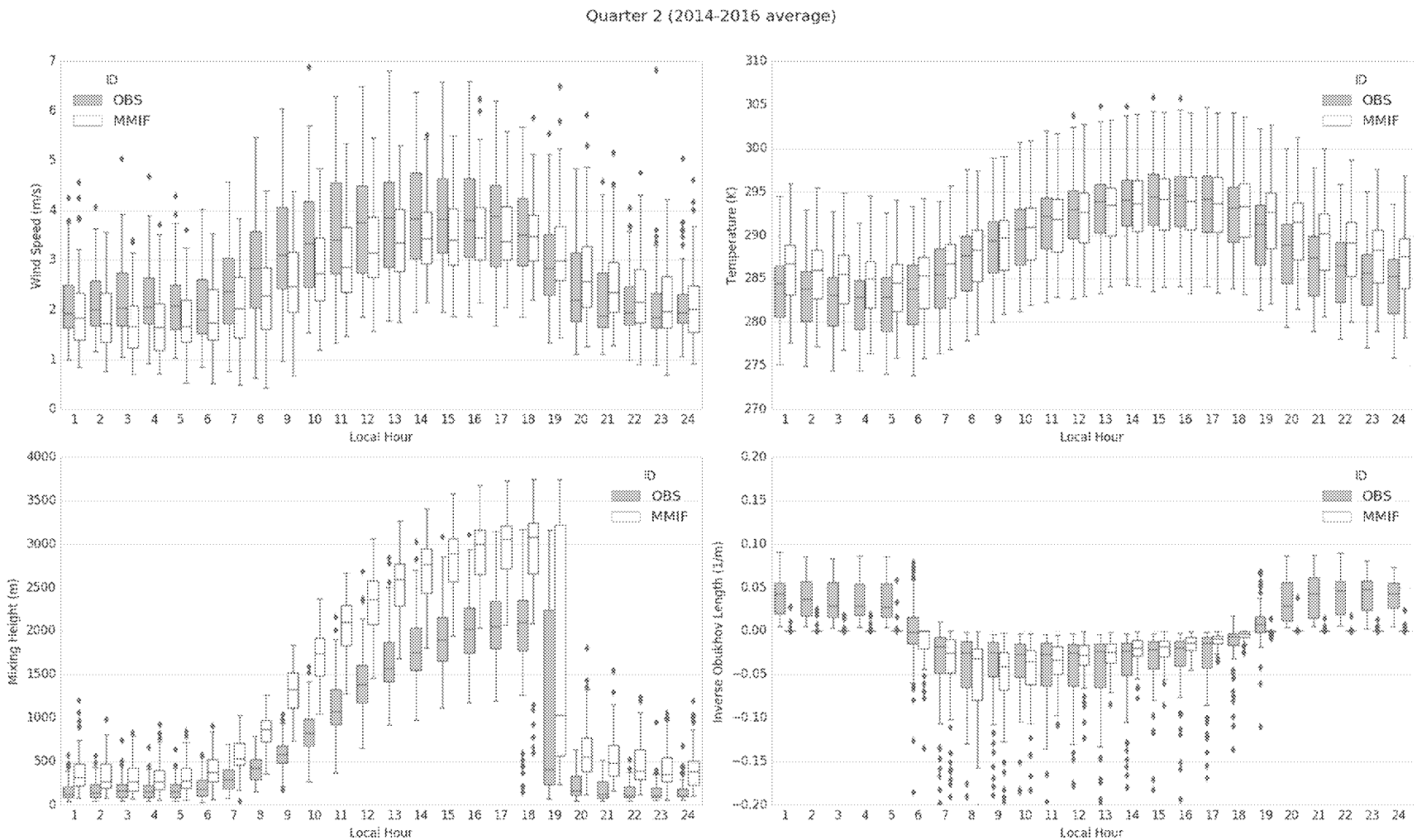


Figure 5-47. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at KSFF

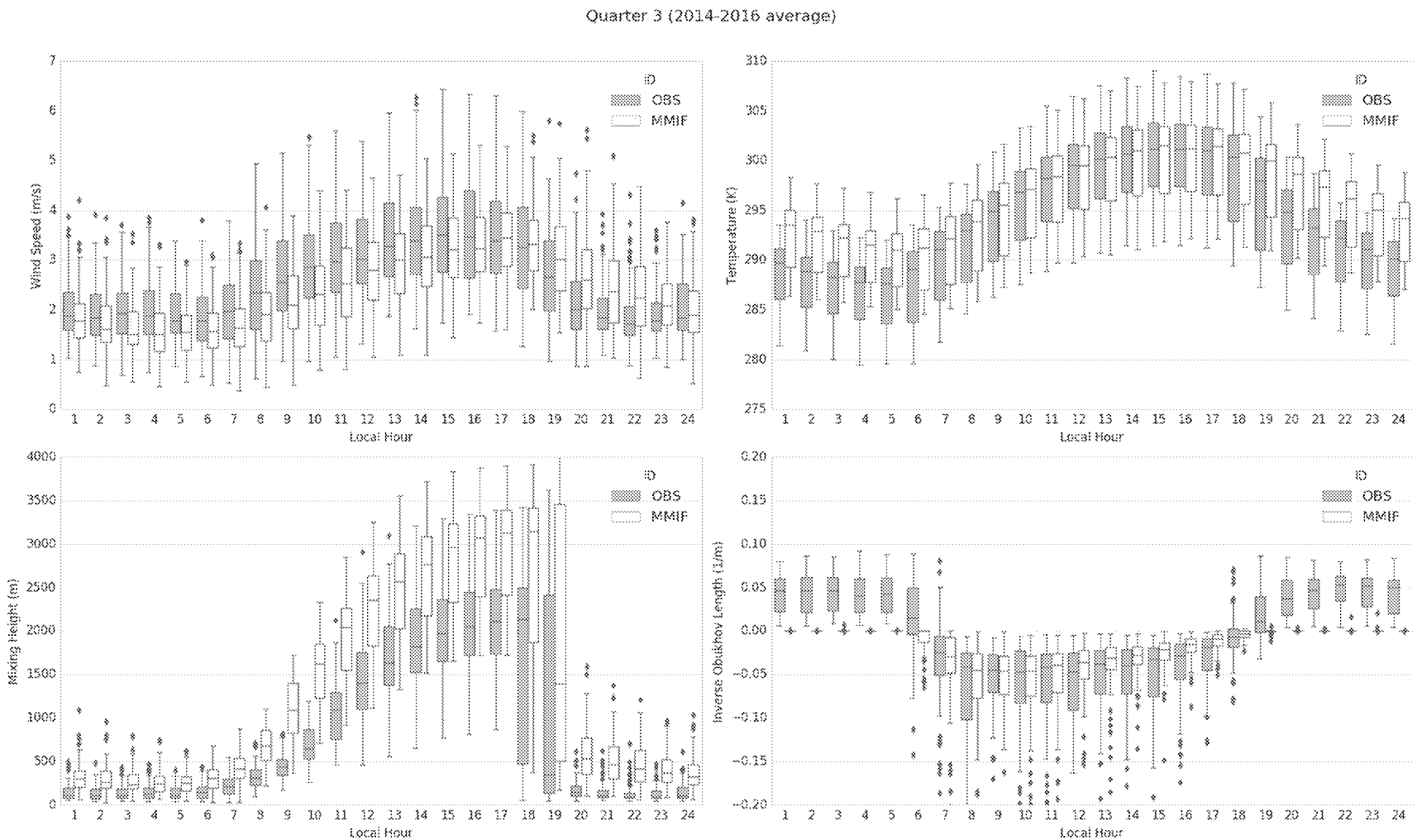


Figure 5-48. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at KSFF

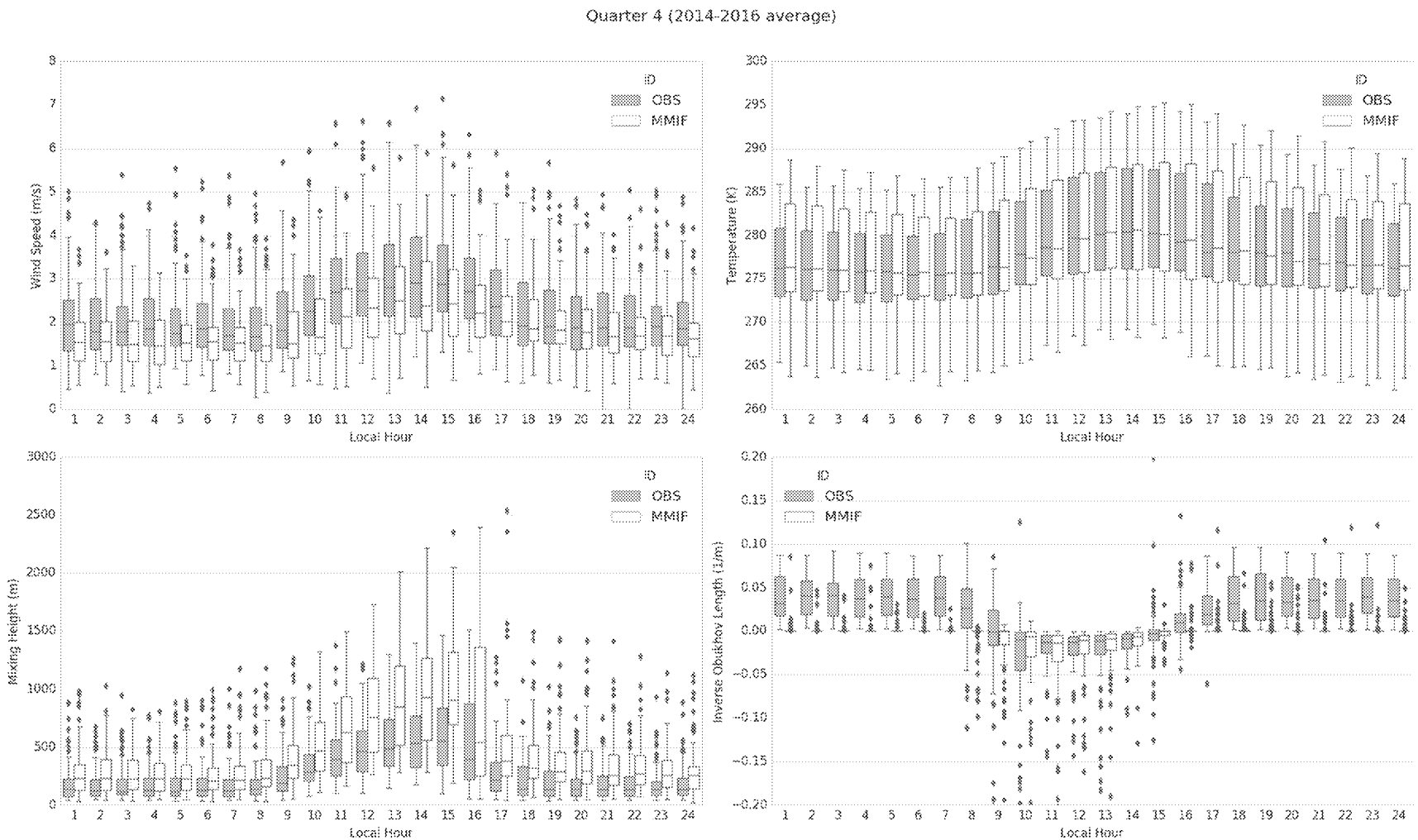


Figure 5-49. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at KSFF

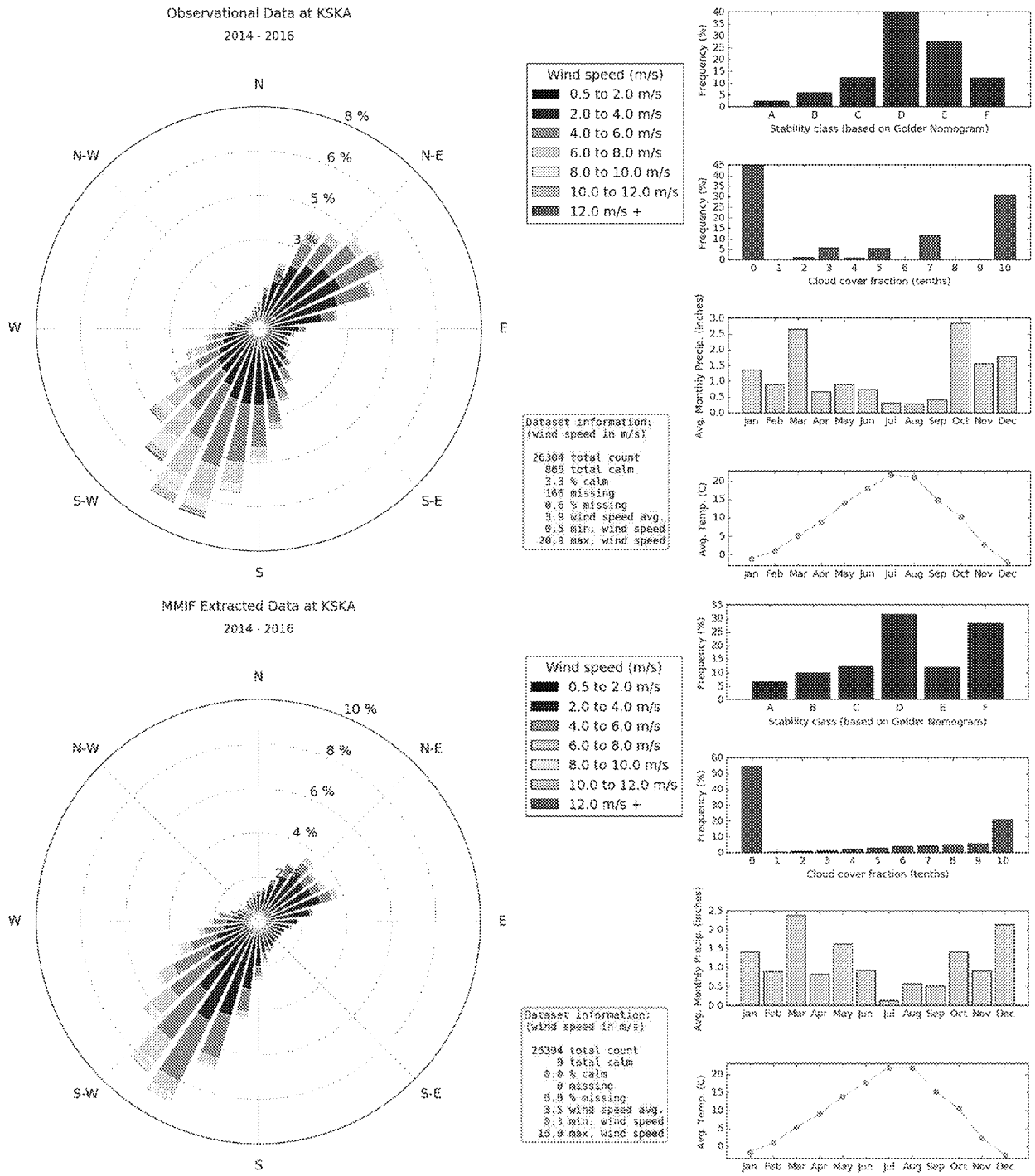


Figure 5-50. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KSKA

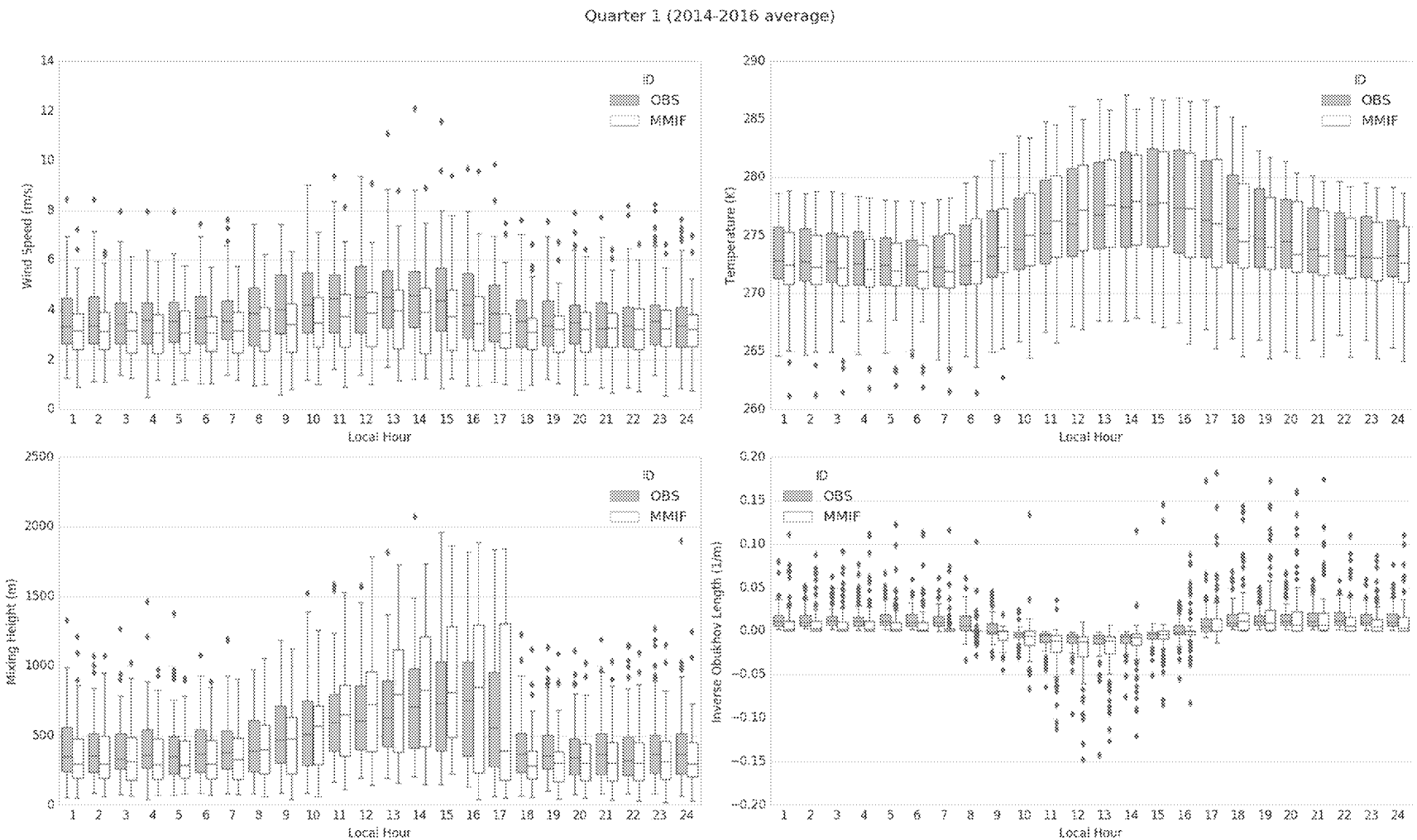


Figure 5-51. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at KSKA

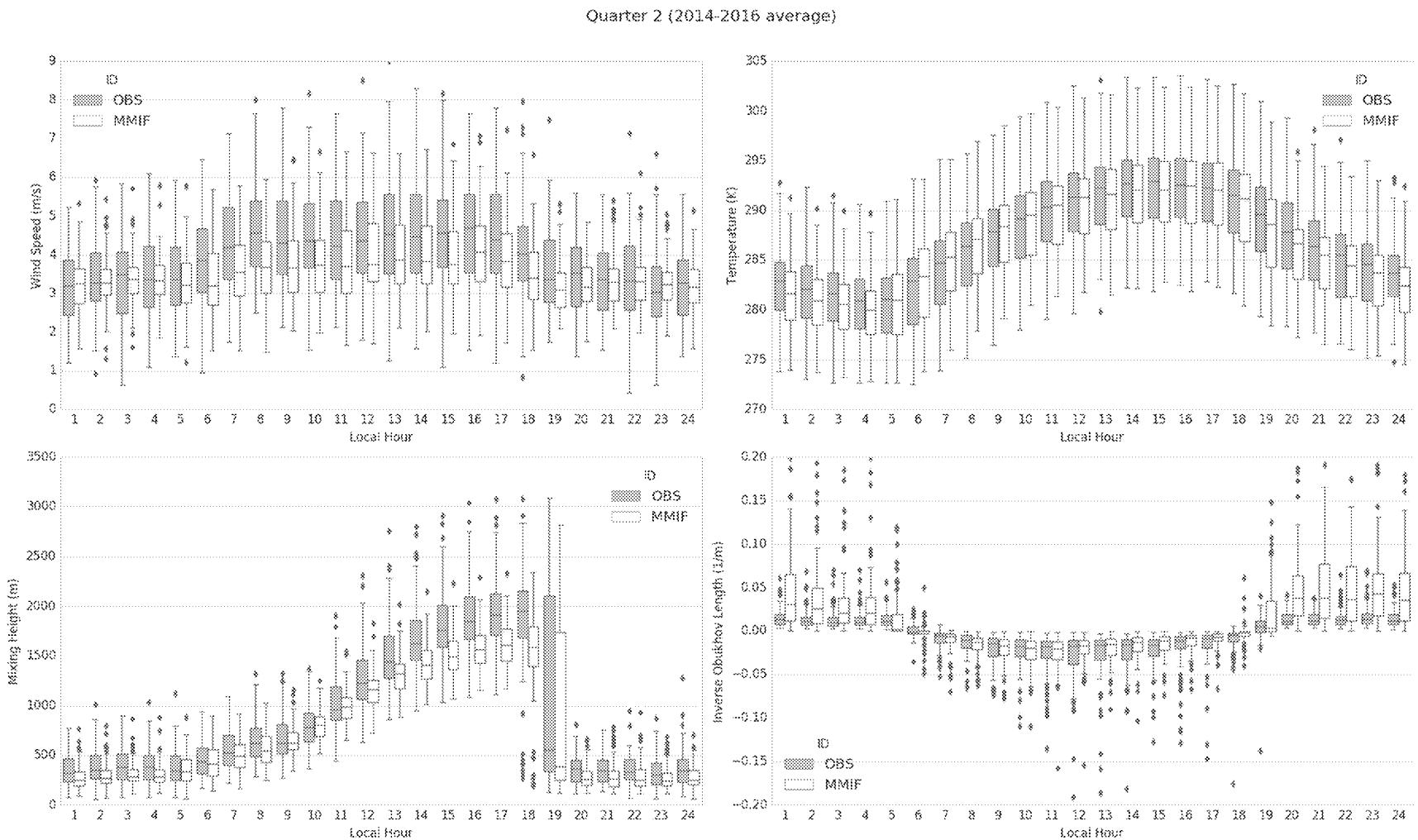


Figure 5-52. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at KSKA

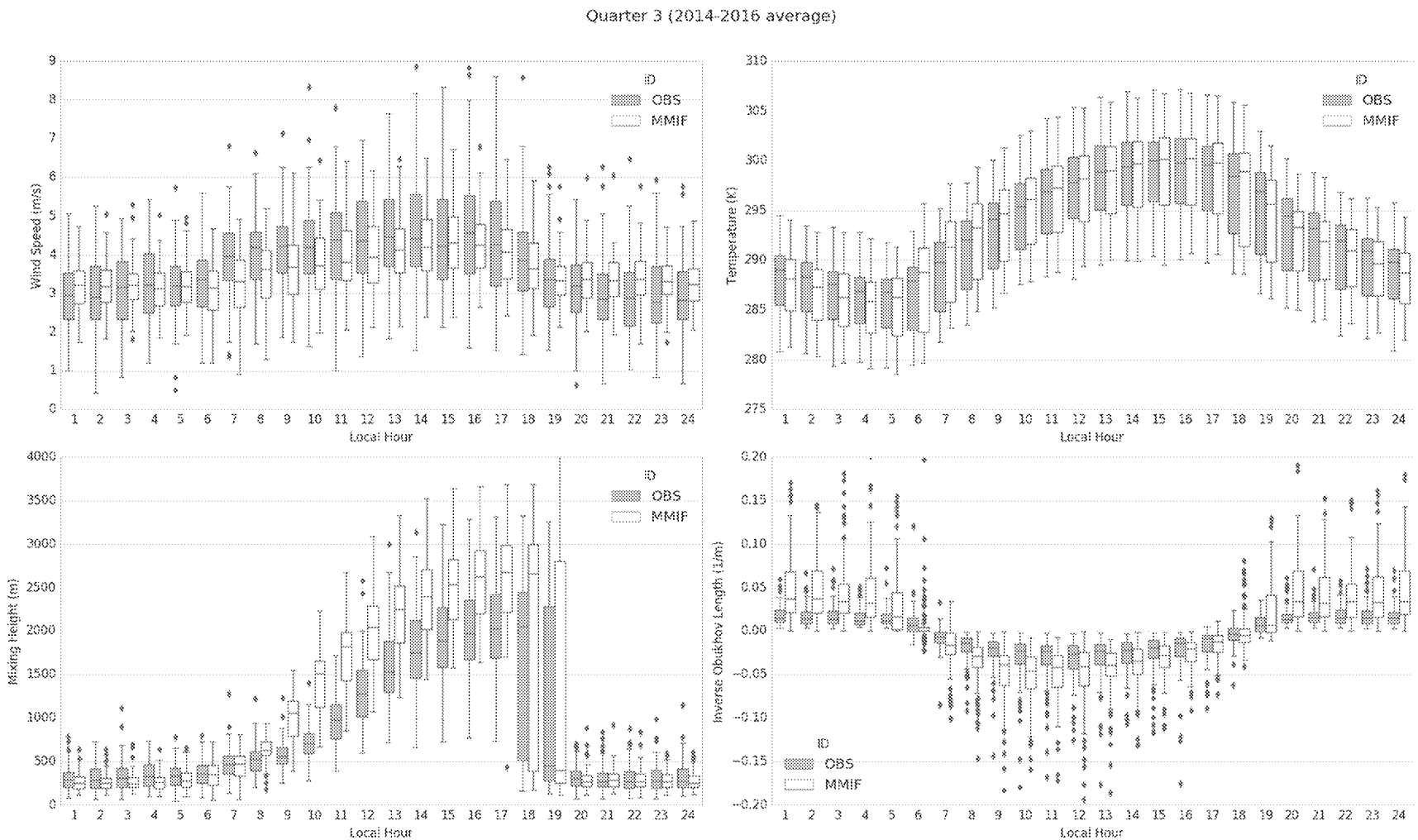


Figure 5-53. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at KSKA

ED_013256A_00000461-00094

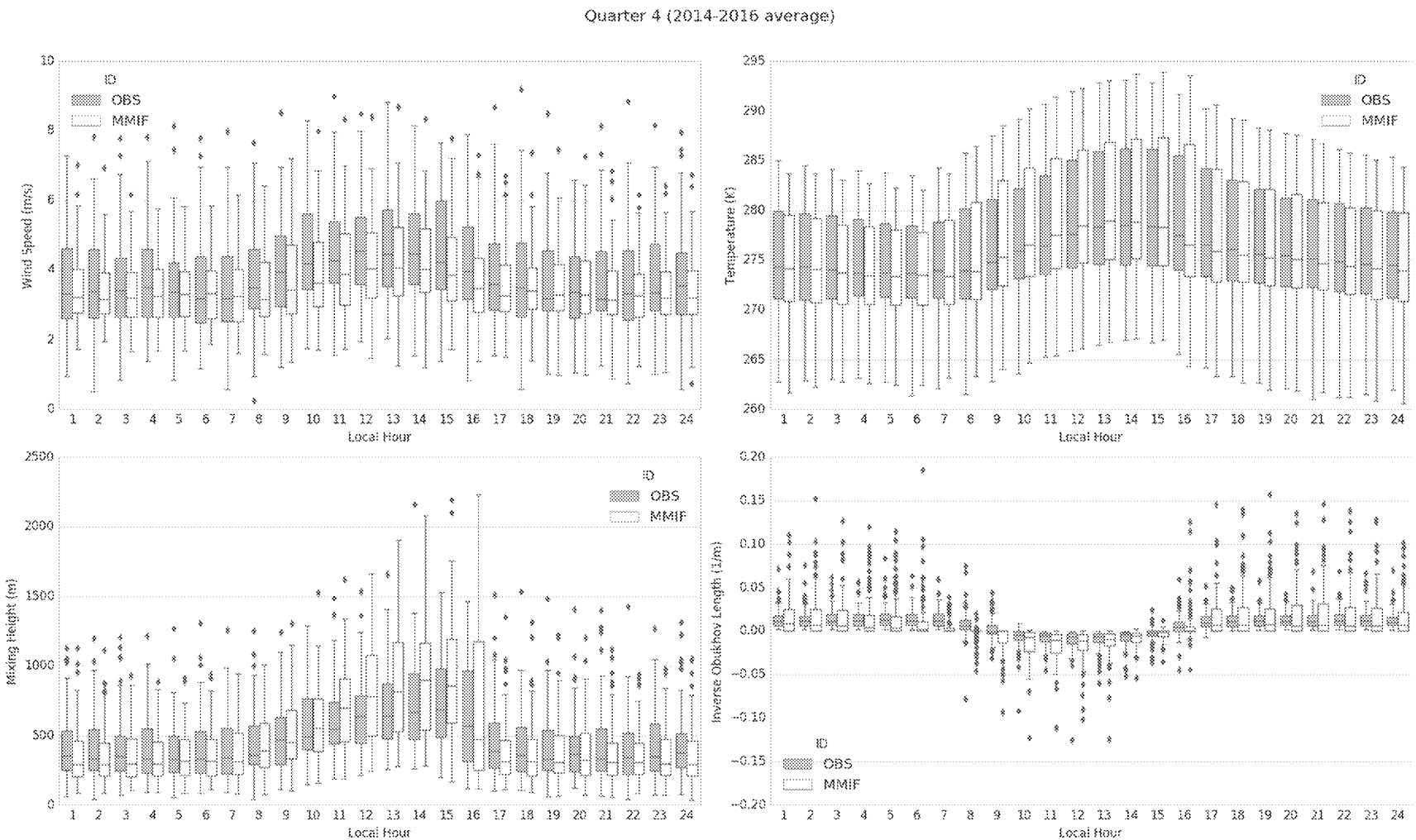


Figure 5-54. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at KSKA

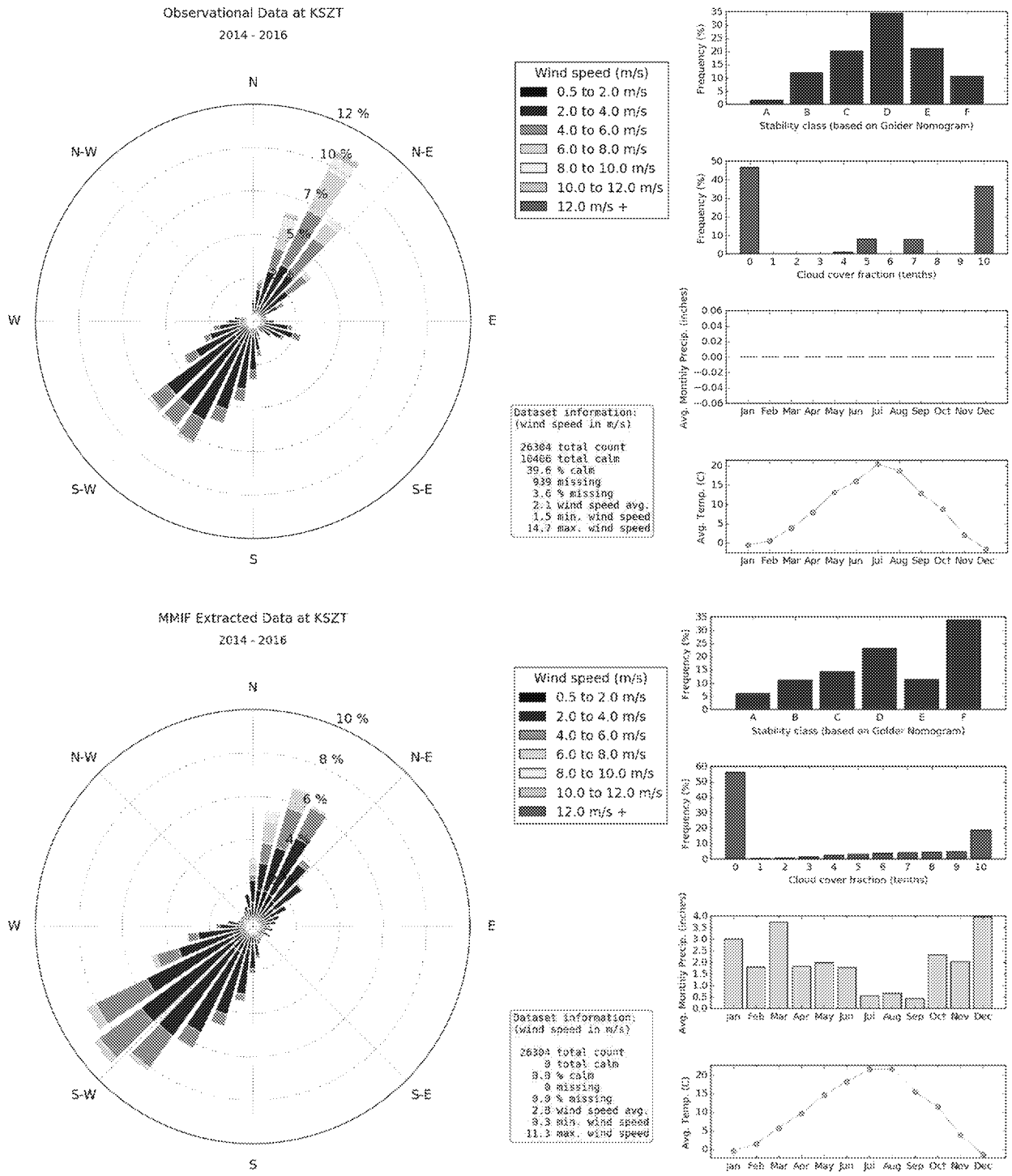


Figure 5-55. Observed (top) and MMIF (bottom) wind roses and meteorological charts at KSZT

ED_013256A_00000461-00096

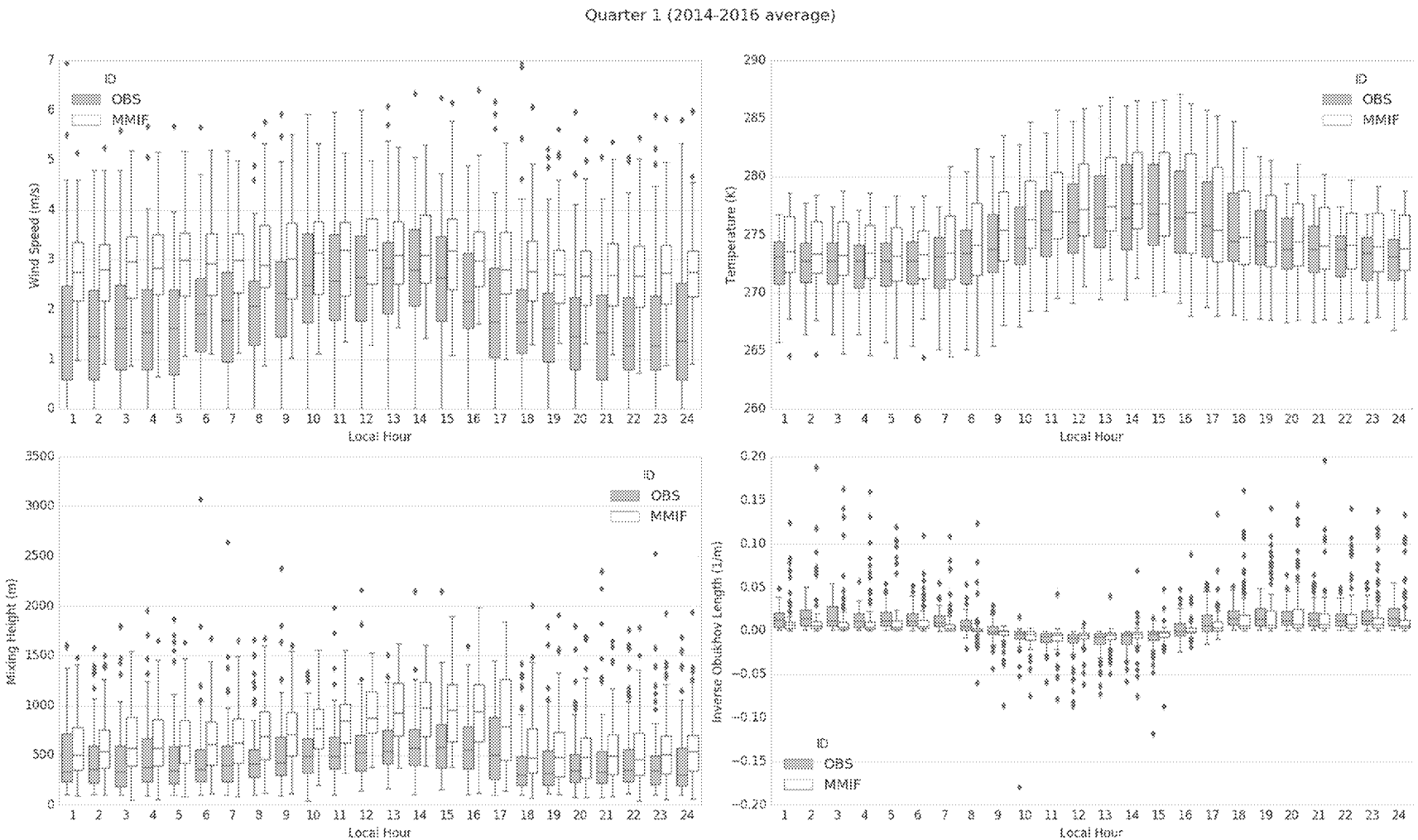


Figure 5-56. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at KSZT

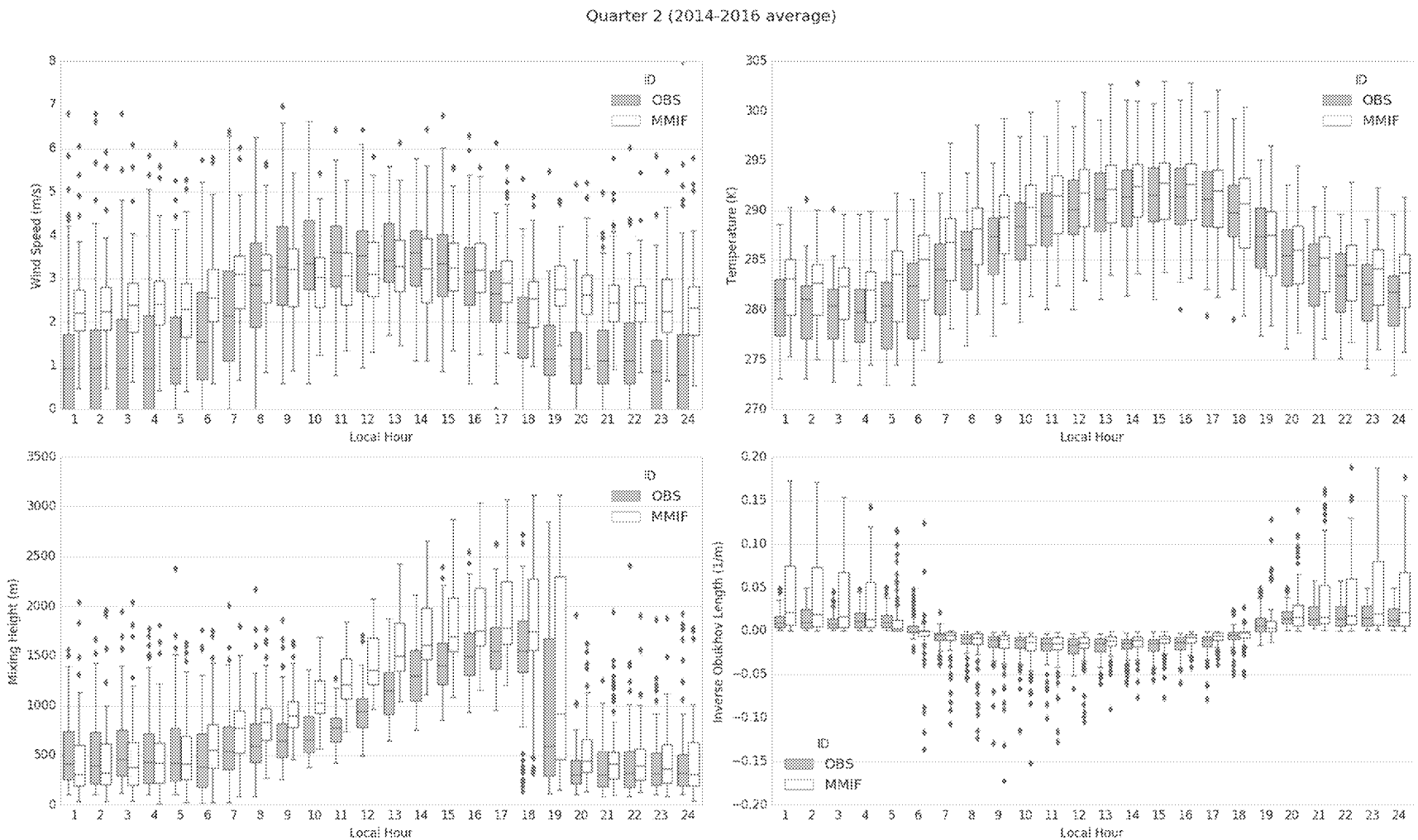


Figure 5-57. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at KSZT

ED_013256A_00000461-00098

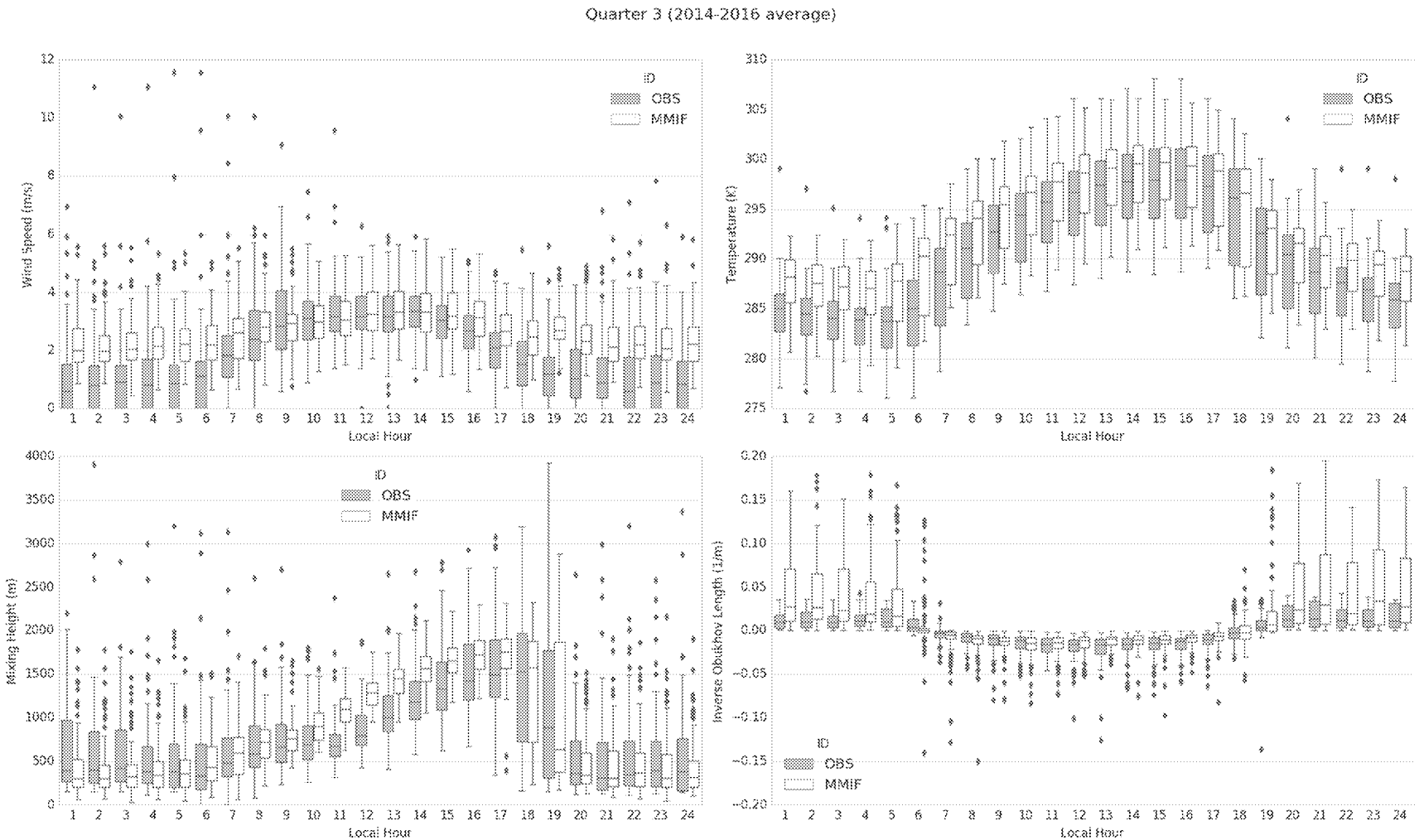


Figure 5-58. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at KSZT

ED_013256A_00000461-00099

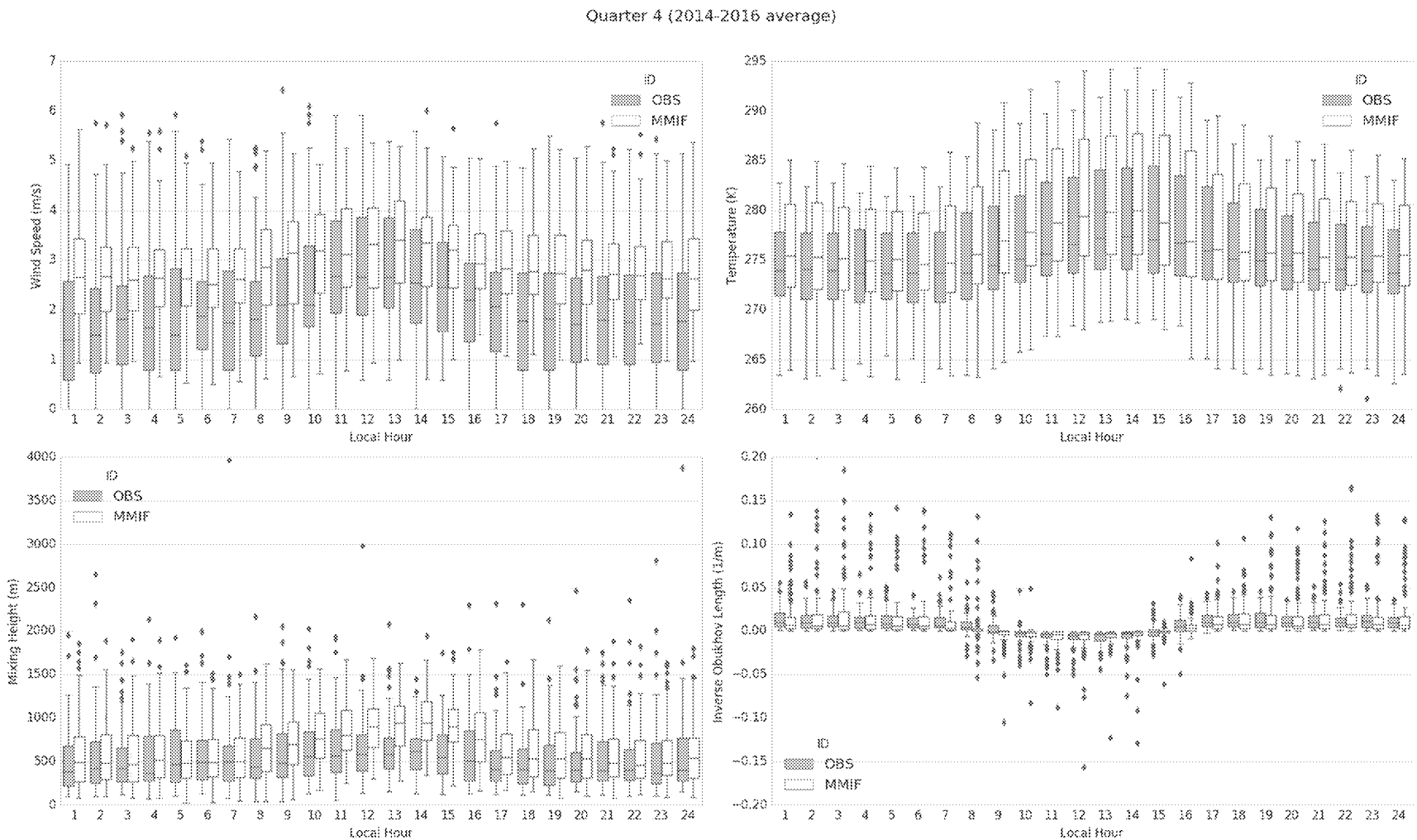


Figure 5-59. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at KSZT

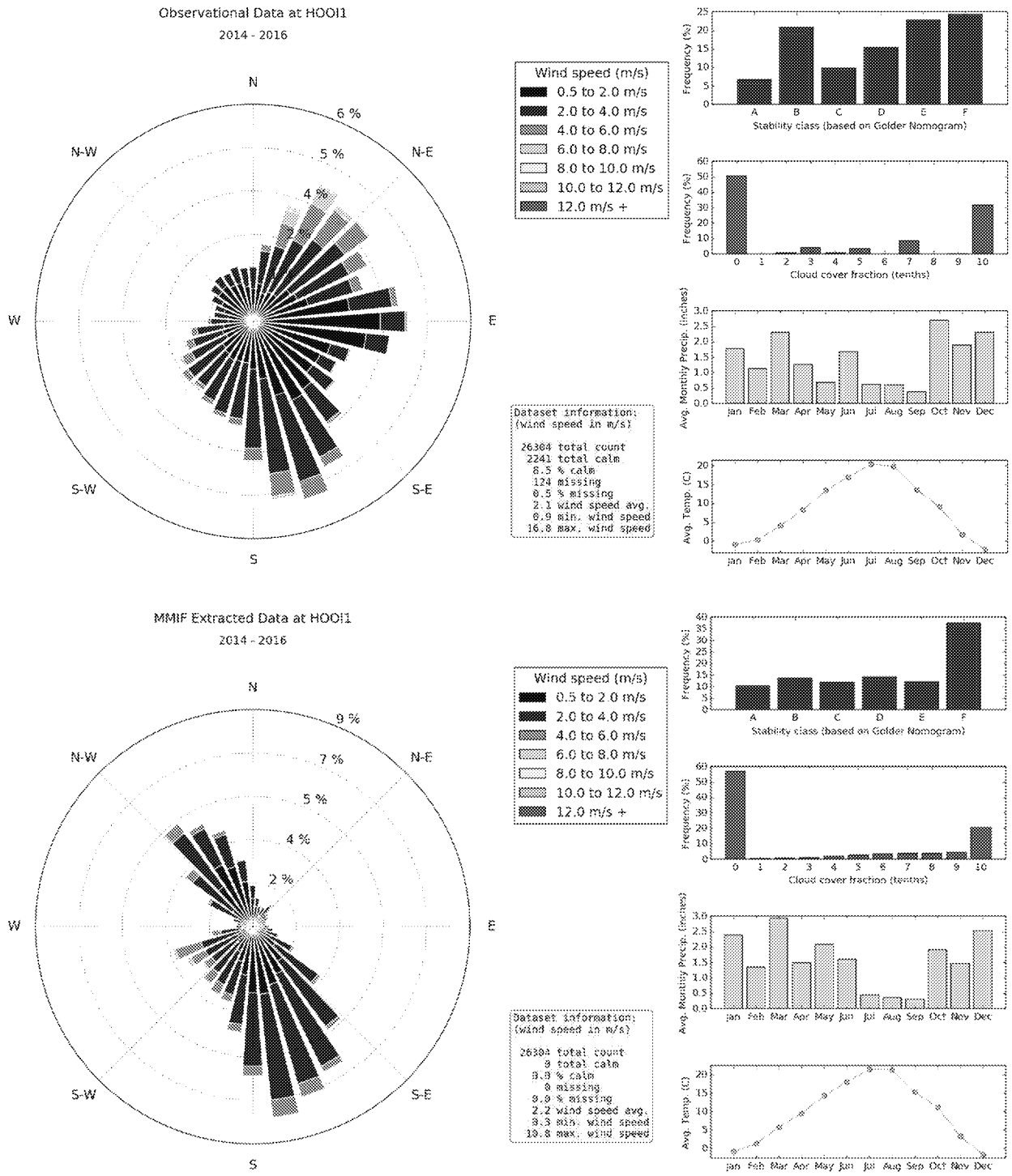


Figure 5-60. Observed (top) and MMIF (bottom) wind roses and meteorological charts at HOOI1

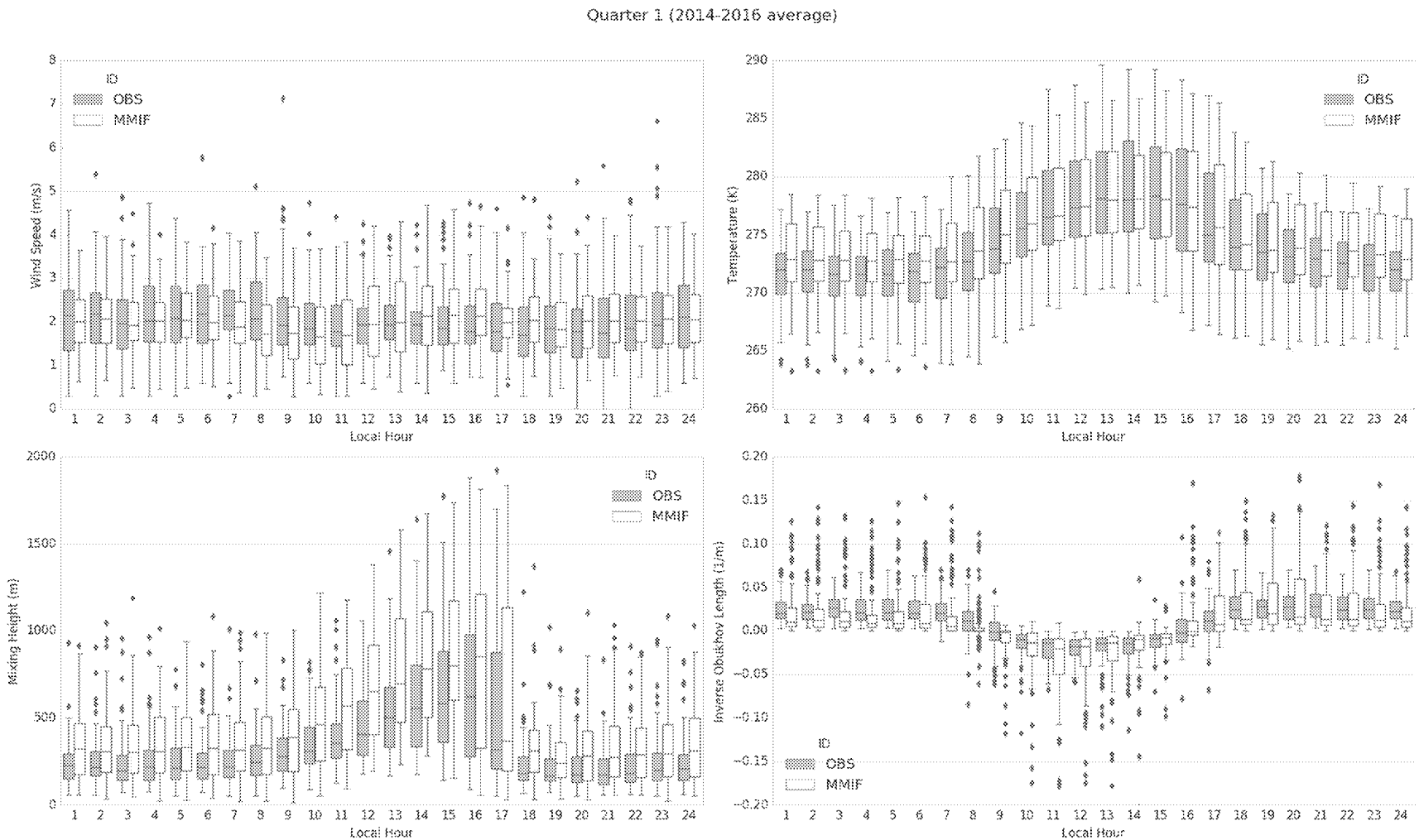


Figure 5-61. Average 2014-2016 Quarter 1 Observed and Modeled (MMIF) stability parameters at HOOI1

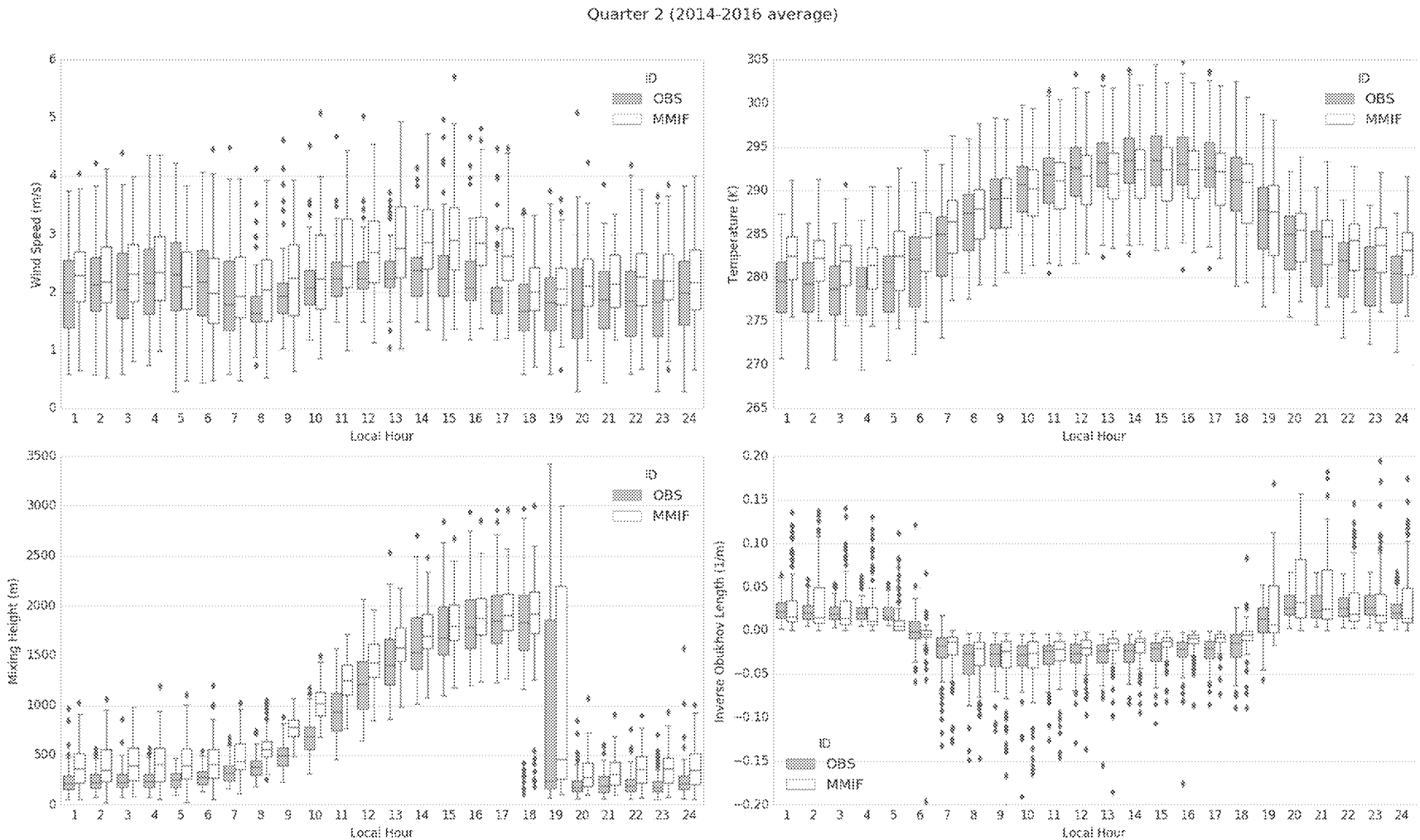


Figure 5-62. Average 2014-2016 Quarter 2 Observed and Modeled (MMIF) stability parameters at HOOI1

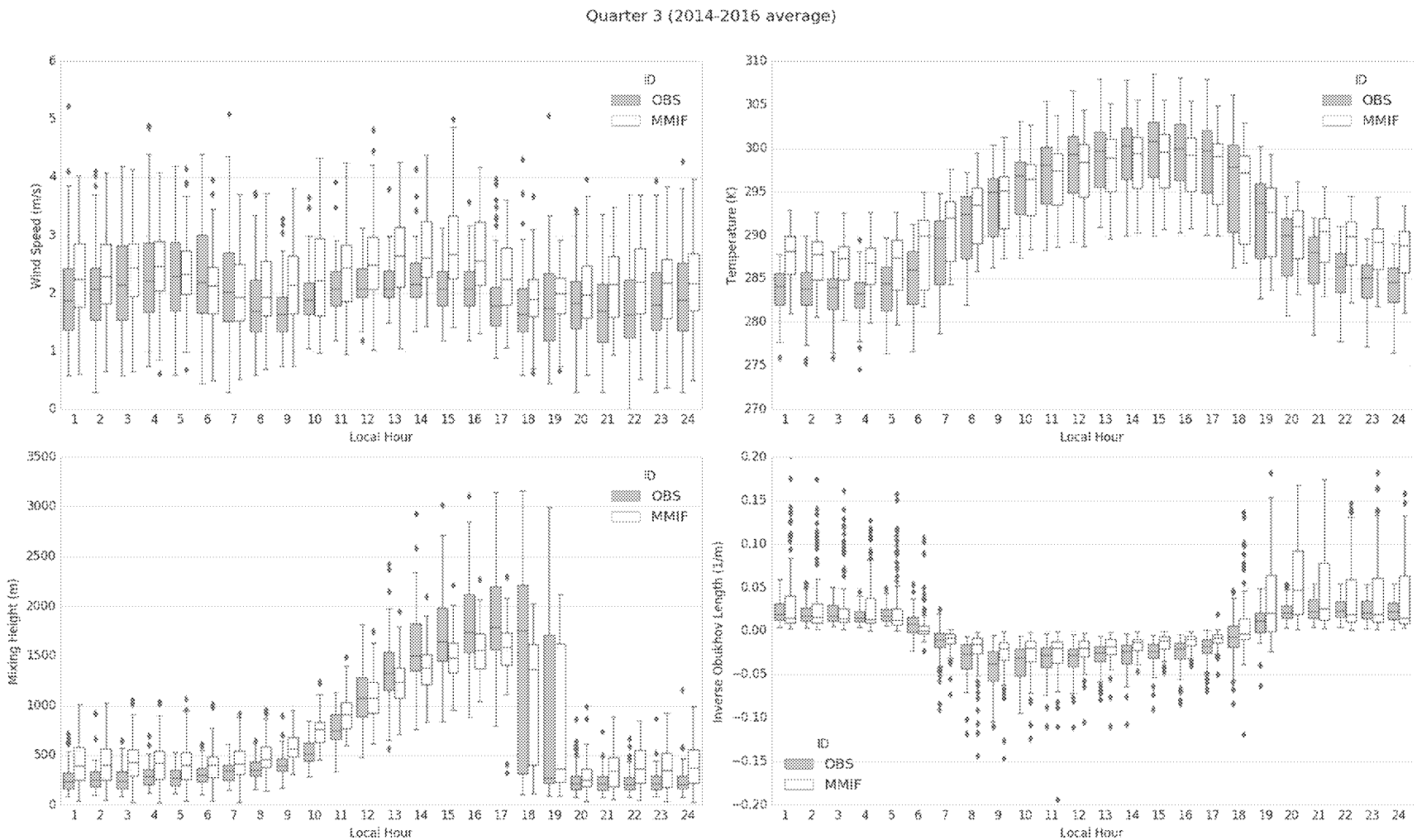


Figure 5-63. Average 2014-2016 Quarter 3 Observed and Modeled (MMIF) stability parameters at HOOI1

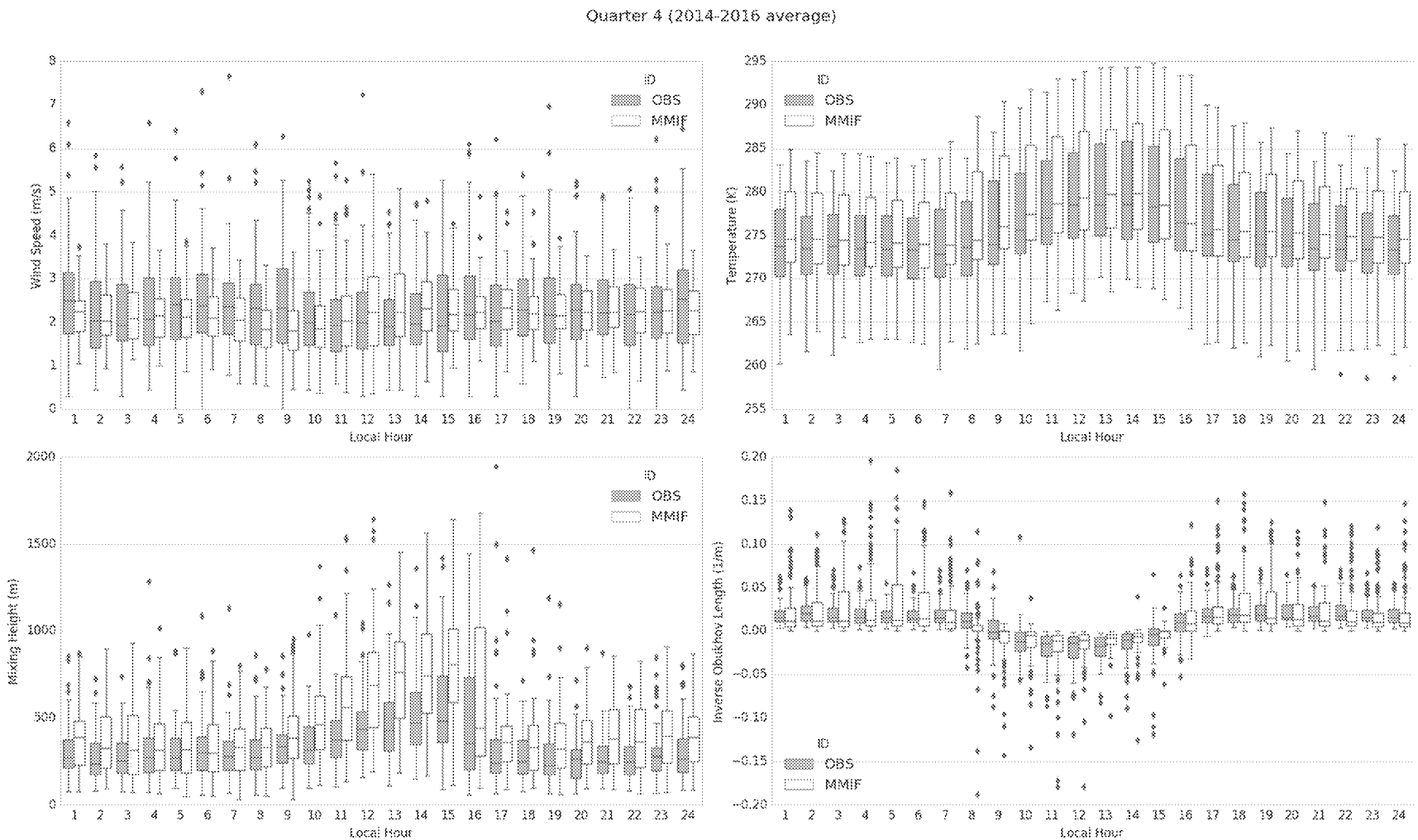


Figure 5-64. Average 2014-2016 Quarter 4 Observed and Modeled (MMIF) stability parameters at HOOI1

6. AERMOD-BASED SENSITIVITY ANALYSIS METHODOLOGY

For air permitting applications, dispersion modeling is used to determine if a project will adversely affect air quality. If a prognostic meteorological data set it to be used for regulatory purposes, it must be shown that it is equivalent to observational data, and will not lead to less conservative concentration estimates, on average. However, the primary use-case for modeled data is at locations where no observational data is available to validate the model. Ramboll took the approach of validating the entire dataset by comparing modeled concentrations at all locations where meteorological data is available within the modeling domain. Hypothetical sources were placed at the location of each meteorological station examined in this MPE, where OBS data is by definition the most representative data possible. AERMOD is used to model concentrations from WRF-generated meteorology and from observed meteorology, and the two are compared. The same WRF meteorological fields and MMIF extraction methods used for this MPE will be used for the PacWest PSD application.

For the PSD application, AERMOD will be used to estimate concentrations for Class II areas and Class I areas within 50 km, and CALPUFF will be used to estimate air quality related values (AQRVs) in mandatory Class I areas. While CALPUFF was not used as an analysis tool in this MPE, the conclusions from this MPE should be applicable to both models. A complete description of the AERMOD and CALPUFF modeling approaches is provided in the accompanying PSD Modeling Protocol. In this section, we present the model configurations used specifically for the AERMOD sensitivity studies described in this MPE.

6.1 Sensitivity Analysis Model Setup

The latest versions (at time of writing) of AERMOD (version 16216r), AERMET (version 16216), AERSURFACE (version 13016), AERMAP (version 11103), and MMIF (version 3.4) were used in this study. Since then, new versions of AERMOD, AERMET, and AERMAP have been released, but should not change the results substantively.

Individual AERMOD runs were performed with a hypothetical source centered on each station listed in Section 3 (DS3505 stations and HOOI1). Unit emission rates (1 g/s) were modeled from two stack heights, shown in Table 4-1. These

ED_013256A_00000461-00106

hypothetical sources resemble the main baghouse stack (tall and hot) and a typical process handling baghouse stack (short and cool) at the proposed PacWest facility. The short and cool stack would also be representative of fugitive sources. Annual AERMOD runs were performed using meteorology from years 2014, 2015, and 2016. Each stack was modeled with its own source group.

Table 6-1. Hypothetical Sources Used in AERMOD

Source	Height (m)	Temperature (K)	Exit Velocity (m/s)	Diameter (m)	Emission Rate (g/s)
Tall, hot	45	450	15	6	1
Short, cool	5	(ambient)	15	1	1

A 16 km by 16 km receptor grid centered on the meteorological tower was created for each station. Receptors were spaced 1000 m apart across the full domain, with nested receptor grids using 100 m and 250 m spacing extending out 1 km and 8 km, respectively. An example grid for station KCOE is shown in Figure 4-1.

ED_013256A_00000461-00107

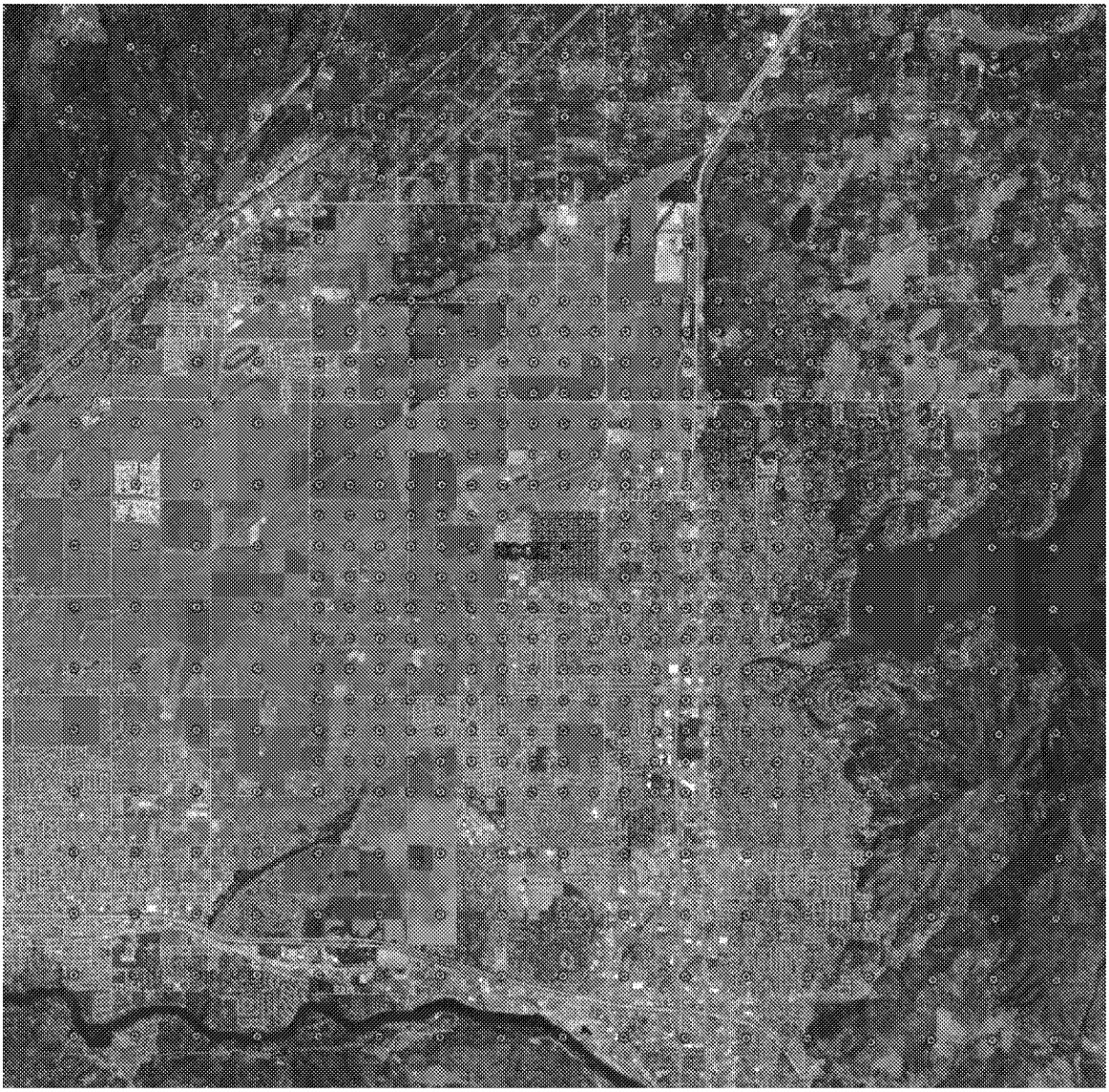


Figure 6-1. Example AERMOD Receptor Grid for KCOE

6.2 MMIF Extraction Methodology

To test the impact of simulated meteorology on pollutant concentrations, two AERMOD modeling scenarios were performed: using observational data, and using WRF-generated data processed with MMIF by following procedures outlined in Appendix W and the MMIF Guidance (U.S. Environmental Protection Agency [EPA], 2018).

The steps for processing WRF data for use with AERMOD are as follows:

ED_013256A_00000461-00108

1. Create a MMIF input file to extract meteorological data from WRF
    a. Set the mixing height extraction (AER_MIXHT) to "AERMET"
    b. Extract one year of data individually
    c. Use MMIF defaults for all other options
2. Run MMIF to produce the following files:
    a. Hourly "on-site" surface conditions (*.DAT) with wind speed and direction, temperature at 2 m and 10 m, solar insolation, and pressure
    b. Upper-air conditions (*.FSL) with wind speed and direction, temperature, and pressure at various levels above ground level every 12 hours
    c. Monthly surface characteristics (*.AERSURFACE.DAT)
    d. AERMET input (*.IN1, *.IN2, and *.IN3) files
3. Run AERMET stages 1, 2, and 3 to produce surface (*.SFC) and profile (*.PFL) files to use as inputs to AERMOD

6.3 Averaging Periods

For each AERMOD run, pollutant concentrations were tracked for four combinations of rank and averaging period (1 hr highest first high [H1H], 1 hr highest eighth high [H8H], 24 hr highest eighth high [H8H], Annual highest first high [H1H]). These combinations are representative of common National Ambient Air Quality Standards (NAAQS) (i.e., for NO_2 and $PM_{2.5}$).

ED_013256A_00000461-00109

7. AERMOD-BASED SENSITIVITY ANALYSIS RESULTS

A variety of statistical metrics were used to evaluate the impact of observed meteorology ("OBS") vs modeled ("MMIF-extracted") meteorology on dispersion parameters. Quantile-quantile (Q-Q) plots are used to visualize concentration differences in AERMOD outputs. Q-Q plots show a scatter plot of ranked pairings of concentrations, where any rank of concentration from one AERMOD run is plotted against the same ranking of concentration from a different AERMOD run to represent the frequency distribution of a year-long dataset with hourly concentrations. Q-Q plots show whether a meteorological configuration leads to bias at the high or low end of the frequency distribution with respect to concentrations from AERMOD runs. Q-Q plots comparing MMIF-extracted and OBS concentrations are shown in Figures 7-2 to 7-8.

A swarmplot was also created to compare maximum design concentrations between observations and MMIF-extracted generated results. This figure shows the normalized mean bias on the y-axis for the AERMOD results at each station, and is split into results for the 5 m and 45 m stacks, with each station's value color coded. Columns within the figure are grouped by standard (e.g. 1 hr H8H, comparable to the NO_2 NAAQS). Additionally, a box showing some statistical values for each set is shown, with the middle line representing the mean of the dataset, and the upper and lower bounds representing the 75th and 25th percentiles, respectively.

Normalized Mean Bias (NBM) was calculated using the following equation:

$$NMB = \frac{MMIF - extracted\ Concentration - \ OBS\ Concentration}{OBS\ Concentration}$$

A value of zero indicates that AERMOD predicted concentrations were identical when using OBS data and MMIF-extracted WRF data as an input to AERMET. Positive values indicate that MMIF-extracted data produced higher (more conservative) concentrations. Negative values indicate that OBS-derived data produced more conservative concentrations. Because changing meteorological inputs can greatly affect concentrations, the mean value of the normalized mean biases was plotted to determine if MMIF-extracted data was more or less conservative, on average. The swarmplot for all stations over the modeled time period (2014-2016) is shown in Figure 7-1.

ED_013256A_00000461-00110

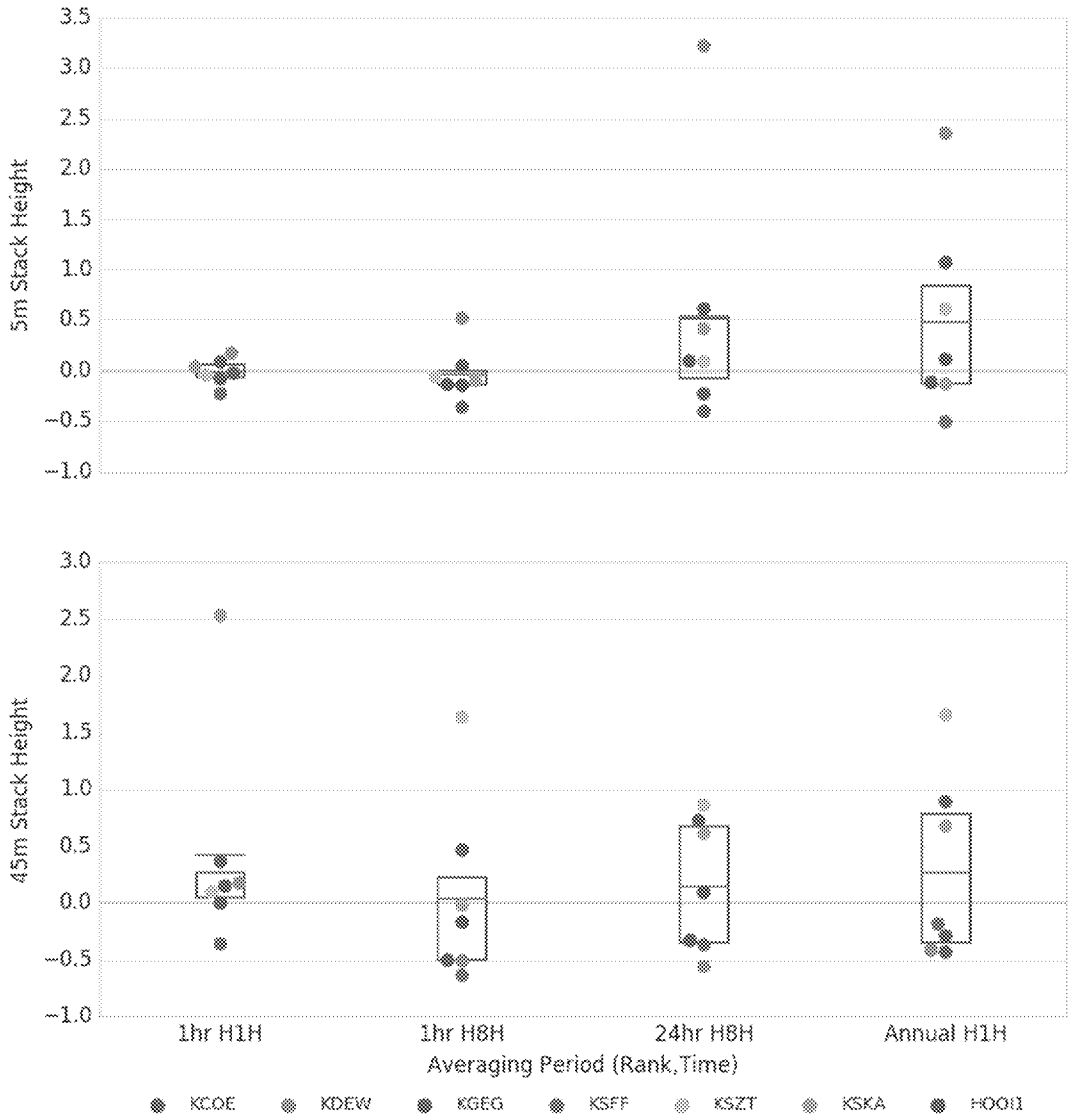


Figure 7-1. Normalized Mean Bias of AERMOD Output Design Concentrations Using Observed vs Modeled Meteorology

7.1 Sensitivity Analysis Design Value Comparison

The swarmplot provided in Figure 7-1 indicates that hourly design concentrations are similar between MMIF-extracted and OBS at both a 5 m and 45 m stack height. With the exception of a few outliers (KSKA 45 m, 1 hr H1H and KSZT 45 m, 1 hr H8H), almost all station's values were within a NMB of ±0.5. While MMIF-processed WRF data generally results in more stable hours, these results indicate that the most stable hours produced don't usually lead to higher design values.

At longer averaging periods, MMIF-extracted data leads to more conservative concentrations due to WRF's consistency in wind direction, especially during low wind days. During low wind hours, when the atmosphere is generally stable and dispersion is low, an anemometer will produce erratic wind direction readings, as any wind movement can change the direction. This inherent variation is not seen in WRF-generated data, which tends to produce much more steady (in time) hourly wind directions, even at low wind speeds. This means that during a low wind speed day, MMIF-extracted data will direct plumes in one direction consistently, leading to higher concentrations at downwind receptors when averaged over the day.

Annual averaging periods show the most variation in concentration. This can be attributed to WRF generating more stable hourly values than observational data, on average. The wind roses in Section 5.4.1 include bar graphs with stability class, estimated using the Golder Nomogram method. In almost all cases, there are more highly stable (Class F) hours in the WRF-generated data than observed data. This means that averaged over the year, concentrations tend to be higher.

Results for a 5 m stack are more correlated than a 45 m stack. This is to be expected, since the stations examined are sited in relatively flat terrain. A 5 m stack will produce highs very close to the source, while emissions from a 45 m stack will have much more time to disperse before impacting terrain, amplifying the effect of meteorological data.

The stations that showed the worst agreement were KDEW at a 5 m stack height, and KSZT at a 45 m stack height. Observations data from KDEW showed very high wind speeds, with a minimum hourly wind speed of 1.6 m/s. WRF data, meanwhile, predicted much more low wind speed hours, with winds as low as 0.3 m/s. From a shorter, 5 m stack, these low wind speed hours increased design concentrations over a 24 hour and annual periods by as much as 3.2 times (NMB of 3.2).

KSZT's high concentrations with a 45 m stack can be attributed to complex terrain near the site. A large hill, 750 m higher than KSZT, is located 1.6 km from the station. The wind roses between observed and WRF data at this site are very similar, but observations data tends to blow directly towards this hill less. The fact that the 1st 1 hr concentration is similar between data sets shows that winds blow towards this terrain feature sometimes, if infrequently.

ED_013256A_00000461-00112

Another interesting result is the difference between observational data. Stations KSKA, KGEG, and KSFF are all located in or near Spokane; at Deer Park Airport, Walla Walla Regional Airport, and Fairchild Airforce Base, respectively. KSKA and KGEG in particular are only 9 km apart. These stations are located in relatively flat terrain, and as a result, WRF data outputs are very similar. One would expect, given these conditions, that both KSKA and KGEG WRF-based concentrations would agree well with OBS-based predictions, or at least be different from the other sites in a similar way. However, the results with a 45 m stack height for these stations are wildly different. For the 24-hour averaging period, KSKA WRF data shows a NMB of around 0.5, while KGEG show a NMB of -0.5. The same trend is seen for the other averaging periods. This illustrates how meteorological data affects AERMOD output concentrations, with results varying significantly even when using very similar datasets.

7.2 Sensitivity Analysis Q-Q Plots

While the swarmplot in Figure 7-1 compares design value concentrations across sites, it does not show the distribution of values at the lower end of the data set. The Q-Q plots provided in Figures 7-2 through 7-8 allow for deeper analysis into trends across the dataset. In general, the maximum (and design) values agree well between MMIF-extracted and OBS. This is not true for most hours in the data set, where MMIF-extracted concentrations are more conservative in almost every case (the one exception being KDEW with a 45 m stack height). In many cases, the results are curves, with agreement at the high and low ends, but MMIF-extracted concentrations being significantly more conservative in the middle of the range. This can be attributed to WRF's use of temperature difference (Bulk Richardson Method) to calculate stability, producing more stable and unstable hours, and fewer neutral hours.

As expected, the stations with the highest agreement (KGEG, KSKA, and HOOI1) are located in relatively flat terrain. However, interestingly, these stations were not necessarily the best performers for design concentrations. Since the highest concentrations usually occur at elevated terrain near the source, and in any data set there will be some hours blowing towards that terrain, it seems that design concentrations are more resistant to the higher number of stable hours.

ED_013256A_00000461-00113

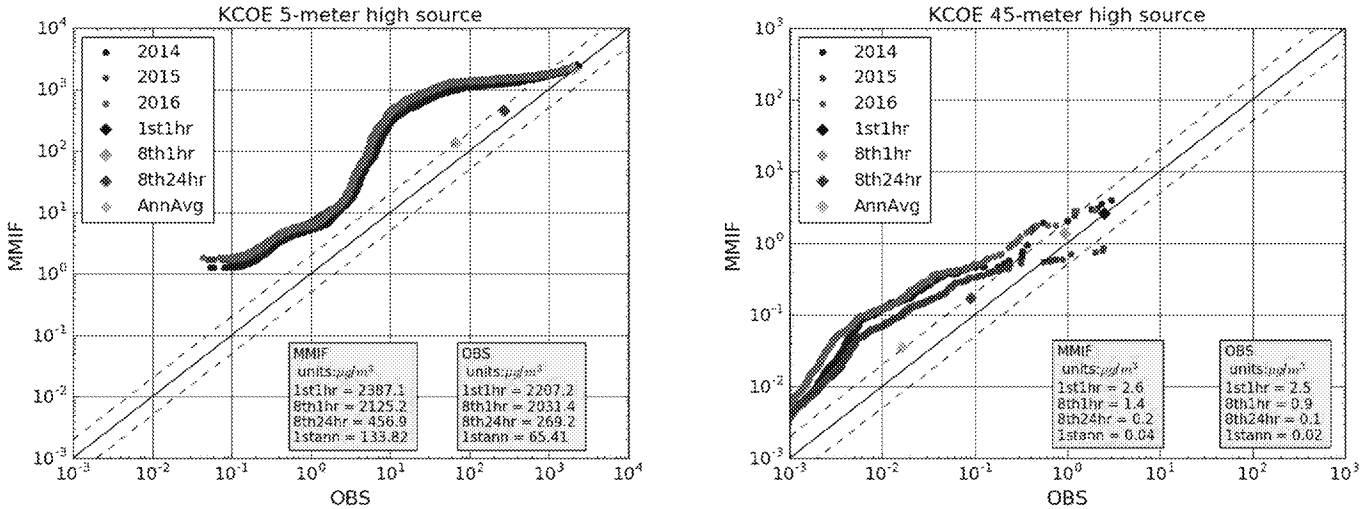


Figure 7-2. KCOE hourly AERMOD Concentrations - 5-m source (left) and 45-m source (right)

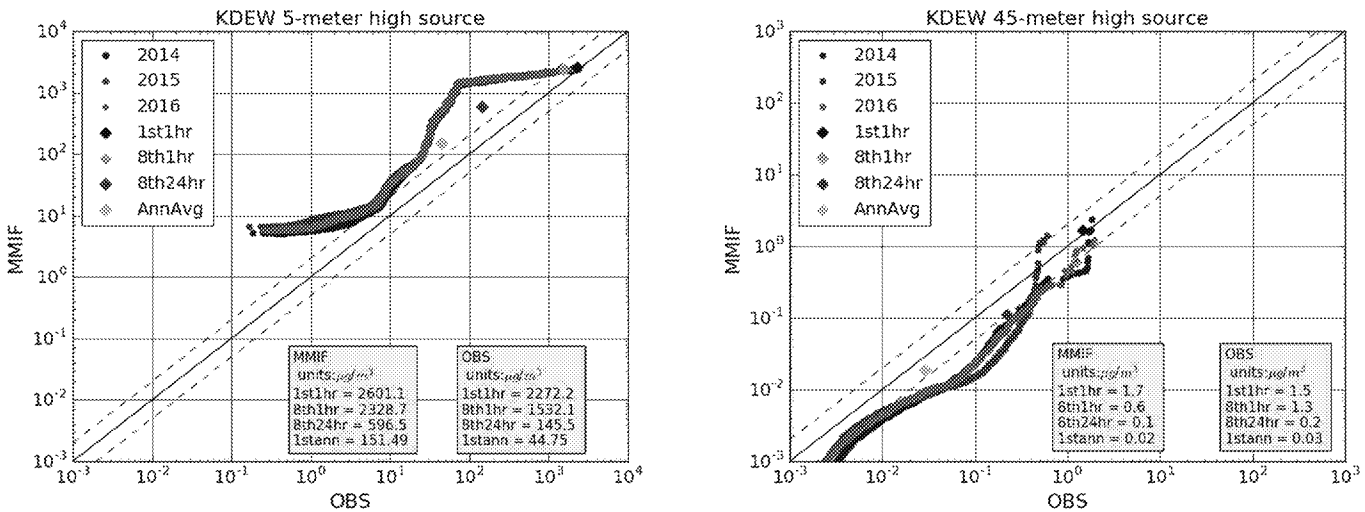


Figure 7-3. KDEW hourly AERMOD Concentrations - 5-m source (left) and 45-m source (right)

ED_013256A_00000461-00114

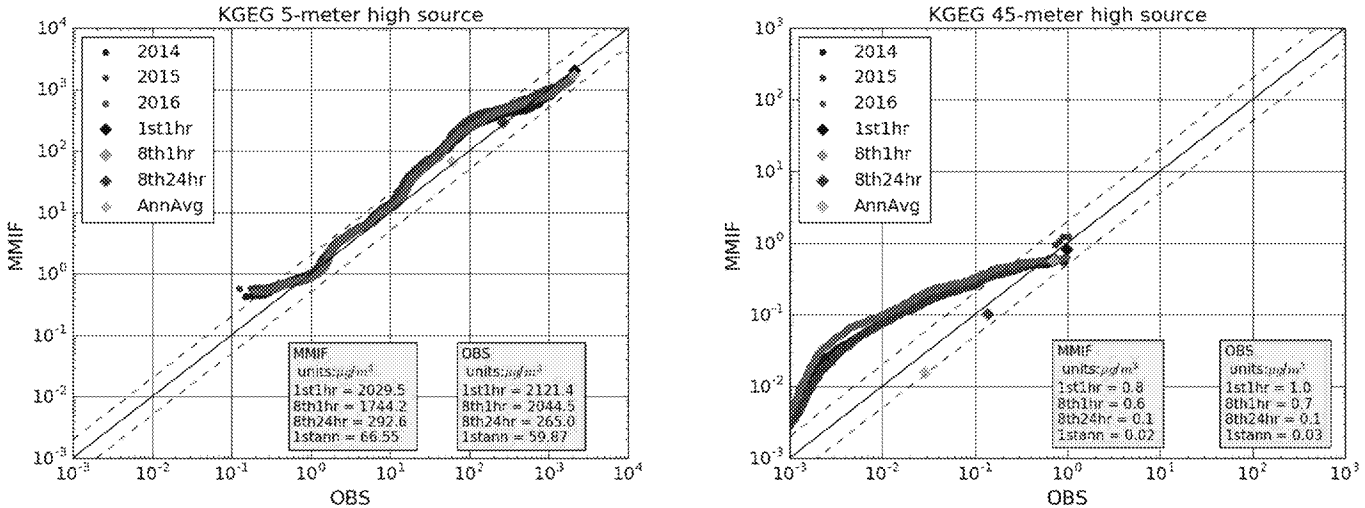


Figure 7-4. KGEG hourly AERMOD Concentrations - 5-m source (left) and 45-m source (right)

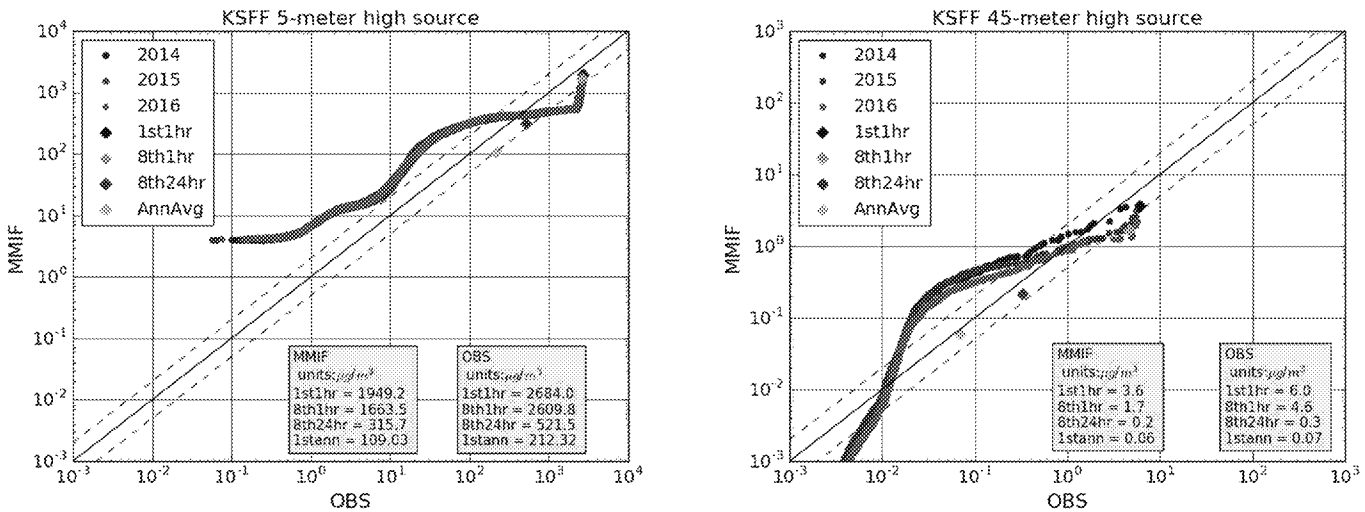


Figure 7-5. KSFF hourly AERMOD Concentrations - 5-m source (left) and 45-m source (right)

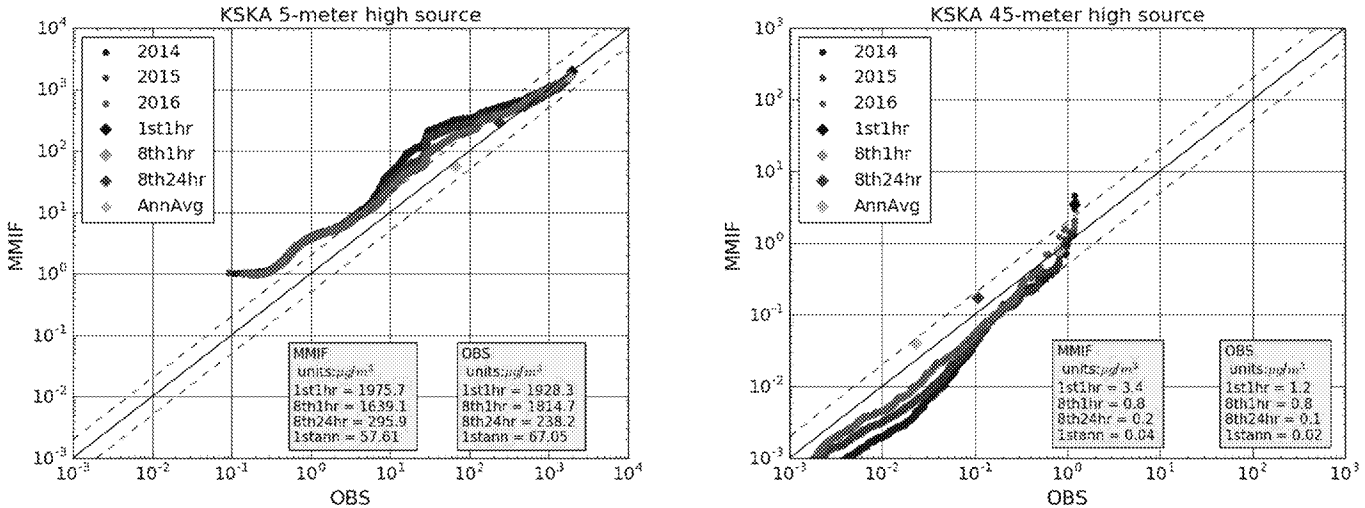


Figure 7-6. KSKA hourly AERMOD Concentrations - 5-m source (left) and 45-m source (right)

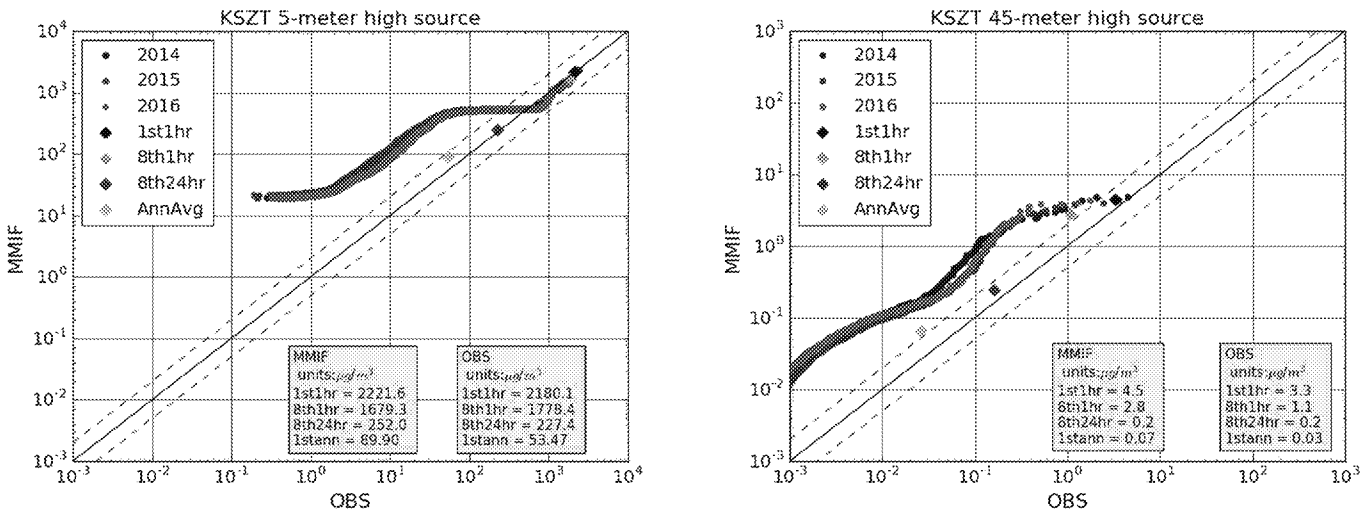


Figure 7-7. KSZT hourly AERMOD Concentrations - 5-m source (left) and 45-m source (right)

ED_013256A_00000461-00116

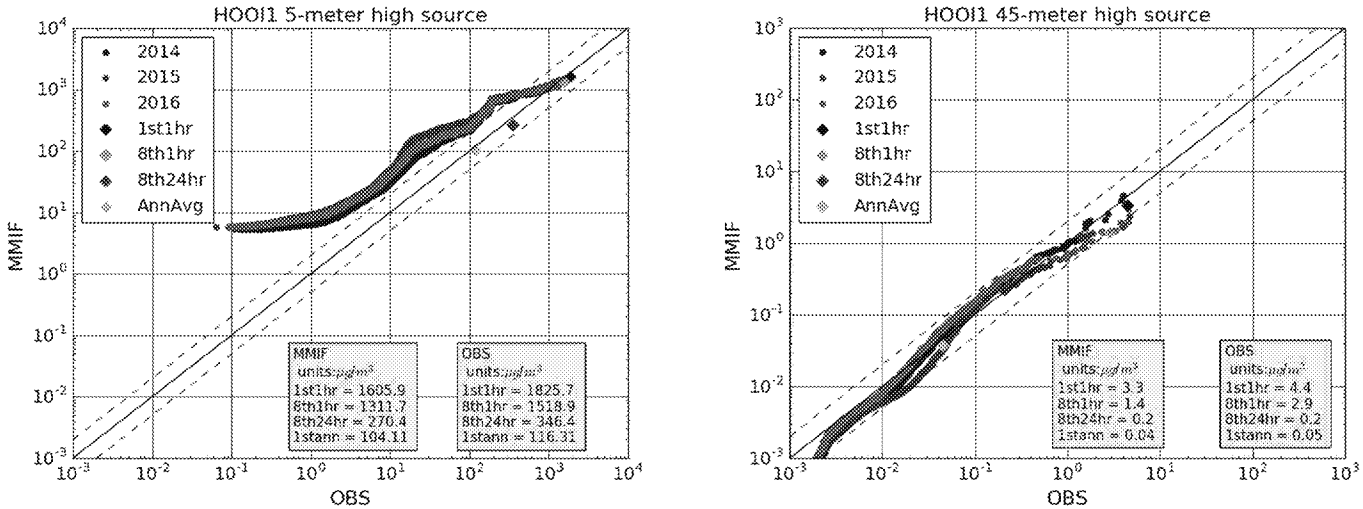


Figure 7-8. HOOI1 hourly AERMOD Concentrations - 5-m source (left) and 45-m source (right)

8. CONCLUSIONS

A WRF dataset was created, validated, and processed using state-of-the-science methods to be used as an input to dispersion modeling in support of a PSD application for the proposed PacWest facility. Multiple observation stations were selected as an independent data source to validate the model, and compared on a meteorological basis, as well as being used with AERMOD to determine the effects of meteorological data on output concentrations.

Soccer plots showed acceptable levels of bias and error, with most stations within the goals for complex terrain. Wind roses also generally showed good agreement between model output and observations, given fine-scale complex terrain near the sites. It was noticed that WRF data produced more stable hours than observational data after being processed through MMIF and AERMET, but there was good agreement regarding precipitation and temperature measurements.

Regarding AERMOD concentrations, for 1-hour periods, WRF-based concentration predictions produced comparable results to observation-based concentration predictions. Over a 24-hour period, it appears that WRF's persistence of wind direction at low wind speeds can lead to more conservative concentrations. Over an annual average, the larger number of stable hours also contributes to higher concentrations with WRF compared to using OBS.

Overall, performance of the WRF data set with MMIF extraction method was deemed acceptable. From a statistical perspective, the two data sets are comparable, and produced similar output concentrations for standards related to the NAAQS.

Because there is no observational meteorology that is representative of conditions at the PacWest site, and because the WRF dataset with MMIF extraction method has been shown to be comparable to observational data at other high-quality meteorological observation sites across the domain, this MMIF-extracted WRF data is acceptable for use with AERMOD for Class II dispersion modeling.

Based on the meteorological analysis presented in Section 5, this dataset is also acceptable for use with CALPUFF for long range Class I dispersion modeling.

ED_013256A_00000461-00118

9. REFERENCES

Daly, C., M. Halbleib, J.I. Smith, W.P. Gibson, M.K. Doggett, G.H. Taylor, J. Curtis, P.P. Pasteris 2008. Physiographically sensitive mapping of climatological temperature and precipitation across the conterminous United States. Int. J. Climatol., (http://prism.nacse.org/documents/Daly2008_PhysiographicMapping_IntJnlClim.pdf)

Daly, Christoper and Bryant, Kirk, 2013. The PRISM Climate and Weather System – An Introduction. Oregon State Universtiy PRISM Climate Group. Available at: http://www.prism.oregonstate.edu/

Emery, C.A., E. Tai, and G. Yarwood. 2001. Enhanced Meteorological Modeling and Performance Evaluation for Two Texas Ozone Episodes. Prepared for the Texas Natural Resource Conservation Commission (now TCEQ), by ENVIRON International Corp, Novato, CA. Available at: http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/mm/EnhancedMetModelingAndPerformanceEvaluation.pdf

EPA, 2018. Guidance on the Use of the Mesoscale Model Interface Program (MMIF) for AERMOD Applications. EPA-454/B-18-005 April 2018. Available at https://www3.epa.gov/ttn/scram/models/relat/mmif/MMIF_Guidance.pdf

Kemball-Cook, S., Y. Jia, C. Emery, and R. Morris, 2005. Alaska MM5 Modeling for the 2002 Annual Period to Support Visibility Modeling. Prepared for the Western Regional Air Partnership, by ENVIRON International Corp., Novato, CA. Available at: http://pah.cert.ucr.edu/aqm/308/docs/alaska/Alaska_MM5_DraftReport_Sept05.pdf

McNally, D. E., 2009. 12 km MM5 Performance Goals. Presentation to the Ad-Hoc Meteorology Group. June 25, 2009. Available at: http://www.epa.gov/scram001/adhoc/mcnally2009.pdf

Ramboll Environ US Corp. 2015. METSTAT. Retrieved from http://www.camx.com/download/support-software.asp

Skamarock, W. C., J. B. Klemp, J. Dudhia, D. O. Gill, D. M. Barker, M. G. Duda, X.-Y. Huang, W. Wang, and J. G. Powers, 2008: A description of the Advanced Research WRF version 3. NCAR Technical Note 475, http://www2.mmm.ucar.edu/wrf/users/docs/arw_v3.pdf

ED_013256A_00000461-00119

Appointment

From: Chi, John [Chi.John@epa.gov]
Sent: 4/23/2018 3:53:55 PM
To: Chi, John [Chi.John@epa.gov]; Bonifacino, Gina [Bonifacino.Gina@epa.gov]; McAlpine, Jerrold [McAlpine.Jay@epa.gov]; Duboiski, Christi [duboiski.christi@epa.gov]; Bray, Dave [Bray.Dave@epa.gov]

Subject: Jefferson County, MO SIP Consistency
Attachments: Appendix W January 17, 2017.pdf; Calcagni 1992 - Processing Redesignations to Attainment.pdf; Region 7 consistency paper for Jeff Co MO S02 Redesignation- April 5 2018 (002).docx
Location: R10Sea-Room-15Birch/R10-Rooms-Service-Center

Start: 5/3/2018 9:00:00 PM
End: 5/3/2018 10:00:00 PM
Show Time As: Busy

Required Attendees: Bonifacino, Gina; McAlpine, Jerrold; Duboiski, Christi; Bray, Dave

*Updated sorry for the time change!

We haven't received any follow up information from HQ about the consensus for the SIP Consistency Meeting so this meeting could be earlier if there is a scheduled call before this meeting.

However, I wanted to have a meeting to discuss Region 10's potential position and this could have an effect on Intalco in 2020.

I've attached all the documents that were discussed during the call last week.

https://www.epa.gov/sites/production/files/2016-06/documents/20140423guidance_nonattainment_sip.pdf

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 51

[EPA–HQ–OAR–2015–0310; FRL–9956–23–OAR]

RIN 2060–AS54

Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches To Address Ozone and Fine Particulate Matter

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: In this action, the Environmental Protection Agency (EPA) promulgates revisions to the *Guideline on Air Quality Models* ("*Guideline*"). The *Guideline* provides EPA's preferred models and other recommended techniques, as well as guidance for their use in estimating ambient concentrations of air pollutants. It is incorporated into the EPA's regulations, satisfying a requirement under the Clean Air Act (CAA) for the EPA to specify with reasonable particularity models to be used in the Prevention of Significant Deterioration (PSD) program. This action includes enhancements to the formulation and application of the EPA's preferred near-field dispersion modeling system, AERMOD (American Meteorological Society (AMS)/EPA Regulatory Model), and the incorporation of a tiered demonstration approach to address the secondary chemical formation of ozone and fine particulate matter ($PM_{2.5}$) associated with precursor emissions from single sources. The EPA is changing the preferred status of and removing several air quality models from appendix A of the *Guideline*. The EPA is also making various editorial changes to update and reorganize information throughout the *Guideline* to streamline the compliance assessment process.

DATES: This rule is effective February 16, 2017. For all regulatory applications covered under the *Guideline*, except for transportation conformity, the changes to the appendix A preferred models and revisions to the requirements and recommendations of the *Guideline* must be integrated into the regulatory processes of respective reviewing authorities and followed by applicants by no later than January 17, 2018. During the 1-year period following promulgation, protocols for modeling analyses based on the 2005 version of the *Guideline*, which are submitted in a timely manner, may be approved at the discretion of the appropriate reviewing authority.

This final rule also starts a 3-year transition period that ends on January 17, 2020 for transportation conformity purposes. Any refined analyses that are started before the end of this 3-year period, with a preferred appendix A model based on the 2005 version of the *Guideline*, can be completed after the end of the transition period, similar to implementation of the transportation conformity grace period for new emissions models. See the discussion in section IV.A.4 of this preamble for details on how this transition period will be implemented.

All applicants are encouraged to consult with their respective reviewing authority as soon as possible to assure acceptance of their modeling protocols and/or modeling demonstration during either of these periods.

ADDRESSES: The EPA has established a docket for this action under Docket ID No. EPA–HQ–OAR–2015–0310. All documents in the docket are listed on the *https://www.regulations.gov* Web site. Although listed in the index, some information is not publicly available, *e.g.*, Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available electronically through *https://www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Mr. George M. Bridgers, Air Quality Assessment Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Mail code C439–01, Research Triangle Park, NC 27711; telephone: (919) 541–5563; fax: (919) 541–0044; email: *Bridgers.George@epa.gov.*

SUPPLEMENTARY INFORMATION:

Table of Contents

The following topics are discussed in this preamble:

I. General Information
A. Does this action apply to me?
B. Where can I get a copy of this rule and related information?
C. Judicial Review
D. List of Acronyms
II. Background
III. The Tenth and Eleventh Conferences on Air Quality Modeling and Public Hearing
IV. Discussion of Public Comments on the Proposed Changes to the Guideline
A. Final Action
1. Clarifications To Distinguish Requirements From Recommendations
2. Updates to EPA's AERMOD Modeling System
3. Status of AERSCREEN
4. Status of CALINE3 Models
5. Addressing Single-Source Impacts on Ozone and Secondary $PM_{2.5}$
6. Status of CALPUFF and Assessing Long-Range Transport for PSD Increments and Regional Haze
7. Role of EPA's Model Clearinghouse (MCH)
8. Updates to Modeling Procedures for Cumulative Impact Analysis
9. Updates on Use of Meteorological Input Data for Regulatory Dispersion Modeling
B. Final Editorial Changes
1. Preface
2. Section 1
3. Section 2
4. Section 3
5. Section 4
6. Section 5
7. Section 6
8. Section 7
9. Section 8
10. Section 9
11. Section 10
12. Section 11
13. Section 12
14. Appendix A to the *Guideline*
V. Statutory and Executive Order Reviews
A. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review
B. Paperwork Reduction Act (PRA)
C. Regulatory Flexibility Act (RFA)
D. Unfunded Mandates Reform Act (UMRA)
E. Executive Order 13132: Federalism
F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments
G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks
H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use
I. National Technology Transfer and Advancement Act
J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations
K. Congressional Review Act (CRA)

I. General Information

A. Does this action apply to me?

This action applies to federal, state, territorial, local, and tribal air quality management agencies that conduct air quality modeling as part of State Implementation Plan (SIP) submittals and revisions, New Source Review (NSR) permitting (including new or modifying industrial sources under Prevention of Significant Deterioration (PSD)), conformity, and other air quality assessments required under EPA regulation. Categories and entities potentially regulated by this action include:

Category	NAICS[a] code
Federal/state/territorial/local/tribal government	924110

[a] North American Industry Classification System.

B. Where can I get a copy of this rule and related information?

In addition to being available in the docket, electronic copies of the rule and related materials will also be available on the Worldwide Web (WWW) through the EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) Web site at *https://www.epa.gov/scram.*

C. Judicial Review

This final rule is nationally applicable, as it revises the *Guideline on Air Quality Models,* 40 CFR part 51, appendix W. Under section 307(b)(1) of the Clean Air Act (CAA), judicial review of this final rule is available by filing a petition for review in the U.S. Court of Appeals for the District of Columbia Circuit by March 20, 2017. Moreover, under section 307(b)(2) of the CAA, the requirements established by this action may not be challenged separately in any civil or criminal proceedings brought by the EPA to enforce these requirements. This rule is also subject to section 307(d) of the CAA.

D. List of Acronyms

AEDT Aviation Environmental Design Tool
AERMET Meteorological data preprocessor for AERMOD
AERMINUTE Pre-processor to AERMET to read 1-minute ASOS data to calculate hourly average winds for input into AERMET
AERMOD American Meteorological Society (AMS)/EPA Regulatory Model
AERSCREEN Program to run AERMOD in screening mode
AERSURFACE Land cover data tool in AERMET
AQRV Air Quality Related Value
AQS Air Quality System
ARM Ambient Ratio Method
ARM2 Ambient Ratio Method 2
ASOS Automated Surface Observing Stations
ASTM American Society for Testing and Materials
B_o Bowen ratio
BART Best available retrofit technology
BID Buoyancy-induced dispersion
BLP Buoyant Line and Point Source model
BOEM Bureau of Ocean Energy Management
BPIPPRM Building Profile Input Program for PRIME
BUKLRN Bulk Richardson Number
CAA Clean Air Act
CAL3QHC Screening version of the CALINE3 model
CAL3QHCR Refined version of the CALINE3 model
CALINE3 CAlifornia LINE Source Dispersion Model
CALMPRO Calms Processor
CALPUFF California Puff model
CALTRANS99 California Department of Transportation Highway 99 Tracer Experiment
CAMx Comprehensive Air Quality Model with Extensions
CFR Code of Federal Regulations
CMAQ Community Multiscale Air Quality
CO Carbon monoxide
CTDMPLUS Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations
CTSCREEN Screening version of CTDMPLUS
CTM Chemical transport model
$d\theta/dz$ Vertical potential temperature gradient
DT Temperature difference
EDMS Emissions and Dispersion Modeling System
EPA Environmental Protection Agency
FAA Federal Aviation Administration
FLAG Federal Land Managers' Air Quality Related Values Work Group Phase I Report
FLM Federal Land Manager
GEP Good engineering practice
GUI Graphical user interface
IBL Inhomogeneous boundary layer
ISC Industrial Source Complex model
IWAQM Interagency Workgroup on Air Quality Modeling
km kilometer
L Monin-Obukhov length
m meter
m/s meter per second
MAKEMET Program that generates a site-specific matrix of meteorological conditions for input to AERMOD
MAR Minimum ambient ratio
MCH Model Clearinghouse
MCHISRS Model Clearinghouse Information Storage and Retrieval System
MERPs Model Emissions Rates for Precursors
METPRO Meteorological Processor for dispersion models
MM5 Mesoscale Model 5
MMIF Mesoscale Model Interface program
MPRM Meteorological Processor for Regulatory Models
NAAQS National Ambient Air Quality Standards
NCEI National Centers for Environmental Information
NH_3 Ammonia
NO Nitric oxide
NOAA National Oceanic and Atmospheric Administration
NO_X Nitrogen oxides
NO_2 Nitrogen dioxide
NSR New Source Review
NTI National Technical Information Service
NWS National Weather Service
OCD Offshore and Coastal Dispersion Model
OCS Outer Continental Shelf
OCSLA Outer Continental Shelf Lands Act
OLM Ozone Limiting Method
PCRAMMET Meteorological Processor for dispersion models
P–G stability Pasquill-Gifford stability
$PM_{2.5}$ Particles less than or equal to 2.5 micrometers in diameter
PM_{10} Particles less than or equal to 10 micrometers in diameter
PRIME Plume Rise Model Enhancements algorithm
PSD Prevention of Significant Deterioration
PVMRM Plume Volume Molar Ratio Method
r Albedo
RHC Robust Highest Concentration
RLINE Research LINE source model for near-surface releases
SCICHEM Second-order Closure Integrated Puff Model
SCRAM Support Center for Regulatory Atmospheric Modeling
SCREEN3 A single source Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources
SDM Shoreline Dispersion Model
SILs Significant impact levels
SIP State Implementation Plan
SMAT Software for Model Attainment Test
SO_2 Sulfur dioxide
SRDT Solar radiation/delta-T method
TSD Technical support document
u Values for wind speed
u^* Surface friction velocity
VOC Volatile organic compound
w^* Convective velocity scale
WRF Weather Research and Forecasting model
z_i Mixing height
Z_o Surface roughness
Z_{ic} Convective mixing height
Z_{im} Mechanical mixing height
σ_v, σ_w Horizontal and vertical wind speeds

II. Background

The *Guideline* is used by the EPA, other federal, state, territorial, local, and tribal air quality agencies, and industry to prepare and review new or modified source permits, SIP submittals or revisions, conformity, and other air quality assessments required under the CAA and EPA regulations. The *Guideline* serves as a means by which national consistency is maintained in air quality analyses for regulatory activities under 40 CFR (Code of Federal Regulations) 51.112, 51.117, 51.150, 51.160, 51.165, 51.166, 52.21, 93.116, 93.123, and 93.150.

The EPA originally published the *Guideline* in April 1978 (EPA–450/2–78–027), and it was incorporated by reference in the regulations for the PSD program in June 1978. The EPA revised the *Guideline* in 1986 (51 FR 32176), and updated it with supplement A in 1987 (53 FR 32081), supplement B in July 1993 (58 FR 38816), and supplement C in August 1995 (60 FR 40465). The EPA published the *Guideline* as appendix W to 40 CFR part 51 when the EPA issued supplement B. The EPA republished the *Guideline* in August 1996 (61 FR 41838) to adopt the CFR system for labeling paragraphs. Subsequently, the EPA revised the *Guideline* on April 15, 2003 (68 FR

18440), to adopt CALPUFF as the preferred model for long-range transport of emissions from 50 to several hundred kilometers (km) and to make various editorial changes to update and reorganize information and remove obsolete models. The EPA further revised the *Guideline* on November 9, 2005 (70 FR 68218), to adopt AERMOD as the preferred model for near-field dispersion of emissions for distances up to 50 km. The publication and incorporation of the *Guideline* into the EPA's PSD regulations satisfies the requirement under CAA section 165(e)(3) for the EPA to promulgate regulations that specify with reasonable particularity models to be used under specified sets of conditions for purposes of the PSD program.

On July 29, 2015, we proposed revisions to the *Guideline* in the **Federal Register** (80 FR 45340). The proposed revisions to the *Guideline* and preferred models are based upon stakeholder input received during the Tenth Conference on Air Quality Modeling. These proposed revisions were presented at the Eleventh Conference on Air Quality Modeling that included the public hearing for the proposed action. The conferences and public hearing are briefly described in section III of this preamble.

Section IV provides a brief discussion of comments received and our responses that support the changes to the *Guideline* being finalized through this action. A more comprehensive discussion of the public comments received and our responses are provided in the Response to Comments document that is included in the docket for this action.

III. The Tenth and Eleventh Conferences on Air Quality Modeling and Public Hearing

To inform the development of our proposed revisions to the *Guideline* and in compliance with CAA section 320, we held the Tenth Conference on Air Quality Modeling in March 2012. The conference addressed updates on: The regulatory status and future development of AERMOD and CALPUFF, review of the Mesoscale Model Interface (MMIF) prognostic meteorological data processing tool for dispersion models, draft modeling guidance for compliance demonstrations of the $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS), modeling for compliance demonstration of the 1-hour nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) NAAQS, and new and emerging models/techniques for future consideration under the *Guideline* to address single-source modeling for ozone and secondary $PM_{2.5}$, as well as long-range transport and chemistry. Based on comments received from stakeholders at the Tenth Modeling Conference, "Phase 3" of the Interagency Workgroup on Air Quality Modeling (IWAQM) was formalized in June 2013 to provide additional guidance for modeling single-source impacts on secondarily formed pollutants (*e.g.*, ozone and $PM_{2.5}$) in the near-field and for long-range transport. A transcript of the conference proceedings and a summary of the public comments received are available in the docket for the Tenth Modeling Conference.[1] Additionally, all of the material associated with this conference are available on the EPA's SCRAM Web site at *https://www3.epa.gov/ttn/scram/10thmodconf.htm.*

The Eleventh Conference on Air Quality Modeling was held August 12–13, 2015, in continuing compliance with CAA section 320. The Eleventh Modeling Conference included the public hearing for this action. The conference began with a thorough overview of the proposed revisions to the *Guideline,* including presentations from EPA staff on the formulation updates to the preferred models and the research and technical evaluations that support these and other revisions. Specifically, there were presentations summarizing the proposed updates to the AERMOD modeling system, replacement of CALINE3 with AERMOD for modeling of mobile sources, incorporation of prognostic meteorological data for use in dispersion modeling, the proposed screening approach for long-range transport for NAAQS and PSD increments assessments with use of CALPUFF as a screening technique rather than an EPA-preferred model, the proposed 2-tiered screening approach to address ozone and $PM_{2.5}$ in PSD compliance demonstrations, the status and role of the Model Clearinghouse, and updates to procedures for single-source and cumulative modeling analyses (*e.g.*, modeling domain, source input data, background data, and compliance demonstration procedures).

At the conclusion of these presentations, the public hearing on the proposed revisions to the *Guideline* was convened. The public hearing was held on the second half of the first day and on the second day of the conference. There were 26 presentations by stakeholders and interested parties. The EPA presentations and the presentations from the public hearing are provided in the docket for this action. A transcript of the conference proceedings is also available in the docket. Additionally, all of the material associated with the Eleventh Modeling Conference and the public hearing are available on the EPA's SCRAM Web site at *https://www3.epa.gov/ttn/scram/11thmodconf.htm.*

IV. Discussion of Public Comments on the Proposed Changes to the Guideline

In this action, the EPA is finalizing two types of revisions to the *Guideline.* The first type involves substantive changes to address various topics, including those presented and discussed at the Tenth and Eleventh Modeling Conferences. These revisions to the *Guideline* include enhancements to the formulation and application of the EPA's preferred dispersion modeling system, AERMOD, and the incorporation of a tiered demonstration approach to address the secondary chemical formation of ozone and $PM_{2.5}$ associated with precursor emissions from single sources. The second type of revision involves editorial changes to update and reorganize information throughout the *Guideline.* These latter revisions are not intended to meaningfully change the substance of the *Guideline,* but rather to make the *Guideline* easier to use and to streamline the compliance assessment process.

The EPA recognizes that the scope and extent of the final changes to the *Guideline* may not address all of the current concerns identified by the stakeholder community or emerging science issues. The EPA is committed to ensuring in the future that the *Guideline* and associated modeling guidance reflect the most up-to-date science and will provide appropriate and timely updates. Adhering to the existing procedures under CAA section 320, which requires the EPA to conduct a conference on air quality modeling at least every 3 years, the Twelfth Conference on Air Quality Modeling will occur within the next 2 years to provide a public forum for the EPA and the stakeholder community to engage on technical issues, introduce new air quality modeling research and techniques, and discuss recommendations on future areas of air quality model development and subsequent revisions to the *Guideline.* A formal notice announcing the next Conference on Air Quality Modeling will be published in the **Federal Register** at the appropriate time and will provide information to the stakeholder community on how to register to attend and/or present at the conference.

[1] *See* Docket ID No. EPA–HQ–OAR–2015–0310.

A. Final Action

In this section, we offer summaries of the substantive comments received and our responses and explain the final changes to the *Guideline* in terms of the main technical and policy concerns addressed by the EPA. A more comprehensive discussion of the public comments received and our responses is provided in the Response to Comments document located in the docket for this action.

Air quality modeling involves estimating ambient concentrations using scientific methodologies selected from a range of possible methods, and should utilize the most advanced practical technology that is available at a reasonable cost to users, keeping in mind the intended uses of the modeling and ensuring transparency to the public. With these revisions, we believe that the *Guideline* continues to reflect scientific advances in the field and balances these important considerations for regulatory assessments. This action amends appendix W of 40 CFR part 51 as detailed below:

1. Clarifications To Distinguish Requirements From Recommendations

We proposed revisions to the *Guideline* to provide clarity in distinguishing requirements from recommendations while noting the continued flexibilities provided within the *Guideline,* including but not limited to use and approval of alternative models. The vast majority of the public comments were supportive of the overall proposed reorganization and revisions to the regulatory text. There were only a few comments specific to the distinction between requirements and recommendations. All but one of these comments commended the EPA for providing this level of clarity of what is required in regulatory modeling demonstrations and where there is appropriate flexibility in the technique or approach. One comment expressed a concern that allowing for flexibility is critical when regulations, standards, and modeling techniques are constantly evolving. In this final action, the EPA reaffirms that significant flexibility and adaptability remain in the *Guideline,* while the revisions we are adopting serve to provide clarity in portions of the *Guideline* that have caused confusion in the past.

As discussed in the preamble to the proposed rule, the EPA's PSD permitting regulations specify that "[a]ll applications of air quality modeling involved in this subpart shall be based on the applicable models, data bases, and other requirements specified in appendix W of this part (*Guideline on Air Quality Models*)." 40 CFR 51.166(l)(1); see also 40 CFR 52.21(l)(1). The "applicable models" are the preferred models listed in appendix A to appendix W to 40 CFR part 51. However, there was some ambiguity in the past with respect to the "other requirements" specified in the *Guideline* that must be used in PSD permitting analysis and other regulatory modeling assessments.

Ambiguity could arise because the *Guideline* generally contains "recommendations" and these recommendations are expressed in non-mandatory language. For instance, the *Guideline* frequently uses "should" and "may" rather than "shall" and "must." This approach is generally preferred throughout the *Guideline* because of the need to exercise expert judgment in air quality analysis and the reasons discussed in the *Guideline* that "dictate against a strict modeling 'cookbook'." 40 CFR part 51, appendix W, section 1.0(c).

Considering the non-mandatory language used throughout the *Guideline,* the EPA's Environmental Appeals Board observed:

> Although appendix W has been promulgated as codified regulatory text, appendix W provides permit issuers broad latitude and considerable flexibility in application of air quality modeling. Appendix W is replete with references to "recommendations," "guidelines," and reviewing authority discretion.

In Re Prairie State Generating Company, 13 E.A.D. 1, 99 (EAB 2005) (internal citations omitted).

Although this approach appears throughout the *Guideline,* there are instances where the EPA does not believe permit issuers should have broad latitude. Some principles of air quality modeling described in the *Guideline* must always be applied to produce an acceptable analysis. Thus, to promote clarity in the use and interpretation of the revised *Guideline,* we are finalizing the specific use of mandatory language, as proposed, along with references to "requirements," where appropriate, to distinguish requirements from recommendations in the application of models for regulatory purposes.

2. Updates to EPA's AERMOD Modeling System

In our proposed action, we invited comments on the proposed scientific updates to the regulatory version of the AERMOD modeling system, including:

1. A proposed "ADJ_U*" option incorporated in AERMET to adjust the surface friction velocity (u*) to address issues with AERMOD model tendency to overprediction from some sources under stable, low wind speed conditions.

2. A proposed "LOWWIND3" option in AERMOD to address issues with model tendency to overprediction under low wind speed conditions. The low wind option increases the minimum value of the lateral turbulence intensity (sigma-v) from 0.2 to 0.3 and adjusts the dispersion coefficient to account for the effects of horizontal plume meander on the plume centerline concentration. It also eliminates upwind dispersion, which is incongruous with a straight-line, steady-state plume dispersion model, such as AERMOD.

3. Modifications to AERMOD formulation to address issues with model tendency to overprediction for applications involving relatively tall stacks located near relatively small urban areas.

4. Proposed regulatory options in AERMOD to address plume rise for horizontal and capped stacks based on the July 9, 1993, Model Clearinghouse memorandum,[2] with adjustments to account for the Plume Rise Model Enhancements (PRIME) algorithm for sources subject to building downwash.

5. A proposed buoyant line source option, based on the Buoyant Line and Point Source (BLP) model, incorporated in AERMOD.

6. Proposed updates to the NO_2 Tier 2 and Tier 3 screening techniques coded within AERMOD.

The EPA's final action related to each of these proposed updates is discussed below.

Incorporation of the ADJ_U* Option Into AERMET

The EPA has integrated the ADJ_U* option into the AERMET meteorological processor for AERMOD to address issues with model overprediction of ambient concentrations from some sources associated with underprediction of the surface friction velocity (u*) during light wind, stable conditions. The proposed update to AERMET included separate ADJ_U* algorithms for applications with and without the Bulk Richardson Number (BULKRN) option in AERMET. The ADJ_U* option with BULKRN utilizes measured vertical temperature difference data (*i.e.,* delta-T data) and is based on Luhar and Rayner (2009, BLM v.132). The ADJ_U*

[2] U.S. Environmental Protection Agency, 1993. Proposal for Calculating Plume Rise for Stacks with Horizontal Releases or Rain Caps for Cookson Pigment, Newark, New Jersey. Memorandum dated July 9, 1993, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/mch/new_mch/R1076_TIKVART_9_JUL_93.pdf.*

option without BULKRN does not utilize delta-T data and is based on Qian and Venkatram (2011, BLM v. 138). These studies also include meteorological evaluations of predicted versus observed values of u*, which demonstrate improved skill in predicting u* during stable light wind conditions, and we consider these meteorological evaluations as key components of the overall technical assessment of these model formulation changes.

The majority of public comments supported the adoption of the ADJ_U* option in AERMET, while a few commenters expressed concern regarding the potential for the ADJ_U* option to underestimate ambient concentrations. Some commenters also expressed concern regarding the appropriateness of the field study databases used in the EPA model evaluations. We acknowledge the issues and potential challenges associated with conducting field studies for use in model performance evaluations, especially during stable light wind conditions, given the potentially high degree of variability that may exist across the modeling domain and the increased potential for microscale influences on plume transport and dilution. This variability is one of the reasons that we discourage placing too much weight on modeled versus predicted concentrations paired in time and space in model performance evaluations. This also highlights the advantages of conducting field studies that utilize circular arcs of monitors at several distances to minimize the potential influence of uncertainties associated with the plume transport direction on model-to-monitor comparisons. The 1974 Idaho Falls, Idaho, and 1974 Oak Ridge, Tennessee, field studies,[3] [4] conducted by the National Oceanic and Atmospheric Administration (NOAA), are two of the key databases included in the evaluation of the ADJ_U* option in AERMET (as well as the LOWWIND3 option in AERMOD), and both utilized circular arcs of monitors at 100 meter (m), 200 m, and 400 m downwind of the tracer release point.

Initial evaluations of the ADJ_U* option in AERMET and LOWWIND options in AERMOD were first presented as "beta" options in appendix F of the AERMOD User's Guide Addendum for version 12345. This included results for the Idaho Falls and Oak Ridge field studies. Updated evaluations based on these NOAA studies were included in the AERMOD User's Guide Addendum for v15181, along with additional evaluations for the Lovett database involving a tall stack with nearby complex terrain. Additional evaluations of these proposed modifications to AERMET and AERMOD were also presented at the Eleventh Modeling Conference, including an evaluation based on the 1993 Cordero Mine PM_{10} field study in Wyoming, as summarized in the Response to Comments document.

One commenter provided a detailed modeling assessment of the proposed ADJ_U* option in AERMET (as well as the proposed LOWWIND3 option in AERMOD) across a number of field studies to support their position that the proposed model updates will "reduce model accuracy" and "in some cases quite significantly reduce[s] modeled impacts, particularly so in the case of the Tracy validation study data." The EPA's review of the modeling results provided by the commenter indicated almost no influence of the ADJ_U* option on those field studies associated with tall stacks in flat terrain, including the Baldwin and Kincaid field studies. These results are expected since the "worst-case" meteorological conditions for tall stacks in flat terrain generally occur during daytime convective conditions that are not affected by the ADJ_U* option. In addition, the commenter's modeling results presented for the Lovett field study, a tall stack with nearby complex terrain, appear to show improved performance (with less underprediction) with the ADJ_U* option as compared to the default option in AERMET, thereby supporting use of the ADJ_U* option in appropriate situations.

The commenter also stated that the issue of underprediction with the ADJ_U* option is "particularly so in the case of the Tracy validation study." The Tracy field study involved a tall stack located with nearby terrain similar to the Lovett field study; however, the Tracy field study differs from the Lovett and other complex terrain field studies in that Tracy had the most extensive set of site-specific meteorological data, including several levels of wind speed, wind direction, ambient temperature, and turbulence parameters (*i.e.,* sigma-theta and/or sigma-w), extending from 10 m above ground up to 400 m above ground for some parameters. The Tracy field study also included the largest number of ambient monitors of any complex terrain study used in evaluating AERMOD performance, including 106 monitors extending across a domain of about 75 square kilometers, and used sulfur hexafluoride (SF_6) as a tracer which reduces uncertainty in evaluating model performance by minimizing the influence of background concentrations on the model-to-monitor comparisons. The EPA's review of the commenter's results for the Tracy database confirms their finding of a bias toward underprediction by almost a factor of two with the ADJ_U* option in AERMET, compared to relatively unbiased results with the default option in AERMET based on the full set of meteorological inputs. However, there was no diagnostic performance evaluation included with the commenter's analysis that could provide the necessary clarity regarding the potential connection between the ADJ U* option and cause for the bias to underpredict concentrations.

After proposal, the EPA received several requests through its Model Clearinghouse (MCH) for alternative model approval of the ADJ U* option under section 3.2.2 of the *Guideline.* The EPA issued two MCH concurrences on February 10, 2016, for the Donlin Gold, LLC mining facility in EPA Region 10 (*i.e.,* ground level, fugitive emissions of particulate matter from sources with low release heights during periods of low-wind/stable conditions), and on April 29, 2016, for the Schiller Station facility in EPA Region 1 (*i.e.,* SO_2 emissions from tall stack sources with impacts on distant complex terrain, during low-wind/stable conditions). In both cases, the request memoranda from the EPA Regions to the MCH noted the potential for underprediction by AERMOD with the ADJ U* option in situations where turbulence data from site-specific meteorological data inputs were also used. Through the MCH concurrence for each case, the EPA acknowledged the potential for this underprediction and effectively communicated to the stakeholder community that these turbulence data were not used in the approved alternative model. There was no detailed diagnostic performance evaluation included with the MCH requests to provide insights regarding the potential connection between the ADJ U* option and use of on-site turbulence data.

To evaluate the public comments in light of these MCH concurrences, the EPA has conducted additional meteorological data degradation analyses for the Tracy field study and

[3] NOAA Technical Memorandum ERL ARL–52, 1974. Diffusion under Low Wind Speed, Inversion Conditions. Sagendorf, J.F., C. Dickson. Air Resources Laboratory, Idaho Falls, Idaho.

[4] NOAA Technical Memorandum ERL ARL–61, 1976. Diffusion under Low Wind Speed Conditions near Oak Ridge, Tennessee. Wilson, R.B., G. Start, C. Dickson, N. Ricks. Air Resources Laboratory, Idaho Falls, Idaho.

the 1972 Idaho Falls field study for a ground-level release in flat terrain to provide a better understanding of the nature of the tendency to underpredict concentrations when applying the ADJ_U* option with site-specific turbulence measurements. The full meteorological dataset available for the Tracy field study provides a robust case study for this assessment because it includes several levels of turbulence data, *i.e.*, sigma-theta (the standard deviation of horizontal wind direction fluctuations) and/or sigma-w (the standard deviation of the vertical wind speed fluctuations), in addition to several levels of wind speed, direction and temperature. The 1972 Idaho Falls field study also included a robust set of meteorological data to assess this potential issue for ground-level sources.

The results of this EPA study confirm good performance for the Tracy field study using the full set of meteorological inputs with the default options (*i.e.*, without the ADJ_U* option in AERMET and without any LOWWIND option in AERMOD). Including the ADJ_U* option in AERMET with full meteorological data results in an underprediction of about 40 percent. On the other hand, AERMOD results without the ADJ_U* option in AERMET and without the observed profiles of temperature and turbulence (*i.e.*, mimicking standard airport meteorological inputs) results in significant overprediction by about a factor of 4. However, using the ADJ_U* option with the degraded meteorological data shows very good agreement with observations, comparable to or slightly better than the results with full meteorological inputs. Full results from this study to assess the use of the ADJ_U* option with various levels of meteorological data inputs are detailed in our Response to Comments document provided in the docket for this action. The Response to Comments document also provides evidence of this potential bias toward underprediction when the ADJ_U* option is applied for applications that also include site-specific meteorological data with turbulence parameters based on the 1972 Idaho Falls study. As with the Tracy field study, the Idaho Falls field study results with site-specific turbulence data do not show a bias toward underprediction without the ADJ_U* option, but do show a bias toward underprediction using turbulence data with the ADJ_U* option.

Based on these detailed findings, the public cannot be assured that the proposed ADJ_U* option, when used with site-specific meteorological inputs including turbulence data (*i.e.*, sigma-theta and/or sigma-w), would not bias model predictions towards underestimation, which would be inconsistent with section 3.2.2 of the *Guideline*. Therefore, the EPA has determined that the ADJ_U* option should not be used in AERMET in combination with use of measured turbulence data because of the observed tendency for model underpredictions resulting from the combined influences of the ADJ_U* and the turbulence parameters within the current model formulation.

While these findings suggest that the ADJ_U* option is not appropriate for use in regulatory applications involving site-specific meteorological data that include measured turbulence parameters, the model performance and diagnostic evaluations strongly support the finding that the ADJ_U* option provides for an appropriate adjustment to the surface friction velocity parameter when standard National Weather Service (NWS) airport meteorological data, site-specific meteorological data without turbulence parameters, or prognostic meteorological input data are used for the regulatory application.

Therefore, based on these findings of improved model performance with the ADJ_U* option for sources where peak impacts are likely to occur during low wind speed and stable conditions, as well as the peer-reviewed studies demonstrating improved estimates of the surface friction velocity (u*) based on these options, the EPA is adopting the proposed ADJ_U* option in AERMET as a regulatory option for use in AERMOD for sources using standard NWS airport meteorological data, site-specific meteorological data without turbulence parameters, or prognostic meteorological inputs derived from prognostic meteorological models.

Incorporation of the LOWWIND3 Option Into AERMOD

In addition to the ADJ_U* option in AERMET, the EPA also proposed the incorporation of LOWWIND3 as a regulatory option in AERMOD to address issues with model overprediction for some sources under low wind speed conditions. Beginning with version 12345 of AERMOD, two LOWWIND "beta" options were included in AERMOD (*i.e.*, LOWWIND1 and LOWWIND2), and a third option, LOWWIND3, was incorporated at the time of proposal in version 15181 of AERMOD. The LOWWIND options modify the minimum value of sigma-v, the lateral turbulence intensity, which is used to determine the lateral plume dispersion coefficient (*i.e.*, sigma-y). With respect to the specific issue of setting a minimum value of sigma-v, the LOWWIND options can be considered as empirical options based on applicable parameter specifications from the scientific literature. However, the LOWWIND options go beyond this empirical specification of the minimum sigma-v parameter to address the horizontal meander component in AERMOD that also contributes to lateral plume spread, especially during low wind, stable conditions. Furthermore, since the horizontal meander component in AERMOD is a function of the "effective" sigma-v value, lateral plume dispersion may be further enhanced under the LOWWIND3 option by increased meander, beyond the influence of the minimum sigma-v value alone.

The current default option in AERMOD uses a minimum sigma-v of 0.2 meters per second (m/s). Setting a higher minimum value of sigma-v would tend to increase lateral dispersion during low wind conditions and, therefore, could reduce predicted ambient concentrations. It is also worth noting that the values of sigma-v derived in AERMOD are based on the dispersion parameters generated in AERMET (*i.e.*, the surface friction velocity (u*) and the convective velocity scale (w*)), as well as the user-specified surface characteristics (*i.e.*, the surface roughness length, Bowen ratio, and albedo) used in processing the meteorological inputs through AERMET. As a result, application of the ADJ_U* option in AERMET will tend to increase sigma-v values in AERMOD and generally tend to lower predicted peak concentrations, separate from application of the LOWWIND options. Unlike the proposed ADJ_U* option in AERMET that adjusts u* under stable conditions, the LOWWIND options in AERMOD are applied for both stable and unstable/convective conditions. However, since atmospheric turbulence will generally be higher during unstable/convective conditions than for stable conditions, the potential influence of the minimum sigma-v value on plume dispersion is likely to be much less important during unstable/convective conditions.

The majority of commenters supported the EPA's proposal to incorporate the LOWWIND3 option into the regulatory version of AERMOD because they believed it would provide a more realistic treatment of low wind situations and reduce the potential for overprediction of the current regulatory version of AERMOD for such conditions. However, one commenter indicated that the proposed

LOWWIND3 option in AERMOD will "reduce model accuracy" along with model results, showing a tendency for underprediction across a number of evaluation databases. As discussed in the Response to Comments document, the influence of the LOWWIND3 option on model performance is mixed, and has shown a tendency toward underprediction with increasing distance in some cases, especially when LOWWIND3 is applied in conjunction with the ADJ_U* option in AERMET. The EPA's reassessment of model performance confirmed this finding of underprediction with increasing distance, in particular for the 1972 Idaho Falls field study database (discussed previously) and the Prairie Grass, Kansas, field study, which involved a near-surface tracer release in flat terrain. As noted above, there is an interaction between the ADJ_U* option and LOWWIND options because the values of sigma-v derived in AERMOD are based on the surface friction velocity (u*) parameter generated in AERMET. As a result, the ADJ_U* option in conjunction with the LOWWIND3 option influences the AERMOD derived sigma-v parameter and, in some cases, may exacerbate the tendency for AERMOD with LOWWIND3 to underpredict at higher concentrations, as shown in the commenter's assessment and the EPA's reassessment.

Another aspect of the AERMOD model formulation that may contribute to an increasing bias toward underprediction with distance is the treatment of the "inhomogeneous boundary layer" (IBL) that accounts for changes in key parameters such as wind speed and temperature with height above ground. The IBL approach determines "effective" values of wind speed, temperature, and turbulence that are averaged across a layer of the plume between the plume centerline height and the height of the receptor. The extent of this layer depends on the vertical dispersion coefficient (*i.e.*, sigma-z). Therefore, as the plume grows downwind of the source, the extent of the layer used to calculate the effective parameters will increase (up to specified limits). The potential influence of this aspect of AERMOD formulation on modeled concentrations will depend on several factors, including source characteristic, meteorological condition, and the topographic characteristics of the modeling domain.

Several commenters recommended that the EPA's proposed revisions to AERMOD be further evaluated given either the lack or paucity of peer-reviewed literature upon which they are based. Specifically, one commenter noted that "while this overprediction phenomenon can occur under certain conditions, additional studies produced by a more diverse group of organizations should be evaluated." Unlike the situation with the ADJ_U* option, the EPA does not have a published, peer-reviewed model formulation update with supporting model performance evaluations that fully address the complex issues of concern for the LOWWIND options. Therefore, the EPA agrees with commenters that additional study and evaluation is warranted for the proposed LOWWIND3 option, as well as other low wind options, in order to gain the understanding across the modeling community that is necessary to determine whether it would be appropriate to incorporate it into an EPA-preferred model used to inform regulatory decisions. The EPA will continue to work with the modeling community to further assess the theoretical considerations and model performance results under relevant conditions to inform considerations for appropriate adjustments to the default minimum value of sigma-v from 0.2 m/s that, as noted by some commenters, may be considered separate from any specific LOWWIND option.

Based on EPA's review of public comments and further consideration of the issues, the public cannot be assured that the proposed LOWWIND3 option does not have a tendency to bias model predictions towards underestimation (especially in combination with the ADJ_U* option and/or site-specific turbulence parameters), which would be inconsistent with section 3.2.2 of the *Guideline*. Therefore, lacking sufficient evidence to support adoption of LOWWIND3 (or other LOWWIND options) as a regulatory option in AERMOD, we are not incorporating LOWWIND3 as a regulatory option in AERMOD at this time, and we are deferring action on the LOWWIND options in general pending further analysis and evaluation in conjunction with the modeling community.

Modifications to AERMOD Formulation for Tall Stack Applications Near Small Urban Areas

As proposed, the EPA recognized the need to address observed overpredictions by AERMOD when applied to situations involving tall stacks located near small urban areas. The tendency to overpredict concentrations results from an unrealistic limit on plume rise imposed within the dispersion model. The EPA received broad support in the public comments for these proposed modifications to the AERMOD formulation that appropriately address overprediction for applications involving relatively tall stacks located near small urban areas. The EPA is finalizing this model formulation update, as proposed, into the regulatory version of AERMOD.

Address Plume Rise for Horizontal and Capped Stacks in AERMOD

As proposed, the EPA updated the regulatory options in AERMOD to address plume rise for horizontal and capped stacks based on the July 9, 1993, MCH memorandum,[2] with adjustments to account for the PRIME algorithm for sources subject to building downwash. There was broad-based support for this model update across the public comments. One commenter noted that the use of this proposed option for horizontal stacks, although a better method than the previous version, can lead to extremely high concentrations for sources with building downwash in complex terrain. Despite the noted improved performance of the proposed option in the case of building downwash, the EPA recognizes the ongoing issues with this option in the presence of building downwash and with its inherent complexities and its particular application in such situations with complex terrain. The EPA also recognizes that the appropriateness of this option for that particular situation would be a matter of consultation with the appropriate reviewing authority. However, given the broad support stated in public comments for the improved treatment, the EPA is finalizing this formulation update, as proposed, as a regulatory option within AERMOD.

Incorporation of the BLP Model Into AERMOD

As proposed, the EPA has integrated the BLP model into the AERMOD modeling system and removed BLP from appendix A as a preferred model. The comments received on the BLP integration into AERMOD are summarized in four categories: (1) Strongly supportive of the integration and replacement of BLP; (2) supportive of the integration, but with concerns that the integration of BLP is not fully consistent with the dispersion algorithms in AERMOD; (3) supportive of the integration, but suggestive that more time is needed to evaluate the implementation and that BLP should remain in appendix A until more evaluation can be made of the new code; and (4) concerned that modeled concentrations between the original BLP and BLP integrated in AERMOD are not identical. Despite the concerns expressed, all the comments received

were supportive of the concept of integrating the two models and removing BLP from appendix A.

The EPA's integration of BLP into AERMOD was not intended to update the model science within BLP into AERMOD. Thus, while the comments relating to inconsistencies between AERMOD (*e.g.*, based on Monin-Obukhov length and similarity profiling) and BLP (*e.g.*, based on Pasquill-Gifford stability classes) are largely accurate, they do not affect the status of the proposed BLP integration. Many of the comments on the proposal suggested that the EPA needs to more quickly integrate updates to the AERMOD modeling system to address these inconsistencies. However, the EPA does not find it appropriate to delay the release of the integrated model, particularly since the stated purposed of the integration and evaluation is to assure equivalency and not a fundamental update to the BLP model science to be consistent with that of AERMOD, which would require additional time and effort to appropriately inform a possible future EPA action. The EPA appreciates the comments identifying potential issues where model equivalency was not fully demonstrated. These instances have been further evaluated and corrections have been made to the code to sufficiently address these issues. The details of these corrections, along with the comments relating to inconsistencies in underlying dispersion science, are addressed in detail in the Response to Comments document located in the docket for this action.

Therefore, the EPA is integrating the BLP model into the AERMOD modeling system, is removing BLP from appendix A as an EPA-preferred model, and is updating the summary description of the AERMOD modeling system to appendix A of the *Guideline* as proposed.

Updates to the NO_2 Tier 2 and Tier 3 Screening Techniques in AERMOD

In the proposed action, we solicited comments on whether we have reasonably addressed technical concerns regarding the 3-tiered demonstration approach and specific NO_2 screening techniques within AERMOD and whether we were on sound foundation to recommend the proposed updates. Section 5.2.4 of the 2005 version of the *Guideline* details a 3-tiered approach for assessing nitrogen oxides (NO_X) sources, which was recommended to obtain annual average estimates of NO_2 concentrations from point sources for purposes of NSR analyses and for SIP planning purposes. This 3-tiered approach addresses the co-emissions of nitric oxide (NO) and NO_2 and the subsequent conversion of NO to NO_2 in the atmosphere. In January 2010, the EPA promulgated a new 1-hour NO_2 NAAQS (75 FR 6474). Prior to the adoption of the 1-hour NO_2 standard, few PSD permit applications required the use of Tier 3 options, and guidance available at the time did not fully address the modeling needs for a 1-hour standard (*i.e.*, tiered approaches for NO_2 in the 2005 version of the *Guideline* specifically targeted an annual standard). In response to the 1-hour NO_2 standard, the EPA proposed the incorporation of several modifications to the Tier 2 and Tier 3 NO_2 screening techniques as regulatory options in AERMOD, so that alternative model approval would no longer be needed.

The proposed modifications specifically included: (1) Replacing the existing Tier 2 Ambient Ratio Method (ARM) [5] with a revised Ambient Ratio Method 2 (ARM2) [6] approach; and (2) incorporating the existing detailed screening option of the Ozone Limiting Method (OLM) [7] and updated version of the Plume Volume Molar Ratio Method (PVMRM) [8] as regulatory options in AERMOD as preferred Tier 3 screening methods for NO_2 modeling. The vast majority of the public comments supported the proposed changes to these methods. However, there were two subsets of comments that required additional response.

First, several commenters stated that the proposed default NO_2/NO_X minimum ambient ratio (MAR) of 0.5, for use with the ARM2 approach, was too high and that a MAR of 0.2 should be used instead. The MAR is the lowest NO_2/NO_X ratio used in the ARM2 method at the highest NO_X levels. The MAR increases from this minimum level to a maximum NO_2/NO_X ratio of 0.9 at the lowest NO_X levels. While commenters believe that the MAR of 0.2 is more representative of ambient data, the EPA maintains that consistency in the tiered approach for NO_2 modeling, with the Tier 2 methods being more conservative than the Tier 3 methods, is needed and that national default model inputs need to be conservative, in line with the CAA's objective to prevent potential NAAQS violations. The revised text allows for alternative MARs that should not be overly difficult to justify to the appropriate reviewing authority when lower MARs are appropriate. The EPA reaffirms that site-specific data are always preferred, but provides the national default model inputs when these data are unavailable.

Second, several commenters noted that the specific version of PVMRM2 intended for regulatory use was not entirely clear. Version 15181 of AERMOD included both PVMRM and PVMRM2 with the proposal preamble text indicating that we would be promulgating PVMRM2; however, the proposed regulatory text identified PVMRM, which caused confusion. The methodology employed in the "PVMRM2" option in AERMOD version 15181 is now the "PVMRM" regulatory option in AERMOD, and the methodology employed in the "PVMRM" option in AERMOD version 15181 has been removed entirely from the model. The basis for this decision is that the updated PVMRM2 is a more complete implementation of the PVMRM approach outlined by Hanrahan (1999) than the original PVMRM implementation in AERMOD.

Therefore, the EPA is updating the regulatory version of the AERMOD modeling system to reflect these changes for NO_2 modeling and has updated the related descriptions of the AERMOD modeling system in section 4.2.3.4 of the *Guideline* as proposed.

EPA's Preferred Version of the AERMOD Modeling System

As described throughout section IV.A.2 of this preamble, we are revising the summary description of the AERMOD modeling system in appendix A of the *Guideline* to reflect these updates. Model performance evaluation and scientific peer review references for the updated AERMOD modeling system are cited, as appropriate. An updated user's guide and model formulation documents for version 16216 are located in the docket for this action. The essential codes, preprocessors, and test cases have been updated and posted on the EPA's SCRAM Web site at *https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod.*

[5] Chu, S.H. and E.L. Meyer, 1991. Use of Ambient Ratios to Estimate Impact of NO_X Sources on Annual NO_2 Concentrations. Proceedings, 84th Annual Meeting & Exhibition of the Air & Waste Management Association, June 16–21 1991, Vancouver, B.C.

[6] Podrez, M. 2015. An Update to the Ambient Ratio Method for 1-h NO_2 Air Quality Standards Dispersion Modeling. *Atmospheric Environment*, 103: 163–170.

[7] Cole, H.S. and J.E. Summerhays, 1979. A Review of Techniques Available for Estimation of Short-Term NO_2 Concentrations. *Journal of the Air Pollution Control Association*, 29(8): 812–817.

[8] Hanrahan, P.L., 1999. The Polar Volume Polar Ratio Method for Determining NO_2/NO_X Ratios in Modeling—Part I: Methodology. *Journal of the Air & Waste Management Association*, 49: 1324–1331.

3. Status of AERSCREEN

In our proposed action, we invited comment on the incorporation of AERSCREEN into the *Guideline* as the recommended screening model for AERMOD that may be suitable for applications in all types of terrain and for applications involving building downwash. AERSCREEN uses the EPA's preferred near-field dispersion model AERMOD in screening mode and represents the state of the science versus the outdated algorithms of SCREEN3 that are based on the Industrial Source Complex model (ISC).

We received some comments that SCREEN3 should be retained as it is simpler to use than AERSCREEN. The EPA disagrees with those comments and reminds users that AERSCREEN is already being utilized by much of the stakeholder community and represents the state of the science as stated in the paragraph above. Given the preferred status of AERMOD over ISC and the fact that AERSCREEN is now incorporating fumigation, an option available in SCREEN3, we feel that there are no valid technical reasons to retain SCREEN3 as a recommended screening model.

We also received comments expressing concerns about the fumigation options and conservatism of the fumigation outputs. The fumigation options implemented in AERSCREEN are the same algorithms used in SCREEN3, such that the current capabilities in that screening model are now available in AERSCREEN. However, these fumigation options take advantage of the AERMOD equations for the dispersion parameters sigma-y and sigma-z that are needed for the fumigation calculations. AERSCREEN also takes advantage of the meteorological data generated by MAKEMET to calculate those parameters based on the boundary layer algorithms included in AERMET, as opposed to using standard dispersion curves used by SCREEN3. Some commenters suggested that the Shoreline Dispersion Model (SDM) algorithms be investigated for fumigation calculations. We agree with these commenters and will investigate the incorporation of the SDM algorithms in AERSCREEN for a future release. One commenter noted a bug in building outputs when running AERSCREEN with downwash and user-supplied BPIPPRM input files. The commenter stated that AERSCREEN takes the maximum and minimum dimensions over the 36 directions output by BPIPPRM for use in modeling. For some directions, there may be no building influence and AERSCREEN erroneously takes a zero dimension as a building width. The EPA has determined that this is not a bug in AERSCREEN. Rather, it is a product of the output of BPIPPRM, which may report a value of zero for building widths and, thus, AERSCREEN reports a value of zero as a minimum building width. To address this issue, we have modified AERSCREEN to only output non-zero widths.

Finally, several commenters pointed out a typographical error in the AERSCREEN conversion factors from 1-hour to 3-, 8-, and 24-hour and annual results in section 4.2.1.1 of the *Guideline.* The original text reported the SCREEN3 factors and not the AERSCREEN factors listed in the AERSCREEN user's guide. These factors have been corrected in the final revisions to the *Guideline* to reflect the AERSCREEN factors. Another commenter also found a typographical error in section 4.2.1.1(c) where BPIPPRM was misspelled. This too was corrected. We also received a comment that the term "unresolvable" in section 4.2.1.3(c) implies that a problem cannot be solved. Suggested language of "unforeseen challenges" was suggested. We agreed that the "unresolvable" is erroneous and changed the term to "unforeseen."

Therefore, the EPA is incorporating AERSCREEN into the *Guideline* as the recommended screening model for AERMOD that may be used in applications across all types of terrain and for applications involving building downwash.

4. Status of CALINE3 Models

We solicited comment on our proposal to replace CALINE3 [9] with AERMOD as the preferred appendix A model for its intended regulatory applications, primarily determining near-field impacts for primary emissions from mobile sources for $PM_{2.5}$, PM_{10}, and carbon monoxide (CO) hot-spot analyses.[10] This proposed action was based on the importance of reflecting the latest science in AERMOD, its improved model performance over CALINE3, and the availability of more representative meteorological data for use in AERMOD. The EPA's proposal also set forth a 1-year transition period for the adoption of AERMOD for all regulatory applications.

The mobile source modeling applications under the CAA requirements that are most affected by the replacement of CALINE3 with AERMOD are transportation conformity hot-spot analyses for $PM_{2.5}$, PM_{10}, and CO.[11] To date, PM hot-spot analyses have involved a refined analysis that can be accomplished with either AERMOD or CAL3QHCR (a variant of CALINE3).[10] For CO hot-spot analyses, screening analyses are typically conducted with CAL3QHC (a variant of CALINE3).[12]

The EPA received several comments supporting and several comments opposed to the proposed replacement of CALINE3 with AERMOD as the preferred appendix A model for mobile source emissions. The commenters who supported the proposed replacement agreed with the reasons set forth in the proposal, mainly that AERMOD reflects the state-of-the-science for Gaussian plume dispersion models, with on-going updates and enhancements supported by the EPA, has more accurate performance and is more flexible and can be applied to more project types than other dispersion models, can utilize more recent and more representative meteorological data, and that a single model will generally streamline the process of conducting and securing approval of model demonstrations.[13] Alternatively, the commenters who did not support the proposal believed: that the science indicating AERMOD has more accurate performance is unclear; that AERMOD would increase the time required to complete hot-spot analyses, particularly for CO screening; and that a longer transition period, such as a 3-year period, would be needed for the adoption of new models for conformity analyses.

The adverse comments related to the sufficiency of the EPA's technical and scientific basis for the replacement of

[9] Benson, Paul E., 1979. CALINE3—A Versatile Dispersion Model for Predicting Air Pollutant Levels Near Highways and Arterial Streets. Interim Report, Report Number FHWA/CA/TL–79/23. Federal Highway Administration, Washington, DC (NTIS No. PB 80–220841).

[10] U.S. Environmental Protection Agency, 2015, Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas. Publication No. EPA–420–B–15–084, Office of Transportation and Air Quality, Ann Arbor, MI.

[11] Transportation conformity is required under Clean Air Act section 176(c) for federally funded or approved transportation projects in nonattainment and maintenance areas; EPA's transportation conformity regulations can be found at 40 CFR part 93.

[12] U.S. Environmental Protection Agency, 1992, Guideline for Modeling Carbon Monoxide from Roadway Intersections, EPA–454/R–92–005, Office of Air Quality Planning and Standards, RTP, NC.

[13] U.S. Environmental Protection Agency, 2016. Technical Support Document (TSD) for Replacement of CALINE3 with AERMOD for Transportation Related Air Quality Analyses. Publication No. EPA–454/B–16–006. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

CALINE3 with AERMOD included statements that AERMOD does not have an explicit line-source algorithm; that the peer-reviewed literature shows mixed results for model assessments; and that AERMOD performance for roadways has not been as well documented for an array of transportation projects.

First, the EPA notes that, based on implementation of conformity requirements to date, the majority of PM hot-spot analyses have been conducted with AERMOD and its existing algorithms have been used to perform these analyses. While it is true that AERMOD does not have an explicit line-source algorithm, it does have a LINE source input pathway that mimics the input requirements for CALINE3 and simplifies using elongated area sources such as roadways. While roadway sources are often described as "line sources," they are in fact three-dimensional entities. The roadway width is one of the model inputs for CALINE3 and the width of a roadway is frequently many times the distance from the edge of the roadway to the closest receptor. The actual formulation of these source types is not as explicit as the names suggest. For example, LINE source in AERMOD performs an explicit numerical integration of emissions from the LINE source, whereas CALINE uses a rough integration based on a series of finite line segments. Thus, an elongated area source in AERMOD is likely to represent the distribution of roadway emissions more accurately than the approach taken in CALINE3. In fact, the body of literature focused on roadway emissions suggests that the formulation of the Gaussian plume (*i.e.,* line, area or volume) is not as important as the appropriate settings of the source characteristics and the quality of the emissions and meteorological inputs (see discussion in the Response to Comments document in the docket for this action).

These commenters also believed that the Heist (2013) journal article [14] cited primarily as supporting the proposal was too limited in scope. The quality of the emissions inputs, in particular, is one of the reasons the EPA focused on Heist (2013) to support the proposal. The EPA reviewed current model assessments in the literature and found that the majority used traffic counts and an emissions model to estimate emissions (see the Response to Comments document for more details). Although this approach introduces significant uncertainty in the model evaluation, this uncertainty was not addressed in these types of studies. Studies that use tracer emissions rather than traffic counts and emissions models remove this uncertainty and allow an evaluation of the dispersion model itself, rather than a joint evaluation of the emissions model and the dispersion model. The studies based on tracer releases rather than modeled emissions are limited to the CALTRANS99 and the 2008 Idaho Falls field studies examined in Heist (2013), and its robust model performance evaluations of these two studies. Thus, Heist (2013) was the primary literature the EPA considered in making a determination regarding AERMOD replacing CALINE3, rather than the small number of other recent model evaluations available in the peer-reviewed literature. Since the CALTRANS99 field campaign evaluated by Heist (2013) included an emission measurement system attached to vehicles driving on an operational highway, the results are fully representative of operational highways. The Heist (2013) study compared a developmental line-source model, RLINE, to AERMOD with volume and line sources as well as CALINE3 and CALINE4. RLINE showed nearly equivalent performance to the area and volume formulations from AERMOD. CALINE3 was clearly the worst performing model from the six model formulations evaluated. While CALINE4 had better performance than CALINE3, CALINE4 was still the second-worst performing model. It should also be noted that most recent literature only evaluates the CALINE4 model rather than the CALINE3 model, which further highlights that the CALINE3 model is outdated in its science, even within its own class of models.

In terms of regulatory applications, AERMOD has been demonstrated to be useful for a range of transportation applications and is generally relied on over CAL3QHCR for more complicated projects because of its greater flexibility in source types (*e.g.,* CAL3QHCR is unable to model certain types of projects or project features such as intermodal terminals or tunnels) and meteorological processing. Additionally, the Federal Aviation Administration (FAA) replaced CALINE3 with AERMOD in 2005 in its Emissions and Dispersion Modeling System (EDMS) to expand its capability and improve its accuracy in evaluating airport impacts.[15] This, along with the fact that AERMOD has been used for many years already for PM hot-spot analyses for transportation conformity determinations, shows that AERMOD is more than capable of being useful for a wide variety of transportation projects and that the performance has been more than adequate for even the most complicated projects.

Comments were also made with respect to potential longer AERMOD model run times and the time necessary to set up model files and obtain meteorological data. These statements are not entirely reflective of the EPA's experience to date in implementing the PM hot-spot requirement. The EPA believes that AERMOD has been used for more complicated projects, since PM hot-spot analyses are completed for projects that are often very large and involve different project components that significantly increase the number of diesel vehicles. By their nature, these types of transportation projects involve more time to set up and complete and few transportation modelers have actually run both CAL3QHCR and AERMOD for equivalent projects.[16] In addition, volume sources have frequently been selected by implementers for AERMOD demonstrations, and this approach involves more time and effort in setting up the model runs, and more sources to be used than would be necessary with area sources. In addition, since AERMOD is already used in all 50 states for NSR purposes, meteorological input data for AERMOD are frequently prepared as a matter of course by the state and local air agencies and often made publicly available for download. Therefore, the EPA's understanding and experience is that the amount of time and resources necessary to create model inputs and complete PM hot-spot model simulations for AERMOD versus CAL3QHCR is not distinguishable from the overall process of running a traffic model, developing design alternatives for multiple purposes beyond conformity, and running the emissions model for the scenarios. In addition, as stated above and in the EPA's existing guidance, AERMOD has several advantages when conducting a PM hot-spot analysis: The ability to model a

[14] Heist, D., V. Isakov, S. Perry, M. Snyder, A. Venkatram, C. Hood, J. Stocker, D. Carruthers, S. Arunachalam, and R.C. Owen. Estimating near-road pollutant dispersion: A model inter-comparison. Transportation Research Part D: Transport and Environment. Elsevier BV, AMSTERDAM, Netherlands, 25:93–105, (2013).

[15] 70 FR 68218, Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, November 9, 2005.

[16] Quantitative PM hot-spot analyses are not required for most new projects in PM nonattainment and maintenance areas, and most state departments of transportation have not been required to complete such an analysis to date for transportation conformity.

variety of different transportation project types; the reliance on existing and more recent AERMET meteorological datasets obtained through the interagency consultation process; and additional capabilities that reduce the number of steps in conducting a PM hot-spot analyses.[17]

In response to the comments received and based on the analysis conducted by the EPA, the following actions are being taken in the final rulemaking:

• The EPA is replacing CALINE3 with AERMOD as the appendix A preferred model for refined modeling for mobile source applications. The EPA has reviewed the available literature and conducted its own analysis[13] that demonstrates AERMOD provides superior performance to that of CALINE3 for refined applications. The EPA emphasizes that AERMOD has been the only model that is applicable to all types of projects, including highway interchanges and intersections; transit, freight, and other terminal projects; intermodal projects; and projects in which nearby sources also need to be modeled.[10]

• The EPA acknowledges that the implementation of AERMOD for all refined modeling may take time, as many state transportation departments are not yet experienced with the AERMOD modeling system. Many states may have attended one of the EPA's multiple trainings but have not been involved in a quantitative PM hot-spot analysis to date. Thus, we are providing an extended 3-year transition period before AERMOD is required as the sole dispersion model for refined modeling in transportation conformity determinations. In addition, any refined analyses for which the air quality modeling was begun before the end of this 3-year period with a CALINE3-based model can be completed after the end of the transition period with that model, similar to the way the transportation conformity grace period for new emissions models is implemented.

• The EPA acknowledges that there are limited demonstrations of using AERMOD for multi-source screening and that additional development work is necessary to develop an AERMOD-based screening approach for CO that satisfies the need for this type of analysis. Thus, we have modified section 4.2.3.1(b) of the *Guideline* to reference the EPA's 1992 CO guidance that employs CAL3QHC for CO screening analysis.[12] This technical guidance will remain in place as the recommended approach for CO screening until such time that the EPA (1) develops a new CO screening approach based on AERMOD or another appropriate model and (2) updates the *Guideline* to include the new CO screening approach. The use of CAL3QHC for CO screening does not need to undergo the review process discussed in the Guideline section 2.2(d). That review process is not necessary for CAL3QHC because its use is already well-established for CO hot-spot analyses and the review criteria have already been met.

• Finally, the EPA has formally recommended the establishment of a standing air quality modeling workgroup with the U.S. Department of Transportation, including the Federal Highway Administration, Federal Transit Administration, and FAA, to continue to evaluate and develop modeling practices for the transportation sector to ensure that future updates to dispersion models and methods reflect the latest available science and implementation.

See the docket for this action for the Response to Comments document for this part of the proposal as well as the EPA's latest technical support document (TSD) for using AERMOD for CO hot-spot screening analyses.

5. Addressing Single-Source Impacts on Ozone and Secondary $PM_{2.5}$

As discussed in our proposed action, on January 4, 2012, the EPA granted a petition submitted on behalf of the Sierra Club on July 28, 2010,[18] which requested that the EPA initiate rulemaking regarding the establishment of air quality models for ozone and $PM_{2.5}$ for use by all major sources applying for a PSD permit. In granting that petition, the EPA committed to engage in rulemaking to evaluate whether updates to the *Guideline* are warranted and, as appropriate, incorporate new analytical techniques or models for ozone and secondarily formed $PM_{2.5}$. This final action completes the rulemaking process described in the EPA's granting of the Sierra Club petition. As discussed in the proposal, the EPA has determined that advances in chemical transport modeling science indicate it is now reasonable to provide more specific, generally-applicable guidance that identifies particular models or analytical techniques that may be used under specific circumstances for assessing the impacts of an individual or single source on ozone and secondary $PM_{2.5}$. For assessing secondary pollutant impacts from single sources, the degree of complexity required to appropriately assess potential impacts varies depending on the nature of the source, its emissions, and the background environment. In order to provide the user community flexibility in estimating single-source secondary pollutant impacts that allows for different approaches to credibly address these different areas, the EPA proposed a two-tiered demonstration approach for addressing single-source impacts on ozone and secondary $PM_{2.5}$.

The first tier involves use of technically credible relationships between precursor emissions and a source's impacts that may be published in the peer-reviewed literature, developed from modeling that was previously conducted for an area by a source, a governmental agency, or some other entity and that is deemed sufficient, or generated by a peer-reviewed reduced form model. The second tier involves application of more sophisticated case-specific chemical transport models (CTMs) (*e.g.*, photochemical grid models) to be determined in consultation with the EPA Regional Offices and conducted consistent with the EPA single-source modeling guidance.[19] The appropriate tier for a given application should be selected in consultation with the appropriate reviewing authority and be consistent with EPA guidance. We invited comments on whether our proposed two-tiered demonstration approach and related EPA technical guidance are appropriately based on sound science and practical application of available models and tools to address single-source impacts on ozone and secondary $PM_{2.5}$.

Multiple commenters expressed support for the two-tiered approach for estimating single-source secondary impacts for permit-related programs, while other commenters did not support

[17] See Sections 7 and 9 of EPA's 2015 Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas. For example, Exhibit 7–2 in this guidance highlights that AERMOD can be used for all project types that require PM hot-spot analyses under the transportation conformity rule, and Exhibit 7–3 clarifies the number of runs typically necessary for a PM hot-spot analysis with AERMOD (1–5 runs) versus CAL3QHCR (20 runs).

[18] U.S. Environmental Protection Agency, 2012. Sierra Club Petition Grant. Administrative Action dated January 4, 2012, U.S. Environmental Protection Agency, Washington, District of Columbia 20460. *https://www3.epa.gov/ttn/scram/10thmodconf/review_material/Sierra_Club_Petition_OAR-11-002-1093.pdf.*

[19] U.S. Environmental Protection Agency, 2016. Guidance on the use of models for assessing the impacts of emissions from single sources on the secondarily formed pollutants ozone and $PM_{2.5}$. Publication No. EPA 454/R–16–005. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

a multi-tiered approach for this purpose. Commenters also sought flexibility in the first tier to allow for area-specific demonstrations, thereby avoiding the second tier assessments where chemical transport modeling may be part of the demonstration. Most commenters support the idea of developing Model Emissions Rates for Precursors (MERPs) for use as a Tier 1 demonstration tool, as described in the preamble of the proposed rule. However, some commenters expressed the need for more specific information about Tier 1 demonstration tools, particularly MERPs. Furthermore, one commenter expressed concern about the particular use of demonstration tools, such as MERPs, not reflecting the combined ambient impacts across precursors and, in the context of $PM_{2.5}$, in combining primary and secondary ambient impacts.

The EPA has issued draft guidance for use by permitting authorities and permit applicants and deferred rulemaking at this time to address how permitting authorities may develop and use significant impact levels (SILs) for ozone and $PM_{2.5}$. In addition, we are not establishing a single set of national MERPs through rulemaking as we had anticipated in the preamble of the proposed rule. Instead, the EPA developed a draft technical guidance document to provide a framework for permitting authorities to develop area-specific MERPs consistent with the *Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program.*[20] Through this process, the EPA believes it has provided sufficient information regarding Tier 1 demonstration tools, such as MERPs. The draft MERPs technical guidance document[21] illustrates how permitting authorities may appropriately develop MERPs for specific areas and use them as a Tier 1 demonstration tool for permit-related programs. This draft guidance also explicitly addresses the commenter concern regarding the appropriate use of MERPs such that their use reflects the combined ambient impacts across precursors and, in the case of $PM_{2.5}$, the combined primary and secondary ambient impacts. This approach provides the flexibility requested by many commenters with respect to Tier 1 demonstration tools, such as MERPs, to generate information relevant for specific regions or areas rather than a single, national level that may not be representative of secondary formation in a particular region or area.

Specifically, the draft MERPs technical guidance provides information about how to use CTMs to estimate single-source impacts on ozone and secondary $PM_{2.5}$ and how these model simulation results can be used to develop empirical relationships for specific areas that may be appropriate as a Tier 1 demonstration tool. It also provides results from EPA photochemical modeling of multiple hypothetical situations across geographic areas and source types that may be used in developing MERPs consistent with the guidance or with supplemental modeling in situations where the EPA's modeling may not be representative. This flexible and scientifically credible approach allows for the development of area-specific Tier 1 demonstration tools that better represent the chemical and physical characteristics and secondary pollutant formation within that region or area.

The draft MERPs technical guidance[21] and the EPA's draft single-source modeling guidance[19] provide information to stakeholders about how to appropriately address the variety of chemical and physical characteristics regarding a project scenario and key receptor areas that should be addressed in conducting additional modeling to inform development of MERPs. The development of MERPs for ozone and secondary $PM_{2.5}$ precursors is just one example of a suitable Tier 1 demonstration tool. The EPA will continue to engage with the modeling community to identify credible alternative approaches for estimating single-source secondary pollutant impacts, which provide flexibility and are less resource intensive for permit demonstrations.

Commenters also stated that requiring chemical transport modeling as a Tier 2 demonstration tool places undue burden financially on the states, as they do not have the expertise to run or review such models, and that the regulated community does not have the expertise to run such models. Commenters requested a clearer rationale and procedure for applying CTMs for the purposes of estimating single-source secondary impacts for permit-related programs. In response, the EPA believes that its technical guidance on single-source modeling provides both the clarity necessary to conduct such modeling and the flexibility appropriate to address such situations.

First, based on peer-reviewed assessments of models used for estimating ozone and secondary $PM_{2.5}$ for single-source impacts, the EPA continues to recommend that CTMs (including photochemical grid models or Lagrangian models) be used where a more refined Tier 2 demonstration for ozone or secondary $PM_{2.5}$ may be necessary. Given interest in the stakeholder community in different types of CTMs for the purposes of estimating single-source impacts for permit-related programs, and that these models, where applied appropriately, are fit for this purpose, selection of a single model for preferred status under the *Guideline* would impede sources from using a model or technique deemed most appropriate for specific situations, recognizing the diversity in chemical and physical environments across the United States.

Second, as discussed above, the EPA expects that the use of MERPs (or a similarly credible screening approach) as a Tier 1 demonstration tool will be sufficient for most sources to satisfy their compliance demonstration. For those situations where a refined Tier 2 demonstration is necessary, the EPA has provided detailed single-source modeling guidance with clear and credible procedures for estimating single-source secondary impacts from sources doing permit related assessments. The EPA has future plans to provide a module as part of its *Software for Model Attainment Test* (SMAT) tool, a publicly available, Windows-based program, that will allow users to work with output generated from CTMs to provide a consistent approach for estimating single-source ozone or secondary $PM_{2.5}$ impacts consistent with EPA guidance and the *Guideline.*

Multiple commenters do not agree that photochemical grid models can adequately assess single-source impacts. A commenter recognized that photochemical grid model evaluations using in-plume traverses are encouraging as documented in the IWAQM reports, but stated that more work is needed to generate additional confidence in the technique, and further requests that the EPA use newer field study data from 2013 to evaluate CTM performance against in-plume transects of ozone and secondary $PM_{2.5}$.

As referenced in the preamble to the proposal, the EPA has relied upon extensive peer-reviewed literature showing that photochemical grid models have been applied for single-

[20] U.S. Environmental Protection Agency, 2016. Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[21] U.S. Environmental Protection Agency, 2016. Guidance on the Use of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Permit Related Programs. Publication No. EPA 454/R–16–006. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

source impacts and, compared with near-source downwind in-plume measurements, that the models adequately represent secondary pollutant impacts from a specific facility. The literature shows that these models can clearly differentiate impacts of a specific facility from those of other sources.[22 23] Other peer-reviewed research has clearly shown that photochemical grid models are able to simulate impacts from single sources on secondarily-formed pollutants.[24 25 26] Further, single-source secondary impacts have been provided in technical reports that further support the utility of these tools for single-source scientific and regulatory assessments.[27 28 29] The EPA firmly believes that the peer-reviewed science clearly demonstrates that photochemical grid models can adequately assess single-source impacts. The EPA recognizes that ongoing evaluations in this area that will lead to continual improvements in the applicability of these models, such as the work underway to compare photochemical grid model estimates of single-source impacts with in-plume aircraft measurements made as part of the 2013 SENEX field campaign.[30]

Commenters requested that the EPA consider Lagrangian CTMs for use in assessing single-source secondary impacts. A commenter proposed that the Second-order Closure Integrated Puff Model (SCICHEM) can provide an alternative modeling platform for all single-source regulatory applications including ozone and secondary $PM_{2.5}$ impacts. Commenters note that SCICHEM does not suffer from limitations of other Lagrangian puff models with respect to overlapping puffs having similar access to background species as noted in the EPA's single-source modeling guidance.

The proposed revisions to the *Guideline* and EPA's single-source modeling guidance clearly indicate that CTMs are appropriate for estimating single-source impacts on ozone and secondary $PM_{2.5}$ as a Tier 2 demonstration tool or as means to develop a Tier 1 demonstration tool. Both Lagrangian puff models and photochemical grid models may be appropriate for this purpose where those models fulfill alternative model criteria detailed in section 3.2.2 of the *Guideline.* Furthermore, the single-source modeling guidance has been updated to reflect the difference in treatment of overlapping puffs and background in SCICHEM compared to other Lagrangian puff models. However, the EPA believes photochemical grid models are generally most appropriate for addressing ozone and secondary $PM_{2.5}$ because they provide a spatially and temporally dynamic realistic chemical and physical environment for plume growth and chemical transformation.[23 34] Publicly available and documented Eulerian photochemical grid models such as the Comprehensive Air Quality Model with Extensions (CAMx)[31] and the Community Multiscale Air Quality (CMAQ)[32] model treat emissions, chemical transformation, transport, and deposition using time and space variant meteorology. These modeling systems include primarily emitted species and secondarily formed pollutants such as ozone and $PM_{2.5}$.[33 34 35 36] In addition, these models have been used extensively to support ozone and $PM_{2.5}$ SIPs and to explore relationships between inputs and air quality impacts in the United States and elsewhere.[23 37 38]

The EPA is promulgating the two-tiered demonstration approach as described in section 5 of the *Guideline* and updating EPA technical guidance that was released at the time of proposal in response to public comments. These revisions to the *Guideline* and supporting technical guidance are based on sound science and practical application of available models and tools to address single-source impacts on ozone and secondary $PM_{2.5}$. In particular, the EPA has updated its previous $PM_{2.5}$ modeling guidance for permitting[39] to reflect these changes and also incorporated appropriate sections for ozone in releasing its *Guidance for Ozone* and $PM_{2.5}$ Permit Modeling[40] with this final rule.

6. Status of CALPUFF and Assessing Long-Range Transport for PSD Increments and Regional Haze

The EPA proposed a screening approach to address long-range transport for purposes of assessing PSD increments, its decision to remove CALPUFF as a preferred model in appendix A for such long-range transport assessments, and its decision

[22] Baker, K.R., Kelly, J.T., 2014. Single Source Impacts Estimated with Photochemical Model Source Sensitivity and Apportionment Approaches. Atmospheric Environment 96, 266–274.

[23] Zhou, W., Cohan, D.S., Pinder, R.W., Neuman, J.A., Holloway, J.S., Peischl, J., Ryerson, T.B., Nowak, J.B., Flocke, F., Zheng, W.G., 2012. Observation and Modeling of the Evolution of Texas Power Plant Plumes. Atmospheric Chemistry and Physics 12, 455–468.

[24] Baker, K.R., Kotchenruther, R.A., Hudman, R.C., 2015. Estimating Ozone and Secondary $PM_{2.5}$ Impacts from Hypothetical Single Source Emissions in the Central and Eastern United States. Atmospheric Pollution Research 7, 122–133.

[25] Bergin, M.S., Russell, A.G., Odman, M.T., Cohan, D.S., Chameldes, W.L., 2008. Single-Source Impact Analysis Using Three-Dimensional Air Quality Models. Journal of the Air & Waste Management Association 58, 1351–1359.

[26] Kelly, J.T., Baker, K.R., Napelenok, S.L., Roselle, S.J., 2015. Examining Single-Source Secondary Impacts Estimated from Brute-force, Decoupled Direct Method, and Advanced Plume Treatment Approaches. Atmospheric Environment 111, 10–19.

[27] ENVIRON, 2012a. Comparison of Single-Source Air Quality Assessment Techniques for Ozone, $PM_{2.5}$, other Criteria Pollutants and AQRVs, EPA Contract No: EP–D–07–102. September 2012. 06–20443M6.

[28] ENVIRON, 2012b. Evaluation of Chemical Dispersion Models Using Atmospheric Plume Measurements from Field Experiments, EPA Contract No: EP–D–07–102. September 2012. 06–20443M6.

[29] Yarwood, G., Scorgie, Y., Agapides, N., Tai, E., Karamchandani, P., Duc, H., Trieu, T., Bawden, K., 2011. Ozone Impact Screening Method for New Sources Based on High-order Sensitivity Analysis of CAMx Simulations for NSW Metropolitan Areas.

[30] National Oceanic & Atmospheric Administration. Southeast Nexus (SENEX) 2013. Studying the Interactions Between Natural and Anthropogenic Emissions at the Nexus of Climate Change and Air Quality. *http://www.esrl.noaa.gov/csd/projects/senex.*

[31] ENVIRON, 2014. User's Guide Comprehensive Air Quality Model with Extensions version 6, *http://www.camx.com.* ENVIRON International Corporation, Novato.

[32] Byun, D., Schere, K.L., 2006. Review of the Governing Equations, Computational Algorithms, and Other Components of the Models-3 Community Multiscale Air Quality (CMAQ) modeling system. *Applied Mechanics Reviews,* 59: 51–77.

[33] Chen, J., Lu, J., Avise, J.C., DaMassa, J.A., Kleeman, M.J., Kaduwela, A.P., 2014. Seasonal Modeling of $PM_{2.5}$ in California's San Joaquin Valley. *Atmospheric Environment,* 92: 182–190.

[34] Civerolo, K., Hogrefe, C., Zalewsky, E., Hao, W., Sistla, G., Lynn, B., Rosenzweig, C., Kinney, P.L., 2010. Evaluation of an 18-year CMAQ Simulation: Seasonal Variations and Long-term Temporal Changes in Sulfate and Nitrate. *Atmospheric Environment,* 44: 3745–3752.

[35] Russell, A.G., 2008. EPA Supersites Program-related Emissions-based Particulate Matter Modeling: Initial Applications and Advances. *Journal of the Air & Waste Management Association,* 58: 289–302.

[36] Tesche, T., Morris, R., Tonnesen, G., McNally, D., Boylan, J., Brewer, P., 2006. CMAQ/CAMx Annual 2002 Performance Evaluation Over the Eastern US. *Atmospheric Environment,* 40: 4906–4919.

[37] Cai, C., Kelly, J.T., Avise, J.C., Kaduwela, A.P., Stockwell, W.R., 2011. Photochemical Modeling in California with Two Chemical Mechanisms: Model Intercomparison and Response to Emission Reductions. *Journal of the Air & Waste Management Association,* 61: 559–572.

[38] Hogrefe, C., Hao, W., Zalewsky, E., Ku, J.-Y., Lynn, B., Rosenzweig, C., Schultz, M., Rast, S., Newchurch, M., Wang, L., 2011. An Analysis of Long-term Regional-scale Ozone Simulations Over the Northeastern United States: Variability and Trends. *Atmospheric Chemistry and Physics,* 11: 567–582.

[39] U.S. Environmental Protection Agency, 2014. Guidance for $PM_{2.5}$ Modeling. May 20, 2014. Publication No. EPA–454/B–14–001. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[40] U.S. Environmental Protection Agency, 2016. Guidance for Ozone and $PM_{2.5}$ Permit Modeling. Publication No. EPA–454/B–16–005. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

to consider CALPUFF as a screening technique along with other Lagrangian models to be used in consultation with the appropriate reviewing authority. In order to provide the user community flexibility in estimating single-source secondary pollutant impacts and given the availability of more appropriate modeling techniques, such as photochemical grid models (which address limitations of models like CALPUFF [41]), the EPA proposed that the *Guideline* no longer contain language that requires the use of CALPUFF or another Lagrangian puff model for long-range transport assessments. The EPA did recognize that long-range transport assessments may be necessary in certain limited situations for PSD increments, particularly for Class I areas. For these situations, the EPA proposed a screening approach where CALPUFF, along with other appropriate screening tools and methods, may be used to support long-range transport assessments of PSD increments.

We received comment that there may also be certain situations where long-range transport assessments of NAAQS compliance may be necessary because either near-field NAAQS compliance is not required or the nearest receptors of concern are greater than 50 km (*e.g.*, many Outer Continental Shelf sources). We agree with this comment and are amending the proposed screening approach in section 4.2 of the *Guideline* to also include a long-range assessment of NAAQS compliance, when appropriate. Specifically, to determine if NAAQS or PSD increments analyses may be necessary beyond 50 km (*i.e.*, long-range transport assessment), the EPA is updating its recommended screening approach to cases where near-field NAAQS compliance is not required or the nearest receptors of concern are greater than 50 km away.

Some commenters also expressed concern about the appropriateness of the EPA's technical basis for establishing the long-range transport screening assessment and, in particular, the appropriateness of the ambient levels used as benchmarks for evaluating the hypothetical source impacts. To support the EPA's proposed approach for long-range transport, we provided a TSD that demonstrated the level of single-source impacts from a variety of facility types.[42] The facility impacts were compared to benchmark ambient values for NO_2, SO_2, PM_{10}, and $PM_{2.5}$ in order to determine which facility types and pollutants might have impacts above these levels at 50 km from the source. The comments on the proposal indicated confusion about which values were applied in the TSD and, in particular, confusion about values used for Class I areas for both NAAQS and PSD increments. The EPA believes that because each NAAQS is uniform throughout the class areas, no class-specific protection is necessary when assessing whether a source causes or contributes to a violation of the NAAQS. Thus, for all NAAQS analyses, a uniform set of benchmark ambient values were used in the TSD across all class areas. However, the EPA recognizes that, historically, Congress has provided special protections to Class I areas, via more protective PSD increments. Thus, for all PSD increments analyses detailed in the TSD, more conservative benchmark ambient values applicable to Class I areas for PSD increments were used. The EPA has updated the TSD to more clearly reflect these conditions and alleviate the confusion on behalf of the commenters. These modifications do not affect the results or conclusions from the analysis or the finalization of the EPA's approach for long-range transport screening.

A number of commenters expressed concern about the EPA's proposed removal of CALPUFF as the preferred long-range transport model in appendix A and do not support its removal without replacement. Other commenters indicated that a lack of an EPA-preferred long-range transport model increases uncertainty in performing Class I PSD increment analyses or could lead to inconsistent modeling approaches for such analyses. Also, many of these same commenters expressed concerns about the need for its approval as an alternative model and the additional time that such a process would entail.

The EPA has presented a well-reasoned and technically sound screening approach for long-range transport assessments for NAAQS and PSD increments that streamlines the time and resources necessary to conduct such analyses and provides for appropriate flexibility in the use of CALPUFF or other Lagrangian models as a screening technique. To address concerns by commenters related to the approval of CALPUFF or other Lagrangian model in this screening approach, the EPA has modified section 4.2.1 of the *Guideline* to specifically recognize the use of Lagrangian models as an appropriate screening technique, for this purpose, that does not need to be approved by the EPA as an alternative model. Rather, the selection of specific model and model parameters must be done in consultation with the appropriate reviewing authority and EPA Regional Office. We consider the flexibility in selection of the appropriate screening technique provided by this long-range screening approach to be critically important for applicants to apply the most suitable technical basis to inform these complex situations. To the extent that a cumulative impact analysis is necessary at distances beyond 50 km, then the use of a Lagrangian or other model is subject to approval under section 3.2.2(e) of the *Guideline*. In response to commenter concerns about the additional time and potential delays associated with such approvals, as discussed in more detail later in this preamble, the EPA disagrees with such contentions and notes that the recently observed average response time of MCH concurrences on alternative models is less than a month.

Some commenters also stated that the EPA had not provided sufficient scientific or technical justification for removal of CALPUFF in appendix A, while other commenters supported the removal of CALPUFF as a preferred model. One commenter provided detailed information documenting the inconsistent nature of CALPUFF performance to more fully support the EPA's proposed action to remove it as a preferred model. As detailed in the Response to Comments document, the EPA has fully documented the past and current concerns related to the regulatory use of the CALPUFF modeling system and believes that these concerns, including the well-documented scientific and technical issues with the modeling system, support the EPA's decision to remove it as a preferred model in appendix A of the *Guideline*. In addition, there was no substantive or technical information submitted in the public comments that would lead the EPA to reconsider its documented concerns about the CALPUFF modeling system and its regulatory use.

In addition, a few commenters recommended that the EPA consider Lagrangian CTMs to address long-range transport from single sources. In this regard, some commenters mentioned the

[41] U.S. Environmental Protection Agency, 2016. Reassessment of the Interagency Workgroup on Air Quality Modeling Phase 2 Summary Report; Revisions to Phase 2 Recommendations. Publication No. EPA–454/R–16–007. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[42] U.S. Environmental Protection Agency, 2015. Technical Support Document (TSD) for AERMOD-Based Assessments of Long-Range Transport Impacts for Primary Pollutants. Publication No. EPA–454/B–15–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

more advanced version of CALPUFF for consideration here and specifically proposed that the SCICHEM model can also provide an alternative modeling platform for all single-source regulatory applications including ozone and secondary $PM_{2.5}$ impacts. In addition, they noted that SCICHEM does not suffer from limitations of other Lagrangian puff models with respect to overlapping puffs having similar access to background species as noted in the EPA's single-source modeling guidance. While the information provided by commenters is not sufficient for the EPA to adopt a replacement to CALPUFF as an appendix A model for long-range transport, this information clearly indicates that there are other models available and potentially suitable for use in these situations. Given the EPA's determination regarding the appropriateness of using current models and tools to address single-source impacts on ozone and secondary $PM_{2.5}$, we will continue to work with the modeling community on the development and evaluation of models that may be suitable for future consideration as preferred models to meet long-range assessment needs, as well as broader use in demonstrating compliance with NAAQS and PSD increments. Such developments would further strengthen the scientific credibility of the models and approaches used under the *Guideline* and continue to streamline their regulatory application through use of integrated models with capabilities to address multiple pollutants.

As previously noted in the proposed rule, Phase 3 of the IWAQM process was reinitiated in June 2013 to further the EPA's commitment to update the *Guideline* to address chemically reactive pollutants in near-field and long-range transport applications. This Phase 3 effort included the establishment of a workgroup composed of EPA and Federal Land Managers (FLM) technical staff focused on long-range transport of primary and secondary pollutants with an emphasis on use of consistent approaches to those being developed and applied to meet near-field assessment needs for ozone and secondarily-formed $PM_{2.5}$. The EPA expects that such approaches will be focused on state-of-the-science CTMs as detailed in IWAQM reports [43] [44] and published literature.

To inform future consideration of visibility modeling in regulatory applications consistent with the EPA's guidance for addressing chemistry for single-source impact on ozone and secondary $PM_{2.5}$, the final report [44] of the IWAQM long-range transport subgroup identified that modern CTMs have evolved sufficiently and provide a credible platform for estimating potential visibility impacts from a single or small group of emission sources. Such CTMs are well suited for the purpose of estimating long-range impacts of secondary pollutants, such as $PM_{2.5}$, that contribute to regional haze and other secondary pollutants, such as ozone, that contribute to negative impacts on vegetation through deposition processes. These multiple needs require a full chemistry photochemical model capable of representing gas, particle, and aqueous phase chemistry for $PM_{2.5}$, haze, and ozone.

Photochemical grid models are suitable for estimating visibility and deposition since important physical and chemical processes related to the formation and transport of PM are realistically treated. Source sensitivity and apportionment techniques implemented in photochemical grid models have evolved sufficiently and provide the opportunity for estimating potential visibility and deposition impacts from one or a small group of emission sources using a full science photochemical grid model. Photochemical grid models using meteorology output from prognostic meteorological models have demonstrated skill in estimating source-receptor relationships in the near-field [24] [27] and over long distances.[45]

Photochemical grid models have been shown to demonstrate similar skill to Lagrangian models for pollutant transport when compared to measurements made from multiple mesoscale field experiments.[45] Use of CTMs for Air Quality Related Values (AQRV) analysis requirements, while not subject to specific EPA model approval requirements outlined in 40 CFR 51.166(l)(2) and 40 CFR 52.21(l)(2), should be justified for each application following the general recommendations outlined in section 3.2.2 of the *Guideline,* and concurrence sought with the affected FLM(s).

As proposed, with revisions discussed above, we are taking final action to codify the screening approach to address long-range transport for purposes of assessing NAAQS and/or PSD increments; removing CALPUFF as a preferred model in appendix A for such long-range transport assessments; and confirming our recommendation to consider CALPUFF as a screening technique along with other Lagrangian models that may be used as part of this screening approach without alternative model approval. As detailed in the preamble of the proposed rule, it is important to note that the EPA's final action to remove CALPUFF as a preferred appendix A model in this *Guideline* does not affect its use under the FLM's guidance regarding AQRV assessments (FLAG 2010) nor any previous use of this model as part of regulatory modeling applications required under the CAA. Similarly, this final action does not affect the EPA's recommendation that states use CALPUFF to determine the applicability and level of best available retrofit technology in regional haze implementation plans.[46] It is also important to note that the use of CALPUFF in the near-field as an alternative model for situations involving complex terrain and complex winds is not changed by removal of CALPUFF as a preferred model in appendix A. The EPA recognizes that AERMOD, as a Gaussian plume dispersion model, may be limited in its ability to appropriately address such situations, and that CALPUFF or other Lagrangian model may be more suitable, so we continue to provide the flexibility of alternative model approvals (as has been in place since the 2003 revisions to the *Guideline*).

7. Role of EPA's Model Clearinghouse (MCH)

We proposed to codify our existing practice of requiring consultation and coordination between the EPA Regional Offices and the EPA's MCH on all approvals (under section 3.2.2 of the *Guideline*) of alternative models or techniques. This coordination process has been in practice for almost three decades during which the MCH has served a critical role in helping resolve issues that have arisen from unique situations that were not specifically addressed in the *Guideline* or necessitated the consideration of an alternative model or technique for a

[43] U.S. Environmental Protection Agency, 2015. Interagency Workgroup on Air Quality Modeling Phase 3 Summary Report: Near-Field Single Source Secondary Impacts. Publication No. EPA 454/P–15–002. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[44] U.S. Environmental Protection Agency, 2015. Interagency Workgroup on Air Quality Modeling Phase 3 Summary Report: Long Range Transport and Air Quality Related Values. Publication No. EPA 454/P–15–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

[45] ENVIRON, 2012. Documentation of the Evaluation of CALPUFF and Other Long Range Transport Models using Tracer Field Experiment Data, EPA Contract No: EP–D–07–102. February 2012. 06–20443M4. *https://www3.epa.gov/ttn/scram/reports/EPA-454_R-12-003.pdf.*

[46] *See* 70 FR 39104, 39122–23 (July 6, 2005).

specific application or range of applications. However, the most comprehensive documentation of this coordination process was a 1988 EPA memorandum to the EPA Regional Offices defining the Model Clearinghouse Operational Plan,[47] which was not widely available to the regulated modeling community until it is was included in the docket for the proposed rule. In response to the proposal and docketed information, the EPA received a wide range of comments regarding the MCH and the related proposed revisions to the *Guideline.*

The majority of the commenters expressed varying levels of concern with the potential for significant delay to the permit review process if all the EPA Regional Office alternative model approvals were required to seek concurrence from the MCH. Several commenters suggested that the current process, as defined in the existing *Guideline,* is appropriate and should not be changed. Other commenters stated that the current MCH process is slow, cumbersome, and in many ways, not needed. Certain industry commenters recommended the establishment of specific timeline requirements for the EPA Regional Office and MCH alternative model approvals. Other industry comments recommended the establishment of an external review committee for alternative model approvals and/or an external advisory group to recommend additional changes to the MCH process. Finally, there were a few comments expressing concern that the MCH process is not well-known and that decisions by the MCH are not widely disseminated.

With regard to comments about possible delay to the approval process for an alternative model, it is important to point out that the revisions to the *Guideline* are only codifying an existing process between the EPA Regional Offices and the Model Clearinghouse. Therefore, the administrative processing time for these approvals should not be affected by codifying the existing process. In fact, we anticipate that this action will further streamline the process by clarifying it for the regulatory modeling community. Additionally, the revisions will ensure fairness, consistency, and transparency in modeling decisions across all EPA Regional Offices. Additional important aspects of these revisions were noted and supported through comment by several state air permitting agencies, an organization representing the state agencies, and a large industrial trade organization.

It is important to note that the EPA's MCH has formally accepted and concurred with five alternative model requests from the EPA Regional Offices since proposal of this rule. The average MCH response time for those five requests was 28 days. There was some variability in the timing of these formal concurrences with one of the concurrences being completed within less than a day; three of the concurrences taking approximately 22 days; and one of the more complex requests taking slightly longer than 2 months. The range of MCH response times over the past year is indicative of applicants that have either engaged early with their respective EPA Regional Office through vetting of a modeling protocol and the identification and coordination of significant issues prior to submittal of their modeling compliance demonstration, or applicants that have performed a substantial amount of modeling work and justification documentation prior to any engagement with the EPA Regional Office or MCH.

When applicants do not engage with the EPA early in the process, additional time is often needed for the justification of the alternative model or options selected and/or remodeling of their facility based on issues realized through review by the EPA. In a few cases, the approach desired by an applicant had to be completely reworked from the beginning, which created significant delays in the permit review and approval process. Early engagement with the EPA will result in the shortest amount of time needed for any alternative model approval by the Agency. However, complex situations involving facilities with unique issues, and requesting a completely new or novel alternative model approach, will require additional time for the applicant, the appropriate reviewing authority, the EPA Regional Office, and the EPA's MCH to collaboratively work together through an informed and iterative process to achieve an approvable alternative model submittal. For these reasons and the recently observed response time of MCH concurrences on alternative models of less than a month, we believe that it is unwarranted to impose a regulatory time limit on the MCH concurrence process. The revised Model Clearinghouse Operational Plan outlines the MCH process by defining the roles and responsibilities of all parties, providing thorough descriptions and flow diagrams, referencing the current databases that store all formal MCH decisions, making available templates for request memoranda and other pertinent information, and providing "best practice" examples of request memoranda that highlight how to best inform the MCH process. We believe these enhancements will increase clarity and understanding of this process and make the imposition of a regulatory time limit unnecessary. This Model Clearinghouse Operational Plan is included in the docket and available on the EPA's SCRAM Web site.

The suggestion by commenters to use an external review committee for alternative model approvals is unnecessary and inappropriate. The CAA requires that air quality models are specified by the EPA Administrator. Any modification or substitution of a regulatory model under the *Guideline* can only be made with written approval of the Administrator. The delegation of this preferred model or alternative model approval process can only occur within the EPA. Also, an external review committee would add another layer of review and coordination to the prerequisite EPA processes and would ultimately result in delays in the overall permit review and approval process. Aside from future regulatory revisions of the *Guideline,* the EPA is required per CAA section 320 to conduct a Conference on Air Quality Modeling at least every 3 years, at which time formal public comment on the MCH process or any other aspect of the *Guideline* can be provided. The EPA believes that the current process demonstrates our continued commitment to provide the regulatory community with scientifically credible models and techniques developed through collaborative efforts, which are provided in updates to the *Guideline.*

In this action, as proposed, we are codifying the long-standing process of the EPA Regional Offices consulting and coordinating with the MCH on all approvals of alternative models or techniques. While the Regional Administrators are the delegated authority to issue such approvals under section 3.2.2 of the *Guideline,* all alternative model approvals will be issued only after consultation with the EPA's MCH and formal documentation through a concurrence memorandum that indicates that the alternative model requirements in section 3.2.2 have been met.

8. Updates to Modeling Procedures for Cumulative Impact Analysis

As discussed in the preamble to our proposed action, based on input from the Tenth Modeling Conference and

[47] U.S. Environmental Protection Agency, 2016. Model Clearinghouse: Operational Plan. Publication No. EPA–454/B–16–008. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

recent permit modeling experiences under the 1-hour NAAQS for SO_2 and NO_2, we proposed revisions in section 8 of the *Guideline* and associated guidance to provide the necessary clarification in selecting and establishing the model domain and inputs for conducting the regulatory modeling for PSD and SIP applications. In addition to solicited public feedback on section 8, we received numerous public comments with respect to section 9 of the *Guideline,* which is revised to more clearly summarize the general concepts represented throughout the *Guideline* and set the stage for appropriate regulatory application of models and/or, in rare circumstance, air quality monitoring data.

Many of these revisions are based on the EPA clarification memoranda issued since 2010 that were intended to provide the necessary clarification regarding applicability of the *Guideline* to PSD modeling for these new standards.[48 49 50 51] The EPA has specifically cautioned against the literal and uncritical application of very prescriptive procedures for conducting NAAQS and PSD increments modeling compliance demonstrations as described in chapter C of the 1990 draft New Source Review Workshop Manual.[52] Following such procedures in a literal and uncritical manner has led to practices that are overly conservative and unnecessarily complicate the permitting process.

Commenters were supportive of the addition of the definition of the modeling domain, including the appropriate factors to consider, for NAAQS and PSD increments assessments and for SIP attainment demonstrations in section 8 of the *Guideline.* However, several commenters stated that the discussion in the proposed *Guideline* could result in conservatively large modeling domains regularly extending to 50 km. A typographical error was identified in that discussion that may have caused this confusion and is corrected in this final rule. With this correction, it is now clear that the modeling domain or proposed project's impact area is defined as an area with a radius extending from the new or modifying source to: (1) The most distant location where air quality modeling predicts a significant ambient impact will occur, or (2) the nominal 50 km distance considered applicable for Gaussian dispersion models, whichever is *less* [emphasis added]. In most situations, the extent to which a significant ambient impact could occur from a new or modifying source likely will be considerably less than 50 km.

Commenters also were supportive of the expanded discussion of receptor sites in section 9 of the *Guideline.* There were several requests for additional considerations for the potential exclusion of receptors from the modeling domain based on various factors. Along these lines, a few commenters requested that we add a formal definition of "ambient air" into the *Guideline* and provide specific exceptions to allow for the exclusion of certain receptors. The definition of "ambient air" and related provisions are provided in 40 CFR 50.1(e). Principles for justifying exclusion of particular areas from this definition of "ambient air" are discussed in EPA guidance for the PSD program. The EPA has not proposed to revise this definition or how the EPA has interpreted it in guidance. Thus, we do not believe it is necessary to address this topic within the *Guideline.*

There was overwhelming support by the stakeholder community for revisions to the *Guideline* that would bring additional clarity and flexibility concerning the process of determining background concentrations used in constructing the design concentration, or total air quality concentration, as a part of a cumulative impact analysis for NAAQS and PSD increments. There were, however, numerous specific public comments highlighting typographical errors or requesting additional clarifications on particular details of this process. Where appropriate, revisions were made to the *Guideline* to address many of these comments. A few of the public comments identified concerns that we have already addressed within other portions of the *Guideline* or desired more technical detail than is necessary in regulatory text and are best addressed through updates to existing technical guidance.

In particular, there were numerous requests to further clarify the analysis of significant concentration gradients from "nearby sources," as used in the selection of which nearby sources should be explicitly modeled in a cumulative impact assessment under PSD. In the proposed revisions to the *Guideline,* we expanded the concept of significant concentration gradients from the previous version of the *Guideline.* Given the uniqueness of each modeling situation and the large number of variables involved in identifying nearby sources, we continue to believe that comprehensively defining significant concentration gradients in the *Guideline* is inappropriate and could be unintentionally and excessively restrictive. Rather, the identification of nearby sources to be explicitly modeled is regarded as an exercise of professional judgment to be accomplished jointly by the applicant and the appropriate reviewing authority. Following this final action, we will continue to work with the stakeholder community to clarify and improve upon the existing technical guidance and associated approaches that could be used to develop and analyze significant concentrations gradients from nearby sources.

We received numerous comments from the stakeholder community supporting the proposed revisions to Tables 8–1 and 8–2 that allow for the modeling of nearby sources using a representation of average actual emissions based on the most recent 2 years of normal source operation. Typographical errors were noted in the public comments and have subsequently been corrected in both of these tables. The public comments also include additional recommendations for alternate procedures to develop or calculate actual emissions; however, these commenters either did not include substantive technical support for these recommendations or they were inconsistent with the required application of the preferred appendix A model.

[48] U.S. Environmental Protection Agency, 2010. Applicability of Appendix W Modeling Guidance for the 1-hour NO2 NAAQS. Memorandum dated June 28, 2010, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/clarification/ClarificationMemo_AppendixW_Hourly-NO2-NAAQS_FINAL_06-28-2010.pdf.*

[49] U.S. Environmental Protection Agency, 2010. Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 NAAQS. Memorandum dated August 23, 2010, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/clarification/ClarificationMemo_AppendixW_Hourly-SO2-NAAQS_FINAL_08-23-2010.pdf.*

[50] U.S. Environmental Protection Agency, 2011. Additional Clarification Regarding Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS. Memorandum dated March 1, 2011, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf.*

[51] U.S. Environmental Protection Agency, 2014. Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard. Memorandum dated September 30, 2014, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/clarification/NO2_Clarification_Memo-20140930.pdf.*

[52] U.S. Environmental Protection Agency, 1990. New Source Review Workshop Manual: Prevention of Significant Deterioration and Nonattainment Area Permitting (Draft). Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www.epa.gov/nsr.*

Several commenters from the industrial sector suggested that the *Guideline* should be further amended to allow modeling approaches that account for emissions variability in NSR permitting for new and modifying sources. Additionally, there was public comment that highly intermittent sources should be categorically excluded from NAAQS assessments for statistically-based short-term standards. The emissions variability approaches and exclusion of highly intermittent sources would be a significant departure from long-standing EPA policy in the NSR program and are not addressed in the *Guideline.* If there are future revisions to the NSR program that would allow for such considerations, then appropriate revisions to the *Guideline* would be considered at that time.

A few public comments expressed concern with our recommendation of using the current monitored design value as the background ambient concentration to be included with any explicitly modeled nearby sources and the estimated modeled impact of the source for comparison to the appropriate NAAQS in PSD assessments. The concern expressed in the comments is that this practice is exceedingly conservative and results in very unrealistic characterizations of the design concentration. We agree that certain combinations of monitored background data and modeled concentrations can lead to overly conservative assessments. However, we also point out that section 8.3.2(c) of the *Guideline* clearly states that the best starting point for many cases is the use of the current design value, but there are many cases in which the current design value may not be appropriate. We then provide four example cases where the use of the current monitored design value is not appropriate and further state that this list of examples is not exhaustive such that other cases could be considered on a case-by-case basis with approval by the appropriate reviewing authority.

The modeling protocols discussion at the beginning of section 9 of the *Guideline* received a few public comments. One commenter wanted the discussion to be less prescriptive and not require involvement of the EPA Regional office for every protocol. Another commenter wanted the EPA to establish specific deadlines for approvals (or disapprovals) of modeling protocols. We are aware that the discussion on modeling protocols does not contain any specific requirements for applicants or permit reviewing authorities. Rather, the modeling protocol discussion is provided to recommend best practices to streamline the regulatory modeling process and avoid unnecessary work and additional permit delays. Given the added complexity of the technical issues that arise in the context of demonstrating regulatory compliance through air quality modeling, we strongly encourage the development of comprehensive modeling protocols by the applicants and a thorough vetting of these protocols by the appropriate reviewing authority prior to the start of any work on a project. In circumstances where alternative models or non-*Guideline* procedures are being considered, it is advisable to also include the EPA Regional Office in the initial protocol meeting if it is not the primary permit reviewing authority.

Finally, there were a few general comments on the discussion of NAAQS and PSD increments compliance demonstrations within section 9 of the *Guideline.* Some of those comments offered additional suggestions for revisions to the *Guideline* that are addressed in the Response to Comments document located in the docket for this action. In particular, one commenter criticized the multi-stage process recommended by the EPA, which has been applied in the PSD program for more than 25 years. The commenter argued that a cumulative impact analysis must always be conducted and that there was no other rational way to show that a new or modifying source will not cause or contribute to a violation of the NAAQS or PSD increments. In this context, the commenter argued against the use of "significant impact levels" to show, based on a single-source analysis, that an individual source does not cause or contribute to a violation of the NAAQS or PSD increments. The EPA has revised section 9.2.3 of the proposed *Guideline* to make more clear that this two-stage approach is a recommendation and not a requirement. To the extent this recommendation is followed, interested parties retain the opportunity to comment on the adequacy of a single-source analysis and to call for a cumulative impact analysis to make the required demonstration in the context of individual permits.

Further, the EPA is not establishing SILs in this rulemaking and did not intend to codify the use of these values in the *Guideline.* Our use of the term "significant impact" was intended to carry forward principles previously reflected in sections 10.2.1(b), 10.2.1(c) and 10.2.3.2(a) of the 2005 version of the *Guideline.* To make clear that this rule is not codifying the application of SILs and is only describing the outline of a recommended multi-stage process for making the required demonstration, we have removed the term "significant impact" from many parts of section 9.2.3. In a separate guidance,[20] the EPA has provided a legal and technical rationale that permitting authorities may consider adopting to support the use of "significant impact levels" to quantify a degree of concentration impact below which a source does not have the potential to cause or contribute to a violation. This rationale, which is not adopted by the EPA in this rule, differs in material respects from the basis for a prior EPA rulemaking to adopt SILs that this commenter criticized.

As proposed, we are finalizing revisions to sections 8 and 9 of the *Guideline* to add necessary clarity where requested by public commenters and to correct typographical errors. The EPA fully expects that, by providing more clarity in the *Guideline* of the factors to be considered in conducting both the single-source impact and cumulative impact assessments, permit applicants and permitting authorities will find the proper balance across the various competing factors that contribute to these analyses.

9. Updates on Use of Meteorological Input Data for Regulatory Dispersion Modeling

The EPA solicited comments on the proposed updates regarding use of meteorological input data for regulatory application of dispersion models, including the use of 2-minute Automated Surface Observing Stations (ASOS) for hourly average winds to replace standard hourly observations, and the use of prognostic meteorological data for areas where there is no representative NWS data and it is infeasible or prohibitive to collect site-specific data.

For near-field dispersion modeling applications using NWS ASOS sites, the EPA released a pre-processor to AERMET, called AERMINUTE, in 2011 that calculates hourly averaged winds from 2-minute winds reported every minute at NWS ASOS sites. AERMET substitutes these hourly averaged winds for the standard hourly observations, and thus reduces the number of calms and missing winds for input to AERMOD. The presence of calms and missing winds were due to the METAR reporting methodology of surface observations. In March 2013, the EPA released a memorandum regarding the

use of ASOS data in AERMOD,[53] as well as the use of AERMINUTE. When using meteorological data from ASOS sites for input to AERMOD, hourly averaged winds from AERMINUTE should be used in most cases.

For a near-field dispersion modeling application where there is no representative NWS station, and it is prohibitive or not feasible to collect adequately representative site-specific data, it may be necessary to use prognostic meteorological data for the application. The EPA released the MMIF program that converts the prognostic meteorological data into a format suitable for dispersion modeling applications. The most recent 3 years of prognostic data are preferred. Use of the prognostic data are contingent on the concurrence of the appropriate reviewing authority and collaborating agencies that the data are of acceptable quality and representative of the modeling application.

We received many comments favorable to the use of prognostic meteorological data. While supporting the use of prognostic meteorological data, many commenters also requested additional guidance on running the prognostic meteorological models, assessing the suitability of the model output, and the use of MMIF to generate the meteorological data needed for AERMET and AERMOD. Based on the comments received, the EPA has updated the guidance [54] on use of the prognostic meteorological data.

Therefore, as proposed, the EPA is updating the *Guideline* to recommend that AERMINUTE output should be routinely used in most cases when meteorological data from NWS ASOS sites are used for input to AERMOD and that representative prognostic meteorological data are appropriate for use in dispersion modeling within areas where there is no representative NWS data, or it is infeasible or prohibitive to collect site-specific meteorological data.

B. Final Editorial Changes

In this action, the EPA is making editorial changes to update and reorganize information throughout the *Guideline.* These revisions are intended to make the *Guideline* easier to use, without meaningfully changing the substance of the *Guideline,* by grouping topics together in a more logical manner to make related content easier to find. This in turn should streamline the compliance assessment process.

We describe these editorial changes below for each affected section of the *Guideline,* as well as changes associated with the resolution of the comments and issues discussed in section IV.A. of this preamble and the correction of typographical errors identified in our proposal. For ease of reference, we are publishing the entire text of appendix W and its appendix A, as revised through today's action.

1. Preface

As proposed, the preface is updated to reflect minor text revisions for consistency with the remainder of the *Guideline.*

2. Section 1

The introduction section is updated to reflect the reorganized nature of the revised *Guideline* as proposed. Additional information is provided regarding the importance of CAA section 320 to amendments of the *Guideline.*

3. Section 2

As proposed, section 2 is revised to more appropriately discuss the process by which models are evaluated and considered for use in particular applications. Information from the previous section 9 pertaining to model accuracy and uncertainty is incorporated within this section to clarify how model performance evaluation is critical in determining the suitability of models for particular application.

A discussion is provided in section 2.1 of the three types of models historically used for regulatory demonstrations. For each type of model, some strengths and weaknesses are listed to assist readers in understanding the particular regulatory applications to which they are most appropriate.

In addition, we revised section 2.2 with respect to the recommended practice of progressing from simplified and conservative air quality analysis toward more complex and refined analysis. In this section, we clarify distinctions between various types of models that have previously been described as screening models. In addition, this section clarifies distinctions between models used for screening purposes and screening techniques and demonstration tools that may be acceptable in certain applications.

A few typographical corrections were made in this section based on public comment and additional review of the proposed regulatory text. Also, based on public comment, clarity was added to the description of the modeling process to indicate that an applicant may choose to implement controls or operational limits based on screening modeling rather than performing additional refined modeling.

4. Section 3

There were minor modifications, including a few typographical corrections, made to section 3 based on public comment to more accurately reflect current EPA practices. As proposed, the discussion of the EPA's MCH is moved to a revised section 3.3 for ease of reference and prominence within the *Guideline.* With this action, EPA Regional Office consultation with and concurrence by the MCH is required on all alternative model approvals. Previously, section 3 included various requirements under a recommendation subheading that were not clearly identified as requirements. Accordingly, we modified section 3 with the incorporation of requirement subsections to eliminate any ambiguity. Finally, the metric used to demonstrate equivalency of models (section 3.2.2) is modified based on public comment to be more appropriate for both deterministic and probabilistic based standards.

5. Section 4

As proposed, section 4 is revised to incorporate the modeling approaches recommended for air quality impact analyses for the following criteria pollutants: CO, lead, SO_2, NO_2, and primary $PM_{2.5}$ and PM_{10}. The revised section 4 is now a combination of the previous sections 4 and 5, reflecting inert criteria pollutants only. We also modified section 4 to incorporate requirement subsections that provide clarity to the various requirements where, previously, sections 4 and 5 included various requirements under recommendation subheadings.

Section 4 now provides an in-depth discussion of screening and refined models, including the introduction of AERSCREEN as the recommended screening model for simple and complex terrain for single sources. We included a clear discussion of each appendix A preferred model in section 4.3. We modified the discussion for each preferred model (*i.e.,* AERMOD Modeling System, CTDMPLUS, and OCD) from the previous section 4 with

[53] U.S. Environmental Protection Agency, 2013. Use of ASOS Meteorological Data in AERMOD Dispersion Modeling. Memorandum dated March 8, 2013, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/clarification/20130308_Met_Data_Clarification.pdf.*

[54] U.S. Environmental Protection Agency, 2016 Guidance on the Use of the Mesoscale Model Interface Program (MMIF) for AERMOD Applications. Publication No. EPA–454/B–16–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

appropriate edits and some streamlining based on information available in the respective model formulation documentation and user's guides.

We added a subsection specifically addressing the modeling recommendations for SO_2 where, previously, section 4 of the *Guideline* was generally understood to be applicable for SO_2. We made minor updates with respect to the modeling recommendations for each of the other inert criteria pollutants that were previously found in section 5. For NO_2, the ARM2 is added as a Tier 2 option, and the Tier 3 options of OLM and PVMRM are now regulatory options in AERMOD. For refined modeling of mobile sources, we have revised our previous language regarding the use of the CALINE3 models and are now listing AERMOD, where appropriate. As previously discussed in section IV.A.4 of this preamble, the section on CO modeling has been revised to reference existing guidance for CO screening rather than discussing screening approaches with AERMOD.

Throughout section 4, typographical errors in our proposal were noted by commenters. We have corrected those errors and made some minor revisions for additional clarity addressing some confusion that was expressed in several public comments. Of note, modifications to the requirements discussion of section 4.2 from our proposal were made to account for the potential need for a NAAQS compliance demonstration for long-range transport situations where a near-field assessment for NAAQS is not available or indicates a significant ambient impact at or about 50 km.

6. Section 5

As stated above, much of the previous section 5 (*i.e.*, the portions pertaining to the inert criteria pollutants) is now incorporated into the revised section 4. As proposed, the revised section 5 focuses only on the modeling approaches recommended for ozone and secondary $PM_{2.5}$. Other than addressing a few typographical errors based on public comment, the only additions to section 5 from proposal are a few transitional statements that were added for additional clarity.

Both ozone and secondary $PM_{2.5}$ are formed through chemical reactions in the atmosphere and are not appropriately modeled with traditional steady-state Gaussian plume models, such as AERMOD. Chemical transport models are necessary to appropriately assess the single-source air quality impacts of precursor pollutants on the formation of ozone or secondary $PM_{2.5}$.

While the revisions to section 5 do not specify a particular EPA-preferred model or technique for use in air quality assessments, we have established a two-tiered screening approach for ozone and secondary $PM_{2.5}$ with appropriate references to the EPA's new single-source modeling guidance. The first tier consists of technically credible and appropriate relationships between emissions and the impacts developed from existing modeling simulations. If existing technical information is not available or appropriate, then a second tier approach would apply, involving use of sophisticated CTMs (*e.g.*, photochemical grid models) as determined in consultation with the appropriate EPA Regional Office on a case-by-case basis based upon the EPA's new single-source modeling guidance.

7. Section 6

As proposed, section 6 is revised to more clearly address the modeling recommendations of other federal agencies, such as the FLMs, that have been developed in response to EPA rules or standards. Based on public comment from a tribal association and several tribes, we have added clarifying language that indicates that other state, local, or tribal agencies with air quality and land management responsibilities may also have specific modeling approaches for their own regulatory or other requirements. While no attempt was made to comprehensively discuss each topic, we provide appropriate references to the respective federal agency guidance documents.

The revisions to section 6 focus primarily on AQRVs, including near-field and long-range transport assessments for visibility impairment and deposition. The interests of the Bureau of Ocean Energy and Management (BOEM) for Outer Continental Shelf (OCS) permitting situations and the FAA for airport and air base permitting situations are represented in section 6.3.

The discussion of Good Engineering Practices (GEP) for stack height consideration is modified and moved to section 7. We have removed the discussion of long-range transport for PSD Class I increments and the references to the previously preferred long-range transport model, CALPUFF, in accordance with the more detailed discussion in section IV.A.6 of this preamble.

8. Section 7

As proposed, we revised section 7 to be more streamlined and appropriate to the variety of general modeling issues and considerations that are not covered in sections 4, 5, and 6 of the *Guideline.* Information concerning design concentrations and receptor sites is moved to section 9. The discussion of stability categories has been removed from section 7 because it is specifically addressed in the model formulation documentation and guidance for the dispersion models that require stability categories to be defined. As stated above, the GEP discussion from the previous section 6 is now incorporated into this section. Based on public comment, we added a statement to the plume rise discussion to clarify that refinements to the preferred model may be considered for plume rise and downwash effects only with agreement from the appropriate reviewing authority and approval by the EPA Regional Office.

We expanded the recommendations for determining rural or urban dispersion coefficients to provide more clarity with respect to appropriate characterization within AERMOD, including a discussion on the existence of highly industrialized areas where population density is low, which may be best treated with urban rather than rural dispersion coefficients. References to CALPUFF in the Complex Winds subsection have been removed in keeping with our approach to not explicitly name models that are not listed in appendix A, so as to not imply any preferential status vis-a-vis other available models. If necessary for special complex wind situations, the setup and application of an alternative model should now be determined in consultation with the appropriate reviewing authority. Finally, we revised section 7, as proposed, to include a new discussion of modeling considerations specific to mobile sources.

9. Section 8

We made extensive updates and modifications to section 8, as proposed, to reflect current EPA practices, requirements, and recommendations for determining the appropriate modeling domain and model input data from new or modifying source(s) or sources under consideration for a revised permit limit, from background concentrations (including air quality monitoring data and nearby and others sources), and from meteorology. As with earlier sections, we modified section 8 to incorporate requirement subsections where previously section 8 ambiguously included various requirements under recommendation subheadings. Commenters identified typographical errors that have been corrected along with appropriate clarifications in this section.

The Background Concentration subsection has been significantly modified from the existing *Guideline* to include a clearer and more comprehensive discussion of "nearby" and "other" sources. This is intended to eliminate confusion over how to identify nearby sources that should be explicitly modeled and all other sources that should be generally represented by air quality monitoring data. In addition, a brief discussion on the use of photochemical grid modeling to appropriately characterize background concentrations has been included in this section. Updates to Tables 8–1 and 8–2 are made per changes in the considerations for nearby sources, as discussed in section IV.A.8 of this preamble. Based on several public comments, Table 8–2 was further updated to correctly state that the operational level for nearby sources for short-term average times is the "temporally representative level when actually operating, reflective of the most recent 2 years."

The use of prognostic mesoscale meteorological models to provide meteorological input for regulatory dispersion modeling applications has been incorporated throughout the "Meteorological Input Data" subsection, including the introduction of the MMIF as a tool to inform regulatory model applications. We made additional minor modifications to the recommendations in this subsection based on current EPA practices, of which the most substantive edit was the recommendation to use the AERMINUTE meteorological data processor to calculate hourly average wind speed and direction when processing NWS ASOS data for developing AERMET meteorological inputs to the AERMOD dispersion model.

10. Section 9

As proposed, we moved all of the information previously in section 9 related to model accuracy and evaluation into other sections in the revised *Guideline* (primarily to the revised section 2 and some to the revised section 4). This provides greater clarity in those topics as applied to selection of models under the *Guideline.* We removed a subsection on the "Use of Uncertainty in Decision Making." Also, we revised section 9 to focus on the regulatory application of models, which includes the majority of the information found previously in section 10.

We revised the discussion portion of section 9 to more clearly summarize the general concepts presented in earlier sections of the *Guideline* and to set the stage for the appropriate regulatory application of models and/or, in rare circumstances, air quality monitoring data in lieu of modeling. The importance of developing and vetting a modeling protocol is more prominently presented in a separate subsection.

The information related to design concentrations is updated and unified from previous language found in sections 7 and 10. An expanded discussion of receptor sites is based on language from the previous section 7 and new considerations given past practices of model users tending to define an excessively large and inappropriate number of receptors based on vague guidance.

We added the recommendations for NAAQS and PSD increments compliance demonstrations that had been in section 10. In additions, we updated the recommendations to more clearly and accurately reflect the long-standing practice of performing a single-source impact analysis as a first stage of the NAAQS and PSD increments compliance demonstration and, as necessary, conducting a more comprehensive cumulative impact analysis as the second stage. The appropriate considerations and applications of screening and/or refined model are described in each stage.

Finally, we revised the "Use of Measured Data in Lieu of Model Estimates" subsection to provide more details on the process for determining the rare circumstances in which air quality monitoring data may be considered for determining the most appropriate emissions limit for a modification to an existing source. As with other portions of the revised section 9, the language throughout this subsection is updated to reflect current EPA practices, as appropriate.

11. Section 10

As proposed, we incorporated the majority of the information found previously in section 10 into the revised section 9. Section 10 now consists of the references that were in the previous section 12. Each reference is updated, as appropriate, based on the text revisions throughout the *Guideline.*

12. Section 11

In a streamlining effort, we removed the bibliography section from the *Guideline* as proposed.

13. Section 12

As stated earlier, this references section is now section 10 with appropriate updates.

14. Appendix A to the *Guideline*

As proposed, we revised appendix A to the *Guideline* to remove the BLP model, CALINE3, and CALPUFF as refined air quality models preferred for specific regulatory applications. The rationale for the removal of these air quality models from the preferred status can be found in section IV.A.2, section IV.A.4, and section IV.A.6 of this preamble. Finally, we made minor modifications, including a few typographical corrections, to appendix A based on public comment and additional review of the proposed regulatory text.

V. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review

This action is a significant regulatory action that was submitted to the Office of Management and Budget (OMB) for review. The OMB determined that this regulatory action could potentially interfere with an action taken or planned by another agency. Any changes made in response to OMB recommendations have been documented in the docket.

B. Paperwork Reduction Act (PRA)

This final action does not impose an information collection burden under the PRA. This action does not contain any information collection activities, nor does it add any information collection requirements beyond those imposed by existing NSR requirements.

C. Regulatory Flexibility Act (RFA)

I certify that this action will not have a significant economic impact on a substantial number of small entities under the RFA. In making this determination, the impact of concern is any significant adverse economic impact on small entities. An agency may certify that a rule will not have a significant economic impact on a substantial number of small entities if the rule relieves regulatory burden, has no net burden or otherwise has a positive economic effect on the small entities subject to the rule.

The modeling techniques described in this action are primarily used by air agencies and by industries owning major sources subject to NSR permitting requirements. To the extent that any small entities would have to conduct air quality assessments, using the models and/or techniques described in this action are not expected to pose any additional burden on these entities. The

revisions to the existing EPA-preferred model, AERMOD, serve to increase efficiency and accuracy by changing only mathematical formulations and specific data elements. Also, this action will streamline resources necessary to conduct modeling with AERMOD by incorporating model algorithms from the BLP model. Although this final action calls for new models and/or techniques for use in addressing ozone and secondary $PM_{2.5}$, we expect most small entities will generally be able to rely on existing modeling simulations. We have, therefore, concluded that this action will have no net regulatory burden for all directly regulated small entities.

D. Unfunded Mandates Reform Act (UMRA)

This action does not contain an unfunded mandate of $100 million or more as described in UMRA, 2 U.S.C. 1531–1538 and does not significantly or uniquely affect small governments. This action imposes no enforceable duty on any state, local or tribal governments or the private sector beyond those imposed by the existing NSR requirements.

E. Executive Order 13132: Federalism

This action does not have federalism implications. It will not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

This action does not have tribal implications, as specified in Executive Order 13175. The final rule provides revisions to the *Guideline* which is used by the EPA, other federal, state, territorial, local, and tribal air quality agencies, and industry to prepare and review new source permits, source permit modifications, SIP submittals and revisions, conformity, and other air quality assessments required under EPA regulation. The Tribal Air Rule implements the provisions of section 301(d) of the CAA authorizing eligible tribes to implement their own tribal air program. Thus, Executive Order 13175 does not apply to this action. In the spirit of Executive Order 13175, the EPA provided an informational webinar with the National Tribal Air Association (NTAA) on September 10, 2015, and also received comment on the proposed action from the NTAA and several individual tribes. These comments and our responses are included in the docket for this action.

G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks

The EPA interprets Executive Order 13045 as applying only to those regulatory actions that concern environmental health or safety risks that the EPA has reason to believe may disproportionately affect children, per the definition of "covered regulatory action" in section 2–202 of the Executive Order. This action is not subject to Executive Order 13045 because it does not concern an environmental health risk or safety risk.

H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use

This action is not a "significant energy action" as defined in Executive Order 13211 (66 FR 28355, May 22, 2001), because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. Further, we have concluded that this action is not likely to have any adverse energy effects because its purpose is to streamline the procedures by which stakeholders apply air quality modeling and technique in conducting their air quality assessments required under the CAA and, also, increases the scientific credibility and accuracy of the models and techniques used for conducting these assessments.

I. National Technology Transfer and Advancement Act

This rulemaking does not involve technical standards.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

The EPA believes that this action is not subject to Executive Order 12898 (59 FR 7629, February 16, 1994) because it does not establish an environmental health or safety standard. This regulatory action provides updates and clarifications to the *Guideline* and does not have any impact on human health or the environment.

K. Congressional Review Act (CRA)

This action is subject to the Congressional Review Act (CRA), and the EPA will submit a rule report to each House of the Congress and to the Comptroller General of the United States. This action is not a "major rule" as defined by 5 U.S.C. 804(2).

List of Subjects in 40 CFR Part 51

Environmental protection, Administrative practice and procedure, Air pollution control, Carbon monoxide, Intergovernmental relations, Nitrogen oxides, Ozone, Particulate matter, Reporting and recordkeeping requirements, Sulfur oxides.

Dated: December 20, 2016.

Gina McCarthy,

Administrator.

For the reasons stated in the preamble, the Environmental Protection Agency is amending title 40, chapter I of the Code of Federal Regulations as follows:

PART 51—REQUIREMENTS FOR PREPARATION, ADOPTION, AND SUBMITTAL OF IMPLEMENTATION PLANS

■ 1. The authority citation for part 51 continues to read as follows:

Authority: 23 U.S.C. 101; 42 U.S.C. 7401–7671q.

■ 2. Appendix W to part 51 is revised to read as follows:

Appendix W to Part 51—Guideline on Air Quality Models

Preface

a. Industry and control agencies have long expressed a need for consistency in the application of air quality models for regulatory purposes. In the 1977 Clean Air Act (CAA), Congress mandated such consistency and encouraged the standardization of model applications. The *Guideline on Air Quality Models* (hereafter, *Guideline*) was first published in April 1978 to satisfy these requirements by specifying models and providing guidance for their use. The *Guideline* provides a common basis for estimating the air quality concentrations of criteria pollutants used in assessing control strategies and developing emissions limits.

b. The continuing development of new air quality models in response to regulatory requirements and the expanded requirements for models to cover even more complex problems have emphasized the need for periodic review and update of guidance on these techniques. Historically, three primary activities have provided direct input to revisions of the *Guideline.* The first is a series of periodic EPA workshops and modeling conferences conducted for the purpose of ensuring consistency and providing clarification in the application of models. The second activity was the solicitation and review of new models from the technical and user community. In the March 27, 1980, **Federal Register**, a procedure was outlined for the submittal to the EPA of privately developed models. After extensive evaluation and scientific review, these models, as well as those made available by the EPA, have been considered for recognition in the *Guideline.* The third activity is the extensive on-going research efforts by the EPA and

others in air quality and meteorological modeling.

c. Based primarily on these three activities, new sections and topics have been included as needed. The EPA does not make changes to the guidance on a predetermined schedule, but rather on an as-needed basis. The EPA believes that revisions of the *Guideline* should be timely and responsive to user needs and should involve public participation to the greatest possible extent. All future changes to the guidance will be proposed and finalized in the **Federal Register**. Information on the current status of modeling guidance can always be obtained from the EPA's Regional Offices.

Table of Contents

List of Tables

1.0 Introduction
2.0 Overview of Model Use
2.1 Suitability of Models
2.1.1 Model Accuracy and Uncertainty
2.2 Levels of Sophistication of Air Quality Analyses and Models
2.3 Availability of Models
3.0 Preferred and Alternative Air Quality Models
3.1 Preferred Models
3.1.1 Discussion
3.1.2 Requirements
3.2 Alternative Models
3.2.1 Discussion
3.2.2 Requirements
3.3 EPA's Model Clearinghouse
4.0 Models for Carbon Monoxide, Lead, Sulfur Dioxide, Nitrogen Dioxide and Primary Particulate Matter
4.1 Discussion
4.2 Requirements
4.2.1 Screening Models and Techniques
4.2.1.1 AERSCREEN
4.2.1.2 CTSCREEN
4.2.1.3 Screening in Complex Terrain
4.2.2 Refined Models
4.2.2.1 AERMOD
4.2.2.2 CTDMPLUS
4.2.2.3 OCD
4.2.3 Pollutant Specific Modeling Requirements
4.2.3.1 Models for Carbon Monoxide
4.2.3.2 Models for Lead
4.2.3.3 Models for Sulfur Dioxide
4.2.3.4 Models for Nitrogen Dioxide
4.2.3.5 Models for $PM_{2.5}$
4.2.3.6 Models for PM_{10}
5.0 Models for Ozone and Secondarily Formed Particulate Matter
5.1 Discussion
5.2 Recommendations
5.3 Recommended Models and Approaches for Ozone
5.3.1 Models for NAAQS Attainment Demonstrations and Multi-Source Air Quality Assessments
5.3.2 Models for Single-Source Air Quality Assessments
5.4 Recommended Models and Approaches for Secondarily Formed $PM_{2.5}$
5.4.1 Models for NAAQS Attainment Demonstrations and Multi-Source Air Quality Assessments
5.4.2 Models for Single-Source Air Quality Assessments
6.0 Modeling for Air Quality Related Values and Other Governmental Programs
6.1 Discussion
6.2 Air Quality Related Values
6.2.1 Visibility
6.2.1.1 Models for Estimating Near-Field Visibility Impairment
6.2.1.2 Models for Estimating Visibility Impairment for Long-Range Transport
6.2.2 Models for Estimating Deposition Impacts
6.3 Modeling Guidance for Other Governmental Programs
7.0 General Modeling Considerations
7.1 Discussion
7.2 Recommendations
7.2.1 All sources
7.2.1.1 Dispersion Coefficients
7.2.1.2 Complex Winds
7.2.1.3 Gravitational Settling and Deposition
7.2.2 Stationary Sources
7.2.2.1 Good Engineering Practice Stack Height
7.2.2.2 Plume Rise
7.2.3 Mobile Sources
8.0 Model Input Data
8.1 Modeling Domain
8.1.1 Discussion
8.1.2 Requirements
8.2 Source Data
8.2.1 Discussion
8.2.2 Requirements
8.3 Background Concentrations
8.3.1 Discussion
8.3.2 Recommendations for Isolated Single Sources
8.3.3 Recommendations for Multi-Source Areas
8.4 Meteorological Input Data
8.4.1 Discussion
8.4.2 Recommendations and Requirements
8.4.3 National Weather Service Data
8.4.3.1 Discussion
8.4.3.2 Recommendations
8.4.4 Site-specific data
8.4.4.1 Discussion
8.4.4.2 Recommendations
8.4.5 Prognostic meteorological data
8.4.5.1 Discussion
8.4.5.2 Recommendations
8.4.6 Treatment of Near-Calms and Calms
8.4.6.1 Discussion
8.4.6.2 Recommendations
9.0 Regulatory Application of Models
9.1 Discussion
9.2 Recommendations
9.2.1 Modeling Protocol
9.2.2 Design Concentration and Receptor Sites
9.2.3 NAAQS and PSD Increments Compliance Demonstrations for New or Modified Sources
9.2.3.1 Considerations in Developing Emissions Limits
9.2.4 Use of Measured Data in Lieu of Model Estimates
10.0 References
Appendix A to Appendix W of Part 51—Summaries of Preferred Air Quality Models

List of Tables

Table No.	Title
8–1	Point Source Model Emission Inputs for SIP Revisions of Inert Pollutants.
8–2	Point Source Model Emission Inputs for NAAQS Compliance in PSD Demonstrations.

1.0 Introduction

a. The *Guideline* provides air quality modeling techniques that should be applied to State Implementation Plan (SIP) submittals and revisions, to New Source Review (NSR), including new or modifying sources under Prevention of Significant Deterioration (PSD),[1 2 3] conformity analyses,[4] and other air quality assessments required under EPA regulation. Applicable only to criteria air pollutants, the *Guideline* is intended for use by the EPA Regional Offices in judging the adequacy of modeling analyses performed by the EPA, by state, local, and tribal permitting authorities, and by industry. It is appropriate for use by other federal government agencies and by state, local, and tribal agencies with air quality and land management responsibilities. The *Guideline* serves to identify, for all interested parties, those modeling techniques and databases that the EPA considers acceptable. The *Guideline* is not intended to be a compendium of modeling techniques. Rather, it should serve as a common measure of acceptable technical analysis when supported by sound scientific judgment.

b. Air quality measurements[5] are routinely used to characterize ambient concentrations of criteria pollutants throughout the nation but are rarely sufficient for characterizing the ambient impacts of individual sources or demonstrating adequacy of emissions limits for an existing source due to limitations in spatial and temporal coverage of ambient monitoring networks. The impacts of new sources that do not yet exist, and modifications to existing sources that have yet to be implemented, can only be determined through modeling. Thus, models have become a primary analytical tool in most air quality assessments. Air quality measurements can be used in a complementary manner to air quality models, with due regard for the strengths and weaknesses of both analysis techniques, and are particularly useful in assessing the accuracy of model estimates.

c. It would be advantageous to categorize the various regulatory programs and to apply a designated model to each proposed source needing analysis under a given program. However, the diversity of the nation's topography and climate, and variations in source configurations and operating characteristics dictate against a strict modeling "cookbook." There is no one model capable of properly addressing all conceivable situations even within a broad category such as point sources. Meteorological phenomena associated with threats to air quality standards are rarely amenable to a single mathematical treatment; thus, case-by-case analysis and judgment are frequently required. As modeling efforts become more complex, it is increasingly important that they be directed by highly competent individuals with a broad range of experience and knowledge in air quality

meteorology. Further, they should be coordinated closely with specialists in emissions characteristics, air monitoring and data processing. The judgment of experienced meteorologists, atmospheric scientists, and analysts is essential.

d. The model that most accurately estimates concentrations in the area of interest is always sought. However, it is clear from the needs expressed by the EPA Regional Offices, by state, local, and tribal agencies, by many industries and trade associations, and also by the deliberations of Congress, that consistency in the selection and application of models and databases should also be sought, even in case-by-case analyses. Consistency ensures that air quality control agencies and the general public have a common basis for estimating pollutant concentrations, assessing control strategies, and specifying emissions limits. Such consistency is not, however, promoted at the expense of model and database accuracy. The *Guideline* provides a consistent basis for selection of the most accurate models and databases for use in air quality assessments.

e. Recommendations are made in the *Guideline* concerning air quality models and techniques, model evaluation procedures, and model input databases and related requirements. The guidance provided here should be followed in air quality analyses relative to SIPs, NSR, and in supporting analyses required by the EPA and by state, local, and tribal permitting authorities. Specific models are identified for particular applications. The EPA may approve the use of an alternative model or technique that can be demonstrated to be more appropriate than those recommended in the *Guideline*. In all cases, the model or technique applied to a given situation should be the one that provides the most accurate representation of atmospheric transport, dispersion, and chemical transformations in the area of interest. However, to ensure consistency, deviations from the *Guideline* should be carefully documented as part of the public record and fully supported by the appropriate reviewing authority, as discussed later.

f. From time to time, situations arise requiring clarification of the intent of the guidance on a specific topic. Periodic workshops are held with EPA headquarters, EPA Regional Offices, and state, local, and tribal agency modeling representatives to ensure consistency in modeling guidance and to promote the use of more accurate air quality models, techniques, and databases. The workshops serve to provide further explanations of *Guideline* requirements to the EPA Regional Offices and workshop materials are issued with this clarifying information. In addition, findings from ongoing research programs, new model development, or results from model evaluations and applications are continuously evaluated. Based on this information, changes in the applicable guidance may be indicated and appropriate revisions to the *Guideline* may be considered.

g. All changes to the *Guideline* must follow rulemaking requirements since the *Guideline* is codified in appendix W to 40 Code of Federal Regulations (CFR) part 51. The EPA will promulgate proposed and final rules in the **Federal Register** to amend this appendix. The EPA utilizes the existing procedures under CAA section 320 that requires the EPA to conduct a Conference on Air Quality Modeling at least every 3 years (CAA 320, 42 U.S.C. 7620). These modeling conferences are intended to develop standardized air quality modeling procedures and form the basis for associated revisions to this *Guideline* in support of the EPA's continuing effort to prescribe with "reasonable particularity" air quality models and meteorological and emission databases suitable for modeling National Ambient Air Quality Standards (NAAQS)[6] and PSD increments. Ample opportunity for public comment will be provided for each proposed change and public hearings scheduled.

h. A wide range of topics on modeling and databases are discussed in the *Guideline*. Section 2 gives an overview of models and their suitability for use in regulatory applications. Section 3 provides specific guidance on the determination of preferred air quality models and on the selection of alternative models or techniques. Sections 4 through 6 provide recommendations on modeling techniques for assessing criteria pollutant impacts from single and multiple sources with specific modeling requirements for selected regulatory applications. Section 7 discusses general considerations common to many modeling analyses for stationary and mobile sources. Section 8 makes recommendations for data inputs to models including source, background air quality, and meteorological data. Section 9 summarizes how estimates and measurements of air quality are used in assessing source impact and in evaluating control strategies.

i. Appendix W to 40 CFR part 51 contains an appendix: Appendix A. Thus, when reference is made to "appendix A" in this document, it refers to appendix A to appendix W to 40 CFR part 51. Appendix A contains summaries of refined air quality models that are "preferred" for particular applications; both EPA models and models developed by others are included.

2.0 Overview of Model Use

a. Increasing reliance has been placed on concentration estimates from air quality models as the primary basis for regulatory decisions concerning source permits and emission control requirements. In many situations, such as review of a proposed new source, no practical alternative exists. Before attempting to implement the guidance contained in this document, the reader should be aware of certain general information concerning air quality models and their evaluation and use. Such information is provided in this section.

2.1 Suitability of Models

a. The extent to which a specific air quality model is suitable for the assessment of source impacts depends upon several factors. These include: (1) The topographic and meteorological complexities of the area; (2) the detail and accuracy of the input databases, *i.e.*, emissions inventory, meteorological data, and air quality data; (3) the manner in which complexities of atmospheric processes are handled in the model; (4) the technical competence of those undertaking such simulation modeling; and (5) the resources available to apply the model. Any of these factors can have a significant influence on the overall model performance, which must be thoroughly evaluated to determine the suitability of an air quality model to a particular application or range of applications.

b. Air quality models are most accurate and reliable in areas that have gradual transitions of land use and topography. Meteorological conditions in these areas are spatially uniform such that observations are broadly representative and air quality model projections are not further complicated by a heterogeneous environment. Areas subject to major topographic influences experience meteorological complexities that are often difficult to measure and simulate. Models with adequate performance are available for increasingly complex environments. However, they are resource intensive and frequently require site-specific observations and formulations. Such complexities and the related challenges for the air quality simulation should be considered when selecting the most appropriate air quality model for an application.

c. Appropriate model input data should be available before an attempt is made to evaluate or apply an air quality model. Assuming the data are adequate, the greater the detail with which a model considers the spatial and temporal variations in meteorological conditions and permit-enforceable emissions, the greater the ability to evaluate the source impact and to distinguish the effects of various control strategies.

d. There are three types of models that have historically been used in the regulatory demonstrations applicable in the *Guideline*, each having strengths and weaknesses that lend themselves to particular regulatory applications.

i. Gaussian plume models use a "steady-state" approximation, which assumes that over the model time step, the emissions, meteorology and other model inputs, are constant throughout the model domain, resulting in a resolved plume with the emissions distributed throughout the plume according to a Gaussian distribution. This formulation allows Gaussian models to estimate near-field impacts of a limited number of sources at a relatively high resolution, with temporal scales of an hour and spatial scales of meters. However, this formulation allows for only relatively inert pollutants, with very limited considerations of transformation and removal (*e.g.*, deposition), and further limits the domain for which the model may be used. Thus, Gaussian models may not be appropriate if model inputs are changing sharply over the model time step or within the desired model domain, or if more advanced considerations of chemistry are needed.

ii. Lagrangian puff models, on the other hand, are non-steady-state, and assume that model input conditions are changing over the model domain and model time step. Lagrangian models can also be used to determine near- and far-field impacts from a

limited number of sources. Traditionally, Lagrangian models have been used for relatively inert pollutants, with slightly more complex considerations of removal than Gaussian models. Some Lagrangian models treat in-plume gas and particulate chemistry. However, these models require time and space varying concentration fields of oxidants and, in the case of fine particulate matter ($PM_{2.5}$), neutralizing agents, such as ammonia. Reliable background fields are critical for applications involving secondary pollutant formation because secondary impacts generally occur when in-plume precursors mix and react with species in the background atmosphere.[7 8] These oxidant and neutralizing agents are not routinely measured, but can be generated with a three-dimensional photochemical grid model.

iii. Photochemical grid models are three-dimensional Eulerian grid-based models that treat chemical and physical processes in each grid cell and use diffusion and transport processes to move chemical species between grid cells.[9] Eulerian models assume that emissions are spread evenly throughout each model grid cell. At coarse grid resolutions, Eulerian models have difficulty with fine scale resolution of individual plumes. However, these types of models can be appropriately applied for assessment of near-field and regional scale reactive pollutant impacts from specific sources [7 10 11 12] or all sources.[13 14 15] Photochemical grid models simulate a more realistic environment for chemical transformation,[7 12] but simulations can be more resource intensive than Lagrangian or Gaussian plume models.

e. Competent and experienced meteorologists, atmospheric scientists, and analysts are an essential prerequisite to the successful application of air quality models. The need for such specialists is critical when sophisticated models are used or the area has complicated meteorological or topographic features. It is important to note that a model applied improperly or with inappropriate data can lead to serious misjudgments regarding the source impact or the effectiveness of a control strategy.

f. The resource demands generated by use of air quality models vary widely depending on the specific application. The resources required may be important factors in the selection and use of a model or technique for a specific analysis. These resources depend on the nature of the model and its complexity, the detail of the databases, the difficulty of the application, the amount and level of expertise required, and the costs of manpower and computational facilities.

2.1.1 Model Accuracy and Uncertainty

a. The formulation and application of air quality models are accompanied by several sources of uncertainty. "Irreducible" uncertainty stems from the "unknown" conditions, which may not be explicitly accounted for in the model (*e.g.*, the turbulent velocity field). Thus, there are likely to be deviations from the observed concentrations in individual events due to variations in the unknown conditions. "Reducible" uncertainties [16] are caused by: (1) Uncertainties in the "known" input conditions (*e.g.*, emission characteristics and meteorological data); (2) errors in the measured concentrations; and (3) inadequate model physics and formulation.

b. Evaluations of model accuracy should focus on the reducible uncertainty associated with physics and the formulation of the model. The accuracy of the model is normally determined by an evaluation procedure which involves the comparison of model concentration estimates with measured air quality data.[17] The statement of model accuracy is based on statistical tests or performance measures such as bias, error, correlation, etc.[18 19]

c. Since the 1980's, the EPA has worked with the modeling community to encourage development of standardized model evaluation methods and the development of continually improved methods for the characterization of model performance.[16 18 20 21 22] There is general consensus on what should be considered in the evaluation of air quality models; namely, quality assurance planning, documentation and scrutiny should be consistent with the intended use and should include:

- Scientific peer review;
- Supportive analyses (diagnostic evaluations, code verification, sensitivity analyses);
- Diagnostic and performance evaluations with data obtained in trial locations; and
- Statistical performance evaluations in the circumstances of the intended applications.

Performance evaluations and diagnostic evaluations assess different qualities of how well a model is performing, and both are needed to establish credibility within the client and scientific community.

d. Performance evaluations allow the EPA and model users to determine the relative performance of a model in comparison with alternative modeling systems. Diagnostic evaluations allow determination of a model capability to simulate individual processes that affect the results, and usually employ smaller spatial/temporal scale data sets (*e.g.*, field studies). Diagnostic evaluations enable the EPA and model users to build confidence that model predictions are accurate for the right reasons. However, the objective comparison of modeled concentrations with observed field data provides only a partial means for assessing model performance. Due to the limited supply of evaluation datasets, there are practical limits in assessing model performance. For this reason, the conclusions reached in the science peer reviews and the supportive analyses have particular relevance in deciding whether a model will be useful for its intended purposes.

2.2 Levels of Sophistication of Air Quality Analyses and Models

a. It is desirable to begin an air quality analysis by using simplified and conservative methods followed, as appropriate, by more complex and refined methods. The purpose of this approach is to streamline the process and sufficiently address regulatory requirements by eliminating the need of more detailed modeling when it is not necessary in a specific regulatory application. For example, in the context of a PSD permit application, a simplified and conservative analysis may be sufficient where it shows the proposed construction clearly will not cause or contribute to ambient concentrations in excess of either the NAAQS or the PSD increments.[2 3]

b. There are two general levels of sophistication of air quality models. The first level consists of screening models that provide conservative modeled estimates of the air quality impact of a specific source or source category based on simplified assumptions of the model inputs (*e.g.*, preset, worst-case meteorological conditions). In the case of a PSD assessment, if a screening model indicates that the increase in concentration attributable to the source could cause or contribute to a violation of any NAAQS or PSD increment, then the second level of more sophisticated models should be applied unless appropriate controls or operational restrictions are implemented based on the screening modeling.

c. The second level consists of refined models that provide more detailed treatment of physical and chemical atmospheric processes, require more detailed and precise input data, and provide spatially and temporally resolved concentration estimates. As a result, they provide a more sophisticated and, at least theoretically, a more accurate estimate of source impact and the effectiveness of control strategies.

d. There are situations where a screening model or a refined model is not available such that screening and refined modeling are not viable options to determine source-specific air quality impacts. In such situations, a screening technique or reduced-form model may be viable options for estimating source impacts.

i. Screening techniques are differentiated from a screening model in that screening techniques are approaches that make simplified and conservative assumptions about the physical and chemical atmospheric processes important to determining source impacts, while screening models make assumptions about conservative inputs to a specific model. The complexity of screening techniques ranges from simplified assumptions of chemistry applied to refined or screening model output to sophisticated approximations of the chemistry applied within a refined model.

ii. Reduced-form models are computationally efficient simulation tools for characterizing the pollutant response to specific types of emission reductions for a particular geographic area or background environmental conditions that reflect underlying atmospheric science of a refined model but reduce the computational resources of running a complex, numerical air quality model such as a photochemical grid model.

In such situations, an attempt should be made to acquire or improve the necessary databases and to develop appropriate analytical techniques, but the screening technique or reduced-form model may be sufficient in conducting regulatory modeling applications when applied in consultation with the EPA Regional Office.

e. Consistent with the general principle described in paragraph 2.2(a), the EPA may establish a demonstration tool or method as a sufficient means for a user or applicant to

make a demonstration required by regulation, either by itself or as part of a modeling demonstration. To be used for such regulatory purposes, such a tool or method must be reflected in a codified regulation or have a well-documented technical basis and reasoning that is contained or incorporated in the record of the regulatory decision in which it is applied.

2.3 Availability of Models

a. For most of the screening and refined models discussed in the *Guideline,* codes, associated documentation and other useful information are publicly available for download from the EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) Web site at *https://www.epa.gov/scram.* This is a Web site with which air quality modelers should become familiar and regularly visit for important model updates and additional clarifications and revisions to modeling guidance documents that are applicable to EPA programs and regulations. Codes and documentation may also be available from the National Technical Information Service (NTIS), *http://www.ntis.gov,* and, when available, is referenced with the appropriate NTIS accession number.

3.0 Preferred and Alternative Air Quality Models

a. This section specifies the approach to be taken in determining preferred models for use in regulatory air quality programs. The status of models developed by the EPA, as well as those submitted to the EPA for review and possible inclusion in this *Guideline,* is discussed in this section. The section also provides the criteria and process for obtaining EPA approval for use of alternative models for individual cases in situations where the preferred models are not applicable or available. Additional sources of relevant modeling information are: the EPA's Model Clearinghouse [23] (section 3.3); EPA modeling conferences; periodic Regional, State, and Local Modelers' Workshops; and the EPA's SCRAM Web site (section 2.3).

b. When approval is required for a specific modeling technique or analytical procedure in this *Guideline,* we refer to the "*appropriate reviewing authority.*" Many states and some local agencies administer NSR permitting under programs approved into SIPs. In some EPA regions, federal authority to administer NSR permitting and related activities has been delegated to state or local agencies. In these cases, such agencies "*stand in the shoes*" of the respective EPA Region. Therefore, depending on the circumstances, the appropriate reviewing authority may be an EPA Regional Office, a state, local, or tribal agency, or perhaps the Federal Land Manager (FLM). In some cases, the *Guideline* requires review and approval of the use of an alternative model by the EPA Regional Office (sometimes stated as "*Regional Administrator*"). For all approvals of alternative models or techniques, the EPA Regional Office will coordinate and shall seek concurrence with the EPA's Model Clearinghouse. If there is any question as to the appropriate reviewing authority, you should contact the EPA Regional Office modeling contact (*https://www3.epa.gov/ttn/scram/guidance_cont_regions.htm*), whose jurisdiction generally includes the physical location of the source in question and its expected impacts.

c. In all regulatory analyses, early discussions among the EPA Regional Office staff, state, local, and tribal agency staff, industry representatives, and where appropriate, the FLM, are invaluable and are strongly encouraged. Prior to the actual analyses, agreement on the databases to be used, modeling techniques to be applied, and the overall technical approach helps avoid misunderstandings concerning the final results and may reduce the later need for additional analyses. The preparation of a written modeling protocol that is vetted with the appropriate reviewing authority helps to keep misunderstandings and resource expenditures at a minimum.

d. The identification of preferred models in this *Guideline* should not be construed as a determination that the preferred models identified here are to be permanently used to the exclusion of all others or that they are the only models available for relating emissions to air quality. The model that most accurately estimates concentrations in the area of interest is always sought. However, designation of specific preferred models is needed to promote consistency in model selection and application.

3.1 Preferred Models

3.1.1 Discussion

a. The EPA has developed some models suitable for regulatory application, while other models have been submitted by private developers for possible inclusion in the *Guideline.* Refined models that are preferred and required by the EPA for particular applications have undergone the necessary peer scientific reviews [24 25] and model performance evaluation exercises [26 27] that include statistical measures of model performance in comparison with measured air quality data as described in section 2.1.1.

b. An American Society for Testing and Materials (ASTM) reference [28] provides a general philosophy for developing and implementing advanced statistical evaluations of atmospheric dispersion models, and provides an example statistical technique to illustrate the application of this philosophy. Consistent with this approach, the EPA has determined and applied a specific evaluation protocol that provides a statistical technique for evaluating model performance for predicting peak concentration values, as might be observed at individual monitoring locations.[29]

c. When a single model is found to perform better than others, it is recommended for application as a preferred model and listed in appendix A. If no one model is found to clearly perform better through the evaluation exercise, then the preferred model listed in appendix A may be selected on the basis of other factors such as past use, public familiarity, resource requirements, and availability. Accordingly, the models listed in appendix A meet these conditions:

i. The model must be written in a common programming language, and the executable(s) must run on a common computer platform.

ii. The model must be documented in a user's guide or model formulation report which identifies the mathematics of the model, data requirements and program operating characteristics at a level of detail comparable to that available for other recommended models in appendix A.

iii. The model must be accompanied by a complete test dataset including input parameters and output results. The test data must be packaged with the model in computer-readable form.

iv. The model must be useful to typical users, *e.g.,* state air agencies, for specific air quality control problems. Such users should be able to operate the computer program(s) from available documentation.

v. The model documentation must include a robust comparison with air quality data (and/or tracer measurements) or with other well-established analytical techniques.

vi. The developer must be willing to make the model and source code available to users at reasonable cost or make them available for public access through the Internet or National Technical Information Service. The model and its code cannot be proprietary.

d. The EPA's process of establishing a preferred model includes a determination of technical merit, in accordance with the above six items, including the practicality of the model for use in ongoing regulatory programs. Each model will also be subjected to a performance evaluation for an appropriate database and to a peer scientific review. Models for wide use (not just an isolated case) that are found to perform better will be proposed for inclusion as preferred models in future *Guideline* revisions.

e. No further evaluation of a preferred model is required for a particular application if the EPA requirements for regulatory use specified for the model in the *Guideline* are followed. Alternative models to those listed in appendix A should generally be compared with measured air quality data when they are used for regulatory applications consistent with recommendations in section 3.2.

3.1.2 Requirements

a. Appendix A identifies refined models that are preferred for use in regulatory applications. If a model is required for a particular application, the user must select a model from appendix A or follow procedures in section 3.2.2 for use of an alternative model or technique. Preferred models may be used without a formal demonstration of applicability as long as they are used as indicated in each model summary in appendix A. Further recommendations for the application of preferred models to specific source applications are found in subsequent sections of the *Guideline.*

b. If changes are made to a preferred model without affecting the modeled concentrations, the preferred status of the model is unchanged. Examples of modifications that do not affect concentrations are those made to enable use of a different computer platform or those that only affect the format or averaging time of the model results. The integration of a graphical user interface (GUI) to facilitate setting up the model inputs and/or analyzing the model results without otherwise altering the

preferred model code is another example of a modification that does not affect concentrations. However, when any changes are made, the Regional Administrator must require a test case example to demonstrate that the modeled concentrations are not affected.

c. A preferred model must be operated with the options listed in appendix A for its intended regulatory application. If the regulatory options are not applied, the model is no longer "preferred." Any other modification to a preferred model that would result in a change in the concentration estimates likewise alters its status so that it is no longer a preferred model. Use of the modified model must then be justified as an alternative model on a case-by-case basis to the appropriate reviewing authority and approved by the Regional Administrator.

d. Where the EPA has not identified a preferred model for a particular pollutant or situation, the EPA may establish a multi-tiered approach for making a demonstration required under PSD or another CAA program. The initial tier or tiers may involve use of demonstration tools, screening models, screening techniques, or reduced-form models; while the last tier may involve the use of demonstration tools, refined models or techniques, or alternative models approved under section 3.2.

3.2 Alternative Models

3.2.1 Discussion

a. Selection of the best model or techniques for each individual air quality analysis is always encouraged, but the selection should be done in a consistent manner. A simple listing of models in this *Guideline* cannot alone achieve that consistency nor can it necessarily provide the best model for all possible situations. As discussed in section 3.1.1, the EPA has determined and applied a specific evaluation protocol that provides a statistical technique for evaluating model performance for predicting peak concentration values, as might be observed at individual monitoring locations.[29] This protocol is available to assist in developing a consistent approach when justifying the use of other-than-preferred models recommended in the *Guideline* (*i.e.,* alternative models). The procedures in this protocol provide a general framework for objective decision-making on the acceptability of an alternative model for a given regulatory application. These objective procedures may be used for conducting both the technical evaluation of the model and the field test or performance evaluation.

b. This subsection discusses the use of alternate models and defines three situations when alternative models may be used. This subsection also provides a procedure for implementing 40 CFR 51.166(l)(2) in PSD permitting. This provision requires written approval of the Administrator for any modification or substitution of an applicable model. An applicable model for purposes of 40 CFR 51.166(l) is a preferred model in appendix A to the *Guideline.* Approval to use an alternative model under section 3.2 of the *Guideline* qualifies as approval for the modification or substitution of a model under 40 CFR 51.166(l)(2). The Regional Administrators have delegated authority to issue such approvals under section 3.2 of the *Guideline,* provided that such approval is issued after consultation with the EPA's Model Clearinghouse and formally documented in a concurrence memorandum from the EPA's Model Clearinghouse which demonstrates that the requirements within section 3.2 for use of an alternative model have been met.

3.2.2 Requirements

a. Determination of acceptability of an alternative model is an EPA Regional Office responsibility in consultation with the EPA's Model Clearinghouse as discussed in paragraphs 3.0(b) and 3.2.1(b). Where the Regional Administrator finds that an alternative model is more appropriate than a preferred model, that model may be used subject to the approval of the EPA Regional Office based on the requirements of this subsection. This finding will normally result from a determination that: (1) A preferred air quality model is not appropriate for the particular application; or (2) a more appropriate model or technique is available and applicable.

b. An alternative model shall be evaluated from both a theoretical and a performance perspective before it is selected for use. There are three separate conditions under which such a model may be approved for use:

1. If a demonstration can be made that the model produces concentration estimates equivalent to the estimates obtained using a preferred model;

2. If a statistical performance evaluation has been conducted using measured air quality data and the results of that evaluation indicate the alternative model performs better for the given application than a comparable model in appendix A; or

3. If there is no preferred model.

Any one of these three separate conditions may justify use of an alternative model. Some known alternative models that are applicable for selected situations are listed on the EPA's SCRAM Web site (section 2.3). However, inclusion there does not confer any unique status relative to other alternative models that are being or will be developed in the future.

c. Equivalency, condition (1) in paragraph (b) of this subsection, is established by demonstrating that the appropriate regulatory metric(s) are within ± 2 percent of the estimates obtained from the preferred model. The option to show equivalency is intended as a simple demonstration of acceptability for an alternative model that is nearly identical (or contains options that can make it identical) to a preferred model that it can be treated for practical purposes as the preferred model. However, notwithstanding this demonstration, models that are not equivalent may be used when one of the two other conditions described in paragraphs (d) and (e) of this subsection are satisfied.

d. For condition (2) in paragraph (b) of this subsection, established statistical performance evaluation procedures and techniques [28 29] for determining the acceptability of a model for an individual case based on superior performance should be followed, as appropriate. Preparation and implementation of an evaluation protocol that is acceptable to both control agencies and regulated industry is an important element in such an evaluation.

e. Finally, for condition (3) in paragraph (b) of this subsection, an alternative model or technique may be approved for use provided that:

i. The model or technique has received a scientific peer review;

ii. The model or technique can be demonstrated to be applicable to the problem on a theoretical basis;

iii. The databases which are necessary to perform the analysis are available and adequate;

iv. Appropriate performance evaluations of the model or technique have shown that the model or technique is not inappropriately biased for regulatory application [a]; and

v. A protocol on methods and procedures to be followed has been established.

f. To formally document that the requirements of section 3.2 for use of an alternative model are satisfied for a particular application or range of applications, a memorandum will be prepared by the EPA's Model Clearinghouse through a consultative process with the EPA Regional Office.

3.3 EPA's Model Clearinghouse

a. The Regional Administrator has the authority to select models that are appropriate for use in a given situation. However, there is a need for assistance and guidance in the selection process so that fairness, consistency, and transparency in modeling decisions are fostered among the EPA Regional Offices and the state, local, and tribal agencies. To satisfy that need, the EPA established the Model Clearinghouse [23] to serve a central role of coordination and collaboration between EPA headquarters and the EPA Regional Offices. Additionally, the EPA holds periodic workshops with EPA Headquarters, EPA Regional Offices, and state, local, and tribal agency modeling representatives.

b. The appropriate EPA Regional Office should always be consulted for information and guidance concerning modeling methods and interpretations of modeling guidance, and to ensure that the air quality model user has available the latest most up-to-date policy and procedures. As appropriate, the EPA Regional Office may also request assistance from the EPA's Model Clearinghouse on other applications of models, analytical techniques, or databases or to clarify interpretation of the *Guideline* or related modeling guidance.

c. The EPA Regional Office will coordinate with the EPA's Model Clearinghouse after an initial evaluation and decision has been developed concerning the application of an alternative model. The acceptability and formal approval process for an alternative model is described in section 3.2.

[a] For PSD and other applications that use the model results in an absolute sense, the model should not be biased toward underestimates. Alternatively, for ozone and $PM_{2.5}$ SIP attainment demonstrations and other applications that use the model results in a relative sense, the model should not be biased toward overestimates.

4.0 Models for Carbon Monoxide, Lead, Sulfur Dioxide, Nitrogen Dioxide and Primary Particulate Matter

4.1 Discussion

a. This section identifies modeling approaches generally used in the air quality impact analysis of sources that emit the criteria pollutants carbon monoxide (CO), lead, sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and primary particulates ($PM_{2.5}$ and PM_{10}).

b. The guidance in this section is specific to the application of the Gaussian plume models identified in appendix A. Gaussian plume models assume that emissions and meteorology are in a steady-state, which is typically based on an hourly time step. This approach results in a plume that has an hourly-averaged distribution of emission mass according to a Gaussian curve through the plume. Though Gaussian steady-state models conserve the mass of the primary pollutant throughout the plume, they can still take into account a limited consideration of first-order removal processes (*e.g.*, wet and dry deposition) and limited chemical conversion (*e.g.*, OH oxidation).

c. Due to the steady-state assumption, Gaussian plume models are generally considered applicable to distances less than 50 km, beyond which, modeled predictions of plume impact are likely conservative. The locations of these impacts are expected to be unreliable due to changes in meteorology that are likely to occur during the travel time.

d. The applicability of Gaussian plume models may vary depending on the topography of the modeling domain, *i.e.*, simple or complex. Simple terrain is considered to be an area where terrain features are all lower in elevation than the top of the stack(s) of the source(s) in question. Complex terrain is defined as terrain exceeding the height of the stack(s) being modeled.

e. Gaussian models determine source impacts at discrete locations (receptors) for each meteorological and emission scenario, and generally attempt to estimate concentrations at specific sites that represent an ensemble average of numerous repetitions of the same "event." Uncertainties in model estimates are driven by this formulation, and as noted in section 2.1.1, evaluations of model accuracy should focus on the reducible uncertainty associated with physics and the formulation of the model. The "irreducible" uncertainty associated with Gaussian plume models may be responsible for variation in concentrations of as much as ± 50 percent.[30] "Reducible" uncertainties [16] can be on a similar scale. For example, Pasquill [31] estimates that, apart from data input errors, maximum ground-level concentrations at a given hour for a point source in flat terrain could be in error by 50 percent due to these uncertainties. Errors of 5 to 10 degrees in the measured wind direction can result in concentration errors of 20 to 70 percent for a particular time and location, depending on stability and station location. Such uncertainties do not indicate that an estimated concentration does not occur, only that the precise time and locations are in doubt. Composite errors in highest estimated concentrations of 10 to 40 percent are found to be typical.[32 33] However, estimates of concentrations paired in time and space with observed concentrations are less certain.

f. Model evaluations and inter-comparisons should take these aspects of uncertainty into account. For a regulatory application of a model, the emphasis of model evaluations is generally placed on the highest modeled impacts. Thus, the Cox-Tikvart model evaluation approach, which compares the highest modeled impacts on several timescales, is recommended for comparisons of models and measurements and model inter-comparisons. The approach includes bootstrap techniques to determine the significance of various modeled predictions and increases the robustness of such comparisons when the number of available measurements are limited.[34 35] Because of the uncertainty in paired modeled and observed concentrations, any attempts at calibration of models based on these comparisons is of questionable benefit and shall not be done.

4.2 Requirements

a. For NAAQS compliance demonstrations under PSD, use of the screening and preferred models for the pollutants listed in this subsection shall be limited to the near-field at a nominal distance of 50 km or less. Near-field application is consistent with capabilities of Gaussian plume models and, based on the EPA's assessment, is sufficient to address whether a source will cause or contribute to ambient concentrations in excess of a NAAQS. In most cases, maximum source impacts of inert pollutants will occur within the first 10 to 20 km from the source. Therefore, the EPA does not consider a long-range transport assessment beyond 50 km necessary for these pollutants if a near-field NAAQS compliance demonstration is required.[36]

b. For assessment of PSD increments within the near-field distance of 50 km or less, use of the screening and preferred models for the pollutants listed in this subsection shall be limited to the same screening and preferred models approved for NAAQS compliance demonstrations.

c. To determine if a compliance demonstration for NAAQS and/or PSD increments may be necessary beyond 50 km (*i.e.*, long-range transport assessment), the following screening approach shall be used to determine if a significant ambient impact will occur with particular focus on Class I areas and/or the applicable receptors that may be threatened at such distances.

i. Based on application in the near-field of the appropriate screening and/or preferred model, determine the significance of the ambient impacts at or about 50 km from the new or modifying source. If a near-field assessment is not available or this initial analysis indicates there may be significant ambient impacts at that distance, then further assessment is necessary.

ii. For assessment of the significance of ambient impacts for NAAQS and/or PSD increments, there is not a preferred model or screening approach for distances beyond 50 km. Thus, the appropriate reviewing authority (paragraph 3.0(b)) and the EPA Regional Office shall be consulted in determining the appropriate and agreed upon screening technique to conduct the second level assessment. Typically, a Lagrangian model is most appropriate to use for these second level assessments, but applicants shall reach agreement on the specific model and modeling parameters on a case-by-case basis in consultation with the appropriate reviewing authority (paragraph 3.0(b)) and EPA Regional Office. When Lagrangian models are used in this manner, they shall not include plume-depleting processes, such that model estimates are considered conservative, as is generally appropriate for screening assessments.

d. In those situations where a cumulative impact analysis for NAAQS and/or PSD increments analysis beyond 50 km is necessary, the selection and use of an alternative model shall occur in agreement with the appropriate reviewing authority (paragraph 3.0(b)) and approval by the EPA Regional Office based on the requirements of paragraph 3.2.2(e).

4.2.1 Screening Models and Techniques

a. Where a preliminary or conservative estimate is desired, point source screening techniques are an acceptable approach to air quality analyses.

b. As discussed in paragraph 2.2(a), screening models or techniques are designed to provide a conservative estimate of concentrations. The screening models used in most applications are the screening versions of the preferred models for refined applications. The two screening models, AERSCREEN [37 38] and CTSCREEN, are screening versions of AERMOD (American Meteorological Society (AMS)/EPA Regulatory Model) and CTDMPLUS (Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations), respectively. AERSCREEN is the recommended screening model for most applications in all types of terrain and for applications involving building downwash. For those applications in complex terrain where the application involves a well-defined hill or ridge, CTSCREEN [39] can be used.

c. Although AERSCREEN and CTSCREEN are designed to address a single-source scenario, there are approaches that can be used on a case-by-case basis to address multi-source situations using screening meteorology or other conservative model assumptions. However, the appropriate reviewing authority (paragraph 3.0(b)) shall be consulted, and concurrence obtained, on the protocol for modeling multiple sources with AERSCREEN or CTSCREEN to ensure that the worst case is identified and assessed.

d. As discussed in section 4.2.3.4, there are also screening techniques built into AERMOD that use simplified or limited chemistry assumptions for determining the partitioning of NO and NO_2 for NO_2 modeling. These screening techniques are part of the EPA's preferred modeling approach for NO_2 and do not need to be approved as an alternative model. However, as with other screening models and techniques, their usage shall occur in agreement with the appropriate reviewing authority (paragraph 3.0(b)).

e. As discussed in section 4.2(c)(ii), there are screening techniques needed for long-range transport assessments that will typically involve the use of a Lagrangian model. Based on the long-standing practice and documented capabilities of these models for long-range transport assessments, the use of a Lagrangian model as a screening technique for this purpose does not need to be approved as an alternative model. However, their usage shall occur in consultation with the appropriate reviewing authority (paragraph 3.0(b)) and EPA Regional Office.

f. All screening models and techniques shall be configured to appropriately address the site and problem at hand. Close attention must be paid to whether the area should be classified urban or rural in accordance with section 7.2.1.1. The climatology of the area must be studied to help define the worst-case meteorological conditions. Agreement shall be reached between the model user and the appropriate reviewing authority (paragraph 3.0(b)) on the choice of the screening model or technique for each analysis, on the input data and model settings, and the appropriate metric for satisfying regulatory requirements.

4.2.1.1 AERSCREEN

a. Released in 2011, AERSCREEN is the EPA's recommended screening model for simple and complex terrain for single sources including point sources, area sources, horizontal stacks, capped stacks, and flares. AERSCREEN runs AERMOD in a screening mode and consists of two main components: 1) the MAKEMET program which generates a site-specific matrix of meteorological conditions for input to the AERMOD model; and 2) the AERSCREEN command-prompt interface.

b. The MAKEMET program generates a matrix of meteorological conditions, in the form of AERMOD-ready surface and profile files, based on user-specified surface characteristics, ambient temperatures, minimum wind speed, and anemometer height. The meteorological matrix is generated based on looping through a range of wind speeds, cloud covers, ambient temperatures, solar elevation angles, and convective velocity scales (w^*, for convective conditions only) based on user-specified surface characteristics for surface roughness (Z_o), Bowen ratio (B_o), and albedo (r). For unstable cases, the convective mixing height (Z_{ic}) is calculated based on w^*, and the mechanical mixing height (Z_{im}) is calculated for unstable and stable conditions based on the friction velocity, u^*.

c. For applications involving simple or complex terrain, AERSCREEN interfaces with AERMAP. AERSCREEN also interfaces with BPIPPRM to provide the necessary building parameters for applications involving building downwash using the Plume Rise Model Enhancements (PRIME) downwash algorithm. AERSCREEN generates inputs to AERMOD via MAKEMET, AERMAP, and BPIPPRM and invokes AERMOD in a screening mode. The screening mode of AERMOD forces the AERMOD model calculations to represent values for the plume centerline, regardless of the source-receptor-wind direction orientation. The maximum concentration output from AERSCREEN represents a worst-case 1-hour concentration. Averaging-time scaling factors of 1.0 for 3-hour, 0.9 for 8-hour, 0.60 for 24-hour, and 0.10 for annual concentration averages are applied internally by AERSCREEN to the highest 1-hour concentration calculated by the model for non-area type sources. For area type source concentrations for averaging times greater than one hour, the concentrations are equal to the 1-hour estimates.[37 40]

4.2.1.2 CTSCREEN

a. CTSCREEN[39 41] can be used to obtain conservative, yet realistic, worst-case estimates for receptors located on terrain above stack height. CTSCREEN accounts for the three-dimensional nature of plume and terrain interaction and requires detailed terrain data representative of the modeling domain. The terrain data must be digitized in the same manner as for CTDMPLUS and a terrain processor is available.[42] CTSCREEN is designed to execute a fixed matrix of meteorological values for wind speed (u), standard deviation of horizontal and vertical wind speeds (σv, σw), vertical potential temperature gradient ($d\theta/dz$), friction velocity (u^*), Monin-Obukhov length (L), mixing height (z_i) as a function of terrain height, and wind directions for both neutral/stable conditions and unstable convective conditions. The maximum concentration output from CTSCREEN represents a worst-case 1-hour concentration. Time-scaling factors of 0.7 for 3-hour, 0.15 for 24-hour and 0.03 for annual concentration averages are applied internally by CTSCREEN to the highest 1-hour concentration calculated by the model.

4.2.1.3 Screening in Complex Terrain

a. For applications utilizing AERSCREEN, AERSCREEN automatically generates a polar-grid receptor network with spacing determined by the maximum distance to model. If the application warrants a different receptor network than that generated by AERSCREEN, it may be necessary to run AERMOD in screening mode with a user-defined network. For CTSCREEN applications or AERMOD in screening mode outside of AERSCREEN, placement of receptors requires very careful attention when modeling in complex terrain. Often the highest concentrations are predicted to occur under very stable conditions, when the plume is near or impinges on the terrain. Under such conditions, the plume may be quite narrow in the vertical, so that even relatively small changes in a receptor's location may substantially affect the predicted concentration. Receptors within about a kilometer of the source may be even more sensitive to location. Thus, a dense array of receptors may be required in some cases.

b. For applications involving AERSCREEN, AERSCREEN interfaces with AERMAP to generate the receptor elevations. For applications involving CTSCREEN, digitized contour data must be preprocessed[42] to provide hill shape parameters in suitable input format. The user then supplies receptor locations either through an interactive program that is part of the model or directly, by using a text editor; using both methods to select receptor locations will generally be necessary to assure that the maximum concentrations are estimated by either model. In cases where a terrain feature may "appear to the plume" as smaller, multiple hills, it may be necessary to model the terrain both as a single feature and as multiple hills to determine design concentrations.

c. Other screening techniques may be acceptable for complex terrain cases where established procedures[43] are used. The user is encouraged to confer with the appropriate reviewing authority (paragraph 3.0(b)) if any unforeseen problems are encountered, *e.g.*, applicability, meteorological data, receptor siting, or terrain contour processing issues.

4.2.2 Refined Models

a. A brief description of each preferred model for refined applications is found in appendix A. Also listed in that appendix are availability, the model input requirements, the standard options that shall be selected when running the program, and output options.

4.2.2.1 AERMOD

a. For a wide range of regulatory applications in all types of terrain, and for aerodynamic building downwash, the required model is AERMOD.[44 45] The AERMOD regulatory modeling system consists of the AERMOD dispersion model, the AERMET meteorological processor, and the AERMAP terrain processor. AERMOD is a steady-state Gaussian plume model applicable to directly emitted air pollutants that employs best state-of-practice parameterizations for characterizing the meteorological influences and dispersion. Differentiation of simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the well-known dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions.

b. The AERMOD modeling system has been extensively evaluated across a wide range of scenarios based on numerous field studies, including tall stacks in flat and complex terrain settings, sources subject to building downwash influences, and low-level non-buoyant sources.[27] These evaluations included several long-term field studies associated with operating plants as well as several intensive tracer studies. Based on these evaluations, AERMOD has shown consistently good performance, with "errors" in predicted versus observed peak concentrations, based on the Robust Highest Concentration (RHC) metric, consistently within the range of 10 to 40 percent (cited in paragraph 4.1(e)).

c. AERMOD incorporates the PRIME algorithm to account for enhanced plume growth and restricted plume rise for plumes affected by building wake effects.[46] The PRIME algorithm accounts for entrainment of plume mass into the cavity recirculation region, including re-entrainment of plume mass into the wake region beyond the cavity.

d. AERMOD incorporates the Buoyant Line and Point Source (BLP) Dispersion model to account for buoyant plume rise from line sources. The BLP option utilizes the standard meteorological inputs provided by the AERMET meteorological processor.

e. The state-of-the-science for modeling atmospheric deposition is evolving, new modeling techniques are continually being assessed, and their results are being compared with observations. Consequently, while deposition treatment is available in AERMOD, the approach taken for any purpose shall be coordinated with the appropriate reviewing authority (paragraph 3.0(b)).

4.2.2.2 CTDMPLUS

a. If the modeling application involves an elevated point source with a well-defined hill or ridge and a detailed dispersion analysis of the spatial pattern of plume impacts is of interest, CTDMPLUS is available. CTDMPLUS provides greater resolution of concentrations about the contour of the hill feature than does AERMOD through a different plume-terrain interaction algorithm.

4.2.2.3 OCD

a. If the modeling application involves determining the impact of offshore emissions from point, area, or line sources on the air quality of coastal regions, the recommended model is the OCD (Offshore and Coastal Dispersion) Model. OCD is a straight-line Gaussian model that incorporates overwater plume transport and dispersion as well as changes that occur as the plume crosses the shoreline. OCD is also applicable for situations that involve platform building downwash.

4.2.3 Pollutant Specific Modeling Requirements

4.2.3.1 Models for Carbon Monoxide

a. Models for assessing the impact of CO emissions are needed to meet NSR requirements to address compliance with the CO NAAQS and to determine localized impacts from transportations projects. Examples include evaluating effects of point sources, congested roadway intersections and highways, as well as the cumulative effect of numerous sources of CO in an urban area.

b. The general modeling recommendations and requirements for screening models in section 4.2.1 and refined models in section 4.2.2 shall be applied for CO modeling. Given the relatively low CO background concentrations, screening techniques are likely to be adequate in most cases. In applying these recommendations and requirements, the existing 1992 EPA guidance for screening CO impacts from highways may be consulted.[47]

4.2.3.2 Models for Lead

a. In January 1999 (40 CFR part 58, appendix D), the EPA gave notice that concern about ambient lead impacts was being shifted away from roadways and toward a focus on stationary point sources. Thus, models for assessing the impact of lead emissions are needed to meet NSR requirements to address compliance with the lead NAAQS and for SIP attainment demonstrations. The EPA has also issued guidance on siting ambient monitors in the vicinity of stationary point sources.[48] For lead, the SIP should contain an air quality analysis to determine the maximum rolling 3-month average lead concentration resulting from major lead point sources, such as smelters, gasoline additive plants, etc. The EPA has developed a post-processor to calculate rolling 3-month average concentrations from model output.[49] General guidance for lead SIP development is also available.[50]

b. For major lead point sources, such as smelters, which contribute fugitive emissions and for which deposition is important, professional judgment should be used, and there shall be coordination with the appropriate reviewing authority (paragraph 3.0(b)). For most applications, the general requirements for screening and refined models of section 4.2.1 and 4.2.2 are applicable to lead modeling.

4.2.3.3 Models for Sulfur Dioxide

a. Models for SO_2 are needed to meet NSR requirements to address compliance with the SO_2 NAAQS and PSD increments, for SIP attainment demonstrations,[51] and for characterizing current air quality via modeling.[52] SO_2 is one of a group of highly reactive gases known as "oxides of sulfur" with largest emissions sources being fossil fuel combustion at power plants and other industrial facilities.

b. Given the relatively inert nature of SO_2 on the short-term time scales of interest (*i.e.*, 1-hour) and the sources of SO_2 (*i.e.*, stationary point sources), the general modeling requirements for screening models in section 4.2.1 and refined models in section 4.2.2 are applicable for SO_2 modeling applications. For urban areas, AERMOD automatically invokes a half-life of 4 hours[53] to SO_2. Therefore, care must be taken when determining whether a source is urban or rural (*see* section 7.2.1.1 for urban/rural determination methodology).

4.2.3.4 Models for Nitrogen Dioxide

a. Models for assessing the impact of sources on ambient NO_2 concentrations are needed to meet NSR requirements to address compliance with the NO_2 NAAQS and PSD increments. Impact of an individual source on ambient NO_2 depends, in part, on the chemical environment into which the source's plume is to be emitted. This is due to the fact that NO_2 sources co-emit NO along with NO_2 and any emitted NO may react with ambient ozone to convert to additional NO_2 downwind. Thus, comprehensive modeling of NO_2 would need to consider the ratio of emitted NO and NO_2, the ambient levels of ozone and subsequent reactions between ozone and NO, and the photolysis of NO_2 to NO.

b. Due to the complexity of NO_2 modeling, a multi-tiered screening approach is required to obtain hourly and annual average estimates of NO_2.[54] Since these methods are considered screening techniques, their usage shall occur in agreement with the appropriate reviewing authority (paragraph 3.0(b)). Additionally, since screening techniques are conservative by their nature, there are limitations to how these options can be used. Specifically, modeling of negative emissions rates should only be done after consultation with the EPA Regional Office to ensure that decreases in concentrations would not be overestimated. Each tiered approach (*see* Figure 4–1) accounts for increasingly complex considerations of NO_2 chemistry and is described in paragraphs c through e of this subsection. The tiers of NO_2 modeling include:

i. A first-tier (most conservative) "full" conversion approach;

ii. A second-tier approach that assumes ambient equilibrium between NO and NO_2; and

iii. A third-tier consisting of several detailed screening techniques that account for ambient ozone and the relative amount of NO and NO_2 emitted from a source.

c. For Tier 1, use an appropriate refined model (section 4.2.2) to estimate nitrogen oxides (NO_X) concentrations and assume a total conversion of NO to NO_2.

d. For Tier 2, multiply the Tier 1 result(s) by the Ambient Ratio Method 2 (ARM2), which provides estimates of representative equilibrium ratios of NO_2/NO_X value based ambient levels of NO_2 and NO_X derived from national data from the EPA's Air Quality System (AQS).[55] The national default for ARM2 includes a minimum ambient NO_2/NO_X ratio of 0.5 and a maximum ambient ratio of 0.9. The reviewing agency may establish alternative minimum ambient NO_2/NO_X values based on the source's in-stack emissions ratios, with alternative minimum ambient ratios reflecting the source's in-stack NO_2/NO_X ratios. Preferably, alternative minimum ambient NO_2/NO_X ratios should be based on source-specific data which satisfies all quality assurance procedures that ensure data accuracy for both NO_2 and NO_X within the typical range of measured values. However, alternate information may be used to justify a source's anticipated NO_2/NO_X in-stack ratios, such as manufacturer test data, state or local agency guidance, peer-reviewed literature, and/or the EPA's NO_2/NO_X ratio database.

e. For Tier 3, a detailed screening technique shall be applied on a case-by-case basis. Because of the additional input data requirements and complexities associated with the Tier 3 options, their usage shall occur in consultation with the EPA Regional Office in addition to the appropriate reviewing authority. The Ozone Limiting Method (OLM)[56] and the Plume Volume Molar Ratio Method (PVMRM)[57] are two detailed screening techniques that may be used for most sources. These two techniques use an appropriate section 4.2.2 model to estimate NO_X concentrations and then estimate the conversion of primary NO emissions to NO_2 based on the ambient levels of ozone and the plume characteristics. OLM only accounts for NO_2 formation based on the ambient levels of ozone while PVMRM also accommodates distance-dependent conversion ratios based on ambient ozone. Both PVMRM and OLM require that ambient ozone concentrations be provided on an hourly basis and explicit specification of the NO_2/NO_X in-stack ratios. PVMRM works best for relatively isolated and elevated point source modeling while OLM works best for large groups of sources, area sources, and near-surface releases, including roadway sources.

f. Alternative models or techniques may be considered on a case-by-case basis and their usage shall be approved by the EPA Regional Office (section 3.2). Such models or

techniques should consider individual quantities of NO and NO_2 emissions, atmospheric transport and dispersion, and atmospheric transformation of NO to NO_2. Dispersion models that account for more explicit photochemistry may also be considered as an alternative model to estimate ambient impacts of NO_X sources.

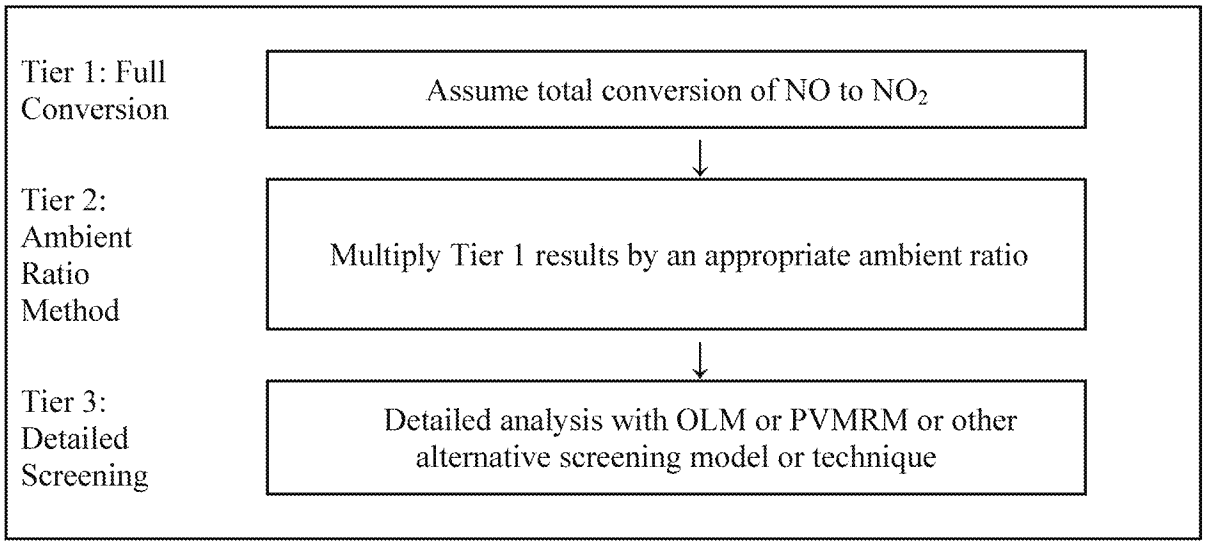


Figure 4-1: Multi-tiered Approach for Estimating NO2 Concentrations

4.2.3.5 Models for $PM_{2.5}$

a. $PM_{2.5}$ is a mixture consisting of several diverse components.[58] Ambient $PM_{2.5}$ generally consists of two components: (1) The primary component, emitted directly from a source; and (2) the secondary component, formed in the atmosphere from other pollutants emitted from the source. Models for $PM_{2.5}$ are needed to meet NSR requirements to address compliance with the $PM_{2.5}$ NAAQS and PSD increments and for SIP attainment demonstrations.

b. For NSR modeling assessments, the general modeling requirements for screening models in section 4.2.1 and refined models in section 4.2.2 are applicable for the primary component of $PM_{2.5}$, while the methods in section 5.4 are applicable for addressing the secondary component of $PM_{2.5}$. Guidance for PSD assessments is available for determining the best approach to handling sources of primary and secondary $PM_{2.5}$.[59]

c. For SIP attainment demonstrations and regional haze reasonable progress goal analyses, effects of a control strategy on $PM_{2.5}$ are estimated from the sum of the effects on the primary and secondary components composing $PM_{2.5}$. Model users should refer to section 5.4.1 and associated SIP modeling guidance[60] for further details concerning appropriate modeling approaches.

d. The general modeling requirements for the refined models discussed in section 4.2.2 shall be applied for $PM_{2.5}$ hot-spot modeling for mobile sources. Specific guidance is available for analyzing direct $PM_{2.5}$ impacts from highways, terminals, and other transportation projects.[61]

4.2.3.6 Models for PM_{10}

a. Models for PM_{10} are needed to meet NSR requirements to address compliance with the PM_{10} NAAQS and PSD increments and for SIP attainment demonstrations.

b. For most sources, the general modeling requirements for screening models in section 4.2.1 and refined models in section 4.2.2 shall be applied for PM_{10} modeling. In cases where the particle size and its effect on ambient concentrations need to be considered, particle deposition may be used on a case-by-case basis and their usage shall be coordinated with the appropriate reviewing authority. A SIP development guide[62] is also available to assist in PM_{10} analyses and control strategy development.

c. Fugitive dust usually refers to dust put into the atmosphere by the wind blowing over plowed fields, dirt roads, or desert or sandy areas with little or no vegetation. Fugitive emissions include the emissions resulting from the industrial process that are not captured and vented through a stack, but may be released from various locations within the complex. In some unique cases, a model developed specifically for the situation may be needed. Due to the difficult nature of characterizing and modeling fugitive dust and fugitive emissions, the proposed procedure shall be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)) for each specific situation before the modeling exercise is begun. Re-entrained dust is created by vehicles driving over dirt roads (*e.g.*, haul roads) and dust-covered roads typically found in arid areas. Such sources can be characterized as line, area or volume sources.[61 63] Emission rates may be based on site-specific data or values from the general literature.

d. Under certain conditions, recommended dispersion models may not be suitable to appropriately address the nature of ambient PM_{10}. In these circumstances, the alternative modeling approach shall be approved by the EPA Regional Office (section 3.2).

e. The general modeling requirements for the refined models discussed in section 4.2.2 shall be applied for PM_{10} hot-spot modeling for mobile sources. Specific guidance is available for analyzing direct PM_{10} impacts from highways, terminals, and other transportation projects.[61]

5.0 Models for Ozone and Secondarily Formed Particulate Matter

5.1 Discussion

a. Air pollutants formed through chemical reactions in the atmosphere are referred to as secondary pollutants. For example, ground-level ozone and a portion of $PM_{2.5}$ are secondary pollutants formed through photochemical reactions. Ozone and secondarily formed particulate matter are closely related to each other in that they share common sources of emissions and are formed in the atmosphere from chemical reactions with similar precursors.

b. Ozone formation is driven by emissions of NO_X and volatile organic compounds (VOCs). Ozone formation is a complicated nonlinear process that requires favorable meteorological conditions in addition to VOC and NO_X emissions. Sometimes complex terrain features also contribute to the build-up of precursors and subsequent ozone formation or destruction.

c. $PM_{2.5}$ can be either primary (*i.e.*, emitted directly from sources) or secondary in nature. The fraction of $PM_{2.5}$ which is primary versus secondary varies by location and season. In the United States, $PM_{2.5}$ is dominated by a variety of chemical species or components of atmospheric particles, such as ammonium sulfate, ammonium nitrate, organic carbon mass, elemental carbon, and other soil compounds and oxidized metals. $PM_{2.5}$ sulfate, nitrate, and ammonium ions are predominantly the result of chemical reactions of the oxidized products of SO_2 and NO_X emissions with direct ammonia emissions.[64]

d. Control measures reducing ozone and $PM_{2.5}$ precursor emissions may not lead to proportional reductions in ozone and $PM_{2.5}$. Modeled strategies designed to reduce ozone

or $PM_{2.5}$ levels typically need to consider the chemical coupling between these pollutants. This coupling is important in understanding processes that control the levels of both pollutants. Thus, when feasible, it is important to use models that take into account the chemical coupling between ozone and $PM_{2.5}$. In addition, using such a multi-pollutant modeling system can reduce the resource burden associated with applying and evaluating separate models for each pollutant and promotes consistency among the strategies themselves.

e. $PM_{2.5}$ is a mixture consisting of several diverse chemical species or components of atmospheric particles. Because chemical and physical properties and origins of each component differ, it may be appropriate to use either a single model capable of addressing several of the important components or to model primary and secondary components using different models. Effects of a control strategy on $PM_{2.5}$ is estimated from the sum of the effects on the specific components comprising $PM_{2.5}$.

5.2 Recommendations

a. Chemical transformations can play an important role in defining the concentrations and properties of certain air pollutants. Models that take into account chemical reactions and physical processes of various pollutants (including precursors) are needed for determining the current state of air quality, as well as predicting and projecting the future evolution of these pollutants. It is important that a modeling system provide a realistic representation of chemical and physical processes leading to secondary pollutant formation and removal from the atmosphere.

b. Chemical transport models treat atmospheric chemical and physical processes such as deposition and motion. There are two types of chemical transport models, Eulerian (grid based) and Lagrangian. These types of models are differentiated from each other by their frame of reference. Eulerian models are based on a fixed frame of reference and Lagrangian models use a frame of reference that moves with parcels of air between the source and receptor point.[9] Photochemical grid models are three-dimensional Eulerian grid-based models that treat chemical and physical processes in each grid cell and use diffusion and transport processes to move chemical species between grid cells.[9] These types of models are appropriate for assessment of near-field and regional scale reactive pollutant impacts from specific sources[7 10 11 12] or all sources.[13 14 15] In some limited cases, the secondary processes can be treated with a box model, ideally in combination with a number of other modeling techniques and/or analyses to treat individual source sectors.

c. Regardless of the modeling system used to estimate secondary impacts of ozone and/or $PM_{2.5}$, model results should be compared to observation data to generate confidence that the modeling system is representative of the local and regional air quality. For ozone related projects, model estimates of ozone should be compared with observations in both time and space. For $PM_{2.5}$, model estimates of speciated $PM_{2.5}$ components (such as sulfate ion, nitrate ion, etc.) should be compared with observations in both time and space.[65]

d. Model performance metrics comparing observations and predictions are often used to summarize model performance. These metrics include mean bias, mean error, fractional bias, fractional error, and correlation coefficient. [65] There are no specific levels of any model performance metric that indicate "acceptable" model performance. The EPA's preferred approach for providing context about model performance is to compare model performance metrics with similar contemporary applications. [60 65] Because model application purpose and scope vary, model users should consult with the appropriate reviewing authority (paragraph 3.0(b)) to determine what model performance elements should be emphasized and presented to provide confidence in the regulatory model application.

e. There is no preferred modeling system or technique for estimating ozone or secondary $PM_{2.5}$ for specific source impacts or to assess impacts from multiple sources. For assessing secondary pollutant impacts from single sources, the degree of complexity required to assess potential impacts varies depending on the nature of the source, its emissions, and the background environment. The EPA recommends a two-tiered approach where the first tier consists of using existing technically credible and appropriate relationships between emissions and impacts developed from previous modeling that is deemed sufficient for evaluating a source's impacts. The second tier consists of more sophisticated case-specific modeling analyses. The appropriate tier for a given application should be selected in consultation with the appropriate reviewing authority (paragraph 3.0(b)) and be consistent with EPA guidance.[66]

5.3 Recommended Models and Approaches for Ozone

a. Models that estimate ozone concentrations are needed to guide the choice of strategies for the purposes of a nonattainment area demonstrating future year attainment of the ozone NAAQS. Additionally, models that estimate ozone concentrations are needed to assess impacts from specific sources or source complexes to satisfy requirements for NSR and other regulatory programs. Other purposes for ozone modeling include estimating the impacts of specific events on air quality, ozone deposition impacts, and planning for areas that may be attaining the ozone NAAQS.

5.3.1 Models for NAAQS Attainment Demonstrations and Multi-Source Air Quality Assessments

a. Simulation of ozone formation and transport is a complex exercise. Control agencies with jurisdiction over areas with ozone problems should use photochemical grid models to evaluate the relationship between precursor species and ozone. Use of photochemical grid models is the recommended means for identifying control strategies needed to address high ozone concentrations in such areas. Judgment on the suitability of a model for a given application should consider factors that include use of the model in an attainment test, development of emissions and meteorological inputs to the model, and choice of episodes to model. Guidance on the use of models and other analyses for demonstrating attainment of the air quality goals for ozone is available. [59 60] Users should consult with the appropriate reviewing authority (paragraph 3.0(b)) to ensure the most current modeling guidance is applied.

5.3.2 Models for Single-Source Air Quality Assessments

a. Depending on the magnitude of emissions, estimating the impact of an individual source's emissions of NO_X and VOC on ambient ozone is necessary for obtaining a permit. The simulation of ozone formation and transport requires realistic treatment of atmospheric chemistry and deposition. Models (*e.g.*, Lagrangian and photochemical grid models) that integrate chemical and physical processes important in the formation, decay, and transport of ozone and important precursor species should be applied. Photochemical grid models are primarily designed to characterize precursor emissions and impacts from a wide variety of sources over a large geographic area but can also be used to assess the impacts from specific sources. [7 11 12]

b. The first tier of assessment for ozone impacts involves those situations where existing technical information is available (*e.g.*, results from existing photochemical grid modeling, published empirical estimates of source specific impacts, or reduced-form models) in combination with other supportive information and analysis for the purposes of estimating secondary impacts from a particular source. The existing technical information should provide a credible and representative estimate of the secondary impacts from the project source. The appropriate reviewing authority (paragraph 3.0(b)) and appropriate EPA guidance [66] should be consulted to determine what types of assessments may be appropriate on a case-by-case basis.

c. The second tier of assessment for ozone impacts involves those situations where existing technical information is not available or a first tier demonstration indicates a more refined assessment is needed. For these situations, chemical transport models should be used to address single-source impacts. Special considerations are needed when using these models to evaluate the ozone impact from an individual source. Guidance on the use of models and other analyses for demonstrating the impacts of single sources for ozone is available. [66] This guidance document provides a more detailed discussion of the appropriate approaches to obtaining estimates of ozone impacts from a single source. Model users should use the latest version of the guidance in consultation with the appropriate reviewing authority (paragraph 3.0(b)) to determine the most suitable refined approach for single-source ozone modeling on a case-by-case basis.

5.4 Recommended Models and Approaches for Secondarily Formed $PM_{2.5}$

a. Models that estimate $PM_{2.5}$ concentrations are needed to guide the choice of strategies for the purposes of a nonattainment area demonstrating future year attainment of the $PM_{2.5}$ NAAQS. Additionally, models that estimate $PM_{2.5}$ concentrations are needed to assess impacts from specific sources or source complexes to satisfy requirements for NSR and other regulatory programs. Other purposes for $PM_{2.5}$ modeling include estimating the impacts of specific events on air quality, visibility, deposition impacts, and planning for areas that may be attaining the $PM_{2.5}$ NAAQS.

5.4.1 Models for NAAQS Attainment Demonstrations and Multi-Source Air Quality Assessments

a. Models for $PM_{2.5}$ are needed to assess the adequacy of a proposed strategy for meeting the annual and 24-hour $PM_{2.5}$ NAAQS. Modeling primary and secondary $PM_{2.5}$ can be a multi-faceted and complex problem, especially for secondary components of $PM_{2.5}$ such as sulfates and nitrates. Control agencies with jurisdiction over areas with secondary $PM_{2.5}$ problems should use models that integrate chemical and physical processes important in the formation, decay, and transport of these species (*e.g.*, photochemical grid models). Suitability of a modeling approach or mix of modeling approaches for a given application requires technical judgment as well as professional experience in choice of models, use of the model(s) in an attainment test, development of emissions and meteorological inputs to the model, and selection of days to model. Guidance on the use of models and other analyses for demonstrating attainment of the air quality goals for $PM_{2.5}$ is available.[59 60] Users should consult with the appropriate reviewing authority (paragraph 3.0(b)) to ensure the most current modeling guidance is applied.

5.4.2 Models for Single-Source Air Quality Assessments

a. Depending on the magnitude of emissions, estimating the impact of an individual source's emissions on secondary particulate matter concentrations may be necessary for obtaining a permit. Primary $PM_{2.5}$ components shall be simulated using the general modeling requirements in section 4.2.3.5. The simulation of secondary particulate matter formation and transport is a complex exercise requiring realistic treatment of atmospheric chemistry and deposition. Models should be applied that integrate chemical and physical processes important in the formation, decay, and transport of these species (*e.g.*, Lagrangian and photochemical grid models). Photochemical grid models are primarily designed to characterize precursor emissions and impacts from a wide variety of sources over a large geographic area and can also be used to assess the impacts from specific sources.[7 10] For situations where a project source emits both primary $PM_{2.5}$ and $PM_{2.5}$ precursors, the contribution from both should be combined for use in determining the source's ambient impact. Approaches for combining primary and secondary impacts are provided in appropriate guidance for single source permit related demonstrations.[66]

b. The first tier of assessment for secondary $PM_{2.5}$ impacts involves those situations where existing technical information is available (*e.g.*, results from existing photochemical grid modeling, published empirical estimates of source specific impacts, or reduced-form models) in combination with other supportive information and analysis for the purposes of estimating secondary impacts from a particular source. The existing technical information should provide a credible and representative estimate of the secondary impacts from the project source. The appropriate reviewing authority (paragraph 3.0(b)) and appropriate EPA guidance[66] should be consulted to determine what types of assessments may be appropriate on a case-by-case basis.

c. The second tier of assessment for secondary $PM_{2.5}$ impacts involves those situations where existing technical information is not available or a first tier demonstration indicates a more refined assessment is needed. For these situations, chemical transport models should be used for assessments of single-source impacts. Special considerations are needed when using these models to evaluate the secondary particulate matter impact from an individual source. Guidance on the use of models and other analyses for demonstrating the impacts of single sources for secondary $PM_{2.5}$ is available.[66] This guidance document provides a more detailed discussion of the appropriate approaches to obtaining estimates of secondary particulate matter concentrations from a single source. Model users should use the latest version of this guidance in consultation with the appropriate reviewing authority (paragraph 3.0(b)) to determine the most suitable single-source modeling approach for secondary $PM_{2.5}$ on a case-by-case basis.

6.0 Modeling for Air Quality Related Values and Other Governmental Programs

6.1 Discussion

a. Other federal government agencies and state, local, and tribal agencies with air quality and land management responsibilities have also developed specific modeling approaches for their own regulatory or other requirements. Although such regulatory requirements and guidance have come about because of EPA rules or standards, the implementation of such regulations and the use of the modeling techniques is under the jurisdiction of the agency issuing the guidance or directive. This section covers such situations with reference to those guidance documents, when they are available.

b. When using the model recommended or discussed in the *Guideline* in support of programmatic requirements not specifically covered by EPA regulations, the model user should consult the appropriate federal, state, local, or tribal agency to ensure the proper application and use of the models and/or techniques. These agencies have developed specific modeling approaches for their own regulatory or other requirements. Most of the programs have, or will have when fully developed, separate guidance documents that cover the program and a discussion of the tools that are needed. The following paragraphs reference those guidance documents, when they are available.

6.2 Air Quality Related Values

a. The 1990 CAA Amendments give FLMs an "affirmative responsibility" to protect the natural and cultural resources of Class I areas from the adverse impacts of air pollution and to provide the appropriate procedures and analysis techniques. The CAA identifies the FLM as the Secretary of the department, or their designee, with authority over these lands. Mandatory Federal Class I areas are defined in the CAA as international parks, national parks over 6,000 acres, and wilderness areas and memorial parks over 5,000 acres, established as of 1977. The FLMs are also concerned with the protection of resources in federally managed Class II areas because of other statutory mandates to protect these areas. Where state or tribal agencies have successfully petitioned the EPA and lands have been redesignated to Class I status, these agencies may have equivalent responsibilities to that of the FLMs for these non-federal Class I areas as described throughout the remainder of section 6.2.

b. The FLM agency responsibilities include the review of air quality permit applications from proposed new or modified major pollution sources that may affect these Class I areas to determine if emissions from a proposed or modified source will cause or contribute to adverse impacts on air quality related values (AQRVs) of a Class I area and making recommendations to the FLM. AQRVs are resources, identified by the FLM agencies, that have the potential to be affected by air pollution. These resources may include visibility, scenic, cultural, physical, or ecological resources for a particular area. The FLM agencies take into account the particular resources and AQRVs that would be affected; the frequency and magnitude of any potential impacts; and the direct, indirect, and cumulative effects of any potential impacts in making their recommendations.

c. While the AQRV notification and impact analysis requirements are outlined in the PSD regulations at 40 CFR 51.166(p) and 40 CFR 52.21(p), determination of appropriate analytical methods and metrics for AQRV's are determined by the FLM agencies and are published in guidance external to the general recommendations of this paragraph.

d. To develop greater consistency in the application of air quality models to assess potential AQRV impacts in both Class I areas and protected Class II areas, the FLM agencies have developed the Federal Land Managers' Air Quality Related Values Work Group Phase I Report (FLAG).[67] FLAG focuses upon specific technical and policy issues associated with visibility impairment, effects of pollutant deposition on soils and surface waters, and ozone effects on vegetation. Model users should consult the latest version of the FLAG report for current modeling guidance and with affected FLM

agency representatives for any application specific guidance which is beyond the scope of the *Guideline.*

6.2.1 Visibility

a. Visibility in important natural areas (*e.g.,* Federal Class I areas) is protected under a number of provisions of the CAA, including sections 169A and 169B (addressing impacts primarily from existing sources) and section 165 (new source review). Visibility impairment is caused by light scattering and light absorption associated with particles and gases in the atmosphere. In most areas of the country, light scattering by $PM_{2.5}$ is the most significant component of visibility impairment. The key components of $PM_{2.5}$ contributing to visibility impairment include sulfates, nitrates, organic carbon, elemental carbon, and crustal material.[67]

b. Visibility regulations (40 CFR 51.300 through 51.309) require state, local, and tribal agencies to mitigate current and prevent future visibility impairment in any of the 156 mandatory Federal Class I areas where visibility is considered an important attribute. In 1999, the EPA issued revisions to the regulations to address visibility impairment in the form of regional haze, which is caused by numerous, diverse sources (*e.g.,* stationary, mobile, and area sources) located across a broad region (40 CFR 51.308 through 51.309). The state of relevant scientific knowledge has expanded significantly since that time. A number of studies and reports[68 69] have concluded that long-range transport (*e.g.,* up to hundreds of kilometers) of fine particulate matter plays a significant role in visibility impairment across the country. Section 169A of the CAA requires states to develop SIPs containing long-term strategies for remedying existing and preventing future visibility impairment in the 156 mandatory Class I Federal areas, where visibility is considered an important attribute. In order to develop long-term strategies to address regional haze, many state, local, and tribal agencies will need to conduct regional-scale modeling of fine particulate concentrations and associated visibility impairment.

c. The FLAG visibility modeling recommendations are divided into two distinct sections to address different requirements for: (1) Near field modeling where plumes or layers are compared against a viewing background, and (2) distant/multi-source modeling for plumes and aggregations of plumes that affect the general appearance of a scene.[67] The recommendations separately address visibility assessments for sources proposing to locate relatively near and at farther distances from these areas.[67]

6.2.1.1 Models for Estimating Near-Field Visibility Impairment

a. To calculate the potential impact of a plume of specified emissions for specific transport and dispersion conditions ("plume blight") for source-receptor distances less than 50 km, a screening model and guidance are available.[67 70] If a more comprehensive analysis is necessary, a refined model should be selected. The model selection, procedures, and analyses should be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)) and the affected FLM(s).

6.2.1.2 Models for Estimating Visibility Impairment for Long-Range Transport

a. Chemical transformations can play an important role in defining the concentrations and properties of certain air pollutants. Models that take into account chemical reactions and physical processes of various pollutants (including precursors) are needed for determining the current state of air quality, as well as predicting and projecting the future evolution of these pollutants. It is important that a modeling system provide a realistic representation of chemical and physical processes leading to secondary pollutant formation and removal from the atmosphere.

b. Chemical transport models treat atmospheric chemical and physical processes such as deposition and motion. There are two types of chemical transport models, Eulerian (grid based) and Lagrangian. These types of models are differentiated from each other by their frame of reference. Eulerian models are based on a fixed frame of reference and Lagrangian models use a frame of reference that moves with parcels of air between the source and receptor point.[9] Photochemical grid models are three-dimensional Eulerian grid-based models that treat chemical and physical processes in each grid cell and use diffusion and transport processes to move chemical species between grid cells.[9] These types of models are appropriate for assessment of near-field and regional scale reactive pollutant impacts from specific sources[7 10 11 12] or all sources.[13 14 15]

c. Development of the requisite meteorological and emissions databases necessary for use of photochemical grid models to estimate AQRVs should conform to recommendations in section 8 and those outlined in the EPA's *Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze.*[60] Demonstration of the adequacy of prognostic meteorological fields can be established through appropriate diagnostic and statistical performance evaluations consistent with recommendations provided in the appropriate guidance.[60] Model users should consult the latest version of this guidance and with the appropriate reviewing authority (paragraph 3.0(b)) for any application-specific guidance that is beyond the scope of this subsection.

6.2.2 Models for Estimating Deposition Impacts

a. For many Class I areas, AQRVs have been identified that are sensitive to atmospheric deposition of air pollutants. Emissions of NO_X, sulfur oxides, NH_3, mercury, and secondary pollutants such as ozone and particulate matter affect components of ecosystems. In sensitive ecosystems, these compounds can acidify soils and surface waters, add nutrients that change biodiversity, and affect the ecosystem services provided by forests and natural areas.[67] To address the relationship between deposition and ecosystem effects, the FLM agencies have developed estimates of critical loads. A critical load is defined as, "A quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge."[71]

b. The FLM deposition modeling recommendations are divided into two distinct sections to address different requirements for: (1) Near field modeling, and (2) distant/multi-source modeling for cumulative effects. The recommendations separately address deposition assessments for sources proposing to locate relatively near and at farther distances from these areas.[67] Where the source and receptors are not in close proximity, chemical transport (*e.g.,* photochemical grid) models generally should be applied for an assessment of deposition impacts due to one or a small group of sources. Over these distances, chemical and physical transformations can change atmospheric residence time due to different propensity for deposition to the surface of different forms of nitrate and sulfate. Users should consult the latest version of the FLAG report[67] and relevant FLM representatives for guidance on the use of models for deposition. Where source and receptors are in close proximity, users should contact the appropriate FLM for application-specific guidance.

6.3 Modeling Guidance for Other Governmental Programs

a. Dispersion and photochemical grid modeling may need to be conducted to ensure that individual and cumulative offshore oil and gas exploration, development, and production plans and activities do not significantly affect the air quality of any state as required under the Outer Continental Shelf Lands Act (OCSLA). Air quality modeling requires various input datasets, including emissions sources, meteorology, and pre-existing pollutant concentrations. For sources under the reviewing authority of the Department of Interior, Bureau of Ocean Energy Management (BOEM), guidance for the development of all necessary Outer Continental Shelf (OCS) air quality modeling inputs and appropriate model selection and application is available from the BOEM's Web site: *https://www.boem.gov/GOMR-Environmental-Compliance.*

b. The Federal Aviation Administration (FAA) is the appropriate reviewing authority for air quality assessments of primary pollutant impacts at airports and air bases. The Aviation Environmental Design Tool (AEDT) is developed and supported by the FAA, and is appropriate for air quality assessment of primary pollutant impacts at airports or air bases. AEDT has adopted AERMOD for treating dispersion. Application of AEDT is intended for estimating the change in emissions for aircraft operations, point source, and mobile source emissions on airport property and quantify the associated pollutant level- concentrations. AEDT is not intended for PSD, SIP, or other regulatory air quality analyses of point or mobile sources at or peripheral to airport property that are unrelated to airport operations. The latest version of AEDT may be obtained from the FAA at: *https://aedt.faa.gov.*

7.0 General Modeling Considerations

7.1 Discussion

a. This section contains recommendations concerning a number of different issues not explicitly covered in other sections of the *Guideline*. The topics covered here are not specific to any one program or modeling area, but are common to dispersion modeling analyses for criteria pollutants.

7.2 Recommendations

7.2.1 All Sources

7.2.1.1 Dispersion Coefficients

a. For any dispersion modeling exercise, the urban or rural determination of a source is critical in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. Historically, steady-state Gaussian plume models used in most applications have employed dispersion coefficients based on Pasquill-Gifford [72] in rural areas and McElroy-Pooler [73] in urban areas. These coefficients are still incorporated in the BLP and OCD models. However, the AERMOD model incorporates a more up-to-date characterization of the atmospheric boundary layer using continuous functions of parameterized horizontal and vertical turbulence based on Monin-Obukhov similarity (scaling) relationships.[44] Another key feature of AERMOD's formulation is the option to use directly observed variables of the boundary layer to parameterize dispersion.[44 45]

b. The selection of rural or urban dispersion coefficients in a specific application should follow one of the procedures suggested by Irwin [74] to determine whether the character of an area is primarily urban or rural (of the two methods, the land use procedure is considered more definitive.):

i. Land Use Procedure: (1) Classify the land use within the total area, A_o, circumscribed by a 3 km radius circle about the source using the meteorological land use typing scheme proposed by Auer; [75] (2) if land use types I1, I2, C1, R2, and R3 account for 50 percent or more of A_o, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients.

ii. Population Density Procedure: (1) Compute the average population density, $\bar{p}$ per square kilometer with A_o as defined above; (2) If $\bar{p}$ is greater than 750 people per square kilometer, use urban dispersion coefficients; otherwise use appropriate rural dispersion coefficients.

c. Population density should be used with caution and generally not be applied to highly industrialized areas where the population density may be low and, thus, a rural classification would be indicated. However, the area is likely to be sufficiently built-up so that the urban land use criteria would be satisfied. Therefore, in this case, the classification should be "urban" and urban dispersion parameters should be used.

d. For applications of AERMOD in urban areas, under either the Land Use Procedure or the Population Density Procedure, the user needs to estimate the population of the urban area affecting the modeling domain because the urban influence in AERMOD is scaled based on a user-specified population. For non-population oriented urban areas, or areas influenced by both population and industrial activity, the user will need to estimate an equivalent population to adequately account for the combined effects of industrialized areas and populated areas within the modeling domain. Selection of the appropriate population for these applications should be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)) and the latest version of the AERMOD Implementation Guide.[76]

e. It should be noted that AERMOD allows for modeling rural and urban sources in a single model run. For analyses of whole urban complexes, the entire area should be modeled as an urban region if most of the sources are located in areas classified as urban. For tall stacks located within or adjacent to small or moderate sized urban areas, the stack height or effective plume height may extend above the urban boundary layer and, therefore, may be more appropriately modeled using rural coefficients. Model users should consult with the appropriate reviewing authority (paragraph 3.0(b)) and the latest version of the AERMOD Implementation Guide [76] when evaluating this situation.

f. Buoyancy-induced dispersion (BID), as identified by Pasquill,[77] is included in the preferred models and should be used where buoyant sources (*e.g.,* those involving fuel combustion) are involved.

7.2.1.2 Complex Winds

a. *Inhomogeneous local winds.* In many parts of the United States, the ground is neither flat nor is the ground cover (or land use) uniform. These geographical variations can generate local winds and circulations, and modify the prevailing ambient winds and circulations. Typically, geographic effects are more apparent when the ambient winds are light or calm, as stronger synoptic or mesoscale winds can modify, or even eliminate the weak geographic circulations.[78] In general, these geographically induced wind circulation effects are named after the source location of the winds, *e.g.,* lake and sea breezes, and mountain and valley winds. In very rugged hilly or mountainous terrain, along coastlines, or near large land use variations, the characteristics of the winds are a balance of various forces, such that the assumptions of steady-state straight-line transport both in time and space are inappropriate. In such cases, a model should be chosen to fully treat the time and space variations of meteorology effects on transport and dispersion. The setup and application of such a model should be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)) consistent with limitations of paragraph 3.2.2(e). The meteorological input data requirements for developing the time and space varying three-dimensional winds and dispersion meteorology for these situations are discussed in paragraph 8.4.1.2(c). Examples of inhomogeneous winds include, but are not limited to, situations described in the following paragraphs:

i. *Inversion breakup fumigation.* Inversion breakup fumigation occurs when a plume (or multiple plumes) is emitted into a stable layer of air and that layer is subsequently mixed to the ground through convective transfer of heat from the surface or because of advection to less stable surroundings. Fumigation may cause excessively high concentrations, but is usually rather short-lived at a given receptor. There are no recommended refined techniques to model this phenomenon. There are, however, screening procedures [40] that may be used to approximate the concentrations. Considerable care should be exercised in using the results obtained from the screening techniques.

ii. *Shoreline fumigation.* Fumigation can be an important phenomenon on and near the shoreline of bodies of water. This can affect both individual plumes and area-wide emissions. When fumigation conditions are expected to occur from a source or sources with tall stacks located on or just inland of a shoreline, this should be addressed in the air quality modeling analysis. The EPA has evaluated several coastal fumigation models, and the evaluation results of these models are available for their possible application on a case-by-case basis when air quality estimates under shoreline fumigation conditions are needed.[79] Selection of the appropriate model for applications where shoreline fumigation is of concern should be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)).

iii. *Stagnation.* Stagnation conditions are characterized by calm or very low wind speeds, and variable wind directions. These stagnant meteorological conditions may persist for several hours to several days. During stagnation conditions, the dispersion of air pollutants, especially those from low-level emissions sources, tends to be minimized, potentially leading to relatively high ground-level concentrations. If point sources are of interest, users should note the guidance provided in paragraph (a) of this subsection. Selection of the appropriate model for applications where stagnation is of concern should be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)).

7.2.1.3 Gravitational Settling and Deposition

a. Gravitational settling and deposition may be directly included in a model if either is a significant factor. When particulate matter sources can be quantified and settling and dry deposition are problems, use professional judgment along with coordination with the appropriate reviewing authority (paragraph 3.0(b)). AERMOD contains algorithms for dry and wet deposition of gases and particles.[80] For other Gaussian plume models, an "infinite half-life" may be used for estimates of particle concentrations when only exponential decay terms are used for treating settling and deposition. Lagrangian models have varying degrees of complexity for dealing with settling and deposition and the selection of a parameterization for such should be included in the approval process for selecting a Lagrangian model. Eulerian grid models tend to have explicit parameterizations for gravitational settling and deposition as well as wet deposition parameters already included as part of the chemistry scheme.

7.2.2 Stationary Sources

7.2.2.1 Good Engineering Practice Stack Height

a. The use of stack height credit in excess of Good Engineering Practice (GEP) stack height or credit resulting from any other dispersion technique is prohibited in the development of emissions limits by 40 CFR 51.118 and 40 CFR 51.164. The definition of GEP stack height and dispersion technique are contained in 40 CFR 51.100. Methods and procedures for making the appropriate stack height calculations, determining stack height credits and an example of applying those techniques are found in several references,[81 82 83 84] that provide a great deal of additional information for evaluating and describing building cavity and wake effects.

b. If stacks for new or existing major sources are found to be less than the height defined by the EPA's refined formula for determining GEP height, then air quality impacts associated with cavity or wake effects due to the nearby building structures should be determined. The EPA refined formula height is defined as H + 1.5L.[83] Since the definition of GEP stack height defines excessive concentrations as a maximum ground-level concentration due in whole or in part to downwash of at least 40 percent in excess of the maximum concentration without downwash, the potential air quality impacts associated with cavity and wake effects should also be considered for stacks that equal or exceed the EPA formula height for GEP. The AERSCREEN model can be used to obtain screening estimates of potential downwash influences, based on the PRIME downwash algorithm incorporated in the AERMOD model. If more refined concentration estimates are required, AERMOD should be used (section 4.2.2).

7.2.2.2 Plume Rise

a. The plume rise methods of Briggs[85 86] are incorporated in many of the preferred models and are recommended for use in many modeling applications. In AERMOD,[44 45] for the stable boundary layer, plume rise is estimated using an iterative approach, similar to that in the CTDMPLUS model. In the convective boundary layer, plume rise is superposed on the displacements by random convective velocities.[87] In AERMOD, plume rise is computed using the methods of Briggs, except in cases involving building downwash, in which a numerical solution of the mass, energy, and momentum conservation laws is performed.[88] No explicit provisions in these models are made for multistack plume rise enhancement or the handling of such special plumes as flares.

b. Gradual plume rise is generally recommended where its use is appropriate: (1) In AERMOD; (2) in complex terrain screening procedures to determine close-in impacts; and (3) when calculating the effects of building wakes. The building wake algorithm in AERMOD incorporates and exercises the thermodynamically based gradual plume rise calculations as described in paragraph (a) of this subsection. If the building wake is calculated to affect the plume for any hour, gradual plume rise is also used in downwind dispersion calculations to the distance of final plume rise, after which final plume rise is used. Plumes captured by the near wake are re-emitted to the far wake as a ground-level volume source.

c. Stack tip downwash generally occurs with poorly constructed stacks and when the ratio of the stack exit velocity to wind speed is small. An algorithm developed by Briggs[86] is the recommended technique for this situation and is used in preferred models for point sources.

d. On a case-by-case basis, refinements to the preferred model may be considered for plume rise and downwash effects and shall occur in agreement with the appropriate reviewing authority (paragraph 3.0(b)) and approval by the EPA Regional Office based on the requirements of section 3.2.2.

7.2.3 Mobile Sources

a. Emissions of primary pollutants from mobile sources can be modeled with an appropriate model identified in section 4.2. Screening of mobile sources can be accomplished by using screening meteorology, *e.g.*, worst-case meteorological conditions. Maximum hourly concentrations computed from screening modeling can be converted to longer averaging periods using the scaling ratios specified in the AERSCREEN User's Guide.[37]

b. Mobile sources can be modeled in AERMOD as either line (*i.e.*, elongated area) sources or as a series of volume sources. However, since mobile source modeling usually includes an analysis of very near-source impacts (*e.g.*, hot-spot modeling, which can include receptors within 5–10 meters (m) of the roadway), the results can be highly sensitive to the characterization of the mobile emissions. Important characteristics for both line/area and volume sources include the plume release height, source width, and initial dispersion characteristics, and should also take into account the impact of traffic-induced turbulence that can cause roadway sources to have larger initial dimensions than might normally be used for representing line sources.

c. The EPA's quantitative PM hot-spot guidance[61] and Haul Road Workgroup Final Report[63] provide guidance on the appropriate characterization of mobile sources as a function of the roadway and vehicle characteristics. The EPA's quantitative PM hot-spot guidance includes important considerations and should be consulted when modeling roadway links. Area, line or volume sources may be used for modeling mobile sources. However, experience in the field has shown that area sources may be easier to characterize correctly compared to volume sources. If volume sources are used, it is particularly important to ensure that roadway emissions are appropriately spaced when using volume source so that the emissions field is uniform across the roadway. Additionally, receptor placement is particularly important for volume sources that have "exclusion zones" where concentrations are not calculated for receptors located "within" the volume sources, *i.e.*, less than 2.15 times the initial lateral dispersion coefficient from the center of the volume.[61] Placing receptors in these "exclusion zones" will result in underestimates of roadway impacts.

8.0 Model Input Data

a. Databases and related procedures for estimating input parameters are an integral part of the modeling process. The most appropriate input data available should always be selected for use in modeling analyses. Modeled concentrations can vary widely depending on the source data or meteorological data used. This section attempts to minimize the uncertainty associated with database selection and use by identifying requirements for input data used in modeling. More specific data requirements and the format required for the individual models are described in detail in the user's guide and/or associated documentation for each model.

8.1 Modeling Domain

8.1.1 Discussion

a. The modeling domain is the geographic area for which the required air quality analyses for the NAAQS and PSD increments are conducted.

8.1.2 Requirements

a. For a NAAQS or PSD increments assessment, the modeling domain or project's impact area shall include all locations where the emissions of a pollutant from the new or modifying source(s) may cause a significant ambient impact. This impact area is defined as an area with a radius extending from the new or modifying source to: (1) The most distant location where air quality modeling predicts a significant ambient impact will occur, or (2) the nominal 50 km distance considered applicable for Gaussian dispersion models, whichever is less. The required air quality analysis shall be carried out within this geographical area with characterization of source impacts, nearby source impacts, and background concentrations, as recommended later in this section.

b. For SIP attainment demonstrations for ozone and $PM_{2.5}$, or regional haze reasonable progress goal analyses, the modeling domain is determined by the nature of the problem being modeled and the spatial scale of the emissions that impact the nonattainment or Class I area(s). The modeling domain shall be designed so that all major upwind source areas that influence the downwind nonattainment area are included in addition to all monitor locations that are currently or recently violating the NAAQS or close to violating the NAAQS in the nonattainment area. Similarly, all Class I areas to be evaluated in a regional haze modeling application shall be included and sufficiently distant from the edge of the modeling domain. Guidance on the determination of the appropriate modeling domain for photochemical grid models in demonstrating attainment of these air quality goals is available.[60] Users should consult the latest version of this guidance for the most current modeling guidance and the appropriate reviewing authority (paragraph 3.0(b)) for any application specific guidance that is beyond the scope of this section.

8.2 Source Data

8.2.1 Discussion

a. Sources of pollutants can be classified as point, line, area, and volume sources. Point sources are defined in terms of size and may vary between regulatory programs. The line sources most frequently considered are roadways and streets along which there are well-defined movements of motor vehicles. They may also be lines of roof vents or stacks, such as in aluminum refineries. Area and volume sources are often collections of a multitude of minor sources with individually small emissions that are impractical to consider as separate point or line sources. Large area sources are typically treated as a grid network of square areas, with pollutant emissions distributed uniformly within each grid square. Generally, input data requirements for air quality models necessitate the use of metric units. As necessary, any English units common to engineering applications should be appropriately converted to metric.

b. For point sources, there are many source characteristics and operating conditions that may be needed to appropriately model the facility. For example, the plant layout (*e.g.,* location of stacks and buildings), stack parameters (*e.g.,* height and diameter), boiler size and type, potential operating conditions, and pollution control equipment parameters. Such details are required inputs to air quality models and are needed to determine maximum potential impacts.

c. Modeling mobile emissions from streets and highways requires data on the road layout, including the width of each traveled lane, the number of lanes, and the width of the median strip. Additionally, traffic patterns should be taken into account (*e.g.,* daily cycles of rush hour, differences in weekday and weekend traffic volumes, and changes in the distribution of heavy-duty trucks and light-duty passenger vehicles), as these patterns will affect the types and amounts of pollutant emissions allocated to each lane and the height of emissions.

d. Emission factors can be determined through source-specific testing and measurements (*e.g.,* stack test data) from existing sources or provided from a manufacturing association or vendor. Additionally, emissions factors for a variety of source types are compiled in an EPA publication commonly known as AP–42.[89] AP–42 also provides an indication of the quality and amount of data on which many of the factors are based. Other information concerning emissions is available in EPA publications relating to specific source categories. The appropriate reviewing authority (paragraph 3.0(b)) should be consulted to determine appropriate source definitions and for guidance concerning the determination of emissions from and techniques for modeling the various source types.

8.2.2 Requirements

a. For SIP attainment demonstrations for the purpose of projecting future year NAAQS attainment for ozone, $PM_{2.5}$, and regional haze reasonable progress goal analyses, emissions which reflect actual emissions during the base modeling year time period should be input to models for base year modeling. Emissions projections to future years should account for key variables such as growth due to increased or decreased activity, expected emissions controls due to regulations, settlement agreements or consent decrees, fuel switches, and any other relevant information. Guidance on emissions estimation techniques (including future year projections) for SIP attainment demonstrations is available.[60 90]

b. For the purpose of SIP revisions for stationary point sources, the regulatory modeling of inert pollutants shall use the emissions input data shown in Table 8–1 for short-term and long-term NAAQS. To demonstrate compliance and/or establish the appropriate SIP emissions limits, Table 8–1 generally provides for the use of "allowable" emissions in the regulatory dispersion modeling of the stationary point source(s) of interest. In such modeling, these source(s) should be modeled sequentially with these loads for every hour of the year. As part of a cumulative impact analysis, Table 8–1 allows for the model user to account for actual operations in developing the emissions inputs for dispersion modeling of nearby sources, while other sources are best represented by air quality monitoring data. Consultation with the appropriate reviewing authority (paragraph 3.0(b)) is advisable on the establishment of the appropriate emissions inputs for regulatory modeling applications with respect to SIP revisions for stationary point sources.

c. For the purposes of demonstrating NAAQS compliance in a PSD assessment, the regulatory modeling of inert pollutants shall use the emissions input data shown in Table 8–2 for short and long-term NAAQS. The new or modifying stationary point source shall be modeled with "allowable" emissions in the regulatory dispersion modeling. As part of a cumulative impact analysis, Table 8–2 allows for the model user to account for actual operations in developing the emissions inputs for dispersion modeling of nearby sources, while other sources are best represented by air quality monitoring data. For purposes of situations involving emissions trading, refer to current EPA policy and guidance to establish input data. Consultation with the appropriate reviewing authority (paragraph 3.0(b)) is advisable on the establishment of the appropriate emissions inputs for regulatory modeling applications with respect to PSD assessments for a proposed new or modifying source.

d. For stationary source applications, changes in operating conditions that affect the physical emission parameters (*e.g.,* release height, initial plume volume, and exit velocity) shall be considered to ensure that maximum potential impacts are appropriately determined in the assessment. For example, the load or operating condition for point sources that causes maximum ground-level concentrations shall be established. As a minimum, the source should be modeled using the design capacity (100 percent load). If a source operates at greater than design capacity for periods that could result in violations of the NAAQS or PSD increments, this load should be modeled. Where the source operates at substantially less than design capacity, and the changes in the stack parameters associated with the operating conditions could lead to higher ground level concentrations, loads such as 50 percent and 75 percent of capacity should also be modeled. Malfunctions which may result in excess emissions are not considered to be a normal operating condition. They generally should not be considered in determining allowable emissions. However, if the excess emissions are the result of poor maintenance, careless operation, or other preventable conditions, it may be necessary to consider them in determining source impact. A range of operating conditions should be considered in screening analyses. The load causing the highest concentration, in addition to the design load, should be included in refined modeling.

e. Emissions from mobile sources also have physical and temporal characteristics that should be appropriately accounted. For example, an appropriate emissions model shall be used to determine emissions profiles. Such emissions should include speciation specific for the vehicle types used on the roadway (*e.g.,* light duty and heavy duty trucks), and subsequent parameterizations of the physical emissions characteristics (*e.g.,* release height) should reflect those emissions sources. For long-term standards, annual average emissions may be appropriate, but for short-term standards, discrete temporal representation of emissions should be used (*e.g.,* variations in weekday and weekend traffic or the diurnal rush-hour profile typical of many cities). Detailed information and data requirements for modeling mobile sources of pollution are provided in the user's manuals for each of the models applicable to mobile sources.[61 63]

Table 8-1. - Point Source Model Emission Inputs for SIP Revisions of Inert Pollutants[1]

Averaging time	Emissions limit (lb/MMBtu)[2]	X	Operating level (MMBtu/hr)[2]	X	Operating factor (*e.g.* , hr/yr, hr/day)
Stationary Point Source(s) Subject to SIP Emissions Limit(s) Evaluation for Compliance with Ambient Standards *(Including Areawide Demonstrations)*					
Annual & quarterly	Maximum allowable emission limit or federally enforceable permit limit.		Actual or design capacity (whichever is greater), or federally enforceable permit condition.		Actual operating factor averaged over the most recent 2 years.[3]
Short term (≤ 24 hours)	Maximum allowable emission limit or federally enforceable permit limit.		Actual or design capacity (whichever is greater), or federally enforceable permit condition.[4]		Continuous operation, i.e., all hours of each time period under consideration (for all hours of the meteorological database).[5]
Nearby Source(s) [6]					
Annual & quarterly	Maximum allowable emission limit or federally enforceable permit limit.[6]		Annual level when actually operating, averaged over the most recent 2 years.[3]		Actual operating factor averaged over the most recent 2 years.[3, 8]
Short term (≤ 24 hours)	Maximum allowable emission limit or federally enforceable permit limit.[6]		Temporally representative level when actually operating, reflective of the most recent 2 years.[3, 7]		Continuous operation, i.e., all hours of each time period under consideration (for all hours of the meteorological database).[5]
Other Source(s) [6, 9]					

The ambient impacts from Non-nearby or Other Sources (*e.g.* , natural sources, minor sources and ,distant major sources, and unidentified sources) can be represented by air quality monitoring data unless adequate data do not exist.

1 . For purposes of emissions trading, NSR, or PSD, other model input criteria may apply. See Section 8.2 for more information regarding attainment demonstrations of primary PM2.5.
2. Terminology applicable to fuel burning sources; analogous terminology (*e.g.* , lb/throughput) may be used for other types of sources.
3. Unless it is determined that this period is not representative.
4. Operating levels such as 50 percent and 75 percent of capacity should also be modeled to determine the load causing the highest concentration.
5. If operation does not occur for all hours of the time period of consideration (*e.g.* , 3 or 24-hours) and the source operation is constrained by a federally enforceable permit condition, an appropriate adjustment to the modeled emission rate may be made (*e.g.* , if operation is only 8 a.m. to 4 p.m. each day, only these hours will be modeled with emissions from the source. Modeled emissions should not be averaged across non-operating time periods.)
6. See Section 8.3.3.
7. Temporally representative operating level could be based on Continuous Emissions Monitoring (CEM) data or other information and should be determined through consultation with the appropriate reviewing authority (Paragraph 3.0(b)).
8. For those permitted sources not in operation or that have not established an appropriate factor, continuous operation (i.e., 8760) should be used.
9. See Section 8.3.2.

Table 8-2. - Point Source Model Emission Inputs for NAAQS Compliance in PSD Demonstrations

Averaging time	Emissions limit (lb/MMBtu)[1]	X	Operating level (MMBtu/hr)[2]	X	Operating factor (*e.g.* , hr/yr, hr/day)
Proposed Major New or Modified Source					
Annual & quarterly	Maximum allowable emission limit or federally enforceable permit limit.		Design capacity or federally enforceable permit condition.		Continuous operation (i.e., 8760 hours).[2]
Short term (≤ 24 hours)	Maximum allowable emission limit or federally enforceable permit limit.		Design capacity or federally enforceable permit condition.[3]		Continuous operation, i.e., all hours of each time period under consideration (for all hours of the meteorological database).[2]
Nearby Source(s) [4,5]					
Annual & quarterly	Maximum allowable emission limit or federally enforceable permit limit.[5]		Annual level when actually operating, averaged over the most recent 2 years.[6]		Actual operating factor averaged over the most recent 2 years.[6,8]
Short term (≤ 24 hours)	Maximum allowable emission limit or federally enforceable permit limit.[5]		Temporally representative level when actually operating, reflective of the most recent 2 years.[6,7]		Continuous operation, i.e., all hours of each time period under consideration (for all hours of the meteorological database).[2]
Other Source(s) [5,9]					
The ambient impacts from Non-nearby or Other Sources (*e.g.* , natural sources, minor sources and ,distant major sources, and unidentified sources) can be represented by air quality monitoring data unless adequate data do not exist.					

1. Terminology applicable to fuel burning sources; analogous terminology (*e.g.* , lb/throughput) may be used for other types of sources.
2. If operation does not occur for all hours of the time period of consideration (*e.g.* , 3 or 24-hours) and the source operation is constrained by a federally enforceable permit condition, an appropriate adjustment to the modeled emission rate may be made (*e.g.* , if operation is only 8 a.m. to 4 p.m. each day, only these hours will be modeled with emissions from the source. Modeled emissions should not be averaged across non-operating time periods.
3. Operating levels such as 50 percent and 75 percent of capacity should also be modeled to determine the load causing the highest concentration.
4. Includes existing facility to which modification is proposed if the emissions from the existing facility will not be affected by the modification. Otherwise use the same parameters as for major modification.
5. See Section 8.3.3.
6. Unless it is determined that this period is not representative.
7. Temporally representative operating level could be based on Continuous Emissions Monitoring (CEM) data or other information and should be determined through consultation with the appropriate reviewing authority (Paragraph 3.0(b)).
8. For those permitted sources not in operation or that have not established an appropriate factor, continuous operation (*i.e.* , 8760) should be used.
9. See Section 8.3.2.

8.3 Background Concentrations

8.3.1 Discussion

a. Background concentrations are essential in constructing the design concentration, or total air quality concentration, as part of a cumulative impact analysis for NAAQS and PSD increments (section 9.2.3). Background air quality should not include the ambient impacts of the project source under consideration. Instead, it should include:

i. Nearby sources: These are individual sources located in the vicinity of the source(s) under consideration for emissions limits that are not adequately represented by ambient monitoring data. Typically, sources that cause a significant concentration gradient in the vicinity of the source(s) under consideration for emissions limits are not adequately represented by background ambient monitoring. The ambient contributions from these nearby sources are thereby accounted for by explicitly modeling their emissions (section 8.2).

ii. Other sources: That portion of the background attributable to natural sources, other unidentified sources in the vicinity of the project, and regional transport contributions from more distant sources (domestic and international). The ambient contributions from these sources are typically accounted for through use of ambient monitoring data or, in some cases, regional-scale photochemical grid modeling results.

b. The monitoring network used for developing background concentrations is expected to conform to the same quality assurance and other requirements as those networks established for PSD purposes.[91] Accordingly, the air quality monitoring data should be of sufficient completeness and follow appropriate data validation procedures. These data should be adequately representative of the area to inform calculation of the design concentration for comparison to the applicable NAAQS (section 9.2.2).

c. For photochemical grid modeling conducted in SIP attainment demonstrations for ozone, $PM_{2.5}$ and regional haze, the emissions from nearby and other sources are included as model inputs and fully accounted for in the modeling application and predicted concentrations. The concept of adding individual components to develop a design concentration, therefore, do not apply in these SIP applications. However, such modeling results may then be appropriate for consideration in characterizing background concentrations for other regulatory applications. Also, as noted in section 5, this modeling approach does provide for an appropriate atmospheric environment to

assess single-source impacts for ozone and secondary $PM_{2.5}$.

d. For NAAQS assessments and SIP attainment demonstrations for inert pollutants, the development of the appropriate background concentration for a cumulative impact analysis involves proper accounting of each contribution to the design concentration and will depend upon whether the project area's situation consists of either an isolated single source(s) or a multitude of sources. For PSD increment assessments, all impacts after the appropriate baseline dates (*i.e.,* trigger date, major source baseline date, and minor source baseline date) from all increment-consuming and increment-expanding sources should be considered in the design concentration (section 9.2.2).

8.3.2 Recommendations for Isolated Single Sources

a. In areas with an isolated source(s), determining the appropriate background concentration should focus on characterization of contributions from all other sources through adequately representative ambient monitoring data.

b. The EPA recommends use of the most recent quality assured air quality monitoring data collected in the vicinity of the source to determine the background concentration for the averaging times of concern. In most cases, the EPA recommends using data from the monitor closest to and upwind of the project area. If several monitors are available, preference should be given to the monitor with characteristics that are most similar to the project area. If there are no monitors located in the vicinity of the new or modifying source, a "regional site" may be used to determine background concentrations. A regional site is one that is located away from the area of interest but is impacted by similar or adequately representative sources.

c. Many of the challenges related to cumulative impact analyses arise in the context of defining the appropriate metric to characterize background concentrations from ambient monitoring data and determining the appropriate method for combining this monitor-based background contribution to the modeled impact of the project and other nearby sources. For many cases, the best starting point would be use of the current design value for the applicable NAAQS as a uniform monitored background contribution across the project area. However, there are cases in which the current design value may not be appropriate. Such cases include but are not limited to:

i. For situations involving a modifying source where the existing facility is determined to impact the ambient monitor, the background concentration at each monitor can be determined by excluding values when the source in question is impacting the monitor. In such cases, monitoring sites inside a 90° sector downwind of the source may be used to determine the area of impact.

ii. There may be other circumstances which would necessitate modifications to the ambient data record. Such cases could include removal of data from specific days or hours when a monitor is being impacted by activities that are not typical or not expected to occur again in the future (*e.g.,* construction, roadway repairs, forest fires, or unusual agricultural activities). There may also be cases where it may be appropriate to scale (multiplying the monitored concentrations with a scaling factor) or adjust (adding or subtracting a constant value the monitored concentrations) data from specific days or hours. Such adjustments would make the monitored background concentrations more temporally and/or spatially representative of the area around the new or modifying source for the purposes of the regulatory assessment.

iii. For short-term standards, the diurnal or seasonal patterns of the air quality monitoring data may differ significantly from the patterns associated with the modeled concentrations. When this occurs, it may be appropriate to pair the air quality monitoring data in a temporal manner that reflects these patterns (*e.g.,* pairing by season and/or hour of day).[92]

iv. For situations where monitored air quality concentrations vary across the modeling domain, it may be appropriate to consider air quality monitoring data from multiple monitors within the project area.

d. Determination of the appropriate background concentrations should be consistent with appropriate EPA modeling guidance[59 60] and justified in the modeling protocol that is vetted with the appropriate reviewing authority (paragraph 3.0(b)).

e. Considering the spatial and temporal variability throughout a typical modeling domain on an hourly basis and the complexities and limitations of hourly observations from the ambient monitoring network, the EPA does not recommend hourly or daily pairing of monitored background and modeled concentrations except in rare cases of relatively isolated sources where the available monitor can be shown to be representative of the ambient concentration levels in the areas of maximum impact from the proposed new source. The implicit assumption underlying hourly pairing is that the background monitored levels for each hour are spatially uniform and that the monitored values are fully representative of background levels at each receptor for each hour. Such an assumption clearly ignores the many factors that contribute to the temporal and spatial variability of ambient concentrations across a typical modeling domain on an hourly basis. In most cases, the seasonal (or quarterly) pairing of monitored and modeled concentrations should sufficiently address situations to which the impacts from modeled emissions are not temporally correlated with background monitored levels.

f. In those cases where adequately representative monitoring data to characterize background concentrations are not available, it may be appropriate to use results from a regional-scale photochemical grid model, or other representative model application, as background concentrations consistent with the considerations discussed above and in consultation with the appropriate reviewing authority (paragraph 3.0(b)).

8.3.3 Recommendations for Multi-Source Areas

a. In multi-source areas, determining the appropriate background concentration involves: (1) Identification and characterization of contributions from nearby sources through explicit modeling, and (2) characterization of contributions from other sources through adequately representative ambient monitoring data. A key point here is the interconnectedness of each component in that the question of which nearby sources to include in the cumulative modeling is inextricably linked to the question of what the ambient monitoring data represents within the project area.

b. *Nearby sources:* All sources in the vicinity of the source(s) under consideration for emissions limits that are not adequately represented by ambient monitoring data should be explicitly modeled. Since an ambient monitor is limited to characterizing air quality at a fixed location, sources that cause a significant concentration gradient in the vicinity of the source(s) under consideration for emissions limits are not likely to be adequately characterized by the monitored data due to the high degree of variability of the source's impact.

i. The pattern of concentration gradients can vary significantly based on the averaging period being assessed. In general, concentration gradients will be smaller and more spatially uniform for annual averages than for short-term averages, especially for hourly averages. The spatial distribution of annual impacts around a source will often have a single peak downwind of the source based on the prevailing wind direction, except in cases where terrain or other geographic effects are important. By contrast, the spatial distribution of peak short-term impacts will typically show several localized concentration peaks with more significant gradient.

ii. Concentration gradients associated with a particular source will generally be largest between that source's location and the distance to the maximum ground-level concentrations from that source. Beyond the maximum impact distance, concentration gradients will generally be much smaller and more spatially uniform. Thus, the magnitude of a concentration gradient will be greatest in the proximity of the source and will generally not be significant at distances greater than 10 times the height of the stack(s) at that source without consideration of terrain influences.

iii. The number of nearby sources to be explicitly modeled in the air quality analysis is expected to be few except in unusual situations. In most cases, the few nearby sources will be located within the first 10 to 20 km from the source(s) under consideration. Owing to both the uniqueness of each modeling situation and the large number of variables involved in identifying nearby sources, no attempt is made here to comprehensively define a "significant concentration gradient." Rather, identification of nearby sources calls for the exercise of professional judgment by the appropriate reviewing authority (paragraph 3.0(b)). This guidance is not intended to alter the exercise of that judgment or to

comprehensively prescribe which sources should be included as nearby sources.

c. For cumulative impact analyses of short-term and annual ambient standards, the nearby sources as well as the project source(s) must be evaluated using an appropriate appendix A model or approved alternative model with the emission input data shown in Table 8–1 or 8–2.

i. When modeling a nearby source that does not have a permit and the emissions limits contained in the SIP for a particular source category is greater than the emissions possible given the source's maximum physical capacity to emit, the "maximum allowable emissions limit" for such a nearby source may be calculated as the emissions rate representative of the nearby source's maximum physical capacity to emit, considering its design specifications and allowable fuels and process materials. However, the burden is on the permit applicant to sufficiently document what the maximum physical capacity to emit is for such a nearby source.

ii. It is appropriate to model nearby sources only during those times when they, by their nature, operate at the same time as the primary source(s) or could have impact on the averaging period of concern. Accordingly, it is not necessary to model impacts of a nearby source that does not, by its nature, operate at the same time as the primary source or could have impact on the averaging period of concern, regardless of an identified significant concentration gradient from the nearby source. The burden is on the permit applicant to adequately justify the exclusion of nearby sources to the satisfaction of the appropriate reviewing authority (paragraph 3.0(b)). The following examples illustrate two cases in which a nearby source may be shown not to operate at the same time as the primary source(s) being modeled: (1) Seasonal sources (only used during certain seasons of the year). Such sources would not be modeled as nearby sources during times in which they do not operate; and (2) Emergency backup generators, to the extent that they do not operate simultaneously with the sources that they back up. Such emergency equipment would not be modeled as nearby sources.

d. *Other sources.* That portion of the background attributable to all other sources (*e.g.,* natural sources, minor and distant major sources) should be accounted for through use of ambient monitoring data and determined by the procedures found in section 8.3.2 in keeping with eliminating or reducing the source-oriented impacts from nearby sources to avoid potential double-counting of modeled and monitored contributions.

8.4 Meteorological Input Data

8.4.1 Discussion

a. This subsection covers meteorological input data for use in dispersion modeling for regulatory applications and is separate from recommendations made for photochemical grid modeling. Recommendations for meteorological data for photochemical grid modeling applications are outlined in the latest version of EPA's *Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$,* and *Regional Haze.*[60] In cases where Lagrangian models are applied for regulatory purposes, appropriate meteorological inputs should be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)).

b. The meteorological data used as input to a dispersion model should be selected on the basis of spatial and climatological (temporal) representativeness as well as the ability of the individual parameters selected to characterize the transport and dispersion conditions in the area of concern. The representativeness of the measured data is dependent on numerous factors including, but not limited to: (1) The proximity of the meteorological monitoring site to the area under consideration; (2) the complexity of the terrain; (3) the exposure of the meteorological monitoring site; and (4) the period of time during which data are collected. The spatial representativeness of the data can be adversely affected by large distances between the source and receptors of interest and the complex topographic characteristics of the area. Temporal representativeness is a function of the year-to-year variations in weather conditions. Where appropriate, data representativeness should be viewed in terms of the appropriateness of the data for constructing realistic boundary layer profiles and, where applicable, three-dimensional meteorological fields, as described in paragraphs (c) and (d) of this subsection.

c. The meteorological data should be adequately representative and may be site-specific data, data from a nearby National Weather Service (NWS) or comparable station, or prognostic meteorological data. The implementation of NWS Automated Surface Observing Stations (ASOS) in the early 1990's should not preclude the use of NWS ASOS data if such a station is determined to be representative of the modeled area.[93]

d. Model input data are normally obtained either from the NWS or as part of a site-specific measurement program. State climatology offices, local universities, FAA, military stations, industry, and pollution control agencies may also be sources of such data. In specific cases, prognostic meteorological data may be appropriate for use and obtained from similar sources. Some recommendations and requirements for the use of each type of data are included in this subsection.

8.4.2 Recommendations and Requirements

a. AERMET[94] shall be used to preprocess all meteorological data, be it observed or prognostic, for use with AERMOD in regulatory applications. The AERMINUTE[95] processor, in most cases, should be used to process 1-minute ASOS wind data for input to AERMET when processing NWS ASOS sites in AERMET. When processing prognostic meteorological data for AERMOD, the Mesoscale Model Interface Program (MMIF)[103] should be used to process data for input to AERMET. Other methods of processing prognostic meteorological data for input to AERMET should be approved by the appropriate reviewing authority. Additionally, the following meteorological preprocessors are recommended by the EPA: PCRAMMET,[96] MPRM,[97] and METPRO.[98] PCRAMMET is the recommended meteorological data preprocessor for use in applications of OCD employing hourly NWS data. MPRM is the recommended meteorological data preprocessor for applications of OCD employing site-specific meteorological data. METPRO is the recommended meteorological data preprocessor for use with CTDMPLUS.[99]

b. Regulatory application of AERMOD necessitates careful consideration of the meteorological data for input to AERMET. Data representativeness, in the case of AERMOD, means utilizing data of an appropriate type for constructing realistic boundary layer profiles. Of particular importance is the requirement that all meteorological data used as input to AERMOD should be adequately representative of the transport and dispersion within the analysis domain. Where surface conditions vary significantly over the analysis domain, the emphasis in assessing representativeness should be given to adequate characterization of transport and dispersion between the source(s) of concern and areas where maximum design concentrations are anticipated to occur. The EPA recommends that the surface characteristics input to AERMET should be representative of the land cover in the vicinity of the meteorological data, *i.e.,* the location of the meteorological tower for measured data or the representative grid cell for prognostic data. Therefore, the model user should apply the latest version AERSURFACE,[100 101] where applicable, for determining surface characteristics when processing measured meteorological data through AERMET. In areas where it is not possible to use AERSURFACE output, surface characteristics can be determined using techniques that apply the same analysis as AERSURFACE. In the case of prognostic meteorological data, the surface characteristics associated with the prognostic meteorological model output for the representative grid cell should be used.[102 103] Furthermore, since the spatial scope of each variable could be different, representativeness should be judged for each variable separately. For example, for a variable such as wind direction, the data should ideally be collected near plume height to be adequately representative, especially for sources located in complex terrain. Whereas, for a variable such as temperature, data from a station several kilometers away from the source may be considered to be adequately representative. More information about meteorological data, representativeness, and surface characteristics can be found in the AERMOD Implementation Guide.[76]

c. Regulatory application of CTDMPLUS requires the input of multi-level measurements of wind speed, direction, temperature, and turbulence from an appropriately sited meteorological tower. The measurements should be obtained up to the representative plume height(s) of interest. Plume heights of interest can be determined by use of screening procedures such as CTSCREEN.

d. Regulatory application of OCD requires meteorological data over land and over water.

The over land or surface data, processed through PCRAMMET[96] or MPRM,[97] that provides hourly stability class, wind direction and speed, ambient temperature, and mixing height, are required. Data over water requires hourly mixing height, relative humidity, air temperature, and water surface temperature. Missing winds are substituted with the surface winds. Vertical wind direction shear, vertical temperature gradient, and turbulence intensities are optional.

e. The model user should acquire enough meteorological data to ensure that worst-case meteorological conditions are adequately represented in the model results. The use of 5 years of adequately representative NWS or comparable meteorological data, at least 1 year of site-specific, or at least 3 years of prognostic meteorological data, are required. If 1 year or more, up to 5 years, of site-specific data are available, these data are preferred for use in air quality analyses. Depending on completeness of the data record, consecutive years of NWS, site-specific, or prognostic data are preferred. Such data must be subjected to quality assurance procedures as described in section 8.4.4.2.

f. Objective analysis in meteorological modeling is to improve meteorological analyses (the "*first guess field*") used as initial conditions for prognostic meteorological models by incorporating information from meteorological observations. Direct and indirect (using remote sensing techniques) observations of temperature, humidity, and wind from surface and radiosonde reports are commonly employed to improve these analysis fields. For long-range transport applications, it is recommended that objective analysis procedures, using direct and indirect meteorological observations, be employed in preparing input fields to produce prognostic meteorological datasets. The length of record of observations should conform to recommendations outlined in paragraph 8.4.2(e) for prognostic meteorological model datasets.

8.4.3 National Weather Service Data

8.4.3.1 Discussion

a. The NWS meteorological data are routinely available and familiar to most model users. Although the NWS does not provide direct measurements of all the needed dispersion model input variables, methods have been developed and successfully used to translate the basic NWS data to the needed model input. Site-specific measurements of model input parameters have been made for many modeling studies, and those methods and techniques are becoming more widely applied, especially in situations such as complex terrain applications, where available NWS data are not adequately representative. However, there are many modeling applications where NWS data are adequately representative and the applications still rely heavily on the NWS data.

b. Many models use the standard hourly weather observations available from the National Centers for Environmental Information (NCEI).[b] These observations are then preprocessed before they can be used in the models. Prior to the advent of ASOS in the early 1990's, the standard "hourly" weather observation was a human-based observation reflecting a single 2-minute average generally taken about 10 minutes before the hour. However, beginning in January 2000 for first-order stations and in March 2005 for all stations, the NCEI has archived the 1-minute ASOS wind data (*i.e.*, the rolling 2-minute average winds) for the NWS ASOS sites. The AERMINUTE processor[95] was developed to reduce the number of calm and missing hours in AERMET processing by substituting standard hourly observations with full hourly average winds calculated from 1-minute ASOS wind data.

8.4.3.2 Recommendations

a. The preferred models listed in appendix A all accept, as input, the NWS meteorological data preprocessed into model compatible form. If NWS data are judged to be adequately representative for a specific modeling application, they may be used. The NCEI makes available surface[104 105] and upper air[106] meteorological data online and in CD–ROM format. Upper air data are also available at the Earth System Research Laboratory Global Systems Divisions Web site (*http://esrl.noaa.gov/gsd*).

b. Although most NWS wind measurements are made at a standard height of 10 m, the actual anemometer height should be used as input to the preferred meteorological processor and model.

c. Standard hourly NWS wind directions are reported to the nearest 10 degrees. Due to the coarse resolution of these data, a specific set of randomly generated numbers has been developed by the EPA and should be used when processing standard hourly NWS data for use in the preferred EPA models to ensure a lack of bias in wind direction assignments within the models.

d. Beginning with year 2000, NCEI began archiving 2-minute winds, reported every minute to the nearest degree for NWS ASOS sites. The AERMINUTE processor was developed to read those winds and calculate hourly average winds for input to AERMET. When such data are available for the NWS ASOS site being processed, the AERMINUTE processor should be used, in most cases, to calculate hourly average wind speed and direction when processing NWS ASOS data for input to AERMOD.[93]

e. Data from universities, FAA, military stations, industry and pollution control agencies may be used if such data are equivalent in accuracy and detail (*e.g.*, siting criteria, frequency of observations, data completeness, etc.) to the NWS data, they are judged to be adequately representative for the particular application, and have undergone quality assurance checks.

f. After valid data retrieval requirements have been met,[107] large number of hours in the record having missing data should be treated according to an established data substitution protocol provided that adequately representative alternative data are available. Data substitution guidance is provided in section 5.3 of reference.[107] If no representative alternative data are available for substitution, the absent data should be coded as missing using missing data codes appropriate to the applicable meteorological pre-processor. Appropriate model options for treating missing data, if available in the model, should be employed.

8.4.4 Site-Specific Data

8.4.4.1 Discussion

a. Spatial or geographical representativeness is best achieved by collection of all of the needed model input data in close proximity to the actual site of the source(s). Site-specific measured data are, therefore, preferred as model input, provided that appropriate instrumentation and quality assurance procedures are followed, and that the data collected are adequately representative (free from inappropriate local or microscale influences) and compatible with the input requirements of the model to be used. It should be noted that, while site-specific measurements are frequently made "on-property" (*i.e.*, on the source's premises), acquisition of adequately representative site-specific data does not preclude collection of data from a location off property. Conversely, collection of meteorological data on a source's property does not of itself guarantee adequate representativeness. For help in determining representativeness of site-specific measurements, technical guidance[107] is available. Site-specific data should always be reviewed for representativeness and adequacy by an experienced meteorologist, atmospheric scientist, or other qualified scientist in consultation with the appropriate reviewing authority (paragraph 3.0(b)).

8.4.4.2 Recommendations

a. The EPA guidance[107] provides recommendations on the collection and use of site-specific meteorological data. Recommendations on characteristics, siting, and exposure of meteorological instruments and on data recording, processing, completeness requirements, reporting, and archiving are also included. This publication should be used as a supplement to other limited guidance on these subjects.[5 91 108 109] Detailed information on quality assurance is also available.[110] As a minimum, site-specific measurements of ambient air temperature, transport wind speed and direction, and the variables necessary to estimate atmospheric dispersion should be available in meteorological datasets to be used in modeling. Care should be taken to ensure that meteorological instruments are located to provide an adequately representative characterization of pollutant transport between sources and receptors of interest. The appropriate reviewing authority (paragraph 3.0(b)) is available to help determine the appropriateness of the measurement locations.

i. *Solar radiation measurements.* Total solar radiation or net radiation should be measured with a reliable pyranometer or net radiometer sited and operated in accordance with established site-specific meteorological guidance.[107 110]

[b] Formerly the National Climatic Data Center (NCDC).

ii. *Temperature measurements.* Temperature measurements should be made at standard shelter height (2m) in accordance with established site-specific meteorological guidance.[107]

iii. *Temperature difference measurements.* Temperature difference (DT) measurements should be obtained using matched thermometers or a reliable thermocouple system to achieve adequate accuracy. Siting, probe placement, and operation of DT systems should be based on guidance found in Chapter 3 of reference 107 and such guidance should be followed when obtaining vertical temperature gradient data. AERMET may employ the Bulk Richardson scheme, which requires measurements of temperature difference, in lieu of cloud cover or insolation data. To ensure correct application and acceptance, AERMOD users should consult with the appropriate reviewing authority (paragraph 3.0(b)) before using the Bulk Richardson scheme for their analysis.

iv. *Wind measurements.* For simulation of plume rise and dispersion of a plume emitted from a stack, characterization of the wind profile up through the layer in which the plume disperses is desirable. This is especially important in complex terrain and/or complex wind situations where wind measurements at heights up to hundreds of meters above stack base may be required in some circumstances. For tall stacks when site-specific data are needed, these winds have been obtained traditionally using meteorological sensors mounted on tall towers. A feasible alternative to tall towers is the use of meteorological remote sensing instruments (*e.g.,* acoustic sounders or radar wind profilers) to provide winds aloft, coupled with 10-meter towers to provide the near-surface winds. Note that when site-specific wind measurements are used, AERMOD, at a minimum, requires wind observations at a height above ground between seven times the local surface roughness height and 100 m. (For additional requirements for AERMOD and CTDMPLUS, *see* appendix A.) Specifications for wind measuring instruments and systems are contained in reference 107.

b. All processed site-specific data should be in the form of hourly averages for input to the dispersion model.

i. *Turbulence data.* There are several dispersion models that are capable of using direct measurements of turbulence (wind fluctuations) in the characterization of the vertical and lateral dispersion (*e.g.,* CTDMPLUS or AERMOD). When turbulence data are used to directly characterize the vertical and lateral dispersion, the averaging time for the turbulence measurements should be 1 hour. For technical guidance on processing of turbulence parameters for use in dispersion modeling, refer to the user's guide to the meteorological processor for each model (*see* section 8.4.2(a)).

ii. *Stability categories.* For dispersion models that employ P–G stability categories for the characterization of the vertical and lateral dispersion, the P–G stability categories, as originally defined, couple near-surface measurements of wind speed with subjectively determined insolation assessments based on hourly cloud cover and ceiling height observations. The wind speed measurements are made at or near 10 m. The insolation rate is typically assessed using observations of cloud cover and ceiling height based on criteria outlined by Turner.[72] It is recommended that the P–G stability category be estimated using the Turner method with site-specific wind speed measured at or near 10 m and representative cloud cover and ceiling height. Implementation of the Turner method, as well as considerations in determining representativeness of cloud cover and ceiling height in cases for which site-specific cloud observations are unavailable, may be found in section 6 of reference 107. In the absence of requisite data to implement the Turner method, the solar radiation/delta-T (SRDT) method or wind fluctuation statistics (*i.e.,* the σ_E and σ_A methods) may be used.

iii. The SRDT method, described in section 6.4.4.2 of reference 107, is modified slightly from that published from earlier work[111] and has been evaluated with three site-specific databases.[112] The two methods of stability classification that use wind fluctuation statistics, the σ_E and σ_A methods, are also described in detail in section 6.4.4 of reference 107 (note applicable tables in section 6). For additional information on the wind fluctuation methods, several references are available.[113 114 115 116]

c. *Missing data substitution.* After valid data retrieval requirements have been met,[107] hours in the record having missing data should be treated according to an established data substitution protocol provided that adequately representative alternative data are available. Such protocols are usually part of the approved monitoring program plan. Data substitution guidance is provided in section 5.3 of reference 107. If no representative alternative data are available for substitution, the absent data should be coded as missing, using missing data codes appropriate to the applicable meteorological pre-processor. Appropriate model options for treating missing data, if available in the model, should be employed.

8.4.5 Prognostic Meteorological Data

8.4.5.1 Discussion

a. For some modeling applications, there may not be a representative NWS or comparable meteorological station available (*e.g.,* complex terrain), and it may be cost prohibitive or infeasible to collect adequately representative site-specific data. For these cases, it may be appropriate to use prognostic meteorological data, if deemed adequately representative, in a regulatory modeling application. However, if prognostic meteorological data are not representative of transport and dispersion conditions in the area of concern, the collection of site-specific data is necessary.

b. The EPA has developed a processor, the MMIF,[102] to process MM5 (Mesoscale Model 5) or WRF (Weather Research and Forecasting) model data for input to various models including AERMOD. MMIF can process data for input to AERMET or AERMOD for a single grid cell or multiple grid cells. MMIF output has been found to compare favorably against observed data (site-specific or NWS).[117] Specific guidance on processing MMIF for AERMOD can be found in reference 103. When using MMIF to process prognostic data for regulatory applications, the data should be processed to generate AERMET inputs and the data subsequently processed through AERMET for input to AERMOD. If an alternative method of processing data for input to AERMET is used, it must be approved by the appropriate reviewing authority (paragraph 3.0(b)).

8.4.5.2 Recommendations

a. *Prognostic model evaluation.* Appropriate effort by the applicant should be devoted to the process of evaluating the prognostic meteorological data. The modeling data should be compared to NWS observational data or other comparable data in an effort to show that the data are adequately replicating the observed meteorological conditions of the time periods modeled. An operational evaluation of the modeling data for all model years (*i.e.,* statistical, graphical) should be completed.[60] The use of output from prognostic mesoscale meteorological models is contingent upon the concurrence with the appropriate reviewing authority (paragraph 3.0(b)) that the data are of acceptable quality, which can be demonstrated through statistical comparisons with meteorological observations aloft and at the surface at several appropriate locations.[60]

b. *Representativeness.* When processing MMIF data for use with AERMOD, the grid cell used for the dispersion modeling should be adequately spatially representative of the analysis domain. In most cases, this may be the grid cell containing the emission source of interest. Since the dispersion modeling may involve multiple sources and the domain may cover several grid cells, depending on grid resolution of the prognostic model, professional judgment may be needed to select the appropriate grid cell to use. In such cases, the selected grid cells should be adequately representative of the entire domain.

c. *Grid resolution.* The grid resolution of the prognostic meteorological data should be considered and evaluated appropriately, particularly for projects involving complex terrain. The operational evaluation of the modeling data should consider whether a finer grid resolution is needed to ensure that the data are representative. The use of output from prognostic mesoscale meteorological models is contingent upon the concurrence with the appropriate reviewing authority (paragraph 3.0(b)) that the data are of acceptable quality.

8.4.6 Treatment of Near-Calms and Calms

8.4.6.1 Discussion

a. Treatment of calm or light and variable wind poses a special problem in modeling applications since steady-state Gaussian plume models assume that concentration is inversely proportional to wind speed, depending on model formulations. Procedures have been developed to prevent the occurrence of overly conservative concentration estimates during periods of calms. These procedures acknowledge that a steady-state Gaussian plume model does not apply during calm conditions, and that our knowledge of wind patterns and plume

behavior during these conditions does not, at present, permit the development of a better technique. Therefore, the procedures disregard hours that are identified as calm. The hour is treated as missing and a convention for handling missing hours is recommended. With the advent of the AERMINUTE processor, when processing NWS ASOS data, the inclusion of hourly averaged winds from AERMINUTE will, in some instances, dramatically reduce the number of calm and missing hours, especially when the ASOS wind are derived from a sonic anemometer. To alleviate concerns about these issues, especially those introduced with AERMINUTE, the EPA implemented a wind speed threshold in AERMET for use with ASOS derived winds.[93 94] Winds below the threshold will be treated as calms.

b. AERMOD, while fundamentally a steady-state Gaussian plume model, contains algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold. Required input to AERMET for site-specific data, the meteorological processor for AERMOD, includes a threshold wind speed and a reference wind speed. The threshold wind speed is the greater of the threshold of the instrument used to collect the wind speed data or wind direction sensor.[107] The reference wind speed is selected by the model as the lowest level of non-missing wind speed and direction data where the speed is greater than the wind speed threshold, and the height of the measurement is between seven times the local surface roughness length and 100 m. If the only valid observation of the reference wind speed between these heights is less than the threshold, the hour is considered calm, and no concentration is calculated. None of the observed wind speeds in a measured wind profile that are less than the threshold speed are used in construction of the modeled wind speed profile in AERMOD.

8.4.6.2 Recommendations

a. Hourly concentrations calculated with steady-state Gaussian plume models using calms should not be considered valid; the wind and concentration estimates for these hours should be disregarded and considered to be missing. Model predicted concentrations for 3-, 8-, and 24-hour averages should be calculated by dividing the sum of the hourly concentrations for the period by the number of valid or non-missing hours. If the total number of valid hours is less than 18 for 24-hour averages, less than 6 for 8-hour averages, or less than 3 for 3-hour averages, the total concentration should be divided by 18 for the 24-hour average, 6 for the 8-hour average, and 3 for the 3-hour average. For annual averages, the sum of all valid hourly concentrations is divided by the number of non-calm hours during the year. AERMOD has been coded to implement these instructions. For hours that are calm or missing, the AERMOD hourly concentrations will be zero. For other models listed in appendix A, a post-processor computer program, CALMPRO[118] has been prepared, is available on the EPA's SCRAM Web site (section 2.3), and should be used.

b. Stagnant conditions that include extended periods of calms often produce high concentrations over wide areas for relatively long averaging periods. The standard steady-state Gaussian plume models are often not applicable to such situations. When stagnation conditions are of concern, other modeling techniques should be considered on a case-by-case basis (*see* also section 7.2.1.2).

c. When used in steady-state Gaussian plume models other than AERMOD, measured site-specific wind speeds of less than 1 m/s but higher than the response threshold of the instrument should be input as 1 m/s; the corresponding wind direction should also be input. Wind observations below the response threshold of the instrument should be set to zero, with the input file in ASCII format. For input to AERMOD, no such adjustment should be made to the site-specific wind data, as AERMOD has algorithms to account for light or variable winds as discussed in section 8.4.6.1(a). For NWS ASOS data, especially data using the 1-minute ASOS winds, a wind speed threshold option is allowed with a recommended speed of 0.5 m/s.[93] When using prognostic data processed by MMIF, a 0.5 m/s threshold is also invoked by MMIF for input to AERMET. Observations with wind speeds less than the threshold are considered calm, and no concentration is calculated. In all cases involving steady-state Gaussian plume models, calm hours should be treated as missing, and concentrations should be calculated as in paragraph (a) of this subsection.

9.0 Regulatory Application of Models

9.1 Discussion

a. Standardized procedures are valuable in the review of air quality modeling and data analyses conducted to support SIP submittals and revisions, NSR, or other EPA requirements to ensure consistency in their regulatory application. This section recommends procedures specific to NSR that facilitate some degree of standardization while at the same time allowing the flexibility needed to assure the technically best analysis for each regulatory application. For SIP attainment demonstrations, refer to the appropriate EPA guidance[51 60] for the recommended procedures.

b. Air quality model estimates, especially with the support of measured air quality data, are the preferred basis for air quality demonstrations. A number of actions have been taken to ensure that the best air quality model is used correctly for each regulatory application and that it is not arbitrarily imposed.

- First, the *Guideline* clearly recommends that the most appropriate model be used in each case. Preferred models are identified, based on a number of factors, for many uses.
- Second, the preferred models have been subjected to a systematic performance evaluation and a scientific peer review. Statistical performance measures, including measures of difference (or residuals) such as bias, variance of difference and gross variability of the difference, and measures of correlation such as time, space, and time and space combined, as described in section 2.1.1, were generally followed.
- Third, more specific information has been provided for considering the incorporation of new models into the *Guideline* (section 3.1), and the *Guideline* contains procedures for justifying the case-by-case use of alternative models and obtaining EPA approval (section 3.2).

c. Air quality modeling is the preferred basis for air quality demonstrations. Nevertheless, there are rare circumstances where the performance of the preferred air quality model may be shown to be less than reasonably acceptable or where no preferred air quality model, screening model or technique, or alternative model are suitable for the situation. In these unique instances, there is the possibility of assuring compliance and establishing emissions limits for an existing source solely on the basis of observed air quality data in lieu of an air quality modeling analysis. Comprehensive air quality monitoring in the vicinity of the existing source with proposed modifications will be necessary in these cases. The same attention should be given to the detailed analyses of the air quality data as would be applied to a model performance evaluation.

d. The current levels and forms of the NAAQS for the six criteria pollutants can be found on the EPA's NAAQS Web site at *https://www.epa.gov/criteria-air-pollutants*. As required by the CAA, the NAAQS are subjected to extensive review every 5 years and the standards, including the level and the form, may be revised as part of that review. The criteria pollutants have either long-term (annual or quarterly) and/or short-term (24-hour or less) forms that are not to be exceeded more than a certain frequency over a period of time (*e.g.*, no exceedance on a rolling 3-month average, no more than once per year, or no more than once per year averaged over 3 years), are averaged over a period of time (*e.g.*, an annual mean or an annual mean averaged over 3 years), or are some percentile that is averaged over a period of time (*e.g.*, annual 99th or 98th percentile averaged over 3 years). The 3-year period for ambient monitoring design values does not dictate the length of the data periods recommended for modeling (*i.e.*, 5 years of NWS meteorological data, at least 1 year of site-specific, or at least 3 years of prognostic meteorological data).

e. This section discusses general recommendations on the regulatory application of models for the purposes of NSR, including PSD permitting, and particularly for estimating design concentration(s), appropriately comparing these estimates to NAAQS and PSD increments, and developing emissions limits. This section also provides the criteria necessary for considering use of an analysis based on measured ambient data in lieu of modeling as the sole basis for demonstrating compliance with NAAQS and PSD increments.

9.2 Recommendations

9.2.1 Modeling Protocol

a. Every effort should be made by the appropriate reviewing authority (paragraph

3.0(b)) to meet with all parties involved in either a SIP submission or revision or a PSD permit application prior to the start of any work on such a project. During this meeting, a protocol should be established between the preparing and reviewing parties to define the procedures to be followed, the data to be collected, the model to be used, and the analysis of the source and concentration data to be performed. An example of the content for such an effort is contained in the Air Quality Analysis Checklist posted on the EPA's SCRAM Web site (section 2.3). This checklist suggests the appropriate level of detail to assess the air quality resulting from the proposed action. Special cases may require additional data collection or analysis and this should be determined and agreed upon at the pre-application meeting. The protocol should be written and agreed upon by the parties concerned, although it is not intended that this protocol be a binding, formal legal document. Changes in such a protocol or deviations from the protocol are often necessary as the data collection and analysis progresses. However, the protocol establishes a common understanding of how the demonstration required to meet regulatory requirements will be made.

9.2.2 Design Concentration and Receptor Sites

a. Under the PSD permitting program, an air quality analysis for criteria pollutants is required to demonstrate that emissions from the construction or operation of a proposed new source or modification will not cause or contribute to a violation of the NAAQS or PSD increments.

i. For a NAAQS assessment, the design concentration is the combination of the appropriate background concentration (section 8.3) with the estimated modeled impact of the proposed source. The NAAQS design concentration is then compared to the applicable NAAQS.

ii. For a PSD increment assessment, the design concentration includes impacts occurring after the appropriate baseline date from all increment-consuming and increment-expanding sources. The PSD increment design concentration is then compared to the applicable PSD increment.

b. The specific form of the NAAQS for the pollutant(s) of concern will also influence how the background and modeled data should be combined for appropriate comparison with the respective NAAQS in such a modeling demonstration. Given the potential for revision of the form of the NAAQS and the complexities of combining background and modeled data, specific details on this process can be found in the applicable modeling guidance available on the EPA's SCRAM Web site (section 2.3). Modeled concentrations should not be rounded before comparing the resulting design concentration to the NAAQS or PSD increments. Ambient monitoring and dispersion modeling address different issues and needs relative to each aspect of the overall air quality assessment.

c. The PSD increments for criteria pollutants are listed in 40 CFR 52.21(c) and 40 CFR 51.166(c). For short-term increments, these maximum allowable increases in pollutant concentrations may be exceeded once per year at each site, while the annual increment may not be exceeded. The highest, second-highest increase in estimated concentrations for the short-term averages, as determined by a model, must be less than or equal to the permitted increment. The modeled annual averages must not exceed the increment.

d. Receptor sites for refined dispersion modeling should be located within the modeling domain (section 8.1). In designing a receptor network, the emphasis should be placed on receptor density and location, not total number of receptors. Typically, the density of receptor sites should be progressively more resolved near the new or modifying source, areas of interest, and areas with the highest concentrations with sufficient detail to determine where possible violations of a NAAQS or PSD increments are most likely to occur. The placement of receptor sites should be determined on a case-by-case basis, taking into consideration the source characteristics, topography, climatology, and monitor sites. Locations of particular importance include: (1) The area of maximum impact of the point source; (2) the area of maximum impact of nearby sources; and (3) the area where all sources combine to cause maximum impact. Depending on the complexities of the source and the environment to which the source is located, a dense array of receptors may be required in some cases. In order to avoid unreasonably large computer runs due to an excessively large array of receptors, it is often desirable to model the area twice. The first model run would use a moderate number of receptors more resolved near the new or modifying source and over areas of interest. The second model run would modify the receptor network from the first model run with a denser array of receptors in areas showing potential for high concentrations and possible violations, as indicated by the results of the first model run. Accordingly, the EPA neither anticipates nor encourages that numerous iterations of modeling runs be made to continually refine the receptor network.

9.2.3 NAAQS and PSD Increments Compliance Demonstrations for New or Modifying Sources

a. As described in this subsection, the recommended procedure for conducting either a NAAQS or PSD increments assessment under PSD permitting is a multi-stage approach that includes the following two stages:

i. The EPA describes the first stage as a single-source impact analysis, since this stage involves considering only the impact of the new or modifying source. There are two possible levels of detail in conducting a single-source impact analysis with the model user beginning with use of a screening model and proceeding to use of a refined model as necessary.

ii. The EPA describes the second stage as a cumulative impact analysis, since it takes into account all sources affecting the air quality in an area. In addition to the project source impact, this stage includes consideration of background, which includes contributions from nearby sources and other sources (*e.g.*, natural, minor, and distant major sources).

b. Each stage should involve increasing complexity and details, as required, to fully demonstrate that a new or modifying source will not cause or contribute to a violation of any NAAQS or PSD increment. As such, starting with a single-source impact analysis is recommended because, where the analysis at this stage is sufficient to demonstrate that a source will not cause or contribute to any potential violation, this may alleviate the need for a more time-consuming and comprehensive cumulative modeling analysis.

c. The single-source impact analysis, or first stage of an air quality analysis, should begin by determining the potential of a proposed new or modifying source to cause or contribute to a NAAQS or PSD increment violation. In certain circumstances, a screening model or technique may be used instead of the preferred model because it will provide estimated worst-case ambient impacts from the proposed new or modifying source. If these worst case ambient concentration estimates indicate that the source will not cause or contribute to any potential violation of a NAAQS or PSD increment, then the screening analysis should generally be sufficient for the required demonstration under PSD. If the ambient concentration estimates indicate that the source's emissions have the potential to cause or contribute to a violation, then the use of a refined model to estimate the source's impact should be pursued. The refined modeling analysis should use a model or technique consistent with the *Guideline* (either a preferred model or technique or an alternative model or technique) and follow the requirements and recommendations for model inputs outlined in section 8. If the ambient concentration increase predicted with refined modeling indicates that the source will not cause or contribute to any potential violation of a NAAQS or PSD increment, then the refined analysis should generally be sufficient for the required demonstration under PSD. However, if the ambient concentration estimates from the refined modeling analysis indicate that the source's emissions have the potential to cause or contribute to a violation, then a cumulative impact analysis should be undertaken. The receptors that indicate the location of significant ambient impacts should be used to define the modeling domain for use in the cumulative impact analysis (section 8.2.2).

d. The cumulative impact analysis, or the second stage of an air quality analysis, should be conducted with the same refined model or technique to characterize the project source and then include the appropriate background concentrations (section 8.3). The resulting design concentrations should be used to determine whether the source will cause or contribute to a NAAQS or PSD increment violation. This determination should be based on: (1) The appropriate design concentration for each applicable NAAQS (and averaging period); and (2) whether the source's emissions cause or contribute to a violation at the time and location of any modeled

violation (*i.e.,* when and where the predicted design concentration is greater than the NAAQS). For PSD increments, the cumulative impact analysis should also consider the amount of the air quality increment that has already been consumed by other sources, or, conversely, whether increment has expanded relative to the baseline concentration. Therefore, the applicant should model the existing or permitted nearby increment-consuming and increment-expanding sources, rather than using past modeling analyses of those sources as part of background concentration. This would permit the use of newly acquired data or improved modeling techniques if such data and/or techniques have become available since the last source was permitted.

9.2.3.1 Considerations in Developing Emissions Limits

a. Emissions limits and resulting control requirements should be established to provide for compliance with each applicable NAAQS (and averaging period) and PSD increment. It is possible that multiple emissions limits will be required for a source to demonstrate compliance with several criteria pollutants (and averaging periods) and PSD increments. Case-by-case determinations must be made as to the appropriate form of the limits, *i.e.,* whether the emissions limits restrict the emission factor (*e.g.,* limiting lb/MMBTU), the emission rate (*e.g.,* lb/hr), or both. The appropriate reviewing authority (paragraph 3.0(b)) and appropriate EPA guidance should be consulted to determine the appropriate emissions limits on a case-by-case basis.

9.2.4 Use of Measured Data in Lieu of Model Estimates

a. As described throughout the *Guideline,* modeling is the preferred method for demonstrating compliance with the NAAQS and PSD increments and for determining the most appropriate emissions limits for new and existing sources. When a preferred model or adequately justified and approved alternative model is available, model results, including the appropriate background, are sufficient for air quality demonstrations and establishing emissions limits, if necessary. In instances when the modeling technique available is only a screening technique, the addition of air quality monitoring data to the analysis may lend credence to the model results. However, air quality monitoring data alone will normally not be acceptable as the sole basis for demonstrating compliance with the NAAQS and PSD increments or for determining emissions limits.

b. There may be rare circumstances where the performance of the preferred air quality model will be shown to be less than reasonably acceptable when compared with air quality monitoring data measured in the vicinity of an existing source. Additionally, there may not be an applicable preferred air quality model, screening technique, or justifiable alternative model suitable for the situation. In these unique instances, there may be the possibility of establishing emissions limits and demonstrating compliance with the NAAQS and PSD increments solely on the basis of analysis of observed air quality data in lieu of an air quality modeling analysis. However, only in the case of a modification to an existing source should air quality monitoring data alone be a basis for determining adequate emissions limits or for demonstration that the modification will not cause or contribute to a violation of any NAAQS or PSD increment.

c. The following items should be considered prior to the acceptance of an analysis of measured air quality data as the sole basis for an air quality demonstration or determining an emissions limit:

i. Does a monitoring network exist for the pollutants and averaging times of concern in the vicinity of the existing source?

ii. Has the monitoring network been designed to locate points of maximum concentration?

iii. Do the monitoring network and the data reduction and storage procedures meet EPA monitoring and quality assurance requirements?

iv. Do the dataset and the analysis allow impact of the most important individual sources to be identified if more than one source or emission point is involved?

v. Is at least one full year of valid ambient data available?

vi. Can it be demonstrated through the comparison of monitored data with model results that available air quality models and techniques are not applicable?

d. Comprehensive air quality monitoring in the area affected by the existing source with proposed modifications will be necessary in these cases. Additional meteorological monitoring may also be necessary. The appropriate number of air quality and meteorological monitors from a scientific and technical standpoint is a function of the situation being considered. The source configuration, terrain configuration, and meteorological variations all have an impact on number and optimal placement of monitors. Decisions on the monitoring network appropriate for this type of analysis can only be made on a case-by-case basis.

e. Sources should obtain approval from the appropriate reviewing authority (paragraph 3.0(b)) and the EPA Regional Office for the monitoring network prior to the start of monitoring. A monitoring protocol agreed to by all parties involved is necessary to assure that ambient data are collected in a consistent and appropriate manner. The design of the network, the number, type, and location of the monitors, the sampling period, averaging time, as well as the need for meteorological monitoring or the use of mobile sampling or plume tracking techniques, should all be specified in the protocol and agreed upon prior to start-up of the network.

f. Given the uniqueness and complexities of these rare circumstances, the procedures can only be established on a case-by-case basis for analyzing the source's emissions data and the measured air quality monitoring data, and for projecting with a reasoned basis the air quality impact of a proposed modification to an existing source in order to demonstrate that emissions from the construction or operation of the modification will not cause or contribute to a violation of the applicable NAAQS and PSD increment, and to determine adequate emissions limits. The same attention should be given to the detailed analyses of the air quality data as would be applied to a comprehensive model performance evaluation. In some cases, the monitoring data collected for use in the performance evaluation of preferred air quality models, screening technique, or existing alternative models may help inform the development of a suitable new alternative model. Early coordination with the appropriate reviewing authority (paragraph 3.0(b)) and the EPA Regional Office is fundamental with respect to any potential use of measured data in lieu of model estimates.

10.0 References

1. *Code of Federal Regulations;* Title 40 (Protection of Environment); part 51; §§ 51.112, 51.117, 51.150, 51.160.
2. U.S. Environmental Protection Agency, 1990. New Source Review Workshop Manual: Prevention of Significant Deterioration and Nonattainment Area Permitting (Draft). Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www.epa.gov/nsr.*
3. *Code of Federal Regulations;* Title 40 (Protection of Environment); part 51; §§ 51.166 and 52.21.
4. *Code of Federal Regulations;* Title 40 (Protection of Environment); part 93; §§ 93.116, 93.123, and 93.150.
5. *Code of Federal Regulations;* Title 40 (Protection of Environment); part 58 (Ambient Air Quality Surveillance).
6. *Code of Federal Regulations;* Title 40 (Protection of Environment); part 50 (National Primary and Secondary Ambient Air Quality Standards).
7. Baker, K.R., Kelly, J.T., 2014. Single source impacts estimated with photochemical model source sensitivity and apportionment approaches. *Atmospheric Environment,* 96: 266–274.
8. ENVIRON, 2012. Evaluation of Chemical Dispersion Models using Atmospheric Plume Measurements from Field Experiments. ENVIRON International, Corp., Novato, CA. Prepared under contract No. EP–D–07–102 for the U.S. Environmental Protection Agency, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/reports/Plume_Eval_Final_Sep_2012v5.pdf.*
9. McMurry, P.H., Shepherd, M.F., Vickery, J.S., 2004. Particulate matter science for policy makers: A NARSTO assessment. Cambridge University Press.
10. Baker, K.R., Foley, K.M., 2011. A nonlinear regression model estimating single source concentrations of primary and secondarily formed $PM_{2.5}$. *Atmospheric Environment,* 45: 3758–3767.
11. Bergin, M.S., Russell, A.G., Odman, M.T., Cohan, D.S., Chameldes, W.L., 2008. Single-Source Impact Analysis Using Three-Dimensional Air Quality Models. *Journal of the Air & Waste Management Association,* 58: 1351–1359.
12. Zhou, W., Cohan, D.S., Pinder, R.W., Neuman, J.A., Holloway, J.S., Peischl, J., Ryerson, T.B., Nowak, J.B., Flocke, F., Zheng, W.G., 2012. Observation and

modeling of the evolution of Texas power plant plumes. *Atmospheric Chemistry and Physics,* 12: 455–468.
13. Chen, J., Lu, J., Avise, J.C., DaMassa, J.A., Kleeman, M.J., Kaduwela, A.P., 2014. Seasonal modeling of PM 2.5 in California's San Joaquin Valley. *Atmospheric Environment,* 92: 182–190.
14. Russell, A.G., 2008. EPA Supersites program-related emissions-based particulate matter modeling: initial applications and advances. *Journal of the Air & Waste Management Association,* 58: 289–302.
15. Tesche, T., Morris, R., Tonnesen, G., McNally, D., Boylan, J., Brewer, P., 2006. CMAQ/CAMx annual 2002 performance evaluation over the eastern US. *Atmospheric Environment,* 40: 4906–4919.
16. Fox, D.G., 1984. Uncertainty in air quality modeling. *Bulletin of the American Meteorological Society,* 65(1): 27–36.
17. Bowne, NE., 1981. Validation and Performance Criteria for Air Quality Models. Appendix F in Air Quality Modeling and the Clean Air Act: Recommendations to EPA on Dispersion Modeling for Regulatory Applications. American Meteorological Society, Boston, MA; pp. 159–171. (Docket No. A–80–46, II–A–106).
18. Fox, D.G., 1981. Judging Air Quality Model Performance. *Bulletin of the American Meteorological Society,* 62(5): 599–609.
19. Simon, H., Baker, K.R., Phillips, S., 2012. Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012. *Atmospheric Environment,* 61: 124–139.
20. Burton, C.S., 1981. The Role of Atmospheric Models in Regulatory Decision-Making: Summary Report. Systems Applications, Inc., San Rafael, CA. Prepared under contract No. 68–01–5845 for the U.S. Environmental Protection Agency, Research Triangle Park, NC. (Docket No. A–80–46, II–M–6).
21. Olesen, H.R., 2001. Ten years of Harmonisation activities: Past, present and future. Introductory address and paper presented at the 7th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes, May 28–31, 2001, Belgirate, Italy. *http://www.harmo.org/Docs/TenYears.pdf.*
22. Weil, Sykes, and Venkatram, 1992. Evaluating Air-Quality Models: Review and Outlook. *Journal of Applied Meteorology,* 31: 1121–1145.
23. U.S. Environmental Protection Agency, 2016. Model Clearinghouse: Operational Plan. Publication No. EPA–454/B–16–008. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
24. American Meteorological Society, 1983. Synthesis of the Rural Model Reviews. Publication No. EPA–600/3–83–108. Office of Research and Development, Research Triangle Park, NC. (NTIS No. PB 84–121037).
25. Hanna, S., M. Garrison and B. Turner, 1998. AERMOD Peer Review report. Prepared by SAI, Inc. under EPA Contract No. 68–D6–0064/1–14 for the U.S. Environmental Protection Agency, Research Triangle Park, NC. 12pp. & appendices. (Docket No. A–99–05, II–A–6).
26. Scire, J.S. and L.L. Schulman, 1981. Evaluation of the BLP and ISC Models with SF6 Tracer Data and SO_2 Measurements at Aluminum Reduction Plants. APCA Specialty Conference on Dispersion Modeling for Complex Sources, St. Louis, MO.
27. U.S. Environmental Protection Agency, 2003. AERMOD: Latest Features and Evaluation Results. Publication No. EPA–454/R–03–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
28. ASTM D6589: Standard Guide for Statistical Evaluation of Atmospheric Dispersion Model Performance. (2010).
29. U.S. Environmental Protection Agency, 1992. Protocol for Determining the Best Performing Model. Publication No. EPA–454/R–92–025. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 93–226082).
30. Hanna, S.R., 1982. Natural Variability of Observed Hourly SO_2 and CO Concentrations in St. Louis. *Atmospheric Environment,* 16(6): 1435–1440.
31. Pasquill, F., 1974. Atmospheric Diffusion, 2nd Edition. John Wiley and Sons, New York, NY; 479pp.
32. Rhoads, R.G., 1981. Accuracy of Air Quality Models. Staff Report. U.S. Environmental Protection Agency, Research Triangle Park, NC. (Docket No. A–80–46, II–G–6).
33. Hanna, S.R., 1993. Uncertainties in air quality model predictions. *Boundary-Layer Meteorology,* 62: 3–20.
34. Hanna, S.R., 1989. Confidence limits for air quality model evaluations, as estimated by bootstrap and jackknife resampling methods. *Atmospheric Environment,* 23(6): 1385–1398.
35. Cox, W.M. and J.A. Tikvart, 1990. A statistical procedure for determining the best performing air quality simulation model. *Atmospheric Environment,* 24A(9): 2387–2395.
36. U.S. Environmental Protection Agency, 2016. Technical Support Document (TSD) for AERMOD-Based Assessments of Long-Range Transport Impacts for Primary Pollutants. Publication No. EPA–454/B–16–007. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
37. U.S. Environmental Protection Agency, 2016. AERSCREEN User's Guide. Publication No. EPA–454–/B–16–004. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
38. U.S. Environmental Protection Agency, 2011. AERSCREEN Released as the EPA Recommended Screening Model. Memorandum dated April 11, 2011, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/clarification/20110411_AERSCREEN_Release_Memo.pdf.*
39. Perry, S.G., D.J. Burns and A.J. Cimorelli, 1990. User's Guide to CTDMPLUS: Volume 2. The Screening Mode (CTSCREEN). Publication No. EPA–600/8–90–087. U.S. Environmental Protection Agency, Research Triangle Park, NC. (NTIS No. PB 91–136564).
40. U.S. Environmental Protection Agency, 1992. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised. Publication No. EPA–454/R–92–019. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 93–219095).
41. Burns, D.J., S.G. Perry and A.J. Cimorelli, 1991. An Advanced Screening Model for Complex Terrain Applications. Paper presented at the 7th Joint Conference on Applications of Air Pollution Meteorology (cosponsored by the American Meteorological Society and the Air & Waste Management Association), January 13–18, 1991, New Orleans, LA.
42. Mills, M.T., R.J. Paine, E.A. Insley and B.A. Egan, 1987. The Complex Terrain Dispersion Model Terrain Preprocessor System—User's Guide and Program Description. Publication No. EPA–600/8–88–003. U.S. Environmental Protection Agency, Research Triangle Park, NC. (NTIS No. PB 88–162094).
43. Environmental Research and Technology, 1987. User's Guide to the Rough Terrain Diffusion Model (RTDM), Rev. 3.20. ERT Document No. P–D535–585. Environmental Research and Technology, Inc., Concord, MA. (NTIS No. PB 88–171467).
44. U.S. Environmental Protection Agency, 2016. AERMOD Model Formulation. Publication No. EPA–454/B–16–014. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
45. Cimorelli, A. *et al.,* 2005. AERMOD: A Dispersion Model for Industrial Source Applications. Part I: General Model Formulation and Boundary Layer Characterization. *Journal of Applied Meteorology,* 44(5): 682–693.
46. L.L. Schulman, D.G. Strimaitis and J.S. Scire, 2002. Development and evaluation of the PRIME plume rise and building downwash model. *Journal of the Air & Waste Management Association,* 50: 378–390.
47. U.S. Environmental Protection Agency, 1992. Guideline for modeling carbon monoxide from roadway intersections. Publication number EPA–454/R–92–005. Office of Air Quality Planning & Standards, Research Triangle Park, NC.
48. U.S. Environmental Protection Agency, 1997. Guidance for Siting Ambient Air Monitors around Stationary Lead Sources. Publication No. EPA–454/R–92–009R. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 97–208094).
49. LEADPOST processor: *https://www3.epa.gov/ttn/scram/models/aermod/leadpost.zip.*
50. U.S. Environmental Protection Agency, 1993. Lead Guideline Document. Publication No. EPA–452/R–93–009. Office of Air Quality Planning and

Standards, Research Triangle Park, NC. (NTIS No. PB 94–111846).
51. U.S. Environmental Protection Agency, 2014. Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions. Memorandum dated April 23, 2011, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www.epa.gov/sites/production/files/2016-06/documents/20140423guidance_nonattainment_sip.pdf.*
52. U.S. Environmental Protection Agency, 2016. SO_2 NAAQS Designations Modeling Technical Assistance Document. Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www.epa.gov/sites/production/files/2016-04/documents/so2modelingtad.pdf.*
53. Turner, D.B., 1964. A Diffusion Model for an Urban Area. *Journal of Applied Meteorology,* 3(1):83–91.
54. U.S. Environmental Protection Agency, 2015. Technical Support Document (TSD) for NO_2-Related AERMOD Options and Modifications. Publication No. EPA–454/B–15–004. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
55. Podrez, M. 2015. An Update to the Ambient Ratio Method for 1-h NO_2 Air Quality Standards Dispersion Modeling. *Atmospheric Environment,* 103: 163–170.
56. Cole, H.S. and J.E. Summerhays, 1979. A Review of Techniques Available for Estimation of Short-Term NO_2 Concentrations. *Journal of the Air Pollution Control Association,* 29(8): 812–817.
57. Hanrahan, P.L., 1999. The Polar Volume Polar Ratio Method for Determining NO_2/NO_X Ratios in Modeling—Part I: Methodology. *Journal of the Air & Waste Management Association,* 49: 1324–1331.
58. U.S. Environmental Protection Agency, 2004. The Particle Pollution Report. Publication No. EPA–454–R–04–002. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
59. U.S. Environmental Protection Agency, 2016. Guidance for Ozone and $PM_{2.5}$ Permit Modeling. Publication No. EPA–454/B–16–005. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
60. U.S. Environmental Protection Agency, 2014. Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze. Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf.*
61. U.S. Environmental Protection Agency, 2015. Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas. Publication No. EPA–420–B–15–084. Office of Transportation and Air Quality, Ann Arbor, MI.
62. U.S. Environmental Protection Agency, 1987. PM_{10} SIP Development Guideline. Publication No. EPA–450/2–86–001. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 87–206488).
63. U.S. Environmental Protection Agency, 2012. Haul Road Workgroup Final Report Submission to EPA–OAQPS. Memorandum dated March 2, 2012, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf.*
64. Seinfeld, J.H., Pandis, S.N., 2012. Atmospheric chemistry and physics: from air pollution to climate change. John Wiley & Sons.
65. Simon, H., Baker, K.R., Phillips, S., 2012. Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012. *Atmospheric Environment,* 61, 124–139.
66. U.S. Environmental Protection Agency, 2016. Guidance on the use of models for assessing the impacts of emissions from single sources on the secondarily formed pollutants ozone and $PM_{2.5}$. Publication No. EPA 454/R–16–005. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
67. U.S. Department of the Interior, 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report—Revised 2010. *http://www.nature.nps.gov/air/pubs/pdf/flag/FLAG_2010.pdf.* Natural Resource Report NPS/NPRC/NRR–2010/232.
68. National Acid Precipitation Assessment Program (NAPAP), 1991. Acid Deposition: State of Science and Technology. Volume III Terrestrial, Materials, Health and Visibility Effects. Report 24, *Visibility: Existing and Historical Conditions—Causes and Effects.* Edited by Patricia M. Irving. Washington, DC, 129pp.
69. National Research Council, 1993. Protecting Visibility in National Parks and Wilderness Areas. National Academy Press, Washington, DC, 446pp.
70. U.S. Environmental Protection Agency, 1992. Workbook for plume visual impact screening and analysis (revised). Publication No. EPA–454/R–92–023. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 93–223592).
71. Nilsson, J., Grennfelt, P., Ministerråd, N., 1988. Critical Loads for Sulphur and Nitrogen: Report from a Workshop Held at Skokloster, Sweden, 19–24 March, 1988. Nordic Council of Ministers.
72. Turner, D.B., 1969. Workbook of Atmospheric Dispersion Estimates. PHS Publication No. 999–AP–26. U.S. Department of Health, Education and Welfare, Public Health Service, Cincinnati, OH. (NTIS No. PB–191482).
73. McElroy, J.L. and F. Pooler, Jr., 1968. St. Louis Dispersion Study, Volume II—Analysis. National Air Pollution Control Administration Publication No. AP–53, U.S. Department of Health, Education and Welfare, Public Health Service, Arlington, VA. (NTIS No. PB–190255).
74. Irwin, J.S., 1978. Proposed Criteria for Selection of Urban Versus Rural Dispersion Coefficients. (Draft Staff Report). Meteorology and Assessment Division, U.S. Environmental Protection Agency, Research Triangle Park, NC. (Docket No. A–80–46, II–B–8).
75. Auer, Jr., A.H., 1978. Correlation of Land Use and Cover with Meteorological Anomalies. *Journal of Applied Meteorology,* 17(5): 636–643.
76. U.S. Environmental Protection Agency, 2016. AERMOD Implementation Guide. Publication No. EPA–454/B–16–013. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
77. Pasquill, F., 1976. Atmospheric Dispersion Parameters in Gaussian Plume Modeling, Part II. Possible Requirements for Change in the Turner Workbook Values. Publication No. EPA–600/4–76–030b. Office of Research and Development, Research Triangle Park, NC. (NTIS No. PB–258036/3BA).
78. Stull, R.B., 1988. An Introduction to Boundary Layer Meteorology. Kluwer Academic Publishers, Boston, MA. 666pp.
79. U.S. Environmental Protection Agency, 1987. Analysis and Evaluation of Statistical Coastal Fumigation Models. Publication No. EPA–450/4–87–002. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 87–175519).
80. Wesely, M.L, P.V. Doskey, and J.D. Shannon, 2002: Deposition Parameterizations for the Industrial Source Complex (ISC3) Model. Draft ANL report ANL/ER/TRB01/003, DOE/xxnnnn, Argonne National Laboratory, Argonne, Illinois 60439.
81. U.S. Environmental Protection Agency, 1981. Guideline for Use of Fluid Modeling to Determine Good Engineering Practice (GEP) Stack Height. Publication No. EPA–450/4–81–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 82–145327).
82. Lawson, Jr., R.E. and W.H. Snyder, 1983. Determination of Good Engineering Practice Stack Height: A Demonstration Study for a Power Plant. Publication No. EPA–600/3–83–024. Office of Research and Development, Research Triangle Park, NC. (NTIS No. PB 83–207407).
83. U.S. Environmental Protection Agency, 1985. Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), Revised. Publication No. EPA–450/4–80–023R. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 85–225241).
84. Snyder, W.H. and R.E. Lawson, Jr., 1985. Fluid Modeling Demonstration of Good Engineering-Practice Stack Height in Complex Terrain. Publication No. EPA–600/3–85–022. Office of Research and Development, Research Triangle Park, NC. (NTIS No. PB 85–203107).
85. Briggs, G.A., 1975. Plume Rise Predictions. Chapter 3 in Lectures on Air Pollution and Environmental Impact

Analyses. American Meteorological Society, Boston, MA; pp. 59–111.
86. Hanna, S.R., G.A. Briggs and R.P. Hosker, Jr., 1982. Plume Rise. Chapter 2 in *Handbook on Atmospheric Diffusion.* Technical Information Center, U.S. Department of Energy, Washington, DC; pp. 11–24. DOE/TIC–11223 (DE 82002045).
87. Weil, J.C., L.A. Corio and R.P. Brower, 1997. A PDF dispersion model for buoyant plumes in the convective boundary layer. *Journal of Applied Meteorology,* 36: 982–1003.
88. L.L. Schulman, D.G. Strimaitis and J.S. Scire, 2002. Development and evaluation of the PRIME plume rise and building downwash model. *Journal of the Air & Waste Management Association,* 50: 378–390.
89. U.S. Environmental Protection Agency, 1995. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources (Fifth Edition, AP–42: GPO Stock No. 055–000–00500–1), and Supplements A–D. Volume I can be downloaded from EPA's Web site at *https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors.*
90. U.S. Environmental Protection Agency, 2014. Draft Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www.epa.gov/sites/production/files/2014-10/documents/2014revisedeiguidance_0.pdf.*
91. U.S. Environmental Protection Agency, 1987. Ambient Air Monitoring Guidelines for Prevention of Significant Deterioration (PSD). Publication No. EPA–450/4–87–007. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 90–168030).
92. U.S. Environmental Protection Agency, 2011. Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard. Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf.*
93. U.S. Environmental Protection Agency, 2013. Use of ASOS meteorological data in AERMOD dispersion modeling. Memorandum dated March 8, 2013, Office of Air Quality Planning and Standards, Research Triangle Park, NC. *https://www3.epa.gov/ttn/scram/guidance/clarification/20130308_Met_Data_Clarification.pdf.*
94. U.S. Environmental Protection Agency, 2016. User's Guide for the AERMOD Meteorological Preprocessor (AERMET). Publication No. EPA–454/B–16–010. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
95. U.S Environmental Protection Agency. 2016. AERMINUTE User's Guide. Publication No. EPA–454/B–15–006. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
96. U.S. Environmental Protection Agency, 1993. PCRAMMET User's Guide. Publication No. EPA–454/R–96–001. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 97–147912).
97. U.S. Environmental Protection Agency, 1996. Meteorological Processor for Regulatory Models (MPRM). Publication No. EPA–454/R–96–002. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 96–180518).
98. Paine, R.J., 1987. User's Guide to the CTDM Meteorological Preprocessor Program. Publication No. EPA–600/8–88–004. Office of Research and Development, Research Triangle Park, NC. (NTIS No. PB–88–162102).
99. Perry, S.G., D.J. Burns, L.H. Adams, R.J. Paine, M.G. Dennis, M.T. Mills, D.G. Strimaitis, R.J. Yamartino and E.M. Insley, 1989. User's Guide to the Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS). Volume 1: Model Descriptions and User Instructions. Publication No. EPA–600/8–89–041. U.S. Environmental Protection Agency, Research Triangle Park, NC. (NTIS No. PB 89–181424).
100. U.S. Environmental Protection Agency, 2008. AERSURFACE User's Guide. Publication No. EPA–454/B–08–001. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
101. Brode, R., K. Wesson, J. Thurman, and C. Tillerson, 2008. AERMOD Sensitivity to the Choice of Surface Characteristics. Paper #811 presented at the 101st Air and Waste Management Association Annual Conference and Exhibition, June 24–27, 2008, Portland, OR.
102. Environ, 2015. The Mesoscale Model Interface Program (MMIF) Version 3.2 User's Manual.
103. U.S. Environmental Protection Agency, 2016. Guidance on the Use of the Mesoscale Model Interface Program (MMIF) for AERMOD Applications. Publication No. EPA–454/B–16–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC.
104. Solar and Meteorological Surface Observation Network, 1961–1990; 3-volume CD–ROM. Version 1.0, September 1993. Produced jointly by National Climatic Data Center and National Renewable Energy Laboratory. Can be ordered from NOAA National Data Center's Web site at *http://www.ncdc.noaa.gov.*
105. Hourly United States Weather Observations, 1990–1995 (CD–ROM). October 1997. Produced jointly by National Climatic Data Center and Environmental Protection Agency. Can be ordered from NOAA National Data Center's Web site at *http://www.ncdc.noaa.gov.*
106. Radiosonde Data of North America, 1946–1996; 4-volume CD–ROM. August 1996. Produced jointly by Forecast Systems laboratory and National Climatic Data Center. Can be ordered from NOAA National Data Center's Web site at *http://www.ncdc.noaa.gov.*
107. U.S. Environmental Protection Agency, 2000. Meteorological Monitoring Guidance for Regulatory Modeling Applications. Publication No. EPA–454/R–99–005. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 2001–103606).
108. ASTM D5527: Standard Practice for Measuring Surface Winds and Temperature by Acoustic Means. (2011).
109. ASTM D5741: Standard Practice for Characterizing Surface Wind Using Wind Vane and Rotating Anemometer. (2011).
110. U.S. Environmental Protection Agency, 1995. Quality Assurance for Air Pollution Measurement Systems, Volume IV—Meteorological Measurements. Publication No. EPA600/R–94/038d. Office of Air Quality Planning and Standards, Research Triangle Park, NC. *Note:* for copies of this handbook, you may make inquiry to ORD Publications, 26 West Martin Luther King Dr., Cincinnati, OH 45268.
111. Bowen, B.M., J.M. Dewart and A.I. Chen, 1983. Stability Class Determination: A Comparison for One Site. Proceedings, Sixth Symposium on Turbulence and Diffusion. American Meteorological Society, Boston, MA; pp. 211–214. (Docket No. A–92–65, II–A–7).
112. U.S. Environmental Protection Agency, 1993. An Evaluation of a Solar Radiation/Delta-T (SRDT) Method for Estimating Pasquill-Gifford (P–G) Stability Categories. Publication No. EPA–454/R–93–055. Office of Air Quality Planning and Standards, Research Triangle Park, NC. (NTIS No. PB 94–113958).
113. Irwin, J.S., 1980. Dispersion Estimate Suggestion #8: Estimation of Pasquill Stability Categories. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. (Docket No. A–80–46, II–B–10).
114. Mitchell, Jr., A.E. and K.O. Timbre, 1979. Atmospheric Stability Class from Horizontal Wind Fluctuation. Presented at 72nd Annual Meeting of Air Pollution Control Association, Cincinnati, OH; June 24–29, 1979. (Docket No. A–80–46, II–P–9).
115. Smedman-Hogstrom, A. and V. Hogstrom, 1978. A Practical Method for Determining Wind Frequency Distributions for the Lowest 200 m from Routine Meteorological Data. *Journal of Applied Meteorology,* 17(7): 942–954.
116. Smith, T.B. and S.M. Howard, 1972. Methodology for Treating Diffusivity. MRI 72 FR–1030. Meteorology Research, Inc., Altadena, CA. (Docket No. A–80–46, II–P–8).
117. U.S. Environmental Protection Agency, 2016. Evaluation of Prognostic Meteorological Data in AERMOD Applications. Publication No. EPA–454/R–16–004. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

118. U.S. Environmental Protection Agency, 1984. Calms Processor (CALMPRO) User's Guide. Publication No. EPA–901/9–84–001. Office of Air Quality Planning and Standards, Region I, Boston, MA. (NTIS No. PB 84–229467).

Appendix A to Appendix W of Part 51—Summaries of Preferred Air Quality Models

Table of Contents

A.0 Introduction and Availability
A.1 AERMOD (AMS/EPA Regulatory Model)
A.2 CTDMPLUS (Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations)
A.3 OCD (Offshore and Coastal Dispersion Model)

A.0 Introduction and Availability

(1) This appendix summarizes key features of refined air quality models preferred for specific regulatory applications. For each model, information is provided on availability, approximate cost (where applicable), regulatory use, data input, output format and options, simulation of atmospheric physics, and accuracy. These models may be used without a formal demonstration of applicability provided they satisfy the recommendations for regulatory use; not all options in the models are necessarily recommended for regulatory use.

(2) Many of these models have been subjected to a performance evaluation using comparisons with observed air quality data. Where possible, several of the models contained herein have been subjected to evaluation exercises, including: (1) Statistical performance tests recommended by the American Meteorological Society, and (2) peer scientific reviews. The models in this appendix have been selected on the basis of the results of the model evaluations, experience with previous use, familiarity of the model to various air quality programs, and the costs and resource requirements for use.

(3) Codes and documentation for all models listed in this appendix are available from the EPA's Support Center for Regulatory Air Models (SCRAM) Web site at *https://www.epa.gov/scram*. Codes and documentation may also available from the National Technical Information Service (NTIS), *http://www.ntis.gov*, and, when available, are referenced with the appropriate NTIS accession number.

A.1 AERMOD (AMS/EPA Regulatory Model)

References

U.S. Environmental Protection Agency, 2016. AERMOD Model Formulation. Publication No. EPA–454/B–16–014. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

Cimorelli, A., *et al.*, 2005. AERMOD: A Dispersion Model for Industrial Source Applications. Part I: General Model Formulation and Boundary Layer Characterization. *Journal of Applied Meteorology*, 44(5): 682–693.

Perry, S. *et al.*, 2005. AERMOD: A Dispersion Model for Industrial Source Applications. Part II: Model Performance against 17 Field Study Databases. *Journal of Applied Meteorology*, 44(5): 694–708.

U.S. Environmental Protection Agency, 2016. User's Guide for the AMS/EPA Regulatory Model (AERMOD). Publication No. EPA–454/B–16–011. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

U.S. Environmental Protection Agency, 2016. User's Guide for the AERMOD Meteorological Preprocessor (AERMET). Publication No. EPA–454/B–16–010. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

U.S. Environmental Protection Agency, 2016. User's Guide for the AERMOD Terrain Preprocessor (AERMAP). Publication No. EPA–454/B–16–012. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

Schulman, L. L., D.G. Strimaitis and J.S. Scire, 2000. Development and evaluation of the PRIME plume rise and building downwash model. *Journal of the Air and Waste Management Association*, 50: 378–390.

Schulman, L. L., and Joseph S. Scire, 1980. Buoyant Line and Point Source (BLP) Dispersion Model User's Guide. Document P–7304B. Environmental Research and Technology, Inc., Concord, MA. (NTIS No. PB 81–164642).

Availability

The model codes and associated documentation are available on EPA's SCRAM Web site (paragraph A.0(3)).

Abstract

AERMOD is a steady-state plume dispersion model for assessment of pollutant concentrations from a variety of sources. AERMOD simulates transport and dispersion from multiple point, area, or volume sources based on an up-to-date characterization of the atmospheric boundary layer. Sources may be located in rural or urban areas, and receptors may be located in simple or complex terrain. AERMOD accounts for building wake effects (*i.e.*, plume downwash) based on the PRIME building downwash algorithms. The model employs hourly sequential preprocessed meteorological data to estimate concentrations for averaging times from 1-hour to 1-year (also multiple years). AERMOD can be used to estimate the concentrations of nonreactive pollutants from highway traffic. AERMOD also handles unique modeling problems associated with aluminum reduction plants, and other industrial sources where plume rise and downwash effects from stationary buoyant line sources are important. AERMOD is designed to operate in concert with two pre-processor codes: AERMET processes meteorological data for input to AERMOD, and AERMAP processes terrain elevation data and generates receptor and hill height information for input to AERMOD.

a. Regulatory Use

(1) AERMOD is appropriate for the following applications:

- Point, volume, and area sources;
- Buoyant, elevated line sources (*e.g.*, aluminum reduction plants);
- Mobile sources;
- Surface, near-surface, and elevated releases;
- Rural or urban areas;
- Simple and complex terrain;
- Transport distances over which steady-state assumptions are appropriate, up to 50km;
- 1-hour to annual averaging times; and
- Continuous toxic air emissions.

(2) For regulatory applications of AERMOD, the regulatory default option should be set, *i.e.*, the parameter DFAULT should be employed in the MODELOPT record in the COntrol Pathway. The DFAULT option requires the use of meteorological data processed with the regulatory options in AERMET, the use of terrain elevation data processed through the AERMAP terrain processor, stack-tip downwash, sequential date checking, and does not permit the use of the model in the SCREEN mode. In the regulatory default mode, pollutant half-life or decay options are not employed, except in the case of an urban source of sulfur dioxide where a 4-hour half-life is applied. Terrain elevation data from the U.S. Geological Survey (USGS) 7.5-Minute Digital Elevation Model (DEM), or equivalent (approx. 30-meter resolution), (processed through AERMAP) should be used in all applications. Starting in 2011, data from the National Elevation Dataset (NED, *https://nationalmap.gov/elevation.html*) can also be used in AERMOD, which includes a range of resolutions, from 1-m to 2 arc seconds and such high resolution would always be preferred. In some cases, exceptions from the terrain data requirement may be made in consultation with the appropriate reviewing authority (paragraph 3.0(b)).

b. Input Requirements

(1) Source data: Required inputs include source type, location, emission rate, stack height, stack inside diameter, stack gas exit velocity, stack gas exit temperature, area and volume source dimensions, and source base elevation. For point sources subject to the influence of building downwash, direction-specific building dimensions (processed through the BPIPPRM building processor) should be input. Variable emission rates are optional. Buoyant line sources require coordinates of the end points of the line, release height, emission rate, average line source width, average building width, average spacing between buildings, and average line source buoyancy parameter. For mobile sources, traffic volume; emission factor, source height, and mixing zone width are needed to determine appropriate model inputs.

(2) Meteorological data: The AERMET meteorological preprocessor requires input of surface characteristics, including surface roughness (zo), Bowen ratio, and albedo, as well as, hourly observations of wind speed between 7zo and 100 m (reference wind speed measurement from which a vertical profile can be developed), wind direction, cloud cover, and temperature between zo and 100 m (reference temperature measurement from which a vertical profile can be developed). Meteorological data can be in the

form of observed data or prognostic modeled data as discussed in paragraph 8.4.1(d). Surface characteristics may be varied by wind sector and by season or month. When using observed meteorological data, a morning sounding (in National Weather Service format) from a representative upper air station is required. Latitude, longitude, and time zone of the surface, site-specific (if applicable) and upper air meteorological stations are required. The wind speed starting threshold is also required in AERMET for applications involving site-specific data. When using prognostic data, modeled profiles of temperature and winds are input to AERMET. These can be hourly or a time that represents a morning sounding. Additionally, measured profiles of wind, temperature, vertical and lateral turbulence may be required in certain applications (*e.g.,* in complex terrain) to adequately represent the meteorology affecting plume transport and dispersion. Optionally, measurements of solar and/or net radiation may be input to AERMET. Two files are produced by the AERMET meteorological preprocessor for input to the AERMOD dispersion model. When using observed data, the surface file contains observed and calculated surface variables, one record per hour. For applications with multi-level site-specific meteorological data, the profile contains the observations made at each level of the meteorological tower (or remote sensor). When using prognostic data, the surface file contains surface variables calculated by the prognostic model and AERMET. The profile file contains the observations made at each level of a meteorological tower (or remote sensor), the one-level observations taken from other representative data (*e.g.,* National Weather Service surface observations), one record per level per hour, or in the case of prognostic data, the prognostic modeled values of temperature and winds at user-specified levels.

(i) Data used as input to AERMET should possess an adequate degree of representativeness to ensure that the wind, temperature and turbulence profiles derived by AERMOD are both laterally and vertically representative of the source impact area. The adequacy of input data should be judged independently for each variable. The values for surface roughness, Bowen ratio, and albedo should reflect the surface characteristics in the vicinity of the meteorological tower or representative grid cell when using prognostic data, and should be adequately representative of the modeling domain. Finally, the primary atmospheric input variables, including wind speed and direction, ambient temperature, cloud cover, and a morning upper air sounding, should also be adequately representative of the source area when using observed data.

(ii) For applications involving the use of site-specific meteorological data that includes turbulences parameters (*i.e.,* sigma-theta and/or sigma-w), the application of the ADJ_U* option in AERMET would require approval as an alternative model application under section 3.2.

(iii) For recommendations regarding the length of meteorological record needed to perform a regulatory analysis with AERMOD, *see* section 8.4.2.

(3) Receptor data: Receptor coordinates, elevations, height above ground, and hill height scales are produced by the AERMAP terrain preprocessor for input to AERMOD. Discrete receptors and/or multiple receptor grids, Cartesian and/or polar, may be employed in AERMOD. AERMAP requires input of DEM or NED terrain data produced by the USGS, or other equivalent data. AERMAP can be used optionally to estimate source elevations.

c. Output

Printed output options include input information, high concentration summary tables by receptor for user-specified averaging periods, maximum concentration summary tables, and concurrent values summarized by receptor for each day processed. Optional output files can be generated for: A listing of occurrences of exceedances of user-specified threshold value; a listing of concurrent (raw) results at each receptor for each hour modeled, suitable for post-processing; a listing of design values that can be imported into graphics software for plotting contours; a listing of results suitable for NAAQS analyses including NAAQS exceedances and culpability analyses; an unformatted listing of raw results above a threshold value with a special structure for use with the TOXX model component of TOXST; a listing of concentrations by rank (*e.g.,* for use in quantile-quantile plots); and a listing of concentrations, including arc-maximum normalized concentrations, suitable for model evaluation studies.

d. Type of Model

AERMOD is a steady-state plume model, using Gaussian distributions in the vertical and horizontal for stable conditions, and in the horizontal for convective conditions. The vertical concentration distribution for convective conditions results from an assumed bi-Gaussian probability density function of the vertical velocity.

e. Pollutant Types

AERMOD is applicable to primary pollutants and continuous releases of toxic and hazardous waste pollutants. Chemical transformation is treated by simple exponential decay.

f. Source-Receptor Relationships

AERMOD applies user-specified locations for sources and receptors. Actual separation between each source-receptor pair is used. Source and receptor elevations are user input or are determined by AERMAP using USGS DEM or NED terrain data. Receptors may be located at user-specified heights above ground level.

g. Plume Behavior

(1) In the convective boundary layer (CBL), the transport and dispersion of a plume is characterized as the superposition of three modeled plumes: (1) The direct plume (from the stack); (2) the indirect plume; and (3) the penetrated plume, where the indirect plume accounts for the lofting of a buoyant plume near the top of the boundary layer, and the penetrated plume accounts for the portion of a plume that, due to its buoyancy, penetrates above the mixed layer, but can disperse downward and re-enter the mixed layer. In the CBL, plume rise is superposed on the displacements by random convective velocities (Weil *et al.,* 1997).

(2) In the stable boundary layer, plume rise is estimated using an iterative approach to account for height-dependent lapse rates, similar to that in the CTDMPLUS model (*see* A.2 in this appendix).

(3) Stack-tip downwash and buoyancy induced dispersion effects are modeled. Building wake effects are simulated for stacks subject to building downwash using the methods contained in the PRIME downwash algorithms (Schulman, *et al.,* 2000). For plume rise affected by the presence of a building, the PRIME downwash algorithm uses a numerical solution of the mass, energy and momentum conservation laws (Zhang and Ghoniem, 1993). Streamline deflection and the position of the stack relative to the building affect plume trajectory and dispersion. Enhanced dispersion is based on the approach of Weil (1996). Plume mass captured by the cavity is well-mixed within the cavity. The captured plume mass is re-emitted to the far wake as a volume source.

(4) For elevated terrain, AERMOD incorporates the concept of the critical dividing streamline height, in which flow below this height remains horizontal, and flow above this height tends to rise up and over terrain (Snyder *et al.,* 1985). Plume concentration estimates are the weighted sum of these two limiting plume states. However, consistent with the steady-state assumption of uniform horizontal wind direction over the modeling domain, straight-line plume trajectories are assumed, with adjustment in the plume/receptor geometry used to account for the terrain effects.

h. Horizontal Winds

Vertical profiles of wind are calculated for each hour based on measurements and surface-layer similarity (scaling) relationships. At a given height above ground, for a given hour, winds are assumed constant over the modeling domain. The effect of the vertical variation in horizontal wind speed on dispersion is accounted for through simple averaging over the plume depth.

i. Vertical Wind Speed

In convective conditions, the effects of random vertical updraft and downdraft velocities are simulated with a bi-Gaussian probability density function. In both convective and stable conditions, the mean vertical wind speed is assumed equal to zero.

j. Horizontal Dispersion

Gaussian horizontal dispersion coefficients are estimated as continuous functions of the parameterized (or measured) ambient lateral turbulence and also account for buoyancy-induced and building wake-induced turbulence. Vertical profiles of lateral turbulence are developed from measurements and similarity (scaling) relationships. Effective turbulence values are determined from the portion of the vertical profile of lateral turbulence between the plume height and the receptor height. The effective lateral turbulence is then used to estimate horizontal dispersion.

k. Vertical Dispersion

In the stable boundary layer, Gaussian vertical dispersion coefficients are estimated as continuous functions of parameterized vertical turbulence. In the convective boundary layer, vertical dispersion is characterized by a bi-Gaussian probability density function and is also estimated as a continuous function of parameterized vertical turbulence. Vertical turbulence profiles are developed from measurements and similarity (scaling) relationships. These turbulence profiles account for both convective and mechanical turbulence. Effective turbulence values are determined from the portion of the vertical profile of vertical turbulence between the plume height and the receptor height. The effective vertical turbulence is then used to estimate vertical dispersion.

l. Chemical Transformation

Chemical transformations are generally not treated by AERMOD. However, AERMOD does contain an option to treat chemical transformation using simple exponential decay, although this option is typically not used in regulatory applications except for sources of sulfur dioxide in urban areas. Either a decay coefficient or a half-life is input by the user. Note also that the Plume Volume Molar Ratio Method and the Ozone Limiting Method (section 4.2.3.4) for NO_2 analyses are available.

m. Physical Removal

AERMOD can be used to treat dry and wet deposition for both gases and particles.

n. Evaluation Studies

American Petroleum Institute, 1998. Evaluation of State of the Science of Air Quality Dispersion Model, Scientific Evaluation, prepared by Woodward-Clyde Consultants, Lexington, Massachusetts, for American Petroleum Institute, Washington, DC 20005–4070.

Brode, R.W., 2002. Implementation and Evaluation of PRIME in AERMOD. Preprints of the 12th Joint Conference on Applications of Air Pollution Meteorology, May 20–24, 2002; American Meteorological Society, Boston, MA.

Brode, R.W., 2004. Implementation and Evaluation of Bulk Richardson Number Scheme in AERMOD. 13th Joint Conference on Applications of Air Pollution Meteorology, August 23–26, 2004; American Meteorological Society, Boston, MA.

U.S. Environmental Protection Agency, 2003. AERMOD: Latest Features and Evaluation Results. Publication No. EPA–454/R–03–003. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

Heist, D., et al, 2013. Estimating near-road pollutant dispersion: A model inter-comparison. *Transportation Research Part D: Transport and Environment,* 25: pp 93–105.

A.2 CTDMPLUS (Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations)

References

Perry, S.G., D.J. Burns, L.H. Adams, R.J. Paine, M.G. Dennis, M.T. Mills, D.G. Strimaitis, R.J. Yamartino and E.M. Insley, 1989. User's Guide to the Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS). Volume 1: Model Descriptions and User Instructions. EPA Publication No. EPA–600/8–89–041. U.S. Environmental Protection Agency, Research Triangle Park, NC. (NTIS No. PB 89–181424).

Perry, S.G., 1992. CTDMPLUS: A Dispersion Model for Sources near Complex Topography. Part I: Technical Formulations. *Journal of Applied Meteorology,* 31(7): 633–645.

Availability

The model codes and associated documentation are available on the EPA's SCRAM Web site (paragraph A.0(3)).

Abstract

CTDMPLUS is a refined point source Gaussian air quality model for use in all stability conditions for complex terrain applications. The model contains, in its entirety, the technology of CTDM for stable and neutral conditions. However, CTDMPLUS can also simulate daytime, unstable conditions, and has a number of additional capabilities for improved user friendliness. Its use of meteorological data and terrain information is different from other EPA models; considerable detail for both types of input data is required and is supplied by preprocessors specifically designed for CTDMPLUS. CTDMPLUS requires the parameterization of individual hill shapes using the terrain preprocessor and the association of each model receptor with a particular hill.

a. Regulatory Use

CTDMPLUS is appropriate for the following applications:

- Elevated point sources;
- Terrain elevations above stack top;
- Rural or urban areas;
- Transport distances less than 50 kilometers; and
- 1-hour to annual averaging times when used with a post-processor program such as CHAVG.

b. Input Requirements

(1) Source data: For each source, user supplies source location, height, stack diameter, stack exit velocity, stack exit temperature, and emission rate; if variable emissions are appropriate, the user supplies hourly values for emission rate, stack exit velocity, and stack exit temperature.

(2) Meteorological data: For applications of CTDMPLUS, multiple level (typically three or more) measurements of wind speed and direction, temperature and turbulence (wind fluctuation statistics) are required to create the basic meteorological data file ("PROFILE"). Such measurements should be obtained up to the representative plume height(s) of interest (*i.e.,* the plume height(s) under those conditions important to the determination of the design concentration). The representative plume height(s) of interest should be determined using an appropriate complex terrain screening procedure (*e.g.,* CTSCREEN) and should be documented in the monitoring/modeling protocol. The necessary meteorological measurements should be obtained from an appropriately sited meteorological tower augmented by SODAR and/or RASS if the representative plume height(s) of interest is above the levels represented by the tower measurements. Meteorological preprocessors then create a SURFACE data file (hourly values of mixed layer heights, surface friction velocity, Monin-Obukhov length and surface roughness length) and a RAWINsonde data file (upper air measurements of pressure, temperature, wind direction, and wind speed).

(3) Receptor data: Receptor names (up to 400) and coordinates, and hill number (each receptor must have a hill number assigned).

(4) Terrain data: User inputs digitized contour information to the terrain preprocessor which creates the TERRAIN data file (for up to 25 hills).

c. Output

(1) When CTDMPLUS is run, it produces a concentration file, in either binary or text format (user's choice), and a list file containing a verification of model inputs, *i.e.,*

- Input meteorological data from "SURFACE" and "PROFILE,"
- Stack data for each source,
- Terrain information,
- Receptor information, and
- Source-receptor location (line printer map).

(2) In addition, if the case-study option is selected, the listing includes:

- Meteorological variables at plume height,
- Geometrical relationships between the source and the hill, and
- Plume characteristics at each receptor, *i.e.,*

—Distance in along-flow and cross flow direction
—Effective plume-receptor height difference
—Effective σy & σz values, both flat terrain and hill induced (the difference shows the effect of the hill)
—Concentration components due to WRAP, LIFT and FLAT.

(3) If the user selects the TOPN option, a summary table of the top four concentrations at each receptor is given. If the ISOR option is selected, a source contribution table for every hour will be printed.

(4) A separate output file of predicted (1-hour only) concentrations ("CONC") is written if the user chooses this option. Three forms of output are possible:

(i) A binary file of concentrations, one value for each receptor in the hourly sequence as run;

(ii) A text file of concentrations, one value for each receptor in the hourly sequence as run; or

(iii) A text file as described above, but with a listing of receptor information (names, positions, hill number) at the beginning of the file.

(5) Hourly information provided to these files besides the concentrations themselves includes the year, month, day, and hour information as well as the receptor number with the highest concentration.

d. Type of Model

CTDMPLUS is a refined steady-state, point source plume model for use in all stability conditions for complex terrain applications.

e. Pollutant Types

CTDMPLUS may be used to model non-reactive, primary pollutants.

f. Source-Receptor Relationship

Up to 40 point sources, 400 receptors and 25 hills may be used. Receptors and sources are allowed at any location. Hill slopes are assumed not to exceed 15°, so that the linearized equation of motion for Boussinesq flow are applicable. Receptors upwind of the impingement point, or those associated with any of the hills in the modeling domain, require separate treatment.

g. Plume Behavior

(1) As in CTDM, the basic plume rise algorithms are based on Briggs' (1975) recommendations.

(2) A central feature of CTDMPLUS for neutral/stable conditions is its use of a critical dividing-streamline height (H_c) to separate the flow in the vicinity of a hill into two separate layers. The plume component in the upper layer has sufficient kinetic energy to pass over the top of the hill while streamlines in the lower portion are constrained to flow in a horizontal plane around the hill. Two separate components of CTDMPLUS compute ground-level concentrations resulting from plume material in each of these flows.

(3) The model calculates on an hourly (or appropriate steady averaging period) basis how the plume trajectory (and, in stable/neutral conditions, the shape) is deformed by each hill. Hourly profiles of wind and temperature measurements are used by CTDMPLUS to compute plume rise, plume penetration (a formulation is included to handle penetration into elevated stable layers, based on Briggs (1984)), convective scaling parameters, the value of H_c, and the Froude number above H_c.

h. Horizontal Winds

CTDMPLUS does not simulate calm meteorological conditions. Both scalar and vector wind speed observations can be read by the model. If vector wind speed is unavailable, it is calculated from the scalar wind speed. The assignment of wind speed (either vector or scalar) at plume height is done by either:

- Interpolating between observations above and below the plume height, or
- Extrapolating (within the surface layer) from the nearest measurement height to the plume height.

i. Vertical Wind Speed

Vertical flow is treated for the plume component above the critical dividing streamline height (H_c); *see* "Plume Behavior."

j. Horizontal Dispersion

Horizontal dispersion for stable/neutral conditions is related to the turbulence velocity scale for lateral fluctuations, σv, for which a minimum value of 0.2 m/s is used. Convective scaling formulations are used to estimate horizontal dispersion for unstable conditions.

k. Vertical Dispersion

Direct estimates of vertical dispersion for stable/neutral conditions are based on observed vertical turbulence intensity, *e.g.*, σw (standard deviation of the vertical velocity fluctuation). In simulating unstable (convective) conditions, CTDMPLUS relies on a skewed, bi-Gaussian probability density function (pdf) description of the vertical velocities to estimate the vertical distribution of pollutant concentration.

l. Chemical Transformation

Chemical transformation is not treated by CTDMPLUS.

m. Physical Removal

Physical removal is not treated by CTDMPLUS (complete reflection at the ground/hill surface is assumed).

n. Evaluation Studies

Burns, D.J., L.H. Adams and S.G. Perry, 1990. Testing and Evaluation of the CTDMPLUS Dispersion Model: Daytime Convective Conditions. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Paumier, J.O., S.G. Perry and D.J. Burns, 1990. An Analysis of CTDMPLUS Model Predictions with the Lovett Power Plant Data Base. U.S. Environmental Protection Agency, Research Triangle Park, NC.

Paumier, J.O., S.G. Perry and D.J. Burns, 1992. CTDMPLUS: A Dispersion Model for Sources near Complex Topography. Part II: Performance Characteristics. *Journal of Applied Meteorology*, 31(7): 646–660.

A.3 OCD (Offshore and Coastal Dispersion Model)

Reference

DiCristofaro, D.C. and S.R. Hanna, 1989. OCD: The Offshore and Coastal Dispersion Model, Version 4. Volume I: User's Guide, and Volume II: Appendices. Sigma Research Corporation, Westford, MA. (NTIS Nos. PB 93–144384 and PB 93–144392).

Availability

The model codes and associated documentation are available on EPA's SCRAM Web site (paragraph A.0(3)).

Abstract

(1) OCD is a straight-line Gaussian model developed to determine the impact of offshore emissions from point, area or line sources on the air quality of coastal regions. OCD incorporates overwater plume transport and dispersion as well as changes that occur as the plume crosses the shoreline. Hourly meteorological data are needed from both offshore and onshore locations. These include water surface temperature, overwater air temperature, mixing height, and relative humidity.

(2) Some of the key features include platform building downwash, partial plume penetration into elevated inversions, direct use of turbulence intensities for plume dispersion, interaction with the overland internal boundary layer, and continuous shoreline fumigation.

a. Regulatory Use

OCD has been recommended for use by the Bureau of Ocean Energy Management for emissions located on the Outer Continental Shelf (50 FR 12248; 28 March 1985). OCD is applicable for overwater sources where onshore receptors are below the lowest source height. Where onshore receptors are above the lowest source height, offshore plume transport and dispersion may be modeled on a case-by-case basis in consultation with the appropriate reviewing authority (paragraph 3.0(b)).

b. Input Requirements

(1) Source data: Point, area or line source location, pollutant emission rate, building height, stack height, stack gas temperature, stack inside diameter, stack gas exit velocity, stack angle from vertical, elevation of stack base above water surface and gridded specification of the land/water surfaces. As an option, emission rate, stack gas exit velocity and temperature can be varied hourly.

(2) Meteorological data: PCRAMMET is the recommended meteorological data preprocessor for use in applications of OCD employing hourly NWS data. MPRM is the recommended meteorological data preprocessor for applications of OCD employing site-specific meteorological data.

(i) Over land: Surface weather data including hourly stability class, wind direction, wind speed, ambient temperature, and mixing height are required.

(ii) Over water: Hourly values for mixing height, relative humidity, air temperature, and water surface temperature are required; if wind speed/direction are missing, values over land will be used (if available); vertical wind direction shear, vertical temperature gradient, and turbulence intensities are optional.

(3) Receptor data: Location, height above local ground-level, ground-level elevation above the water surface.

c. Output

(1) All input options, specification of sources, receptors and land/water map including locations of sources and receptors.

(2) Summary tables of five highest concentrations at each receptor for each averaging period, and average concentration for entire run period at each receptor.

(3) Optional case study printout with hourly plume and receptor characteristics. Optional table of annual impact assessment from non-permanent activities.

(4) Concentration output files can be used by ANALYSIS postprocessor to produce the highest concentrations for each receptor, the cumulative frequency distributions for each receptor, the tabulation of all concentrations exceeding a given threshold, and the manipulation of hourly concentration files.

d. Type of Model

OCD is a Gaussian plume model constructed on the framework of the MPTER model.

e. Pollutant Types

OCD may be used to model primary pollutants. Settling and deposition are not treated.

f. Source-Receptor Relationship

(1) Up to 250 point sources, 5 area sources, or 1 line source and 180 receptors may be used.

(2) Receptors and sources are allowed at any location.

(3) The coastal configuration is determined by a grid of up to 3600 rectangles. Each element of the grid is designated as either land or water to identify the coastline.

g. Plume Behavior

(1) The basic plume rise algorithms are based on Briggs' recommendations.

(2) Momentum rise includes consideration of the stack angle from the vertical.

(3) The effect of drilling platforms, ships, or any overwater obstructions near the source are used to decrease plume rise using a revised platform downwash algorithm based on laboratory experiments.

(4) Partial plume penetration of elevated inversions is included using the suggestions of Briggs (1975) and Weil and Brower (1984).

(5) Continuous shoreline fumigation is parameterized using the Turner method where complete vertical mixing through the thermal internal boundary layer (TIBL) occurs as soon as the plume intercepts the TIBL.

h. Horizontal Winds

(1) Constant, uniform wind is assumed for each hour.

(2) Overwater wind speed can be estimated from overland wind speed using relationship of Hsu (1981).

(3) Wind speed profiles are estimated using similarity theory (Businger, 1973). Surface layer fluxes for these formulas are calculated from bulk aerodynamic methods.

i. Vertical Wind Speed

Vertical wind speed is assumed equal to zero.

j. Horizontal Dispersion

(1) Lateral turbulence intensity is recommended as a direct estimate of horizontal dispersion. If lateral turbulence intensity is not available, it is estimated from boundary layer theory. For wind speeds less than 8 m/s, lateral turbulence intensity is assumed inversely proportional to wind speed.

(2) Horizontal dispersion may be enhanced because of obstructions near the source. A virtual source technique is used to simulate the initial plume dilution due to downwash.

(3) Formulas recommended by Pasquill (1976) are used to calculate buoyant plume enhancement and wind direction shear enhancement.

(4) At the water/land interface, the change to overland dispersion rates is modeled using a virtual source. The overland dispersion rates can be calculated from either lateral turbulence intensity or Pasquill-Gifford curves. The change is implemented where the plume intercepts the rising internal boundary layer.

k. Vertical Dispersion

(1) Observed vertical turbulence intensity is not recommended as a direct estimate of vertical dispersion. Turbulence intensity should be estimated from boundary layer theory as default in the model. For very stable conditions, vertical dispersion is also a function of lapse rate.

(2) Vertical dispersion may be enhanced because of obstructions near the source. A virtual source technique is used to simulate the initial plume dilution due to downwash.

(3) Formulas recommended by Pasquill (1976) are used to calculate buoyant plume enhancement.

(4) At the water/land interface, the change to overland dispersion rates is modeled using a virtual source. The overland dispersion rates can be calculated from either vertical turbulence intensity or the Pasquill-Gifford coefficients. The change is implemented where the plume intercepts the rising internal boundary layer.

l. Chemical Transformation

Chemical transformations are treated using exponential decay. Different rates can be specified by month and by day or night.

m. Physical Removal

Physical removal is also treated using exponential decay.

n. Evaluation Studies

DiCristofaro, D.C. and S.R. Hanna, 1989. OCD: The Offshore and Coastal Dispersion Model. Volume I: User's Guide. Sigma Research Corporation, Westford, MA.

Hanna, S.R., L.L. Schulman, R.J. Paine and J.E. Pleim, 1984. The Offshore and Coastal Dispersion (OCD) Model User's Guide, Revised. OCS Study, MMS 84–0069. Environmental Research & Technology, Inc., Concord, MA. (NTIS No. PB 86–159803).

Hanna, S.R., L.L. Schulman, R.J. Paine, J.E. Pleim and M. Baer, 1985. Development and Evaluation of the Offshore and Coastal Dispersion (OCD) Model. *Journal of the Air Pollution Control Association*, 35: 1039–1047.

Hanna, S.R. and D.C. DiCristofaro, 1988. Development and Evaluation of the OCD/API Model. Final Report, API Pub. 4461, American Petroleum Institute, Washington, DC.

[FR Doc. 2016–31747 Filed 1–13–17; 8:45 am]

BILLING CODE 6560–50–P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

4 SEP 1992

AIR PROGRAMS BRANCH
RECEIVED
SEP 8 1992
EPA-REGION IV
ATLANTA, GA.

MEMORANDUM

SUBJECT: Procedures for Processing Requests to Redesignate Areas to Attainment

FROM: John Calcagni, Director
Air Quality Management Division (MD-15)

TO: Director, Air, Pesticides and Toxics Management Division, Regions I and IV
Director, Air and Waste Management Division, Region II
Director, Air, Radiation and Toxics Division, Region III
Director, Air and Radiation Division, Region V
Director, Air, Pesticides and Toxics Division, Region VI
Director, Air and Toxics Division, Regions VII, VIII, IX, and X

Purpose

The Office of Air Quality Planning and Standards (OAQPS) expects that a number of redesignation requests will be submitted in the near future. Thus, Regions will need to have guidance on the applicable procedures for handling these requests, including maintenance plan provisions. This memorandum, therefore, consolidates the Environmental Protection Agency's (EPA's) guidance regarding the processing of requests for redesignation of nonattainment areas to attainment for ozone (O_3), carbon monoxide (CO), particulate matter (PM-10), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Pb). Regions should use this guidance as a general framework for drafting Federal Register notices pertaining to redesignation requests. Special concerns for areas seeking redesignation from unclassifiable to attainment will be addressed on a case-by-case basis.

Background

Section 107(d)(3)(E) of the Clean Air Act, as amended, states that an area can be redesignated to attainment if the following conditions are met:

1. The EPA has determined that the national ambient air quality standards (NAAQS) have been attained.

2. The applicable implementation plan has been fully approved by EPA under section 110(k).

3. The EPA has determined that the improvement in air quality is due to permanent and enforceable reductions in emissions.

4. The State has met all applicable requirements for the area under section 110 and Part D.

5. The EPA has fully approved a maintenance plan, including a contingency plan, for the area under section 175A.

Each of these criteria is discussed in more detail in the following paragraphs. Particular attention is given to maintenance plan provisions at the end of this document since maintenance plans constitute a new requirement under the amended Clean Air Act. Exceptions to the guidance will be considered on a case-by-case basis.

1. Attainment of the Standard

The State must show that the area is attaining the applicable NAAQS. There are two components involved in making this demonstration which should be considered interdependently. The first component relies upon ambient air quality data. The data that are used to demonstrate attainment should be the product of ambient monitoring that is representative of the area of highest concentration. These monitors should remain at the same location for the duration of the monitoring period required for demonstrating attainment. The data should be collected and quality-assured in accordance with 40 CFR 58 and recorded in the Aerometric Information Retrieval System (AIRS) in order for it to be available to the public for review. For purposes of redesignation, the Regional Office should verify that the integrity of the air quality monitoring network has been preserved.

For PM-10, an area may be considered attaining the NAAQS if the number of expected exceedances per year, according to 40 CFR 50.6, is less than or equal to 1.0. For O_3, the area must show that the average annual number of expected exceedances, according to 40 CFR 50.9, is less than or equal to 1.0 based on data from all monitoring sites in the area or its affected downwind environs. In making this showing, both PM-10 and O_3 must rely on 3 complete, consecutive calendar years of quality-assured air quality monitoring data, collected in accordance with 40 CFR 50, Appendices H and K. For CO, an area may be considered attaining the NAAQS if there are no violations, as determined in accordance

with 40 CFR 50.8, based on 2 complete, consecutive calendar years of quality-assured monitoring data. For SO_2, according to 40 CFR 50.4, an area must show no more than one exceedance annually and for Pb, according to section 50.12, an area may show no exceedances on a quarterly basis.

The second component relies upon supplemental EPA-approved air quality modeling. No such supplemental modeling is required for O_3 nonattainment areas seeking redesignation. Modeling may be necessary to determine the representativeness of the monitored data. For pollutants such as SO_2 and CO, a small number of monitors typically is not representative of areawide air quality or areas of highest concentration. When dealing with SO_2, Pb, PM-10 (except for a limited number of initial moderate nonattainment areas), and CO (except moderate areas with design values of 12.7 parts per million or lower at the time of passage of the Clean Air Act Amendments of 1990), dispersion modeling will generally be necessary to evaluate comprehensively sources' impacts and to determine the areas of expected high concentrations based upon current conditions. Areas which were designated nonattainment based on modeling will generally not be redesignated to attainment unless an acceptable modeling analysis indicates attainment. Regions should consult with OAQPS for further guidance addressing the need for modeling in specific circumstances.

2. State Implementation Plan (SIP) Approval

The SIP for the area must be fully approved under section 110(k),[1] and must satisfy all requirements that apply to the area. It should be noted that approval action on SIP elements and the redesignation request may occur simultaneously. An area cannot be redesignated if a required element of its plan is the subject of a disapproval; a finding of failure to submit or to implement the SIP; or partial, conditional, or limited approval. However, this does not mean that earlier issues with regard to the SIP will be reopened. Regions should not reconsider those things that have already been approved and for which the Clean Air Act Amendments did not alter what is required. In contrast, to the extent the Amendments add a requirement or alter an existing requirement so that it adds something more, Regions should consider those issues. In addition, requests from areas known to be affected by dispersion techniques which are inconsistent with EPA guidance will continue to be considered unapprovable under section 110 and will not qualify for redesignation.

---

[1]Section 110(k) contains the requirements for EPA action on plan submissions. It addresses completeness, deadlines, full and partial approval, conditional approval, and disapproval.

3. Permanent and Enforceable Improvement in Air Quality

The State must be able to reasonably attribute the improvement in air quality to emission reductions which are permanent and enforceable.[2] Attainment resulting from temporary reductions in emission rates (e.g., reduced production or shutdown due to temporary adverse economic conditions) or unusually favorable meteorology would not qualify as an air quality improvement due to permanent and enforceable emission reductions.

In making this showing, the State should estimate the percent reduction (from the year that was used to determine the design value for designation and classification) achieved from Federal measures such as the Federal Motor Vehicle Control Program and fuel volatility rules as well as control measures that have been adopted and implemented by the State. This estimate should consider emission rates, production capacities, and other related information to clearly show that the air quality improvements are the result of implemented controls. The analysis should assume that sources are operating at permitted levels (or historic peak levels) unless evidence is presented that such an assumption is unrealistic.

4. Section 110 and Part D Requirements

For the purposes of redesignation, a State must meet all requirements of section 110 and Part D that were applicable prior to submittal of the complete redesignation request. When evaluating a redesignation request, Regions should not consider whether the State has met requirements that come due under the Act after submittal of a complete redesignation request.[3]

---

[2]This is consistent with EPA's existing policy on redesignations as stated in an April 21, 1983 memorandum titled "Section 107 Designation Policy Summary." This memorandum states that in order for an area to be redesignated to attainment, the State must show that "actual enforceable emission reductions are responsible for the recent air quality improvement." This element of the policy retains its validity under the amended Act pursuant to section 193. [Note: other aspects of the April 21, 1983 memorandum have since been superseded by subsequent memorandums; interested parties should consult with OAQPS before relying on these aspects, e.g. those relating to required years of air quality data.]

[3]Under section 175A(c), however, the requirements of Part D remain in force and effect for the area until such time as it is redesignated. Upon redesignation to attainment, the requirements that became due under section 175A(c) after submittal of the complete redesignation request would no longer be applicable.

However, any requirements that came due prior to submittal of the redesignation request must be fully approved into the plan at or before the time EPA redesignates the area.

To avoid confusion concerning what requirements will be applicable for purposes of redesignation, Regions should encourage States to work closely with the appropriate Regional Office early in the process. This will help to ensure that a redesignation request submitted by the State has a high likelihood of being approved by EPA. Regions should advise States of the practical planning consequences if EPA disapproves the redesignation request or if the request is invalidated because of violations recorded during EPA's review. Under such circumstances, EPA does not have the discretion to adjust schedules for implementing SIP requirements. As a result, an area may risk sanctions and/or Federal implementation plan implementation that could result from failure to meet SIP submittal or implementation requirements.

a. Section 110 Requirements

Section 110(a)(2) contains general requirements for nonattainment plans. Most of the provisions of this section are the same as those contained in the pre-amended Act. We will provide guidance on these requirements as needed.[4]

b. Part D Requirements

Part D consists of general requirements applicable to all areas which are designated nonattainment based on a violation of the NAAQS. The general requirements are followed by a series of subparts specific to each pollutant. The general requirements appear in subpart 1. The requirements relating to O_3, CO, PM-10, SO_2, NO_2, and Pb appear in subparts 2 through 5. In those instances where an area is subject to both the general nonattainment provisions in subpart 1 as well as one of the pollutant-specific subparts, the general provisions may be subsumed within, or superseded by, the more specific requirements of subparts 2 through 5.

If an area was not classified under section 181 for O_3, or section 186 for CO, then that area is only subject to the provisions of subpart 1, "Nonattainment Areas in General." In addition to relevant provisions in subpart 1, an O_3 and CO area, which is classified, must meet all applicable requirements in subpart 2, "Additional Provisions for Ozone Nonattainment Areas," and subpart 3, "Additional Provisions for Carbon Monoxide

---

[4]General guidance regarding the requirements for SIP's may be found in the "General Preamble to Title I of the 1990 Clean Air Act Amendments," 57 FR 13498 (April 16, 1992).

Nonattainment Areas," respectively, before the area may be redesignated to attainment. All PM-10 nonattainment areas (whether classified as moderate or serious) must similarly meet the applicable general provisions of subpart 1 and the specific PM-10 provisions in subpart 4, "Additional Provisions for Particulate Matter Nonattainment Areas." Likewise, SO_2, NO_2, and Pb nonattainment areas are subject to the applicable general nonattainment provisions in subpart 1 as well as the more specific requirements in subpart 5, "Additional Provisions for Areas Designated Nonattainment for Sulfur Oxides, Nitrogen Dioxide, and Lead."

i. Section 172(c) Requirements

This section contains general requirements for nonattainment plans. A thorough discussion of these requirements may be found in the General Preamble to Title I [57 FR 13498 (April 16, 1992)]. The EPA anticipates that areas will already have met most or all of these requirements to the extent that they are not superseded by more specific Part D requirements. The requirements for reasonable further progress, identification of certain emissions increases, and other measures needed for attainment will not apply for redesignations because they only have meaning for areas not attaining the standard. The requirements for an emission inventory will be satisfied by the inventory requirements of the maintenance plan. The requirements of the Part D new source review program will be replaced by the prevention of significant deterioration (PSD) program once the area has been redesignated. However, in order to ensure that the PSD program will become fully effective immediately upon redesignation, either the State must be delegated the Federal PSD program or the State must make any needed modifications to its rules to have the approved PSD program apply to the affected area upon redesignation.

ii. Conformity

The State must work with EPA to show that its SIP provisions are consistent with section 176(c)(4) conformity requirements. The redesignation request should include conformity procedures, if the State already has these procedures in place. Additionally, we currently interpret the conformity requirement to apply to attainment areas. However, EPA has not yet issued its conformity regulations specifying what areas are subject to the conformity requirement. Therefore, if a State does not have conformity procedures in place at the time that it submits a redesignation request, the State must commit to follow EPA's conformity regulation upon issuance, as applicable. If the State submits the redesignation request subsequent to EPA's issuance of the conformity regulations, and the conformity requirement became applicable to the area prior to submission,

the State must adopt the applicable conformity requirements before EPA can redesignate the area.

5. Maintenance Plans

Section 107(d)(3)(E) of the amended Act stipulates that for an area to be redesignated, EPA must fully approve a maintenance plan which meets the requirements of section 175A. A State may submit both the redesignation request and the maintenance plan at the same time and rulemaking on both may proceed on a parallel track. Maintenance plans may, of course, be submitted and approved by EPA before a redesignation is requested. However, according to section 175A(c), pending approval of the maintenance plan and redesignation request, all applicable nonattainment area requirements shall remain in place.

Section 175A defines the general framework of a maintenance plan. The maintenance plan will constitute a SIP revision and must provide for maintenance of the relevant NAAQS in the area for at least 10 years after redesignation. Section 175A further states that the plan shall contain such additional measures, if any, as may be necessary to ensure such maintenance. Because the Act requires a demonstration of maintenance for 10 years after an area is redesignated (not 10 years after submittal of a redesignation request), the State should plan for some lead time for EPA action on the request. In other words, the maintenance demonstration should project maintenance for 10 years, beginning from a date which factors in the time necessary for EPA review and approval action on the redesignation request. In determining the amount of lead time to allow, States should consider that section 107(d)(3)(D) grants the Administrator up to 18 months from receipt of a complete submittal to process a redesignation request. The statute also requires the State to submit a revision of the SIP 8 years after the original redesignation request is approved to provide for maintenance of the NAAQS for an additional 10 years following the first 10-year period [see section 175A(b)].

In addition, the maintenance plan shall contain such contingency measures as the Administrator deems necessary to ensure prompt correction of any violation of the NAAQS [see section 175A(d)]. The Act provides that, at a minimum, the contingency measures must include a requirement that the State will implement all measures contained in the nonattainment SIP prior to redesignation. Failure to maintain the NAAQS and triggering of the contingency plan will not necessitate a revision of the SIP unless required by the Administrator, as stated in section 175A(d).

The following is a list of core provisions that we anticipate will be necessary to ensure maintenance of the relevant NAAQS in an area seeking redesignation from

nonattainment to attainment. We therefore recommend that States seeking redesignation of a nonattainment area consider these provisions. However, any final EPA determination regarding the adequacy of a maintenance plan will be made following review of the plan submittal in light of the particular circumstances facing the area proposed for redesignation and based on all relevant information available at the time.

a. Attainment Inventory

The State should develop an attainment emissions inventory to identify the level of emissions in the area which is sufficient to attain the NAAQS.[5] This inventory should be consistent with EPA's most recent guidance on emission inventories for nonattainment areas available at the time and should include the emissions during the time period associated with the monitoring data showing attainment.[6]

Source size thresholds are 100 tons/year for SO_2, NO_2, and PM-10 areas, and 5 tons/year for Pb based upon 40 CFR 51.100(k) and 51.322, as well as established practice for AIRS data. The source size threshold for serious PM-10 areas is 70 tons/year

---

[5]Where the State has made an adequate demonstration that air quality has improved as a result of the SIP (as discussed previously), the attainment inventory will generally be the actual inventory at the time the area attained the standard.

[6]The EPA's current guidance on the preparation of emission inventories for O_3 and CO nonattainment areas is contained in the following documents: "Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone: Volume I" (EPA-450/4-91-016), "Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone: Volume II" (EPA-450/4-91-014), "Emission Inventory Requirements for Ozone State Implementation Plans" (EPA-450/4-91-010), "Emission Inventory Requirements for Carbon Monoxide Implementation Plans" (EPA-450/4-91-011), "Guideline for Regulatory Application of the Urban Airshed Model" (EPA-450/4-91-013), "Procedures for Emission Inventory Preparation: Volume IV, Mobile Sources" (EPA-450/4-81-026d), and "Procedures for Preparing Emission Inventory Projections" (EPA-450/4-91-019). The EPA does not currently have specific guidance on attainment emissions inventories for SO_2. In lieu thereof, States are referred to the guidance on emissions data to be used as input to modeling demonstrations, contained in Table 9.1 of EPA's "Guideline on Air Quality Models (Revised)" (EPA-450/2-78-027R), July 1987, which is generally applicable to all criteria pollutants. Emission inventory procedures and requirements documents are currently being prepared by OAQPS for PM-10 and Pb; these documents are due for release by summer 1992.

according to Clean Air Act section 189(b)(3). However, the inventory should include sources below these size thresholds if these smaller sources were included in the SIP attainment demonstration. Where sources below the 100, 70, and 5 tons/year-size thresholds (e.g., areas with smaller source size definitions) are subject to a State's minor source permit program, these sources need only be addressed in the aggregate to the extent that they result in areawide growth.

For O_3 nonattainment areas, the inventory should be based on actual "typical summer day" emissions of O_3 precursors (volatile organic compounds and nitrogen oxides) during the attainment year. This will generally correspond to one of the periodic inventories required for nonattainment areas to reconcile milestones. For CO nonattainment areas, the inventory should be based on actual "typical CO season day" emissions for the attainment year. This will generally correspond to one of the periodic inventories required for nonattainment areas.

b. Maintenance Demonstration

A State may generally demonstrate maintenance of the NAAQS by either showing that future emissions of a pollutant or its precursors will not exceed the level of the attainment inventory, or by modeling to show that the future mix of sources and emission rates will not cause a violation of the NAAQS. Under the Clean Air Act, many areas are required to submit modeled attainment demonstrations to show that proposed reductions in emissions will be sufficient to attain the applicable NAAQS. For these areas, the maintenance demonstration should be based upon the same level of modeling. In areas where no such modeling was required, the State should be able to rely on the attainment inventory approach. In both instances, the demonstration should be for a period of 10 years following the redesignation.

Where modeling is relied upon to demonstrate maintenance, each plan should contain a summary of the air quality concentrations expected to result from application of the control strategy. In the process, the plan should identify and describe the dispersion model or other air quality model used to project ambient concentrations (see 40 CFR 51.46).

In either case, to satisfy the demonstration requirement the State should project emissions for the 10-year period following redesignation, either for the purpose of showing that emissions will not increase over the attainment inventory or for conducting modeling.[7] The projected inventory should consider future growth, including population and industry, should be consistent

[7]Guidance for projecting emissions may be found in the emissions inventory guidance cited in footnote 6.

with the attainment inventory, and should document data inputs and assumptions. All elements of the demonstration (e.g., emission projections, new source growth, and modeling) should be consistent with current EPA modeling guidance.[8] For O_3 and CO, the projected emissions should reflect the expected actual emissions based on enforceable emission rates and typical production rates.

For CO, a State should address the areawide component of the maintenance demonstration either by showing that future CO emissions will not increase or by conducting areawide modeling. Preferably, the State should carry out hot-spot modeling that is consistent with the Guideline on Air Quality Models (Revised), in order to demonstrate maintenance of the NAAQS. In particular, if the nonattainment problem is related to a pattern of hot-spots then hot-spot modeling should generally be conducted. However, hot-spot modeling is not automatically required. For example, if the nonattainment problem was related solely to stationary point sources, or if highway improvements have been implemented and the associated emission reductions and travel characteristics can be qualitatively documented, then hot-spot modeling is not required. In such cases, adequate documentation as well as the concurrence of Headquarters is needed.

Any assumptions concerning emission rates must reflect permanent, enforceable measures. In other words, a State generally cannot take credit in the maintenance demonstration for reductions unless there are regulations in place requiring those reductions or the reductions are otherwise shown to be permanent. Therefore, the State will be expected to maintain its implemented control strategy despite redesignation to attainment, unless such measures are shown to be unnecessary for maintenance or are replaced with measures that achieve equivalent reductions (see additional discussion under "Contingency Plan"). Emission reductions from source shutdowns can be considered permanent and enforceable to the extent that those shutdowns have been reflected in the SIP and all applicable permits have been modified accordingly.

Modeling used to demonstrate attainment may be relied upon in the maintenance demonstration where the modeling conforms to current EPA guidance and where the State has projected no significant changes in the modeling inputs during the intervening time. Where the original attainment demonstration may no longer be relied upon, States will be expected to remodel using current

---

[8]The EPA-approved modeling guidance may be found in the following documents: "Guideline on Air Quality Models (Revised)," OAQPS, RTP, NC (EPA-450/2-78-027R), July 1986; and "PM-10 SIP Development Guideline," OAQPS, RTP, NC (EPA-450/2-86-001), June 1987.

EPA referenced techniques.[9] This may be necessary where, for example, there has been a change in emissions or a change in the siting of new sources or modifications such that air quality may no longer be accurately represented by the existing modeling.

c. Monitoring Network

Once an area has been redesignated, the State should continue to operate an appropriate air quality monitoring network, in accordance with 40 CFR Part 58, to verify the attainment status of the area. The maintenance plan should contain provisions for continued operation of air quality monitors that will provide such verification. In cases where measured mobile source parameters (e.g., vehicle miles traveled congestion) have changed over time, the State may also need to perform a saturation monitoring study to determine the need for, and location of, additional permanent monitors.

d. Verification of Continued Attainment

Each State should ensure that it has the legal authority to implement and enforce all measures necessary to attain and to maintain the NAAQS. Sections 110(a)(2)(B) and (F) of the Clean Air Act, as amended, and regulations promulgated at 40 CFR 51.110(k), suggest that one such measure is the acquisition of ambient and source emission data to demonstrate attainment and maintenance.

Regardless of whether the maintenance demonstration is based on a showing that future emission inventories will not exceed the attainment inventory or on modeling, the State submittal should indicate how the State will track the progress of the maintenance plan. This is necessary due to the fact that the emission projections made for the maintenance demonstration depend on assumptions of point and area source growth.

One option for tracking the progress of the maintenance demonstration, provided here as an example, would be for the State to periodically update the emissions inventory. In this case, the maintenance plan should specify the frequency of any planned inventory updates. Such an update could be based, in part, on the annual AIRS update and could indicate new source growth and other changes from the attainment inventory (e.g., changes in vehicle miles travelled or in traffic patterns). As an alternative to a complete update of the inventory, the State may choose to do a comprehensive review of the factors that were used in developing the attainment inventory to show no significant change. If this review does show a significant change, the State should then perform an update of the inventory.

---

[9]See references for modeling guidance cited in footnote 8.

Where the demonstration is based on modeling, an option for tracking progress would be for the State to periodically (typically every 3 years) reevaluate the modeling assumptions and input data. In any event, the State should monitor the indicators for triggering contingency measures (as discussed below).

e. Contingency Plan

Section 175A of the Act also requires that a maintenance plan include contingency provisions, as necessary, to promptly correct any violation of the NAAQS that occurs after redesignation of the area. These contingency measures are distinguished from those generally required for nonattainment areas under section 172(c)(9) and those specifically required for O_3 and CO nonattainment areas under sections 182(c)(9) and 187(a)(3), respectively. For the purposes of section 175A, a State is not required to have fully adopted contingency measures that will take effect without further action by the State in order for the maintenance plan to be approved. However, the contingency plan is considered to be an enforceable part of the SIP and should ensure that the contingency measures are adopted expediently once they are triggered. The plan should clearly identify the measures to be adopted, a schedule and procedure for adoption and implementation, and a specific time limit for action by the State. As a necessary part of the plan, the State should also identify specific indicators, or triggers, which will be used to determine when the contingency measures need to be implemented.

Where the maintenance demonstration is based on the inventory, the State may, for example, identify an "action level" of emissions as the indicator. If later inventory updates show that the inventory has exceeded the action level, the State would take the necessary steps to implement the contingency measures. The indicators would allow a State to take early action to address potential violations of the NAAQS before they occur. By taking early action, States may be able to prevent any actual violations of the NAAQS and, therefore, eliminate the need on the part of EPA to redesignate an area to nonattainment.

Other indicators to consider include monitored or modeled violations of the NAAQS (due to the inadequacy of monitoring data in some situations). It is important to note that air quality data in excess of the NAAQS will not automatically necessitate a revision of the SIP where implementation of contingency measures is adequate to address the cause of the violation. The need for a SIP revision is subject to the Administrator's discretion.

The EPA will review what constitutes a contingency plan on a case-by-case basis. At a minimum, it must require that the State will implement all measures contained in the Part D nonattainment

plan for the area prior to redesignation [see section 175A(d)]. This language suggests that a State may submit a SIP revision at the time of its redesignation request to remove or reduce the stringency of control measures. Such a revision can be approved by EPA if it provides for compensating equivalent reductions. A demonstration that measures are equivalent would have to include appropriate modeling or an adequate justification. Alternatively, a State might be able to demonstrate (through EPA-approved modeling) that the measures are not necessary for maintenance of the standard. In either case, the contingency plan would have to provide for implementation of any measures that were reduced or removed after redesignation of the area.

Summary

As stated previously, this memorandum consolidates EPA's redesignation and maintenance plan guidance and Regions should rely upon it as a general framework in drafting Federal Register notices. It is strongly suggested that the Regional Offices share this document with the appropriate States. This should give the States a better understanding of what is expected from a redesignation request and maintenance plan under existing policy. Any necessary changes to existing Agency policy will be made through our action on specific redesignation requests and the review of section 175A maintenance plans for these particular areas, both of which are subject to notice and comment rulemaking procedures. Thus, in applying this memorandum to specific circumstances in a rulemaking, Regions should consider the applicability of the underlying policies to the particular facts and to comments submitted by any person. If your staff members have questions which require clarification, they may contact Sharon Reinders at (919) 541-5284 for O_3- and CO-related issues, and Eric Ginsburg at (919) 541-0877 for SO_2-, PM-10-, and Pb-related issues.

cc: Chief, Air Branch, Regions I-X
John Cabaniss, OMS
Denise Devoe, OAQPS
Bill Laxton, TSD
Rich Ossias, OGC
John Rasnic, SSCD
John Seitz, OAQPS
Mike Shapiro, OAR
Lydia Wegman, OAQPS

Message

From: Hardesty, Doug [Hardesty.Doug@epa.gov]
Sent: 8/13/2020 11:25:14 PM
To: Bray, Dave [Bray.Dave@epa.gov]; McAlpine, Jerrold [McAlpine.Jay@epa.gov]
CC: Meyer, Dan [Meyer.Dan@epa.gov]; Hedgpeth, Zach [Hedgpeth.Zach@epa.gov]
Subject: FW: Final Permit for Alaska Gasline Development Corporation's Gas Treatment Plant AQ1524CPT01
Attachments: AQ1524CPT01 RTC 08.13.2020.pdf; AQ1524CPT01 Final Permit Trans Ltr 08.13.2020.pdf; AQ1524CPT01 Final TAR 08.13.2020.pdf; AQ1524CPT01 Final Permit 08.13.2020.pdf

FYI. I just received this email reporting that ADEC issued the PSD permit to AGDC for their gas treatment plant on the north slope that we reviewed a year ago. I think they've been working with Jay on it regarding his comments, but we never heard from them on the BACT and other comments. Not exactly good form (unless they addressed all of our comments perfectly).

I'll take a look at it one of these days to see what they said about our comments, but not today, tomorrow or next week.

Doug Hardesty
208.378.5759
Air Permit Program Lead
Air Permits & Toxics Branch, Air & Radiation Division, Region 10, U.S. EPA
950 W Bannock St, Suite 900, Boise, Idaho 83702

From: Jones, Dave F (DEC) <dave.jones2@alaska.gov>
Sent: Thursday, August 13, 2020 4:25 PM
To: Frank Richards <frichards@agdc.us>; Lisa Haas <lhaas@agdc.us>
Cc: Plosay, James R (DEC) <jim.plosay@alaska.gov>; Simpson, Aaron J (DEC) <aaron.simpson@alaska.gov>; Dunn, Patrick E (DEC) <patrick.dunn@alaska.gov>; Olds, Jason R (DEC) <jason.olds@alaska.gov>; Coss, Pablo M (DEC) <Moses.coss@alaska.gov>; Turner, Thomas E (DEC) <tom.turner@alaska.gov>; Wiltse, Denise V (DEC) <denise.wiltse@alaska.gov>; Hardesty, Doug <Hardesty.Doug@epa.gov>; Collins, Catherine <Catherine_Collins@fws.gov>; Stacy, Andrea <Andrea_Stacy@nps.gov>; Shepherd, Don <Don_Shepherd@nps.gov>; King, Kirsten L <kirsten_king@nps.gov>; Blakesley, Andrea J <Andrea_Blakesley@nps.gov>; paul_burger@nps.gov; Allen, Tim <tim_allen@fws.gov>
Subject: RE: Final Permit for Alaska Gasline Development Corporation's Gas Treatment Plant AQ1524CPT01

Mr. Richards,

The Response to Comments PDF in the previous email was corrupted and would not open. Attached please find the Response to Comments as well as the Final Permit, Technical Analysis Report, and Transmittal Letter.

Regards,

Dave Jones
Env. Engineering Assistant II
ADEC – Air Quality – Juneau
dave.jones2@alaska.gov
907.465.5122

From: Jones, Dave F (DEC)
Sent: Thursday, August 13, 2020 12:48 PM
To: Frank Richards <frichards@agdc.us>; Lisa Haas <lhaas@agdc.us>
Cc: James R Plosay (DEC) (jim.plosay@alaska.gov) <jim.plosay@alaska.gov>; Simpson, Aaron J (DEC)

<aaron.simpson@alaska.gov>; Dunn, Patrick E (DEC) <patrick.dunn@alaska.gov>; Olds, Jason R (DEC) <jason.olds@alaska.gov>; Coss, Pablo M (DEC) <moses.coss@alaska.gov>; Turner, Thomas E (DEC) <tom.turner@alaska.gov>; Denise V Wiltse (DEC) (denise.wiltse@alaska.gov) <denise.wiltse@alaska.gov>; 'Hardesty, Doug' <Hardesty.Doug@epa.gov>; Collins, Catherine <Catherine_Collins@fws.gov>; Stacy, Andrea <Andrea_Stacy@nps.gov>; Shepherd, Don <Don_Shepherd@nps.gov>; King, Kirsten L <kirsten_king@nps.gov>; Blakesley, Andrea J <Andrea_Blakesley@nps.gov>; Paul Burger <Paul_Burger@nps.gov>; Allen, Tim <tim_allen@fws.gov>
Subject: Final Permit for Alaska Gasline Development Corporation's Gas Treatment Plant AQ1524CPT01

Mr. Richards,

The Alaska Department of Environmental Conservation (Department) has made a final decision to approve the Alaska Gasline Development Corporation's (AGDC's) Gas Treatment Plant Construction Permit AQ1524CPT01. Attached please find the Permit Transmittal Letter, Final Permit, Technical Analysis Report, and Response to Comments. If you have any questions regarding the permit or supporting documents please do not hesitate to contact me.

Regards,

Dave Jones
Env. Engineering Assistant II
ADEC – Air Quality – Juneau
dave.jones2@alaska.gov
907.465.5122