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THE CITY OF ROCKFORD ILLINOIS, USA

Kyle Saunders
Director
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June 28, 2022

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RE: Southeast Rockford Groundwater Contamination Site
Uniform Federal Policy – Quality Assurance Project Plan Rev. 2.0

Ms. Knoepfle / Mr. Conrath:

Please find enclosed the Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) Revision 2.0 document and the UFP-QAPP Worksheet edit file prepared by Nationwide Environmental Services, Inc. (NES) on behalf of the City of Rockford for the Southeast Rockford Groundwater Contamination Site (the Site).

Please note that the Worksheet edit file identifies the revisions made to the UFP-QAPP 2.0 document to address comments issued by USEPA on the prior version of the UFP-QAPP document in correspondence dated October 4, 2021.

Please advise me if you have any questions regarding the information provided or require any additional information.

Respectfully,

JAMIE ROTT

Jamie Rott
Water Superintendent

W/Enclosures

cc: Tom Turner, Attorney, EPA ORC
Ifeanyi C. Mogbana, City Attorney, City of Rockford
Kyle Saunders, Director of Public Works, City of Rockford
Teri Murray, Assistant Superintendent Water Production, City of Rockford
Josh Baylor, Water Quality Supervisor, City of Rockford

QUALITY ASSURANCE PROJECT PLAN
REMEDIAL DESIGN/REMEDIAL ACTION
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SITE
ROCKFORD, ILLINOIS

April 2022

Prepared for:
City of Rockford
Department of Public Works –Water Divisions
425 East State Street
Rockford, IL 61104

Prepared by:
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ACRONYMS

AEE	Anderson Environmental & Engineering, Co.
ANSI/ASQ	American National Standards Institute/American Society for Quality
ASTM	American Society for Standards and Materials
bgs	below ground surface
BOD	Biological Oxygen Demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	Chemicals of Concern
CWA	Clean Water Act
DO	Dissolved Oxygen
DQI	Data Quality Indicator
DQO	Data Quality Objective
DW	Drinking Water
FD	Field Duplicate
FS	Feasibility Study
FSP	Field Sampling Plan
GAC	Granular Activated Carbon
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information System
GPS	Global Positioning System
GW	Groundwater
HCl	Hydrochloric Acid
ICP	Inductively Coupled Plasma
IDPH	Illinois Department of Public Health
IEPA	Illinois Environmental Protection Agency
ISWS	Illinois State Water Survey
LCS	Laboratory Control Sample
LFB	Laboratory Fortified Blank
LIMS	Laboratory Information Management Systems
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MOU	Memorandum of Understanding
MPC	Measurement Performance Criteria
MQO	Measurement Quality Objectives
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPL	National Priorities List
NA	Not Applicable
NES	Nationwide Environmental Services, Inc.
NIST	National Institute of Standards and Technology
NPL	National Priorities List
O&M	Operation and Maintenance
ORP	Oxidation Reduction Potential
OU	Operable Unit
PAL	Project Action Limit

ACRONYMS (continued)

PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PDF	Portable Document Format
PID	Photoionization Detector
ppb	parts per million
ppm	parts per million
PT	Proficiency Testing (previously known as performance evaluation (PE) sample)
P&T	Purge and Trap
PQOs	Project Quality Objectives
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QS	Quality System
QL	Quantitation Limit
QMP	Quality Management Plan
RAL	Removal Action Level
RAR	Remedial Action Report
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RF	Response Factor
RI	Remedial Investigation
ROD	Record of Decision
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
RSL	Regional Screening Level
RT	Retention Time
SD	Standard Deviation
SDG	Sample Delivery Group
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
SPME	Solid Phase Microextraction
SQLs	Sample Quantitation Limits
SRM	Standard Reference Material
SVOC	Semi Volatile Organic Compound
TCA	1,1,1-Trichloroethane
TCE	Trichloroethene
TVOC	Total Volatile Organic Compounds
UFP	Uniform Federal Policy
ug/l	microgram per liter
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 INTRODUCTION

The United States Environmental Protection Agency (USEPA) requires that parties conducting environmental monitoring and measurement programs mandated or supported by USEPA at Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites participate in a centrally managed quality assurance (QA) program. Parties generating environmental monitoring data under such program has the responsibility to implement minimum procedures to assure that the precision, accuracy, representativeness, completeness, and comparability (PARCC) of its data are known and documented. To ensure this responsibility is met uniformly, each party must prepare a written Quality Assurance Project Plan (QAPP) covering each environmental monitoring project it performs.

The USEPA has adopted use of the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) document format to support the objectives of a managed quality assurance (QA) program which requires parties to formalize the organizational framework, project objectives, and functional activities to achieve those objectives, and the specific Quality Assurance (QA) and Quality Control (QC) measures associated with data collection efforts involved in implementing environmental monitoring programs.

Generally, the UFP-QAPP document format provides for the planning, implementation and documentation of activities conducted in carrying out environmental monitoring programs and establishment of specific protocols to be followed in collecting Site data during the performance of field sampling activity. The UFP-QAPP document format incorporates data collection and management information typically included in a Field Sampling Plan (FSP). Together, the UFP-QAPP and FSP or separately developed site-specific SOPs are intended to guide personnel in the development and conduct of sample collection, sample handling and management, laboratory analytical, and data reporting procedures.

A quality assurance project plan using the UFP-QAPP document format (UFP-QAPP revision 1.0) was prepared for the Southeast Rockford Groundwater Contamination Site (Site) in accordance with applicable guidance documents and submitted to USEPA in March 2017 as a deliverable under the Consent Decree (CD) Statement of Work (SOW) issued for the Site by USEPA. The Site UFP-QAPP document addresses the groundwater monitoring program established for the Site under the remedy selected in the Record of Decision (ROD) for Operable Unit 2 (OU2).

The Site UFP-QAPP document was updated (UFP-QAPP 2.0) to include the addition of 1,4-dioxane as a monitored constituent to the Site groundwater monitoring program and identify updates to key project personnel since completion of the UFP-QAPP revision 1.0 document and replaces the prior version.

1.1 Site Overview

The Site is located in a residential and commercially zoned area in the southeast portion of Rockford, Illinois. The location of the Site is provided on **Figure 1.** The Site was proposed for inclusion to the National Priorities List (NPL) on June 24, 1988, and was formally added to the NPL on March 31, 1989, as a State-lead, federally funded Superfund Site. The USEPA identification number for this Site is ILD981000417. Although contaminants were initially detected in several City municipal water supply wells as early as 1981, the Illinois Environmental Protection Agency (IEPA) became aware of a Volatile Organic Compound (VOC) problem in residential wells in 1984.

Following a study by the Illinois Department of Public Health (IDPH) in October 1984, high levels of chlorinated solvents were found to be present in several residential wells. These solvents included 1,1,1 trichloroethane, trichloroethene and tetrachloroethene. IDPH took an additional 337 water samples from residential wells between 1985 and 1989 to better determine how many residents were affected. The Illinois State Water Survey (ISWS) also performed a regional groundwater investigation. This investigation noted widespread residential and municipal well contamination. As a result of general groundwater contamination, the City closed several municipal wells in southeast Rockford.

When the Site was originally listed on the NPL, the nature and extent of groundwater contamination was largely unknown. As groundwater data from residential and monitoring wells has been collected, the Site was expanded from the original NPL description to include an area of about five square miles. The Site area expanded further to cover an area of ten square miles with boundaries that now comprise the current Site bounded by Broadway Street to the north, Sandy Hollow Road to the south, 20th Street to the east, and the Rock River to the west. The current Site boundaries encompass the groundwater contaminant plume comprised of chlorinated VOCs that was defined in the Remedial Investigation (RI).

The topography of the Site is essentially flat lying, with gradual sloping towards the Rock River, and is in a predominantly suburban residential area, which contains scattered industrial, retail, and commercial operations. Most of the building structures at this Site are one or two story residential dwellings, but several industrial developed areas also exist near residential areas along Harrison Avenue. There are a substantial number of commercial and retail operations along Alpine Road, Eleventh Street, and Kishwaukee Street. Other groundwater plumes within the Site were investigated but were not determined to be sources of chlorinated VOCs found in residential wells at the Site.

The City's primary source of potable water is groundwater because of a relative abundance of groundwater resources in the region. The Rock River to the west of the Site is not used as a source of drinking water by the City. The actual causes that led to groundwater contamination at this Site are largely unknown. Site investigation work performed during the RI noted four primary source areas of groundwater contamination. The four major identified source areas of groundwater contamination at the Site are shown on **Figure 2**.

The waste disposal area identified as "Area 7" apparently began operating in the early to mid-1950s and continued operation through 1970. Although it is not precisely known what volume and time period that wastes were disposed of in Area 7, limited investigations have revealed that most waste disposal activities occurred in the late 1950s to early 1960s during the property ownership of George Johnson. Site investigations at Area 7 have revealed that chlorinated solvents, waste oils and fuels, paint sludge, tank bottoms, hospital wastes, and general refuse were disposed of in Area 7. The primary method of disposal appears to have been direct discharge of liquids or sludge into an old creek ravine which has since been covered. Since the Site was operated before the effective date of the Resource Conservation and Recovery Act (November 19, 1980), the actual types of disposal methods used were determined solely from information obtained from witness accounts of Site activities.

The Swebco Manufacturing facility designated as "Area 4" is another source of groundwater contamination identified at the Site in the RI report. This area appears to be a location where spills and discharges of waste solvents and oils occurred. The former Rockford Varnish facility comprises "Area 11". Like Area 4, this area appears to have been the location of several spills and discharges. The facility has been abandoned for years and the time period of any spills and discharges is not known.

The fourth Site source area "Area 9/10" is located north of the Ninth Street-Harrison Road intersection. Site investigations have indicated a large plume of groundwater contamination down-gradient from an old industrial area. The smaller size of this plume indicates that groundwater contamination may be coming from a spill area or a location where chlorinated solvents were dumped on the ground surface. The precise location of the source area responsible for groundwater contamination here is unknown.

1.2 Site Clean-Up Background and Path Forward

As discussed in the previous section, the groundwater contamination at the Site is assumed to have resulted primarily from historical waste disposal operations. In August 1989, the USEPA sampled 112 residential wells around the Site to determine if immediate removal actions were warranted. USEPA initiated a time-critical removal action later in 1989 that included supplying bottled water for residents whose wells showed VOC levels greater than or equal to 25% of the Removal Action Level (RAL); installation of point-of-use carbon filters in December 1989 at those residences with affected wells as an interim measure; and extension of municipal water supply mains and service connections to the City's municipal water supply for 283 residents. These interim and final removal actions were completed in late 1991.

IEPA began an operable unit groundwater RI and Feasibility Study (FS) that included sampling of 117 residential, commercial, and industrial wells. The objective of this sampling event was to determine how many locations had water supply wells with VOC levels below RALs, but above Maximum Contaminant Levels (MCLs). A Proposed Plan that involved the connection of 264 residences to the City's municipal water supply and the installation of a granulated activated carbon (GAC) unit at one municipal water supply well that had been closed due to unsafe levels of VOCs, was made public in March 1991.

The GAC unit was installed to ensure sufficient capacity for the properties added to the City's municipal water supply system. A total of 547 residences were ultimately connected to the City's municipal water supply upon completion of the USEPA time-critical Removal Action and IEPA's Operable Unit RI/FS. All properties that were connected to the City's municipal water supply were required to have their domestic wells abandoned in accordance with State law.

The ROD for this RI/FS Operable Unit (OU) was signed on June 14, 1991. Construction of the service connections and GAC unit was initiated immediately and carried out by the City under USEPA's removal program so that the project could be completed on a shorter timeframe. A Remedial Action Report (RAR) certifying that the selected remedy for the Operable Unit RI/FS was operational and functional was approved on December 21, 1992.

The interim and final removal actions conducted at the Site significantly reduced the health threat posed by exposure to contaminants detected in groundwater at the Site. A comprehensive groundwater RI/FS was subsequently developed and implemented under the direction of USEPA to better characterize the nature and extent of Site groundwater contamination, and to provide information on the source areas thought to be responsible for contaminants detected in and around the domestic wells identified in the previous Site response actions.

The groundwater RI/FS involved soil sampling activities, installation of new groundwater monitoring wells, sampling of existing domestic water supply wells and ISWS monitoring wells, and a soil gas survey at 14 suspected source areas. The groundwater RI was conducted in phases since locations of the source areas were not known at that time and was completed in 1994. The results of the groundwater investigation showed the area of groundwater affected by VOC contamination to comprise the current limits of the Site and identified the four major source areas described above as presenting the greatest known potential for contribution of VOCs to groundwater.

The chemicals of concern (COC) established for the Site based on the results of the RI/FS, along with additional monitored COC constituents to be included in the groundwater monitoring program at the request of USEPA are listed below.

Primary Chemicals of Concern

Methylene chloride	Chloroform
1,1-Dichloroethene	1,2-Dichloroethane
1,1-Dichloroethane	1,1,1-Trichloroethane
cis-1,2-Dichloroethene	Trichloroethene
trans-1,2-Dichloroethene	Tetrachloroethene
Monitored Constituents[1]	
Vinyl chloride	1,4-dioxane

[1] vinyl chloride and 1,4-dioxane added as monitored COC constituents to the Site groundwater monitoring regimen per USEPA.

1.3 Record of Decision Summary

The ROD for the groundwater response action operable unit OU2 was issued by USEPA in June 1991 and September 1995. The activities required to implement the remedy selected for the groundwater response action operable unit are as follows:

- Groundwater monitoring for 205 years;
- Installation of new municipal water supply mains;
- Municipal water supply service connections to eligible residences;
- Continued operation of the GAC unit at Municipal Well UW-35;
- Future source control measures at the four identified sources; and
- Institutional controls to restrict groundwater usage.

The actions required to construct the groundwater monitoring network phase of the Site remedy are identified in Section II of the RD/RA SOW. The specific tasks involved in constructing the groundwater monitoring network are presented in the Site RD/RA Work Plan (NES, 1998) and include: installation of nine (9) new monitoring wells to complement the monitoring wells installed at the Site under the RI phase of the remedy; initiation of groundwater monitoring activities for 35 monitoring well locations; and establishment of operation and maintenance procedures for the groundwater monitoring network and the granular activated carbon (GAC) units installed at the municipal supply well, MW-35.

The overall function of the Site groundwater response action is to eliminate current and potential human exposures to groundwater contaminants identified in the RI/FS phase of the remedy. This objective is being achieved by: connection of residences with domestic wells affected by contaminated groundwater above health-based levels to the municipal water supply; and installation and operation of a groundwater monitoring network at the Site.

The water main extension component of the selected Site remedy was completed by the City through 1999. Construction of the groundwater monitoring network component of the groundwater response action was completed in August 1999. The objectives of the groundwater monitoring component include: (1) assessing the need for future water main extensions and water service connections; (2) predicting the movement of groundwater contamination and any potential impact on the municipal water supply; and (3) evaluation of the impact of groundwater contamination, if any, on the Rock River.

QAPP Worksheet #1 & 2: Title and Approval Page

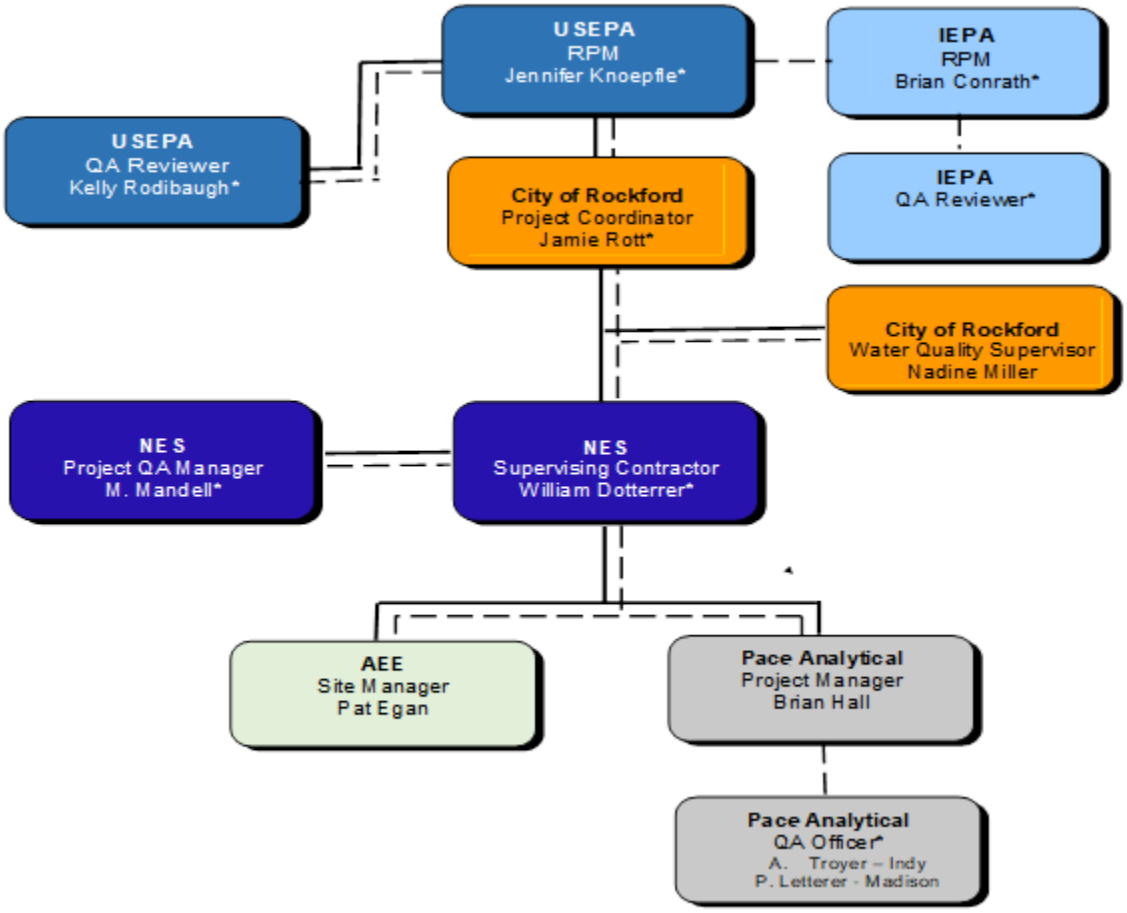
QUALITY ASSURANCE PROJECT PLAN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SITE
ROCKFORD, ILLINOIS

U.S. Environmental Protection Agency Region 5

Prepared by: Nationwide Environmental Services, Inc.

Jennifer Knoepfle, U.S. EPA, Remedial Project Manager	Date
Kelly Rodibaugh, U.S. EPA, Quality Assurance Reviewer	Date
Brian Conrath, Illinois EPA, Remedial Project Manager	Date
Jamie Rott, City of Rockford, Project Coordinator	Date
William Dotterrer, Nes, Inc., Supervising Contractor	Date
Maggie Mandell, NES, Inc., Project Quality Assurance Manager	Date
Anne Troyer, Pace Analytical, QA Officer –Indianapolis	Date
Patrick Letterer, Pace Analytical, QA Officer –Madison	Date

QAPP Worksheet #3 & #5: Project Organization and QAPP Distribution



***QAPP Recipient**
Lines of Authority ——— Lines of Communication — —

Entity	Role	Responsibility
USEPA	RPM	Provide federal regulatory oversight and direction on remedy activity implementation
IEPA	RPM	Provide state regulatory oversight and direction on remedy activity implementation
City of Rockford	Project Coordinator	Project management, performance and communication with regulatory agencies on remedial action.
NES, Inc.	Supervising Contractor	Conduct remedial activities in the field and reporting remedy results to the Project Coordinator
AEE	Remedial Contractor	Conduct groundwater monitoring regimen and providing field reports to NES, Inc.
Pace Analytical	Laboratory Services	Site sample analysis and laboratory reporting

QAPP Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet

ORGANIZATION: City of Rockford

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature*/Date
Jamie Rott	Project Coordinator	Licensed Professional Engineer (IL) B.S. Civil Engineering ~15 years Project Management	N/A	

ORGANIZATION: Nationwide Environmental Services, Inc.

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature*/Date
William Dotterrer	Supervising Contractor	B.S. Environmental Engineering ~20 years industry environmental mgmt. ~20 years environmental consulting	N/A	
Maggie Mandell	QA Manager	B.S. Environmental Engineering M.S. Environmental Engineering ~15 years environmental consulting	N/A	

ORGANIZATION: Pace Analytical Services, Inc.

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature*/Date
Brian Hall	Laboratory Project Manager	B.S. Biology/Chemistry ~17 Years Environmental Laboratory ~6 Years Project Management	N/A	
Anne Troyer	Laboratory QA Officer Indianapolis	B.A. Chemistry ~26 Years Environmental Laboratory ~0.5 Years QA Management	N/A	
Patrick Letterer	Laboratory QA Officer Madison	B.A. Biology ~36 Years Environmental Laboratory ~6 Years QA Management	N/A	

*Signatures indicate personnel have read and agree to implement this UFP-QAPP document as written.

QAPP Worksheet #6: Communication Pathways

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, pathway, documentation, etc.)
Regulatory agency interface (USEPA & IEPA)	NES	William Dotterrer	303.232.2134	Coordination on field events, report submittals, etc.
	City of Rockford	Nadine Miller Jamie Rott	779.348.7373 779.348.7654	
Field activities/reports	Anderson Environmental	Pat Egan	815.703.5935	Coordinate with NES & IEPA on scheduling of field activities. Submit field reports for sampling activities conducted. The field reports shall note any variance in sampling activities, corrective actions employed, and corrective actions needed.
QAPP changes	NES	William Dotterrer	303.232.2134	Changes in activities, personnel, or laboratory shall necessitate an addendum or revision to the existing QAPP.
	City of Rockford	Nadine Miller Jamie Rott	779-348-7373 779-348-7654	
Sample receipt variances	Pace Analytical	Brian Hall	616.975.4500	Coordinate with NES on any variances in sample receipt and note on chain-of-custody and in case narrative.
Laboratory quality control/analytical variances	Pace Analytical	Patrick Letterer Anne Troyer	608.221.8700 317.228.3109	Internal coordination on any variances related to analysis of samples submitted and communicate with NES, as necessary.
Analytical corrective actions	Pace Analytical	Patrick Letterer Anne Troyer	608.221.8700 317.228.3109	Conduct corrective actions as necessary and document in case narrative.
Data verification issues, e.g., incomplete records	Pace Analytical	Patrick Letterer Anne Troyer	608.221.8700 317.228.3109	Coordinate with NES on any data verification issues and note in case narrative.
Data validation/review	NES	Maggie Mandell	303.232.2134	Coordinate with PM on any issues related to quality of data.

QAPP Worksheet #9: Project Planning Session Summary

Date of planning session: 4/10/2020
Location: Conference Call
Purpose: SE Rockford Superfund Site UFC – QAPP Document Revisions
Addition of 1,4-dioxane to groundwater monitoring regimen.

Participants:

Name	Organization	Title/Role	Email/Phone
Terese Van Donsel	USEPA	Remedial Project Manager	Vandonsel.terese@epa.gov 312-353-6564
Jaqueline Adams	USEPA	Regional QA Manager	Adams.Jacqueline@epa.gov 312-886-6180
Robert Thompson	USEPA	Superfund QA Liaison	Thompson.Robert@epa.gov 312-353-9078
Brian Conrath	IEPA	Remedial Project Manager	Brian.Conrath@Illinois.gov 217-557-8155
Kyle Saunders	City of Rockford	Director Public Works	Kyle.Saunders@rockfordil.gov 779-348-7371
Jamie Rott	City of Rockford	Water Superintendent	Jamie.Rott@rockfordil.gov 779-348-7373
Nadine Miller	City of Rockford	Water Quality Supervisor	Nadine.Miller@rockfordil.gov 779-348-7373
William Dotterrer	NES	Supervising Contractor	bdotterrer@nationwideenv.com 303-232-2134
Pat Egan	AE	O&M Contractor	eganpk@gmail.com 815-703-5935

Notes/Comments:

- Discuss addition of 1,4-dioxane as a monitored constituent to S E Rockford Site groundwater monitoring program.
- Determine sample locations, analytical method, and data validation deliverable for 1,4-dioxane sampling and analysis.
- Revision to UFC-QAPP for inclusion of 1,4-dioxane in Site groundwater monitoring program, updates to key project personnel.

Project Planning Session Meeting – 4/10/20

Action Items:

Action	Responsible Party	Timing
NES submit QAPP revision summary to USEPA	W. Dotterrer - NES	Week of 4/27/2020
EPA provide comments on QAPP revision summary	T. Van Donsel - USEPA	Week of 5/11/2020
NES prepare and submit revised QAPP for review comment	W. Dotterrer - NES	7/15/2021*
NES finalize and distribute revised QAPP	W. Dotterrer - NES	TBD**

**Southeast Rockford Groundwater Contamination Site UFP- QAPP revision ver. 2.0 finalized July 2021 to accommodate changes in project personnel occurring since project planning session of April 10, 2020.*

***Date of distribution of approved UFP-QAPP unknown pending review and approval by U.S. EPA*

QAPP Worksheet #10: Conceptual Site Model

The RI concluded that there are four source areas that contribute to the chlorinated VOC plume across the site: Area 4, Area 7, Area 9/10, and Area 11. A brief description of each source area follows.

Area 4: Located at Marshall Street and Alton Avenue, concentrations of 1,1,1-trichloroethane (TCA) were detected in soil samples collected beneath a parking lot at the Swebco facility. Groundwater contamination downgradient from the Swebco facility as well as reported TCA detections in soil gas were noted in the RI report. Soil contamination at up to 360 parts per million (ppm) appears to extend to a depth of 32 feet below ground surface (bgs). Because TCA in contaminated soil is water soluble and desorption from the contaminated soils occurs, contaminants from Area 4 are considered mobile in groundwater. Residential air samples collected during the RI have shown migration of TCA vapors from Area 4 into nearby basements. The potential pathways of contaminant migration include groundwater and void spaces in soil (e.g., soil gas). Surface migration of contaminants is not likely given that most of Area 4 is paved.

Area 7: During the RI, groundwater samples collected in Area 7 had reported detections of chlorinated and non-chlorinated solvents including TCA (380 ppm), tetrachloroethene (PCE) at 260 ppm, trichloroethene (TCE) at 130 ppm, and xylene (210 ppm). Toluene, ethylbenzene, and various degradation products of chlorinated solvents were also detected.

Groundwater samples collected from downgradient monitoring wells have shown groundwater contamination from Area 7 migrating beyond Eleventh Street. Primary groundwater COC associated with the groundwater samples collected from downgradient monitoring wells include TCA (8 ppm), cis-1,2-dichloroethene (5.9 ppm), PCE (1.2 ppm), and TCE (0.65 ppm). During the RI, TCA, PCE, and TCE were also detected in soil gas samples at combined concentrations up to 5.59 parts per billion (ppb). Based on field screening methods conducted during the RI, soil contamination appears to exist to depths of over 47 feet bgs. Contaminants detected in this area are water soluble and mobile in groundwater as evidenced by analyses of groundwater in downgradient wells.

Surface soil samples collected in Area 7 (inclusive of Ekberg Park) have shown only trace concentrations of contaminants. Residential air sampling around Area 7 during the RI reported only trace concentrations of contaminants in basements and there appears to be no correlation between Area 7 site contaminants and low concentrations of basement air contaminants. The potential pathways of contaminant migration from Area 7 are through groundwater and void spaces in soil.

Area 9/10: The RI reported an unknown source of groundwater contamination is present in the vicinity north of the Harrison Avenue/Ninth Street intersection. Analytical results for groundwater samples from downgradient monitoring wells showed detections of 1,1-dichloroethane, TCA, and chloroethane. Contaminants detected in this area are water soluble and mobile in groundwater. Since the location of this source has not yet been identified, potential migration pathways cannot be determined, although high soil gas concentrations on adjacent property indicate a vapor migration pathway through soil.

Area 11: Located east of Eleventh Street and Harrison Avenue, Area 11 is the site of the former Rockford Varnish facility. Contaminants detected in soil samples collected near Area 11 include xylene (2,300 ppm), toluene (1,400 ppm), ethylbenzene (590 ppm), and benzene (1.5 ppm) at depths of 40 feet bgs. The RI reported that chlorinated solvents were not detected in groundwater samples collected from Area 11. However, the RI theorized that the high concentrations of detected compounds may have masked the presence of chlorinated solvents in the analyses. The RI reported that Area 11 does appear to be a significant source of non-chlorinated VOCs in groundwater as evidenced by analyses of groundwater samples collected from monitoring wells close to the source area. Contaminants associated with Area 11 are mobile in groundwater. The RI reported that a vapor migration pathway through soil is likely but has not been established.

Other Source Areas

Several other source areas were identified in the RI. However, these other source areas were not considered as contributors to the chlorinated VOC plume. The RI reported site-related groundwater contaminants present in the upper sand and gravel aquifer, permeating to depths of 220 feet bgs into bedrock. Limited investigations on bedrock characteristics have shown extensive fracturing.

Exposure Routes

Potential exposure routes include:

- Ingestion of groundwater from residential wells.
- Dermal contact with groundwater from residential wells through showering.
- Inhalation of site-related contaminants which volatilized from residential wells during and immediately after showering.

Although an ecological assessment relative solely to groundwater effects has not been performed at this site, the most probable location of environmental exposure would be the Rock River. Endangered species or habitats of endangered species affected by site-related groundwater contaminants have not been identified in the RI.

QAPP Worksheet #11: Project/Data Quality Objectives

1. **State the Problem.**

   Chlorinated volatile organic compounds (VOCs) comprise the principal contaminants found in groundwater, soil, leachate, and drinking water at the Southeast Rockford Groundwater Contamination Site (Site). The Chemicals of Concern (COC) established for the Site, based on the results of the groundwater Remedial Investigation (RI) are listed below.

ethylene chloride	Chloroform
1,1-Dichloroethene	1,2-Dichloroethane
1,1-Dichloroethane	1,1,1-Trichloroethane
cis-1,2-Dichloroethene	Trichloroethene
trans-1,2-Dichloroethene	Tetrachloroethene

   Vinyl chloride was added as a monitored COC constituent to the Site groundwater monitoring program in 1999 and included in the project reporting format for COCs. The current revision to the project UFP-QAPP document provides for analysis and reporting for 1,4-dioxane as a monitored constituent to be included in the project reporting for COCs.

2. **Identify the Goals of the Study.**

   The primary goals and objectives of the response action at the Site is to implement the remedy selected in the 1995 ROD to restrict the access to and usage of affected groundwater. The specific tasks to be performed to implement the remedial action to address affected groundwater at the Site are presented in the RD/RA SOW issued by USEPA in 1995. The compound 1,4-dioxane is being added as a monitored constituent to the Site groundwater monitoring program under this QAPP document revision to augment definition of the extent of affected groundwater at the Site.

3. **Identify Information Inputs.**

   The collection and analysis of groundwater samples shall be used to measure the concentrations of chlorinated VOCs and 1,4-dioxane, with emphasis on COC concentrations, and monitor the TVOC plume extents at the Site over time .

4. **Define the Boundaries of the Study.**

   The target population consists of the groundwater samples collected from the groundwater monitoring network situated within the Site boundary area as shown on **Figure 2**.

5. **Develop the Analytic Approach.**

   The target analytes (COCs) for the Site were identified, based on the results of the groundwater RI, and comprise contaminants contributing to the state of groundwater quality at the Site. USEPA requested that vinyl chloride be added as a monitored COC constituent at the Site (1999) and vinyl chloride is included in the analyses of groundwater and private well samples and reported along with the initial COC list. USEPA has requested that 1,4-dioxane also be included as monitored COC constituent in the groundwater monitoring and reporting regimen performed for the Site

6. **Specify Performance or Acceptance Criteria.**
   The analytical results for Site groundwater samples obtained at the Site shall be compared to USEPA MCLs for which an MCL exists, and applicable Regional Screening Level (RSL) concentrations for those compounds for which MCL are not in place .

7. **Develop the Detailed Plan for Obtaining Data.**
   The sampling program design for the Site was previously developed and is incorporated in the Field Sampling Plan (FSP) and subsequent addenda. The UFC-QAPP 2.0 document addresses the addition of 1,4-dioxane as a monitored COC constituent to the groundwater monitoring program at the Site, and presents the field sampling, QA samples, and analytical methods to be utilized for Site data collection and reporting, obviating the need for a separate update to the FSP.

QAPP Worksheet #12: Measurement Performance Criteria

Matrix: Groundwater
Analytical Group or Method: VOA/8260C
Laboratory SOP: ENV-SOP-IND1-0034, rev. 02
Concentration Level: Low

Data Quality Indicator (DQI)	QC sample or measurement performance activity	Measurement Performance Criteria
Precision	Field Duplicates	RPD ≤ 20% when VOCs are detected in both samples ≥ sample-specific LOQ
Accuracy/Bias	Second source calibration verification.	± 20% recovery
Accuracy/Bias	Internal Standards	Sample ISTD areas must be +/-50% from CCV. Samples ISTD RTs must be +/-10 seconds from CCV.
Accuracy/Bias	Laboratory Control Sample	QC acceptance criteria per in-house limits.
Accuracy/Bias	Matrix Spike/Matrix Spike Duplicate	QC acceptance criteria for accuracy per in-house limits; RSD ≤ 20%
Accuracy/Bias	Surrogate Spikes	Surrogate compounds for 8260C are 4-Bromofluorobenzene, Dibromofluoromethane and Toluene-d8. Specific limits are updated annually.
Overall accuracy/bias (contamination)	Trip Blanks	No target analyte concentrations ≥ LOQ
Completeness	See Worksheet #34	See Worksheet #34

Matrix: Groundwater
Analytical Group or Method: 1,4-dioxane by SPME and GC\MS with SIM[1]
Laboratory SOP: ENV-SOP-MAD1-0060, rev. 02
Concentration Level: Low

Data Quality Indicator (DQI)	QC sample or measurement performance activity	Measurement Performance Criteria
Precision	Field Duplicates	RPD ≤ 30% when analyte is detected in both samples ≥ sample specific LOQ
Accuracy/Bias	Second source calibration verification	± 20% recovery
Accuracy/Bias	Internal Standards	Area count within -50 to +200% RT must be +/- 30 seconds from the last calibration check. (This is an Isotope Dilution method. The Area Count limits are advisory; any recoveries outside of the limits will be reviewed.
Accuracy/Bias	Laboratory Control Sample	QC acceptance criteria per in-house limits.
Accuracy/Bias	Matrix Spike/Matrix Spike Duplicate	QC acceptance criteria for accuracy per in-house limits; RSD ≤ 20%
Accuracy/Bias	Surrogate Spikes	Percent recoveries per in-house limits
Overall accuracy/bias (contamination)	Trip Blanks	No target analyte concentrations ≥ LOQ
Completeness	See Worksheet #34	See Worksheet #34

[1] Laboratory SOP is based on SW-846 Method 8260

QAPP Worksheet #13: Secondary Data Uses and Limitations[1]

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
NA	NA	NA	NA

[1] There are no secondary data uses during the performance of the activities described in this QAPP.

QAPP Worksheet #14/16: Project Tasks & Schedule

Activity	Responsible party	Plan start date	Plan completion date	Deliverable(s)	Deliverable due date
Groundwater sample collection involving field crew mobilization, low flow sample equipment set-up, monitoring well purge and sample collection	NES, Inc.	Semi-annual event conducted at six-month intervals to capture seasonal variability (ex. June and December). Sample event date dependent on field crew schedule and site conditions.	Semi-annual event completed 14 days from start date.	Field Report: summary of site conditions, observations, field sample activity completed. issues, corrective action..	Semi-annual event, report completed up to 90 days following sample event
Groundwater level measurement involving field crew mobilization, water level meter set-up, level measurement.	NES, Inc.	Semi-annual event conducted at six-month intervals to capture seasonal variability (ex. June and December). Sample event date dependent on field crew schedule and site conditions.	Semi-annual event completed 14 days from start date.	Field Report: groundwater elevation measurements.	Semi-annual event, report completed up to 90 days following sample event
Groundwater stabilization criteria measurement involving field crew mobilization, flow through cell set-up, criteria monitoring	NES, Inc.	Semi-annual event conducted at six-month intervals to capture seasonal variability (ex. June and December). Sample event date dependent on field crew schedule and site conditions.	Semi-annual event completed 14 days from start date.	Field Report; groundwater stabilization results.	Semi-annual event, report completed up to 90 days following sample event

Activity	Responsible party	Plan start date	Plan completion date	Deliverable(s)	Deliverable due date
Analysis of groundwater samples for VOCs by method VOA/8260C, and 1,4-dioxane by method SPME and GC\MS with SIM	Pace Analytical	Semi-annual event conducted at six-month intervals to capture seasonal variability (ex. June and December). Sample analysis initiated to meet respective sample hold time upon receipt of samples.	Semi-annual event, laboratory analysis completed within respective delivered sample lot hold time	Laboratory Analytical Report: sample analysis results and analytical method data package	Semi-annual event, report completed up to 90 days following sample event.
Data Validation involving QA/QC review and evaluation of laboratory analytical results and supporting documentation	NES, Inc.	Semi-annual event conducted at six-month intervals to capture seasonal variability (ex. June and December). Data validation initiated upon receipt of laboratory analytical report.	Semi-annual event completed 90 days from receipt of laboratory analytical report.	Data Validation Summary Report.	Semi-annual event, report completed up to 90 days following sample event.
Monitoring Event Report presenting consolidated results of semi-annual monitoring event	NES, Inc.	Semi-annual event conducted at six-month intervals to capture seasonal variability (ex. June and December). Reporting activity initiated upon aggregation of sample event data.	Semi-annual event, report completed 90 days from receipt of analytical results.	Semi-annual Groundwater Monitoring Report	Semi-annual event, report completed up to 90 days following sample event.

QAPP Worksheet #15: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater
Analytical Method: EPA 8260C
Concentration level (if applicable):

Analyte	Project Action Limit (PAL) (µg/l)	PAL Reference	Project Quantitation Limit Goal (µg/l)	Laboratory-specific quantitation limit[2] (µg/l)	Laboratory-specific detection limit[3] (µg/l)
1,1,1-Trichloroethane	200	MCL	10.0	1.0	0.89
1,1-Dichloroethane	NA	MCL	10.0	1.0	0.81
1,1-Dichloroethene	7	MCL	5.0	1.0	0.95
1,2-Dichloroethane	5	MCL	5.0	1.0	0.47
Chloroform	NA	MCL	10.0	1.0	0.0.80
cis-1,2-Dichloroethene	70	MCL	10.0	1.0	1.0
Methylene Chloride	5	MCL	5.0	5.0	0.53
Tetrachloroethene	5	MCL	5.0	1.0	0.84
trans-1,2-Dichloroethene	100	MCL	10.0	1.0	0.95
Trichloroethene	5	MCL	5.0	1.0	1.0
Vinyl chloride	2	MCL	2.0	1.0	0.77

Note: Method Detection Limits (MDLs) are instrument specific and subject to change.

[2] Laboratory reporting limit
[3] Laboratory method detection limit as determined per analysis

Matrix: Groundwater
Analytical Method: 1,4-dioxane by SPME and GC\MS with Selective Ion Monitoring (SIM) Concentration level (if applicable):

Analyte	Project Action Limit (PAL) (µg/l)*	PAL Reference	Project Quantitation Limit Goal (µg/l)	Laboratory-specific quantitation limit[4] (µg/l)	Laboratory-specific detection limit[5] (µg/l)
1,4-dioxane	NA	NA	NA	0.2	0.057

*1,4-dioxane added to project groundwater monitoring regimen as a monitored constituent and no Project Action Level exists for this compound. Screening action level for 1,4-dioxane is 0.46 ug/L, based on USEPA Regional Screening Level.

[4] Laboratory reporting limit
[5] Laboratory method detection limit as determined per analysis

QAPP Worksheet #17: Sampling Design and Rationale

The Site groundwater monitoring network was designed and installed to monitor VOC concentrations in groundwater within the extents of the designated Site Boundary Area. Site monitoring wells were located in or proximate to VOC source areas identified for the Site according to results reported during the groundwater RI, and at locations hydraulically upgradient and downgradient from Site source areas. The Site groundwater monitoring network sample locations and groundwater plume extents are shown in **Figure 2**.

The Site groundwater monitoring program was implemented to characterize the nature and extent of groundwater VOC contamination at the Site, and monitor the VOC groundwater plume migration across the Site over time, the contribution of VOCs from Site source area and associated affects of source area remediation efforts conducted by others, and VOC plume reduction resulting from natural attenuation .

The target analytes (COCs) to be monitored through implementation of the groundwater monitoring program at the Site were identified, based on the results of the groundwater RI, and comprise VOC contaminants contributing to degraded groundwater quality at the Site. USEPA has requested that 1,4-dioxane be included as monitored COC constituent in the groundwater monitoring and reporting regimen performed for the Site. The compound 1,4-dioxane is being added as a monitored constituent to the Site groundwater monitoring program to further assist in definition of the extent of affected groundwater at the Site. The concentrations of VOC present in each groundwater monitoring location comprising the groundwater monitoring network is well documented over time, with no threat to health and safety of field monitoring personnel posed by vapors at the well head, consequently no field screening by Photoionization Detector (PID) or other is currently performed in accessing the well head for sampling.

The results of the RI investigation noted widespread VOC contamination in residential and municipal water supply wells situated within the VOC plume extents. The City closed several municipal wells in southeast Rockford, as a result of groundwater contamination by VOCs and connected a majority of the residential and commercial water supply wells within the contamination plume to a City supplied water source. A residential well sampling program was developed in agreement between the City and USEPA and IEPA and implemented for a period of ten calendar quarters (not consecutive over the period July 2017 to December 2020) to monitor for the presence and concentration of VOCs at designated residences which had not been connected to a City supplied water source. Monitoring for 1,4-dioxane was not included in the residential well sampling program The residential water supply monitoring program was completed in December 2020 and has been discontinued.

The conditions that may occur to limit or prevent access to Site groundwater monitoring locations and procedure(s) to be used in the event that access to monitoring locations comprising the Site groundwater monitoring network is impeded or otherwise inaccessible during a sampling event (semi-annual) are presented in the table below and discussed further in the Field Sampling Plan.

Monitoring Event Planning - Access

Site Access Condition	Remedy Procedure
Inclement weather	Notify City, USEPA, IEPA project representatives of condition and reschedule sample event.
Property owner access refusal	Notify City project representative of well location access refusal and resolve access issue with property owner through the City, with potential sample date reschedule.
Physical obstruction	Notify City project representative of well location access obstruction and resolve access issue with property owner through the City, with potential sample date reschedule.
Damaged monitoring well	Notify City project representative of well location condition and complete monitoring well repair as needed to restore access upon authorization by the City, with potential for sample date reschedule.
Inoperative Well Pump	Remove dedicated pump from well inspect for operating condition and repair as needed. Utilize portable bladder pump in the event dedicated well pump operation cannot be achieved.

QAPP Worksheet #18: Sampling Locations and Methods

The groundwater monitoring locations comprising the site-wide groundwater monitoring network are presented in Figure 2 of this UFP-QAPP 2.0 document. The monitoring network is comprised of 35 monitoring locations located within the Site Boundary Area consisting of twenty-six monitoring wells installed during the RI and subsequent site investigation activities performed by others, and nine new monitoring well installed during the Remedial Action for OU2.

Groundwater samples are collected from the Site groundwater monitoring network using Low Flow micro-purge method, consistent with Low Flow Standard Operating Procedure presented in US EPA Region V guidance document R5-SFD-0006-r0 (USEPA 2021). The low-flow groundwater sampling methodology provides representative results and is generally recommended at sites with wells having a short saturated-screen length (i.e., 10 feet or less) and sites where vertical contaminant stratification in groundwater is not a concern.

The Field Sampling Plan Revision 1.0 (FSP) prepared for the Site is provided in Appendix A to the UFP-QAPP 2.0 document and presents procedures used for deployment of the Low Flow sampling method for collection of groundwater samples at the Site and summarized below.

- The Low-Flow method deployed at the Site involves purging the selected monitoring well using a dedicated bladder pump installed in the well and fitted with downhole pump air supply and sample tubing. The well sample pump and tubing inlet are set within the screened interval of the well, approximately 1.5 feet from the bottom of the well.

- The monitoring well is purged at a low flow rate (typically 100 – 500 milliliters per minute [ml/min]) to minimize groundwater drawdown in the well.

- Groundwater stabilization parameters pH, DO, conductivity, and ORP are measured in a continuous flow-through cell analyzer until the respective stabilization criteria have been met for three consecutive readings. Turbidity is measured using a separate turbidity monitor.

- Groundwater samples are collected from each monitoring well location when established indicator parameters stabilize, and the water level is stable .

- Decontamination procedures for the flow-through cell analyzer are performed prior to use at each groundwater monitoring location.

QAPP Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times

Laboratory:

Sample Type: Groundwater VOCs
Pace Analytical Services, Inc.
7726 Moller Rd,
Indianapolis, IN 46268
Contact: Anne Troyer ph: 317.228.3109

Sample Type: Groundwater 1,4-dioxane
Pace Analytical Services, Inc.
2525 Advance Rd,
Madison, WI 53718
Contact: Patrick Letterer ph: 608.221.8700

Accreditations/certifications: NA
Back-up Laboratory: N/A
Sample Delivery Method: FedEx, Other Common Courier

Analyte/Analyte Group	Matrix	Method/SOP	Accreditation Expiration Date	Container(s) (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Volatile Organic Compounds	Groundwater	SW-846 Method 8260C ENV-SOP-IND1-0034, rev. 02	Illinois Accreditation: #200074 Exp. Date: 10/12/2022	Three 40-ml glass vials with Teflon septum-lined caps	Hydrochloric acid (HCl) to pH <2; Cool to ≤ 6°C	NA	pH>2: Analysis completed within 7 days of collection date. pH<2: Analysis completed within 14 days of collection date. (pH determined post-analysis)	28 days

Analyte/Analyte Group	Matrix	Method/SOP	Accreditation Expiration Date	Container(s) (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
1,4-dioxane	Groundwater	1,4-dioxane by SPME and GC\MS (SIM) ENV-SOP-MAD1-0060, rev. 02	Illinois Accreditation: #200062 Exp. Date: 4/30/2022	Three 40-ml glass vials with Teflon septum-lined caps	Cool to 4 °C; If HCL preserved samples are utilized and analyzed between 7 and 14 days since sampling, the pH must be verified to be <2. If the pH is >2, the sample will be qualified as having insufficient pH preservation.	NA	Unpreserved water samples have a hold time of 7 days. Samples preserved with HCL have a hold time of 14 days.	28 days

QAPP Worksheet #20: Field QC Summary

Matrix	Analyte/ Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Field Blanks	Equipment Blanks	Trip Blanks	Other	Total # analyses
Groundwater	VOCs	35	2	2	2	0	0	2	N/A	43
Groundwater	1,4-dioxane	35	2	2	2	0	0	2	N/A	43

Field Sample Collection Summary

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/ Analytical Group	Sampling SOP	Comments
Groundwater monitoring wells	GW	NA	Investigative	VOCs	Low Flow	
Field Duplicate	GW	NA	QA	VOCs	Low Flow	
Trip Blank	GW	NA	QA	VOCs	per laboratory	provided by laboratory

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/ Analytical Group	Sampling SOP	Comments
Groundwater monitoring wells	GW	NA	Investigative	1, 4-dioxane	Low Flow	
Field Duplicate	GW	NA	QA	1, 4-dioxane	Low Flow	
Trip Blank	GW	NA	QA	1, 4-dioxane	per laboratory	provided by laboratory

Notes:
Refer to **Table 1** for the groundwater monitoring well designations
QC sample frequency based on collection of two sample batches per sample event, with QC sample regimen for each sample batch.
GW - Groundwater.

QAPP Worksheet #21: Field SOPs

SOP # or reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
FSP*	Field Sampling Plan, Rev. 1.0, October 2021	NES	Procedures for field practices and equipment used in Site sample collection and handling.	N	FSP SOP revised to update sample equipment, sample documentation forms.

**Procedures addressing field sample event arrangements, sample collection and handling, and documentation are cross-referenced to applicable UFP-QAPP Worksheets.*

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Activity	SOP Reference	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
Electronic Water Level Indicator Solinst M101 Water Level Meter	Calibration	FSP Appendix A1 O&M Manual	Site Manger	prior to sampling	O&M Manual	O&M Manual
	Maintenance	FSP Appendix A1 O&M Manual	Site Manager	as needed	O&M Manual	O&M Manual
	Testing	FSP Appendix A1 O&M Manual	Site Manager	during sampling	O&M Manual	O&M Manual
	Inspection	FSP Appendix A1 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual

Field Equipment	Activity	SOP Reference	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
Flow-through Cell Analyzer YSI 556 MSP	Calibration	FSP Appendix A2 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual
	Maintenance	FSP Appendix A2 O&M Manual	Site Manager	as needed	O&M Manual	O&M Manual
	Testing	FSP Appendix A2 O&M Manual	Site Manager	during sampling	O&M Manual	O&M Manual
	Inspection	FSP Appendix A2 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual

Field Equipment	Activity	SOP Reference	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
Turbidity Meter LaMotte 2020we	Calibration	FSP Appendix A3 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual
	Maintenance	FSP Appendix A3 O&M Manual	Site Manager	as needed	O&M Manual	O&M Manual
	Testing	FSP Appendix A3 O&M Manual	Site Manager	during sampling	O&M Manual	O&M Manual
	Inspection	FSP Appendix A3 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual

Field Equipment	Activity	SOP Reference	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
Flow Controller QED M10	Calibration	FSP Appendix A4 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual
	Maintenance	FSP Appendix A4 O&M Manual	Site Manager	as needed	O&M Manual	O&M Manual
	Testing	FSP Appendix A4 O&M Manual	Site Manager	during sampling	O&M Manual	O&M Manual
	Inspection	FSP Appendix A4 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual

Field Equipment	Activity	SOP Reference	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
Bladder Pump QED Sample Pro	Calibration	FSP Appendix A5 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual
	Maintenance	FSP Appendix A5 O&M Manual	Site Manager	as needed	O&M Manual	O&M Manual
	Testing	FSP Appendix A5 O&M Manual	Site Manager	during sampling	O&M Manual	O&M Manual
	Inspection	FSP Appendix A5 O&M Manual	Site Manager	prior to sampling	O&M Manual	O&M Manual

QAPP Worksheet #23: Analytical SOP's

SOP #	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
ENV-SOP INDI-0034 rev. 02	Volatile Organic Compounds by Purge and Trap Capillary Column GC/MS 8260C, effective October 21, 2021	Definitive	Water and Soil VOCs	Agilent GC Model 6850 / 6890	N
ENV-SOP-MAD1-0060 rev. 02	1,4-dioxane by SPME and GC\MS with SIM, effective November 16, 2021	Definitive	Water 1,4-dioxane	GC: HP 5890A MSD: HP5972	N
ENV-SOP IND1-0051 rev. 02	Internal Chain of Custody, effective August 10, 2021	NA	Sample shipment and custody	NA	N
ENV-SOP IND1-0001 rev. 02	Sample Management, effective August 21, 2020	NA	Sample login and storage	NA	N
ENV-SOP IND1-0004 rev. 01	Laboratory Waste Management, effective April 13, 2020	NA	Waste Disposal	NA	N

QAPP Worksheet #24: Analytical Instrument Calibration

Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible for Corrective Action	SOP Reference
Instrument: GC/MS					
Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Must meet the ion abundance criteria required by the method.	Reanalyze the BFB tune. If the tune still fails, the criteria, instrument maintenance, and/or preparation of new standards must be considered.	Analyst/Lab Manager	ENV-SOP-IND1-0034 rev. 02 ENV-SOP-MAD1-0060 rev. 02
Initial Calibration (ICAL) for all analytes	Minimum five-point initial calibration (ICAL) after initial setup and prior to sample analysis, and when continuing calibration verification criteria not met.	Must meet method criteria. The percent relative standard deviation (%RSD) should be ≤20% for each target analyte. If % RSD for any compound is >20%, the analyst may employ a linear regression equation, non-weighted or weighted, that does not pass through the origin. The regression calculation will generate a correlation coefficient (r). The correlation coefficient must be > 0.99. The ICV acceptance limits are 70-130% recovery for all compounds except: acetone, acrolein, bromomethane, iodomethane and methyl acetate for which the limits are 50-150%. All target compounds in the CCV must be ± 20% difference from initial calibration. The internal standard areas in the CCV must be between 50%-200% of the internal standard areas of the corresponding standard in the initial calibration. See the SOP for exceptions and more details.	Analyze a new initial calibration curve. Instrument maintenance and/or preparation of new calibration standards should also be considered. Samples associated with a failed initial calibration must be reanalyzed or affected data must be qualified.	Analyst/Lab Manager	

Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible for Corrective Action	SOP Reference
		1,4-dioxane: ICAL curve preparation with six levels of calibration standards are used in the initial calibration. A low-level standard is prepared at the report limit of 0.20 µg/L. The remaining five standards are prepared at 0.5, 1.0, 25, 250, and 500 µg/L. These compounds must meet a linear calibration criterion of correlation coefficient (r^2) of > 0.990.			
Second Source Calibration Verification (SCV) (also called Initial Calibration Verification ([ICV])	Once after each ICAL.	Must meet method criteria. The percent relative standard deviation (%RSD) should be ≤20% for each target analyte. If % RSD for any compound is >20%, the analyst may employ a linear regression equation, non-weighted or weighted, that does not pass through the origin. The regression calculation will generate a correlation coefficient (r). The correlation coefficient must be > 0.99. The ICV acceptance limits are 70-130% recovery for all compounds except: acetone, acrolein, bromomethane, iodomethane and methyl acetate for which the limits are 50-150%. All target compounds in the CCV must be ± 20% difference from initial calibration. The internal standard areas in the CCV must be between 50%-200% of the internal standard areas of the corresponding standard in the initial calibration. See the SOP for exceptions and more details.	Reanalyze an ICV. If the second ICV also exceeds the acceptance range, a new initial calibration should be prepared. Samples associated with a failed ICV must be reanalyzed or affected data must be qualified. *Exception*: If the ICV is outside of the upper control limit, indicating high bias, associated samples determined to be <RL may be reported.	Analyst/Lab Manager	
		1,4-dioxane: The response for each compound to be quantitated should not exceed a 20 % difference when compared to the theoretical value of the standard.			

Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible for Corrective Action	SOP Reference
Retention time window position establishment for each analyte and surrogate	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used. See the SOP for more details.	N/A	Analyst/Lab Manager	
Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units	Correct problem, then rerun ICAL.	Analyst/Lab Manager	
Continuing Calibration Verification (CCV)	Daily before sample analysis and every 12 hours of analysis time.	1. Average RF for VOC SPCCs: ≥0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, ≥0.1 for chloromethane, bromoform, and 1,1-dichloroethane; 2. % Difference/Drift for all target analytes and surrogates: ≤20%. See the SOP for more details.	Reanalyze a CCV. If the second CCV also fails, a new initial calibration should be prepared. Samples associated with a failed CCV must be reanalyzed or affected must be qualified. *Exception*: If the CCV is outside of the upper control limit, indicating high bias, associated samples determined to be <RL may be reported.	Analyst/Lab Manager	
	1,4-dioxane: A CCV standard must be injected at the beginning of each sequence, after every 10 samples, and at the conclusion of each sequence.	The response for each compound to be quantitated should not exceed a 20% difference when compared to the theoretical value of the calibration standard.	Inspect the GC/MS system to determine the cause and perform whatever maintenance is necessary before re-calibrating and proceeding with sample analysis. All samples that were injected after the last acceptable CCV should be re-injected, or the data should be qualified.		

QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment*	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Title/position responsible for corrective action	Reference
Purge & Trap/EST ENCON P&T Concentrator, EST 8100 or Centurion WS P&T Autosampler	• Check waste container/drain • Check water supply for rinsing • Check autosampler/ syringe • Check vacuum • Check gases • Replace trap/ liner/septum/ seal • Clip column • Clean source	VOCs	Check connections, replace worn/dirty equipment.	• Daily • Daily • Daily • Daily • Daily • As needed • As needed • As needed	Instrument performance, sensitivity and system must be in control with passing QC samples	Adjust flow rate or perform leak check. If leak or restriction found fix problem	GC/MS Analyst	ENV-SOP-IND1-0034 rev. 02
GC/MS/Agilent 6850/6890	• Check waste container/drain • Check water supply for rinsing • Check autosampler/ syringe • Check vacuum • Check gases • Replace trap/ liner/septum/ seal • Clip column Clean source	VOCs	Check connections, replace worn/dirty equipment.	• Daily • Daily • Daily • Daily • Daily • As needed • As needed • As needed	Instrument performance, sensitivity and system must be in control with passing QC samples.	Inspect system, correct problem, rerun calibration and affected samples.	GC/MS Analyst	ENV-SOP-IND1-0034 rev. 02

Instrument/ Equipment*	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Title/position responsible for corrective action	Reference
GC: HP 5890A MSD: HP5972	• Check waste container/drain • Check water supply for rinsing • Check autosampler/ syringe • Check vacuum • Check gases • Replace trap/ liner/septum/ seal • Clip column Clean source	1,4-dioxane	Check connections, replace worn/dirty equipment.	• Daily • Daily • Daily • Daily • Daily • As needed • As needed • As needed	Instrument performance, sensitivity and system must be in control with passing QC samples.	Inspect system, correct problem, rerun calibration and affected samples.	GC/MS Analyst	ENV-SOP-MAD1-0060 rev. 02

* Note: Please see Reference SOP as instruments are subject to change.

QAPP Worksheet #26 & 27: Sample Handling, Custody, and Disposal

Sampling Organization: Anderson Environmental & Engineering Co.
Laboratory: Pace Analytical
Method of sample delivery (shipper/carrier): FedEx, Other common courier
Number of days from reporting until sample disposal: 14 days

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	AEE, Site Manager	Field Sampling Plan, rev. 1.0
Chain-of-custody form completion	AEE, Site Manager	Field Sampling Plan, rev. 1.0
Packaging	AEE, Site Manager	Field Sampling Plan, rev. 1.0
Shipping coordination	AEE, Site Manager	Field Sampling Plan, rev. 1.0
Sample receipt, inspection, & log-in	Pace Analytical	ENV-SOP-IND1-0001-rev.02 Sample Management
Sample custody and storage	Pace Analytical	ENV-SOP-IND1-0051-rev.02 Internal COC
Sample disposal management	Pace Analytical	ENV-SOP-IND1-0004-rev.01 Waste Management

QAPP Worksheet #28: Analytical Quality Control and Corrective Action

Matrix: Groundwater
Analytical Group: VOCs
Analytical Method: SW-846 8260C
SOP: ENV-SOP-IND1-0034 rev. 02

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method Blank	One per preparatory batch of up to 20 samples.	No analytes detected >1/2 RL and greater than 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected >RL.	Correct the problem. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/Laboratory Area Supervisor	No analytes detected >1/2 RL and greater than 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected >RL.
Laboratory Control Sample (LCS) containing all analytes to be reported, including surrogates	One per preparatory batch of up to 20 samples	QC acceptance criteria per in-house limits.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst/Laboratory Area Supervisor	QC acceptance criteria per in-house limits.
Matrix Spike (MS)	One per preparatory batch of up to 20 samples.	QC acceptance criteria per in-house limits.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst/Laboratory Area Supervisor	QC acceptance criteria per in-house limits.
Matrix Spike Duplicate (MSD)	One per preparatory batch of up to 20 samples.	MSD: For matrix evaluation, use QC acceptance criteria specified for LCS. MSD: RPD < 20% (between MS and MSD).	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst/Laboratory Area Supervisor	MSD: For matrix evaluation, use QC acceptance criteria specified for LCS. MSD: RPD <20% (between MS and MSD).

Matrix: Groundwater
Analytical Group: 1,4-dioxane
Analytical Method: SW-846 8260/1,4-dioxane by SPME and GC\MS with SIM
SOP: ENV-SOP-MAD1-0060 rev. 02

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method Blank	One per preparatory batch of up to 20 samples.	If target analytes or interferences are present at concentrations that impact the analytical results for samples, the samples (including quality control samples) should be re-analyzed or appropriately qualified.	Correct the problem. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/Laboratory Area Supervisor	If target analytes or interferences are present at concentrations that impact the analytical results for samples, the samples (including quality control samples) should be re-analyzed or appropriately qualified.
Laboratory Control Sample (LCS) containing all analytes to be reported, including surrogates	One per preparatory batch of up to 20 samples	QC acceptance criteria per in-house limits. If the recovery of 1,4-dioxane is outside control limits, the samples (including quality control samples) should be re-extracted or appropriately qualified.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst/Laboratory Area Supervisor	QC acceptance criteria per in-house limits. If the recovery of 1,4-dioxane is outside control limits, the samples (including quality control samples) should be re-extracted or appropriately qualified.
Matrix Spike (MS)	One per preparatory batch of up to 20 samples.	QC acceptance criteria per in-house limits. If the recovery or RPD of 1,4-dioxane is outside control limits, data should be appropriately evaluated for possible re-analysis. If necessary, the data can then be qualified.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst/Laboratory Area Supervisor	QC acceptance criteria per in-house limits. If the recovery or RPD of 1,4-dioxane is outside control limits, data should be appropriately evaluated for possible re-analysis. If necessary, the data can then be qualified.
Matrix Spike Duplicate (MSD)	One per preparatory batch of up to 20 samples.	MSD: For matrix evaluation, use QC acceptance criteria specified for LCS. MSD: RPD < 20% (between MS and MSD).	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst/Laboratory Area Supervisor	MSD: For matrix evaluation, use QC acceptance criteria specified for LCS. MSD: RPD <20% (between MS and MSD).

QAPP Worksheet #29: Project Documents and Records

Sample Collection and Field Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Sample Report	Site Manager	Supervising Contractor	Project file archive paper - electronic format
Field Report	Site Manager	Supervising Contractor	Project file archive Paper – electronic format
Chain of Custody Forms	Site Manager	Supervising Contractor	Project file archive Paper – electronic format
Field notes and correspondence	Site Manager	Supervising Contractor	Project file archive Paper – electronic format
Project Assessments			
Data validation report	Quality Assurance Manager	Supervising Contractor	Project file archive Paper – electronic format
Monitoring Event Report	Quality Assurance Manager	Supervising Contractor	Project file archive Paper – electronic format
Laboratory Records			
Sample Acknowledgment	Laboratory Project Manager	Laboratory Project Manager	Laboratory project archive Electronic format
Analytical Data Records	Laboratory Project Manager	Laboratory Project Manager	Laboratory project archive Electronic format
Analytical Electronic Records*	Laboratory Project Manager	Laboratory Project Manager	Laboratory project archive Electronic format
*Validated EDDs will be uploaded to the USEPA Region 5 electronic data submission site via internet link: https://www.epa.gov/superfund/region-5-superfund-electronic-data-submission			

Laboratory Data Deliverables						
Record	**VOCs**	**SVOCs**	**PCBs**	**Pesticides**	**Metals**	**1,4-dioxane**
Narrative	X	NA	NA	NA	NA	X
COC	X	NA	NA	NA	NA	X
Summary Results	X	NA	NA	NA	NA	X
QC Results	X	NA	NA	NA	NA	X

Project Records Management

Project records generated in the performance of the Site remedy will be retained by designated responsible parties in accordance with provisions identified in the Consent Decree and CD SOW. In the event of a change in the contractors performing the work at the Site, all maintained records will be transferred to the subsequent contractor(s).

Management of project record files generated in the field and consisting of Sample Reports and Field Reports are the responsibility of the Supervising Contractor. The field records are maintained in electronic and hard copy (paper) formats. Electronic field records are stored on contactor server which is backed up on separate electronic media on a continual basis. Record retrieval is accomplished upon request through access to the server archive. In addition, duplicate paper copies of field records are stored at the contractor place of business in a project specific filing system and retrievable upon request.

Management of project record files resulting from review and evaluation of field data and analytical data and consisting of monitoring event reports are the responsibility of the Supervising Contractor and are maintained in electronic and paper formats. Monitoring event reporting documents are stored on contactor server which is backed up on separate electronic media on a continual basis. Record retrieval is accomplished upon request through access to the server archive. Duplicate paper copies of field records are stored at the contractor place of business in a project specific filing system and retrievable upon request.

The laboratory services provider will be responsible for generating and issuing analytical records and data sets resulting from receipt and analysis of submitted sample lots. Raw laboratory data files will be inventoried and maintained by the laboratory for a minimum of five years. Certain laboratory analytical reporting documents are also managed by the Supervising Contractor and are stored on contactor server which is backed up on separate electronic media on a continual basis. Record retrieval is accomplished upon request through access to the server archive. Duplicate paper copies of field records are stored at the contractor place of business in a project specific filing system and retrievable upon request.

QAPP Worksheet #31, 32 & 33: Assessments and Corrective Action

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Monitoring Event Planning Review	AEE Site Manager	One assessment prior to initiating monitoring event	Fourteen days prior to scheduled monitoring event	Monitoring event planning summary	Five business days prior to schedule monitoring event
Monitoring Event Completion Review	AEE Site Manager	One assessment following monitoring event	Seven days following completion of monitoring event	Monitoring event completion summary	Fourteen days following completion of monitoring event
Monitoring Event Report Evaluation	NES Supervising Contractor	One assessment following compilation of monitoring event results	At time of completion of monitoring event report	Monitoring event report task completion summary	At time of monitoring report completion
Laboratory Data Review	Pace department managers and analysts	One assessment following monitoring event sample analysis	At time of completion of monitoring event analytical report	Sample analysis summary	At time of submittal of monitoring event analytical report
Management Review	City of Rockford Project Coordinator	One assessment per calendar quarter	Two weeks following expiration of calendar quarter	Quarterly project status report	Two weeks following expiration of calendar quarter

Assessment Response - Corrective Action:

Assessment Type	Responsibility for response to assessment finding	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsibility for Monitoring Corrective Action
Monitoring Event Planning Review	Site Manager	Monitoring event planning corrective action summary	Seven days following issuance of monitoring event planning corrective action summary	Site Manager	Supervising Contractor
Monitoring Event Completion Review	Site Manager	Monitoring event completion corrective action summary	Seven days following issuance of monitoring event completion corrective action summary	Site Manager	Supervising Contractor
Monitoring Event Report Evaluation	Project QA Manager	Monitoring event report corrective action summary	Fourteen days following issuance of monitoring event report corrective action summary	Project QA Manager	Supervising Contractor
Laboratory Data Review	Project QA Manager	Laboratory data report corrective action summary	Thirty days following issuance of laboratory data review corrective action summary	Laboratory Project Manager	Project QA Manager
Management Review	Supervising Contractor	Project management review corrective action summary	Thirty days following issuance of Management Review corrective action summary	Supervising Contractor	Project Coordinator

Quality Assurance Management Reports:

QA Management Reports	Responsibility for QA Report Submittal	Deliverable Description
Field Reports	Project Coordinator	Field reports are completed by the Site Manager presenting field data collected in completing monitoring events and document adherence to sample collection QA measures. The field reports are included in the monitoring event report submitted to the City for review, followed by submittal to USEPA and IEPA.
Data Validation	Project Coordinator	Data validation reports are completed by Project QA Manager for laboratory analytical data generated for each monitoring event and included in the monitoring event report submitted to the City for review, followed by submittal to USEPA and IEPA.
Laboratory Analytical QA Report	Project Coordinator	Laboratory reports summarizing quality assurance methods utilized in completing analytical procedures for project monitoring event samples are completed by the laboratory and included in the monitoring event report submitted to the City for review, followed by submittal to USEPA and IEPA.

QAPP Worksheet #34: Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	**X**	
2	Contract	**X**	
4	Field SOPs	**X**	
5	Laboratory SOPs	**X**	
Field Records			
6	Field reports	**X**	**X**
7	Equipment calibration records	**X**	
8	Chain-of-Custody Forms	**X**	**X**
9	Sampling diagrams/surveys		
10	Drilling logs		
12	Relevant Correspondence	**X**	
13	Change orders/deviations	**X**	
14	Field audit reports	**X**	**X**
15	Field corrective action reports	**X**	**X**
Analytical Data Package			
16	Cover sheet (laboratory identifying information)	**X**	**X**
17	Case narrative	**X**	**X**
18	Internal laboratory chain-of-custody		
19	Sample receipt records	**X**	**X**
20	Sample chronology (i.e., dates and times of receipt, preparation, & analysis)	**X**	**X**
21	Communication records	**X**	
22	Project-specific PT sample results	**X**	
23	LOD/LOQ establishment and verification	**X**	
24	Standards Traceability	**X**	
25	Instrument calibration records	**X**	
26	Method QC and forms	**X**	
27	Definition of laboratory qualifiers	**X**	**X**
28	Results reporting forms	**X**	**X**
29	QC sample results	**X**	**X**
30	Corrective action reports	**X**	
31	Raw data	**X**	
32	Electronic data deliverable	**X**	

QAPP Worksheet #35: Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Sample Reports, Field Reports	QAPP, FSP	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed, and results are documented.	Daily - Site Manager At conclusion of field activities - QA Manager
Chain-of-custody forms	QAPP, FSP	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook/notes. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Daily - Site Manager At conclusion of field activities - QA Manager
Laboratory Deliverable	QAPP	Review upon receipt is performed by the Project Manager or Coordinator and the before release of level 4 data package may be performed by either QA Manager, QA Analyst or Project Coordinator. The standard level 2 data report review process is automated and performed by data checker function available within our LIMs. If no data checker errors are found the final report is not reviewed by the Project Manager.	Upon Receipt: Project Manager Before Release: QA Manager, QA Analyst
Audit Reports, Corrective Action Reports	QAPP	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	Supervising Contractor

QAPP Worksheet #36: Data Validation Procedures

Data Validator: Nationwide Environmental Services, Inc.

Analytical Group/Method:	**Volatile Organics SW-846 8260B**	**1,4-dioxane by SPME and GC\MS with SIM**
Data deliverable requirements:	Pace Standard Data Package	Pace Enhanced Data Package
Analytical specifications:	Worksheet #28: ENV-SOP-IND1-0034 rev. 02	Worksheet #28: ENV-SOP-MAD1-0060 rev. 02
Measurement performance criteria:	Worksheet #12: ENV-SOP-IND1-0034 rev. 02	Worksheet #12: ENV-SOP-MAD1-0060 rev. 02
Percent of data packages to be validated:	100%	100%
Percent of raw data reviewed:	0%	0%
Percent of results to be recalculated:	0%	0%
Validation procedure:	Data Review and Validation SOP rev. 0 (Appendix G)	Data Review and Validation SOP rev. 0 (Appendix G)
Validation code:	SV2AVM	S2BVM
Electronic validation program/version:	N/A	N/A

Validation Code and Label Identifier Table

Validation Code	Validation Label	Description/Reference
S2AVM	Stage 1 Validation Manual	EPA 540-R-08-005
S2BVM	Stage 2B Validation Manual	EPA 540-R-08-005

The following data qualifiers will be applied during data validation. Potential impacts on project-specific data quality objectives will be discussed in the data validation report.

B – Analyte detected in one or more analytical method blanks.
D – Diluted sample.
J – The result is an estimated value. The nature of the bias will be discussed in the data validation report.
E – Exceeded calibration range of analytical method.
H – Holding time exceeded.
R – Rejected due to non-conformance with analytical method.
U – Undetected at or below the reporting limit.

QAPP Worksheet #37: Data Usability Assessment

Project Manager: William Dotterrer
Project QAM: Maggie Mandell
Field Task Leader: Pat Egan
Statistician: Maggie Mandell

Personnel (organization and position/title) responsible for participating in the data usability assessment:
Nationwide Environmental Services
Supervising Contractor
Project QA Manager

Describe how the usability assessment will be documented:
The data usability will be discussed in the Data Validation Summary Report. Data usability is evaluated against specific criteria to assess whether project/task objectives were achieved. The steps that will be taken as part of this evaluation are identified in the following table.

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:
The data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data are presented in the following table.

Data Usability Process Summary

Step 1	**Review the project's objectives and sampling design** The project/data quality objectives outlined in Worksheet #11 will be reviewed to assess if the stated objectives were met.
Step 2	**Review the data verification and data validation outputs** Review laboratory reports, data verification and validation documentation, and deviation/corrective action documentation to assess potential impacts on the data usability. The following items will be assessed, and conclusions drawn based on their results: **Holding Time:** All sample data will be checked to verify that both sample preparation and analysis were performed within the method required holding time. **Accuracy/Bias Contamination:** Results for laboratory and field blanks will be checked against performance criteria specified in Worksheet #28; results for analytes that exceed criteria will be identified and the impact on field sample data will be assessed. Data will be summarized by type of blank. **Accuracy/Bias Overall:** Reported values of LCS and MS will be evaluated against the spiked or certified concentration and the percent recovery will be calculated and compared to the criteria specified in Worksheet #28. The percent recovery information will be used to assess the bias associated with the analysis. Recovery for the MS will provide information on the impact of the sample matrix on specific analyses. **Precision:** Results of the RPD will be calculated for each analyte in laboratory and field duplicates. These RPDs will be checked against measurement performance criteria presented on Worksheet #28; RPDs exceeding the stated criteria will be identified. This information will be used to draw conclusions about the precision of the analyses and, for field duplicates, the precision of sampling and analysis. Any limitations on the use of the data will also be described. **Sensitivity:** RLs will be checked against the criteria presented on Worksheet #15. **Representativeness:** A review of field records will be used to confirm that sample collection and handling was performed in a manner that conforms to the relevant SOP(s). Deviations or modifications to field or laboratory procedures that might impact the representativeness of the sample will be discussed. **Comparability:** The sampling and analytical procedures used in this program have generally been selected to result in data that will be comparable to prior site-related data. The data will be reviewed for trends, patterns, and anomalies, as applicable and deviations from SOPs or the planned scope will be evaluated. Conditions that may affect comparability with prior results will be noted. **Completeness:** Completeness for the analytical program will be calculated as the number of data points that are accepted as usable, based on the validation process, divided by the total number of data points for each analysis. As shown in Worksheet #12, the analytical completeness goal is ≥95%. Completeness for the field program will be calculated as the number of samples successfully collected compared to the total number proposed in this QAPP. The completeness goal for the field sampling program is ≥95%.
Step 3	**Verify the assumptions of the selected statistical method** Significant deviations from stated assumptions and corrective actions, if applicable, will be documented in data validation report comments and noted in monitoring event reports if applicable.
Step 4	**Document data usability and draw conclusions** Determine if the data can be used as intended, considering implications of deviations and corrective actions. Assess the performance of the sampling design and identify limitations on data use, if any. Prepare the monitoring event report noting any data usability issues.

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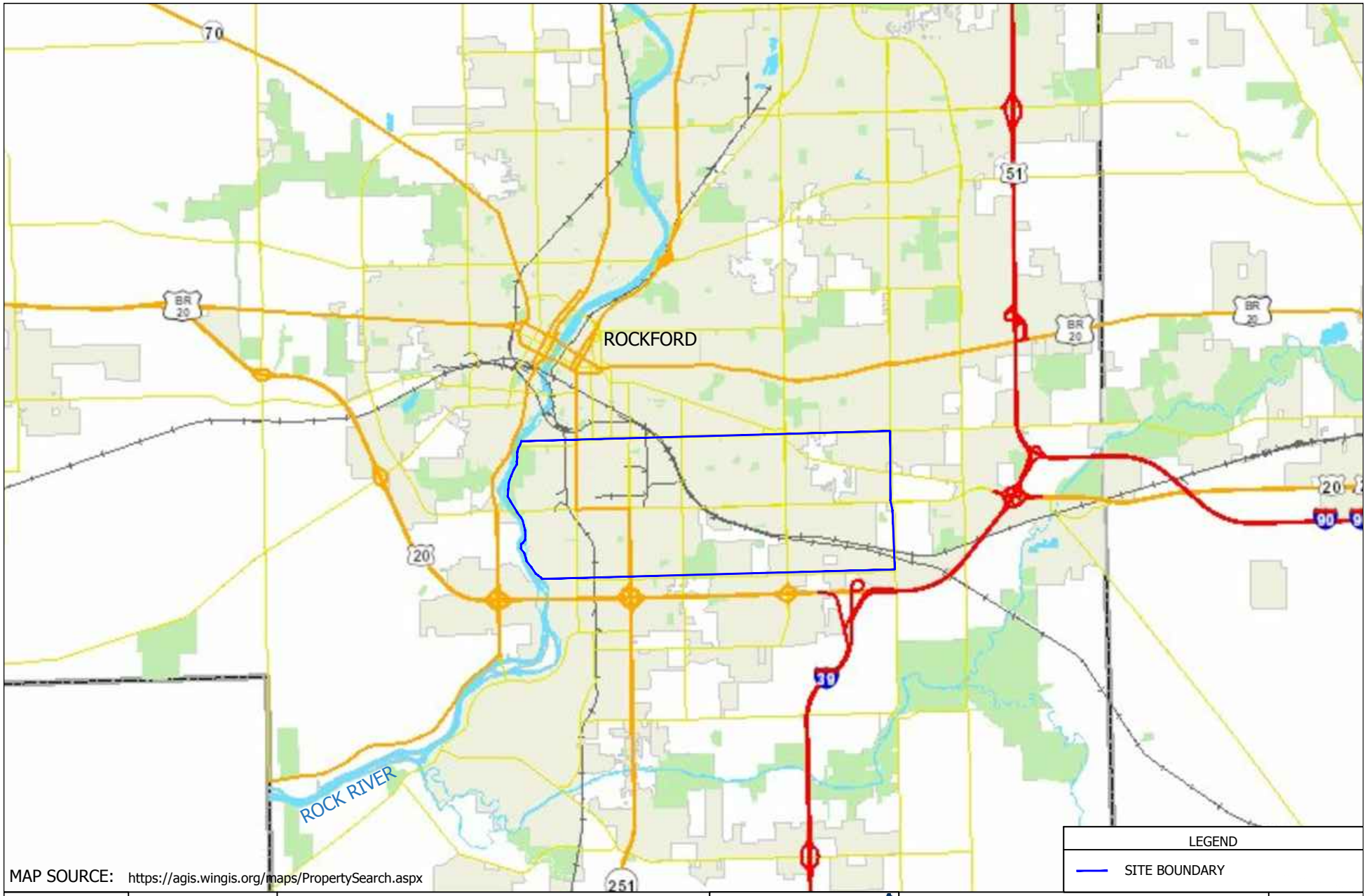
TABLES

Southeast Rockford Groundwater Contamination Site
Groundwater Monitoring Network Inventory

Well ID	Easting	Northing	TOC Elevation (ft amsl)	Ground Surface Elevation (ft amsl)	Total Depth (ft TOC)	Total Depth (ft bgs)	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Screen Length (ft)	Casing (in)	Casing Material	Location Description
MW-16	2593475.34	2030401.25	725.57	725.68	62.25	62.36	40.38	45.38	5.00	2		East of Kinsey Street, north of drain canal
MW-47	2588765.03	2028342.66	735.23	735.56	54.16	54.49	49.86	54.86	5.00	2	SS	Brooke Rd. 1/2 Block West of Kishwaukee Intersection (in shoulder on North side of road).
MW-101A	2598084.40	2029683.41	765.62	764.10	90.35	90.35	78.00	88.00	10.00	2	SS	Northeast corner of Laude and 24th Street
MW-101B	2598093.32	2029682.50	766.62	764.10	153.74	150.10	140.10	150.10	10.00	2	SS	
MW-101C	2598076.01	2029675.69	766.48	764.00	174.89	172.00	162.00	172.00	10.00	2	SS	
MW-101D	2598066.94	2029682.19	764.96	763.90	212.72	212.80	202.80	212.80	10.00	2	SS	
MW-102A	2599371.95	2029982.56	782.69	783.01	34.69	35.00	21.51	31.51	10.00	2	SS	South of RR tracks, east of Laude Street (Owens-Corning Property)
MW-102B	2599380.00	2029990.00	783.01	783.31	97.70	98.00	84.71	94.71	10.00	2	SS	
MW-102C	2599388.00	2029999.00	783.13	783.58	183.85	184.30	170.18	180.18	10.00	2	SS	
MW-113A	2596096.44	2029869.64	766.54	767.00	104.50	105.00	90.00	105.00	15.00	2	SS	West of Willis and 18th Street
MW-113B	2596088.18	2029873.56	766.65	766.40	155.26	155.00	145.00	155.00	10.00	2	SS	
MW-114A	2593333.10	2030016.18	725.15	725.45	94.70	95.00	85.55	95.55	10.00	2	SS	Corner of Willis and Kinsey Street
MW-114B	2593338.00	2030023.51	725.24	725.41	219.84	220.00	210.21	220.21	10.00	2	SS	
MW-117B	2586515.64	2028092.93	696.26	696.40	89.50	89.50	79.50	89.50	10.00	2	SS	Brooke Rd meridian. West of Grant Park Blvd.
MW-117C	2586522.28	2028099.95	696.11	696.40	158.31	159.50	149.50	159.50	10.00	2	SS	
MW-117D	2586502.42	2028081.65	696.10	696.40	200.00	200.00	190.50	200.50	10.00	2	SS	
MW-119	2589374.24	2027137.22	718.97	716.50	62.41	59.50	49.50	59.50	10.00	2	SS	Corner of Sawyer and South 4th Street
MW-121	2587523.45	2030898.78	716.98	714.50	67.55	64.50	54.50	64.50	10.00	2	SS	Corner of Harrison Ave. and Olsen Street
MW-124	2590224.67	2030300.32	731.30	729.00	102.76	100.00	95.00	100.00	5.00	2	SS	South of Park Court, west of railroad track
MW-130	2594440.11	2030701.27	727.95	728.00	38.17	37.50	27.50	37.50	10.00	2	SS	Corner of Alton Ave. and Sewell Street
MW-133A	2600083.74	2028900.38	780.18	777.60	37.85	35.00	25.00	35.00	10.00	2	SS	West end of Balsam Lane
MW-133B	2600084.59	2028906.98	780.33	777.50	61.49	58.00	48.00	58.00	10.00	2	SS	
MW-133C	2600090.11	2028901.64	780.29	777.70	98.49	96.00	86.00	96.00	10.00	2	SS	
MW-136	2603572.26	2027821.67	834.77	834.90	44.33	45.00	40.00	45.00	5.00	2	SS	North end of New England Drive
MW-200	2595998.62	2027199.13	760.16	759.01	89.93	90.00	78.00	88.00	10.00	2	SS	Southeast corner of 17th Street and Sawyer
MW-201	2591771.57	2031653.69	728.51	728.71	49.80	50.00	40.00	50.00	10.00	2	SS	Northeast Corner of Rockford Products Parking lot on the East side of 9th St, North of Harrision Ave.
MW-202	2592985.38	2032213.06	729.62	729.94	50.01	50.00	40.00	50.00	10.00	2	SS	West of 11th Street, South of Harrison Ave./23rd Street (Abe Pekarsky property, parking lot)
MW-203	2592993.40	2032079.04	729.09	729.67	49.35	50.00	40.00	50.00	10.00	2	SS	West of 11th Street, South of Harrison Ave./23rd Street (Abe Pekarsky property, parking lot)
MW 204	2585435.61	2029789.39	717.21	717.21	88.96	90.00	80.00	90.00	10.00	2	SS	South end of Falund Street
MW-205A	2585564.99	2027820.78	696.69	694.30	112.90	110.50	100.50	110.50	10.00	2	SS	North of Brooke Road, east of Rock River
MW-205B	2585567.66	2027827.74	696.92	696.60	150.31	150.00	140.50	150.50	10.00	2	SS	
MW-206A	2585871.82	2026940.34	693.70	694.06	90.24	90.50	80.00	90.00	10.00	2	SS	Between River Blvd. and the Rock River
MW-206B	2585856.13	2026938.65	693.26	693.71	129.94	130.50	120.00	130.00	10.00	2	SS	
MW-206C	2585860.69	2026940.21	693.53	694.19	249.34	250.00	240.00	250.00	10.00	2	SS	
MW-207	2587190.96	2026478.18	724.17	724.47	90.81	90.00	80.00	90.00	10.00	2	SS	Corner of Martin Road & Grant Park Blvd.

FIGURES



MAP SOURCE: https://agis.wingis.org/maps/PropertySearch.aspx

NORTH

CHECKED BY:
M. MANDELL

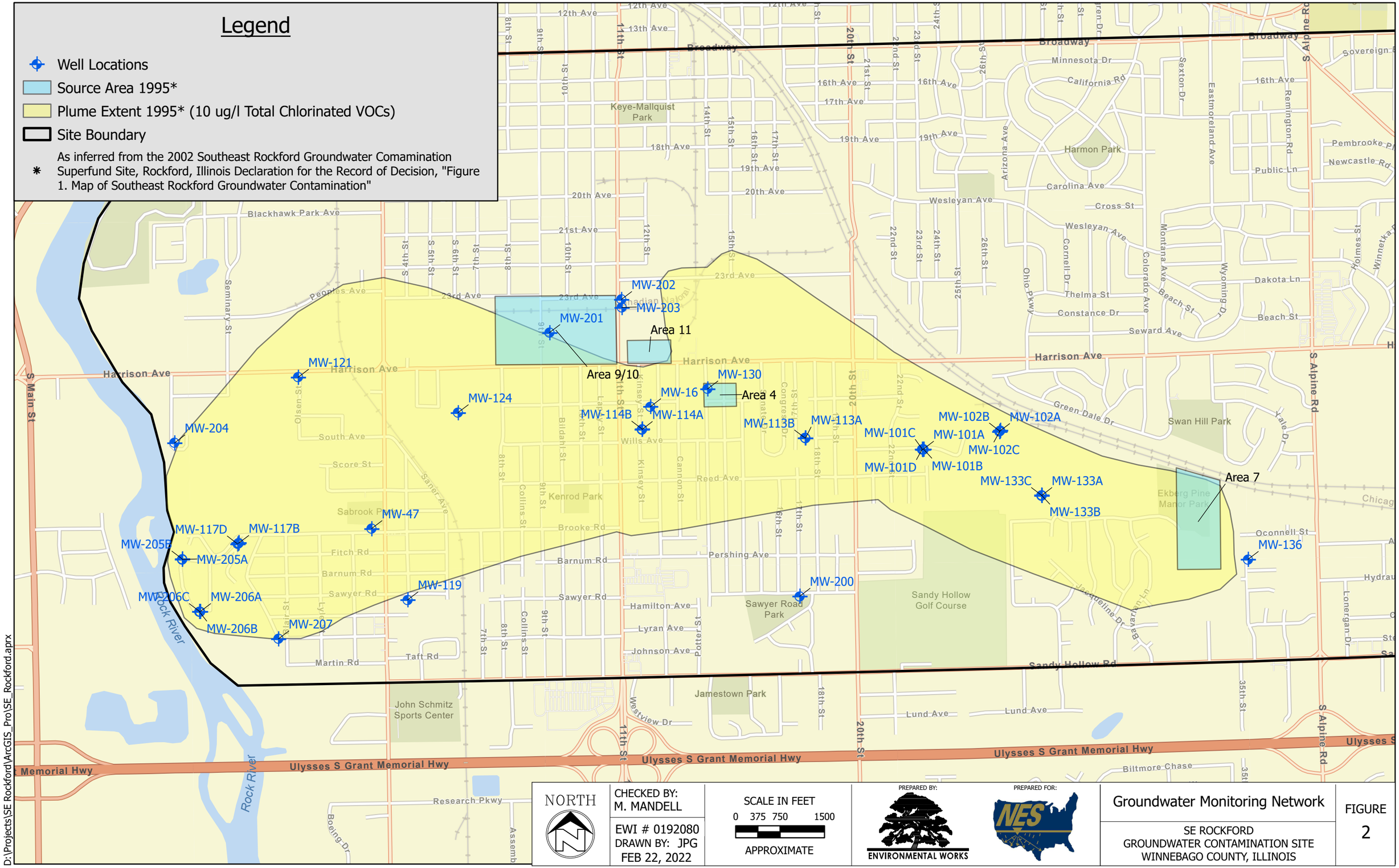
E.W.I. # 192080
DRAWN BY: MLH
July 25, 2021

SCALE IN FEET
0 5,000 10,000
APPROXIMATE

LOCATION MAP

SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SITE
WINNEBAGO COUNTY, ILLINOIS

FIGURE
1.0



NORTH

CHECKED BY: M. MANDELL

EWI # 0192080
DRAWN BY: JPG
FEB 22, 2022

SCALE IN FEET
0 375 750 1500
APPROXIMATE

PREPARED BY: ENVIRONMENTAL WORKS

PREPARED FOR: NES

Groundwater Monitoring Network

SE ROCKFORD
GROUNDWATER CONTAMINATION SITE
WINNEBAGO COUNTY, ILLINOIS

FIGURE
2

APPENDICES

Appendix A

Field Sampling Plan rev. 01

FIELD SAMPLING PLAN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SITE
ROCKFORD, ILLINOIS

Revision 1.0

October 2021

Prepared for :

City of Rockford Water Division

Prepared by:

Nationwide Environmental Services, Inc.

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1.0 INTRODUCTION

The Field Sampling Plan (FSP) for the Southeast Rockford Groundwater Contamination Site (Site) describes the field sampling activities to be performed and associated procedures to be followed in implementing the data collection component of the remedy selected for the Site in the Record of Decision for Operable Unit 2 (ROD OU2), consistent with the Consent Decree (CD) Scope of Work (SOW). The Site FSP was prepared as a deliverable under the CD SOW and was approved by the U.S. Environmental Protection Agency (USEPA) in November 1998.

The Site FSP is a companion document to the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) prepared for the Site, which together serve to document the site remedy objectives, project organization, functional activities, and specific quality assurance (QA) and quality control (QC) measures to be utilized in the collection of samples from the Site groundwater monitoring network and generation of data necessary to implementation and assessment of the Site remedy relative to the Site remedial objectives.

The Site UFP-QAPP document has been revised to standardize and consolidate QA/QC measures involving sample collection and analysis in both the UPF-QAPP and FSP documents (e.g. field sample QA measures) in order to minimize the potential for procedural conflicts between the two documents, with site-specific field sample collection QA/QC practices and procedures presented in the UFP-QAPP and respective field sample activity procedures referenced in the FSP.

<u>Revision Summary</u>

The FSP has been revised since initial submittal and approval of the document by the USEPA in 1998 to improve the Site groundwater sample collection process or otherwise conform field sampling procedural descriptions with the UFP-QAPP and updated regulatory guidance. The FSP revisions are summarized below.

- April 2000: FSP amended for the adoption of Low Flow micro-purge sampling methodology for the collection of groundwater samples from the Site groundwater monitoring network. The Low Flow sample collection procedure replaced the multiple volume purge (bail) method to achieve site sampling in a more efficient manner resulting in the following benefits:
  - Better represent actual groundwater quality conditions.
  - Reduced labor time requirement resulting in cost efficiency and reduced safety concerns.
  - Reduction in volume of well purge water requiring management.

- January 2021: FSP was amended to clarify the field practices to be utilized in performing the Low Flow sampling method for the Site groundwater monitoring network as follows:
  - Identify groundwater stabilization parameters to be measured in the field prior to collection of groundwater samples at each monitoring location.
  - Specify the groundwater stabilization criteria to be monitored prior to collection of samples by Low Flow sampling method.

- May 2017: FSP was amended to include practices and procedures necessary to conduct field sampling of designated residential water supply wells within the extents of the Site boundary to ascertain the presence of Site COC compounds identified in the ROD in water supply wells. The residential water supply monitoring program was established as a short duration study initiated in July 2017 and completed in December 2020, following the completion of ten sample events and distribution of monitoring results to USEPA and IEPA. The residential water supply sampling program has been discontinued and the field sample practices and procedures associated with implementation of the program have been removed from the current FSP Revision 1.0.

- October 2021: FSP was revised to present field sampling practices and procedures in a manner consistent with that identified in the Site UFP-QAPP document. The revised FSP references the appropriate sections of the UFP-QAPP addressing site-specific sample collection, handling and preservation activity; quality control sample regimen; and sample analytical methods in order to eliminate the need to maintain duplicate documents addressing field sample QA/QC procedures and minimize the potential for conflicts related to site-specific procedures and practices that are addressed in both documents. The information contained in the FSP Revision 1.0 supersedes prior versions where conflicts occur.

The major elements presented in the FSP Revision 1.0 document include:

- Site Description
- Project Organization and Key Personnel
- Field sampling procedures (groundwater elevation – groundwater quality)
- Sample documentation and recordkeeping procedures
- Appendices containing field sample collection support information.

2.0 SITE DESCRIPTION

The Southeast Rockford Groundwater Contamination Site (Site) is located in Rockford, Illinois (City), and principally consists of an area located in the southeast quadrant of the city in which groundwater has been determined to be affected by past activities conducted at four source areas. The Site boundary consists of the groundwater contamination plume generally bounded by South Mulford Road on the east, Sandy Hollow Road to the south, the Rock River to the west and Broadway Street on the north. The Site location is shown in Figure 1.

The topography of the Site is generally flat and slopes gradually to the west towards the Rock River, with a drop in elevation of approximately 100 ft. from the east to the west boundary of the Site . The Site exists in a predominantly suburban residential area, but industrial, retail and commercial operations are scattered throughout the project area. Most of the building structures within the Site consist of one- or two-story residential dwellings or commercial buildings. A substantial number of commercial and retail operations are located along Alpine Road, Eleventh Street and Kishwaukee Street in the center of the Site. The majority of the industrial operations are located along Harrison Avenue which are occupied by structures of varying construction (e.g. steel frame, masonry block) and dimensions.

2.1 Site Contamination Summary

Upon initial investigation, Volatile Organic Compounds (VOCs) were detected in several City municipal wells as early as 1981, and the Illinois Environmental Protection Agency (IEPA) became aware of issues with VOC contamination in residential wells in 1984. High levels of chlorinated solvents were found to be present in several residential water supply wells following completion of a study conducted by the Illinois Department of Public Health (IDPH) in October 1984. The identified solvents included 1,1,1-trichloroethane, trichloroethene and tetrachloroethene. IDPH collected an additional 337 water samples from residential wells between 1985 and 1989 to better determine the extent of the affected groundwater plume and how many residents were affected. The Illinois State Water Survey (ISWS) also performed a regional groundwater investigation. This investigation noted widespread residential and municipal well contamination. The City subsequently closed several municipal water supply wells in southeast Rockford as a result of the general groundwater contamination.

Interim and final removal actions were implemented by IEPA and USEPA, since discovering the extent of groundwater contamination at the Site, significantly reducing the health threat posed by exposure to groundwater contaminants. A comprehensive Remedial Investigation / Feasibility Study (RI/FS) for affected groundwater was subsequently developed and implemented under the direction of USEPA. The intent of the groundwater RI/FS was to characterize the nature and extent of groundwater contamination at the Site, as well as, to obtain information on source areas that were responsible for groundwater contamination in and around residential wells that were identified in conducting previous Site response actions.

A Record of Decision (ROD) was issued by USEPA in 1995 for the Second Operable Unit (OU2) at the Site, specifying the primary chemicals of concern (COC) identified from the RI and identifying the selected remedy to be implemented to address the affected groundwater plume. The primary chemicals of concern (COC) for the Site identified in the ROD, and monitored constituents subsequently added to the Site groundwater monitoring regimen are listed below.

Site Chemicals of Concern

Methylene chloride	Chloroform
1,1-Dichloroethene	1,2-Dichloroethane
1,1-Dichloroethane	1,1,1-Trichloroethane
cis-1,2-Dichloroethene	Trichloroethene
trans-1,2-Dichloroethene	Tetrachloroethene
Monitored Constituents[1]	
Vinyl chloride	1,4-dioxane

[1.] *vinyl chloride and 1,4-dioxane added as monitored COC constituents*

The ROD OU2 identified the groundwater response action to be implemented at the Site which included the remedial components presented below, and the requirements for implementing the selected remedy were specified in the Consent Decree (CD) Scope of Work (SOW).

- Groundwater monitoring for 205 years.
- Installation of new municipal water supply mains.
- Municipal water supply service connections to eligible residences.
- Continued operation of the GAC unit at Municipal Well UW-35.
- Future source control measures at the four identified sources; and
- Institutional controls to restrict groundwater usage.

The groundwater response remedial action construction for OU2 was initiated at the Site in 1998 in accordance with the CD SOW and completed in 1999. The Site Remedial Action Report (RAR) was submitted in September 1999 and subsequently approved by USEPA. The RAR documents completion of Site remedial action construction activities identified in the CD SOW and the remedy is now in the O&M phase of the remedy, which principally involves long-term monitoring of the Site groundwater monitoring network.

The Site groundwater monitoring network consists of twenty-six (26) groundwater monitoring wells installed during the Site investigation phase of the remedy and nine (9) new groundwater monitoring wells installed during performance of the remedial action construction. The Site groundwater monitoring network layout is provided in Figure 2. A depiction of the typical groundwater monitoring well arrangement at the Site is provided in Figure 3. An inventory and key information for the monitoring wells comprising the Site groundwater monitoring network is provided in Table 1.

2.2 Media to be Sampled

The media to be sampled and analyzed at the Site under the Operation and Maintenance (O&M) phase of the Site remedial action included groundwater from the groundwater monitoring network installed at the Site (35 locations) and spent carbon removed from the granular activated carbon (GAC) unit installed on municipal supply well UM-35. Sampling and analysis of spent GAC media from municipal supply well UM-35 has since been removed from the remedy O&M phase scope.

2.3 Groundwater Monitoring Program Objectives

The monitoring wells in the groundwater monitoring network are sampled at the frequency and for the analytes identified in the CD SOW, and subsequent changes in sample frequency and analyte list that that have occurred for the Site to date upon direction of the USEPA. The analytical results obtained from the groundwater monitoring network will be used to:

- Determine whether additional residences are to be connected to the municipal water supply system extension.
- Monitor the status of groundwater at the Site relative to the groundwater cleanup standards.
- Evaluate the sample collection frequency and sample analytes necessary for monitoring well locations in the groundwater monitoring network.

2.4 Groundwater Monitoring Network Operation and Maintenance

An inventory of the monitoring wells comprising the Site groundwater monitoring network is presented in Table 1, which identifies the monitoring well location, and well-specific installation information. The groundwater monitoring network configuration is presented in Figure 2.

The Site groundwater monitoring network is inspected as an element of each semi-annual groundwater monitoring event and the condition of each monitoring well is documented in the Field Report record prepared for each monitoring event. A maintenance request is prepared and submitted to the City for any maintenance or repair activity identified in conducting the monitoring well inspection addressing current well condition and recommended maintenance activity. Completed monitoring well maintenance activity is documented in a maintenance completion report for the specific well location and completed maintenance activity updated in the Site monitoring well inventory.

3.0 KEY PROJECT PERSONNEL

The key project personnel and respective project responsibilities with respect to field sampling activities conducted at the Site are summarized in the table below and identify respective project representatives presented in the UFP-QAPP 2.0 document.

Key Project Personnel Summary

Party	Position	Responsibilities
City of Rockford	**Project Coordinator** Jamie Rott	Representative responsible for actions required underthe CD, ROD and RD/RA SOW.
City of Rockford	**Project Manger** Nadine Miller	Representative responsible for coordinating field activities with Supervising Contractor.
Nationwide Environmental Services, Inc.	**Supervising Contractor** William Dotterrer	Representative responsible for coordinating actions inthe RD/RA Work Plan with duties to include: • Project administration • Overall technical direction of the project • Supervision of project teams • Liaison among the City, Subcontractors, USEPA, and IEPA • Coordination, preparation, and approval of project deliverables • Preparation for and attendance at project meetings
Anderson Environmental & Engineering Co.	**Field Operations Manager** Pat Egan	Representative responsible for overseeing groundwater sample collection and transfer to laboratory support subcontractor, and maintenance of groundwater monitoring network. • Coordinating field activities • Supervision of field crews • Field records • Sample handling and transport
Pace Analytical®	**Project Manager** Brian Hall	Representative responsible for coordinating laboratoryservices to support project to include: • Liaison with NES and Pace Analytical® technical staff • Monitor workloads and ensure availability of resources • Analytical report preparation and overview • In-house chain-of-custody supervision • Quality assurance oversight

4.0 FIELD SAMPLING PROCEDURES

The following section of the FSP presents the field procedures utilized at the Site to perform groundwater monitoring events in accordance with the long-term groundwater monitoring program established under the O&M phase of the Site remedy. Groundwater monitoring events are presently conducted for the Site groundwater monitoring network, which is comprised of thirty-five (35) monitoring well locations, on a semi-annual basis , and involve the following activities:

- Measure groundwater elevation at each monitoring well location.
- Collection of groundwater quality samples at each monitoring well location for VOC and 1,4-dioxane constituents.
- Conduct operation and maintenance inspection for each monitoring well location .

4.1 UFP-QAPP Document References

The relevant sections of the UFP-QAPP applicable to performance of the field sampling activities identified above are listed below and to be referenced in conducting groundwater monitoring events for the Site. The UFP-QAPP procedures to be refenced under the FSP are segregated by task.

UFP-QAPP Procedure Reference Summary
Monitoring Event Planning
Worksheet #6: Communication Pathways
Worksheet #11: Project/Data Quality Objectives
Worksheet #14/16: Project Tasks & Schedule
Worksheet #17: Sampling Design and Rationale
Worksheet #18: Sampling Locations and Methods
Sample Collection
Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times
Worksheet #20: Field QC Summary
Worksheet #21: Field SOPs
Documentation - Recordkeeping
Worksheet #26 & 27: Sample Handling, Custody, and Disposal
Worksheet #29: Project Documents and Records

The procedures to be followed before, during, and after the performance of groundwater monitoring events at the Site, which involve the measurement of groundwater surface elevation and collection of groundwater quality samples for subsequent laboratory analysis are presented in the following sections of the FSP. Field activities performed in implementing Site monitoring events are performed in accordance with the respective procedures contained in the companion UFP-QAPP 2.0 document prepared for the Site and referenced in the FSP. Field sampling personnel are familiar with the site-specific UFP-QAPP document presenting key information pertaining to the implementation of groundwater monitoring events at the Site.

4.2 Monitoring Event Planning

Field sampling personnel prepare a daily schedule of field activities to beperformed to complete the groundwater monitoring event and provide a copy of the schedule to the Project Coordinator. The Project Coordinator provides the monitoring event schedule to the City for subsequent notification of designated regulatory representatives, and others as may be appropriate (e.g. source area remedy contractors). The sampling activities schedule is recorded as an element of the field sampling record and identifies the steps necessary to implement the Low Flow sampling procedure.

The activity involved in setting up and implementing a particular groundwater monitoring event are presented in the summary table below. Minor variations may occur in the sample set-up procedure as a result of unknown conditions (weather, monitoring well location access, etc.) and are addressed at such time as they occur and recorded as an element of recordkeeping process presented in Section 5 of the FSP.

Groundwater Monitoring Event Planning Summary

Item	Task	Description
1	Planning	Select monitoring event schedule dates, notify monitoring location property owner as needed (based on property access arrangements), provide schedule to designated City, regulatory agency representatives, and laboratory staff via electronic communication, or other.
2	Sample Containers	Arrange for receipt of sample containers from the laboratory and inspect sample container lot for compatibility with monitoring event sample regimen. Resolve discrepancies in sample container lot with laboratory.
3	Equipment	Calibrate applicable sample collection equipment in accordance with manufacturer specifications and record. Assess and resolve any sample collection equipment functionality issues (e.g. flow-through cell). Implement decontamination procedure for all common equipment deployed downhole in the monitoring well before and after each measurement or sample collection.
4	Access	Review access to monitoring well locations and identify issues preventing access for scheduled monitoring event as they may occur (e.g. weather, physical obstruction, damaged well head, etc.). Implement corrective action necessary to resolve monitoring well access condition.
5	Screening	Open monitoring wellhead cap and screen background and casing headspace with potable analyzer: PID used for organic vapors, explosimeter used for explosive gases. Appropriate PPE will be utilized in the event conditions at the wellhead pose a safety concern to field sampling personnel.
6	Recordkeeping	Record date and time of sample collection, weather condition, and well condition and other pertinent observations, along with pertinent well-specific information for each groundwater monitoring well (e.g. ID number, TOC elevation, casing diameter, etc.).

4.3 Sample Equipment

The field sampling equipment utilized in implementing groundwater monitoring events at the Site is identified in the Table 2. Specific information on operation and maintenance procedures for the field equipment utilized for sample collection is provided in **Appendix A**. Certain sampling equipment identified below is rented on an event by event basis, and thus equipment specific operating procedures may differ from that presented for the listed equipment in **Appendix A**. The operating instructions supplied with the rented equipment are followed in such instances.

Dedicated well sample pumps are installed in each monitoring well comprising the Site groundwater monitoring network and the water level measurement equipment and flow though analyzer for measuring groundwater well stabilization parameters are the only equipment used that is common to all monitoring well locations and normally requiring decontamination procedures to be applied. In the event a dedicated well pump is inoperative of otherwise unusable during a sample event for a particular monitoring location(s), a portable pump is utilized to complete sample collection. The procedure to be used for deployment of a portable sample pump in place of a dedicated well pump is provided in **Appendix D.** Equipment decontamination procedures for the portable pump and appurtenances will be applied. Field decontamination procedures used for non-dedicated sample equipment are consistent with USEPA guidance (Field Equipment Cleaning and Decontamination SOP, USEPA Region 4, 2013) and are provided in **Appendix B**.

4.4 Groundwater Elevation Monitoring

The groundwater elevation data obtained in the field from the Site groundwater monitoring network is used to establish the groundwater flow direction and gradients across the Site, and to evaluate the state of groundwater contamination at depth within the Site groundwater column. The measurement of groundwater elevations at the Site is routinely conducted in conjunction with the groundwater quality sampling regimen.

Groundwater elevation measurements are obtained relative to an established reference point on each well casing and documented in the monitoring event field record. The groundwater elevation measurement at each monitoring well is obtained using an electronic water level indicator or sounder which consists of a spool of dual conductor wire, a water level probe attached to the end of the conducting wire and an electric signal indicator producing both a light signal for visual confirmation and a sound signal for audio confirmation of the monitoring well water level. Groundwater level measurements are recorded to the nearest 0.01 foot at each monitoring location in the field record. The groundwater surface elevation for each monitoring location in feet above mean sea level (amsl) is determined by subtracting the measured groundwater surface elevation from the known top of the respective monitoring well casing TOC elevation.

Principle considerations involved in performing groundwater elevation monitoring at the Site include:

- Potential for cross-contamination between monitoring well locations.
- Utilization of accurate monitoring well Top of Casing (TOC) elevations in well inventory.
- Documentation and memorialization of site-specific monitoring water level measurements.

Quality control measures considered in conducting groundwater elevation monitoring at the Site are identified below:

- Groundwater level measuring device reading is confirmed against a standardized measuring tape and verified measurement accuracy is within 0.01 feet per 10 feet of length with an allowable error of 0.03 feet in the first 30 feet.
- Decontamination of groundwater level measurement device between Site monitoring locations to prevent cross-contamination is performed in accordance with practices presented in **Appendix B**.

4.5 Groundwater Quality Monitoring

The Low Flow micro-purge field sampling procedure is utilized at the Site to collect groundwater samples for water quality analysis to meet the long-term groundwater monitoring requirements identified in the CD SOW, and are specific to the VOC and 1,4-dioxane constituents established under the Site groundwater monitoring program. The Low Flow sample method utilized for collection of groundwater samples is based on the standard operating procedure (SOP) developed by USEPA (Groundwater Sampling Procedures, USEPA Region 5, May 2021).

A general description of the field activities performed in implementing the Low Flow sampling method are presented below. Sampling equipment is located away from potential sources of non-representative environmental conditions (e.g. field vehicles, fuel, generators, decontamination chemicals, etc.). The groundwater quality sampling procedures utilized at the Site are further described in **Appendix C**.

- Applicable field sampling equipment is calibrated in accordance with equipment specific calibration procedures prior to commencing field sampling activity.
- Plastic sheeting is placed on the ground surface proximate to the monitoring well and field sample equipment placed on the sheeting to prevent contamination.
- The air line from the air compressor is attached to the dedicated well pump air line to supply energy source to the pump, with in-line controller to regulate air flow to the well pump.
- Dedicated bladder type well pumps are in place at each monitoring well location (the well pump inlet is situated in the middle of the well screen interval.
- The dedicated downhole sample tubing is connected to the inlet side of the flow controller and a short piece of tubing from the flow controller outlet is directed to a purge water collection pail.

- The monitoring well is purged at a flow rate of approximately 250 ml/min, as determined by use of a graduated cylinder and stopwatch to minimize groundwater drawdown, and purge time and volume are recorded.
- Groundwater stabilization indicator parameters for extracted groundwater are monitored using flow through cell analyzer and groundwater pump rate adjusted as needed to achieve stable drawdown.
- The monitoring well is sampled when groundwater indicator parameters and the groundwater water level are stable, and low turbidity is achieved. Groundwater samples for each monitoring are collected in laboratory-supplied sample containers with appropriate preservative.
- Field QA/QC samples are collected from the monitoring well in conjunction with the well sample in sample bottles supplied by the laboratory.
- Collected groundwater samples are managed in accordance with established sample handling procedures (see FSP Section 5).
- Field sample equipment is decontaminated, isolated, and packed up for transport to the next sample location.

4.6 Sample Identification and Labelling

Sample labels will be provided by the laboratory or the field sampling crew and will be attached to each sample bottle or container. Sample information will also be noted in the Field Record, so the information is recoverable if labels are accidentally lost, voided, or damaged. Each sample will be identified by a separate sample label and the information recorded on the label will include the following:

- Sample collector address, telephone number and signature.
- Sample identification number.
- Project code if applicable.
- Date: a six-digit number indicating the day, month, and year of collection.
- Time: a four-digit number indicating the 24-hour clock time of collection.
- Media type: the type of sample (groundwater, GAC unit residual etc.).
- Sample location.
- Sample container type.
- Sample technique (i.e. composite, grab).
- Preservative: the label will indicate whether a preservative was used and the type of preservative.
- Analysis: the type of analysis requested (if no analyses are to be performed, such will be noted).
- Remarks clarifying sample issues as needed.

4.7 Sample Classification and Handling

Groundwater samples collected for VOC and 1,4-dioxane analysis during monitoring events utilizing the Low Flow sample method are classified as environmental samples, based on historical sample constituents and concentration data in samples obtained from the Site groundwater monitoring network. Environmental samples contain low levels of contaminants necessitating limited precautionary procedures for safe handling and transportation. Samples other than groundwater which may be collected at the Site (e.g. drill cuttings) may contain hazardous levels of contaminants, and as such may be classified as hazardous. In the event any sample collected from the Site is determined to constitute a hazardous sample, such will be packaged and labeled according to the applicable procedures specified by the United Sates Department of Transportation (USDOT) and common carrier stipulations.

Field sample containers are provided to field sampling personnel by the laboratory services supplier following receipt of sample event notice. The sample containers, sample preservation methods, maximum holding times, and collection instructions for each of the sample types to be collected at the Site are described in the applicable pages of the Site UFP-QAPP document referenced in Section 4.0.

Groundwater samples for VOC and 1,4-dioxane analysis are collected in 40 ml vials are filled completely to eliminate to entrainment of air in the sample container. Groundwater samples, other than VOC or 1,4-dioxane samples are collected in appropriate sample containers provided by the laboratory services provider, and samples collected as described for proper analysis by the respective analytical procedure.

Historically samples collect from the Site groundwater monitoring network do not require filtration consistent with the analytical procedures for designated constituents. In the event samples require filtration, such will be accomplished using in-line filters. All samples requiring filtration will be filtered through a 0.45-micron filter. When duplicate samples are being collected, the collection of analyses will alternate from sample to sample (e.g. VOCs for all samples first, SVOCs for all samples next, etc.).

4.8 Sample Transport

All samples will be shipped by overnight courier to the appropriate laboratory for analyses in accordance with the identified handling, packaging, and shipping procedures. The sample collection method, fractions collected, and the number of bottles is recorded on the CoC form and the form placed in the sample shipping container.

Collected samples are placed inside the USDOT approved shipping container and packaged in a manner to prevent breakage. Sample shipping containers are cooled by placing sealed plastic bags of ice and/or cooler packs around the sample containers. Remaining space in the sample shipping container is filled with appropriate packing material, to limit movement of the sample containers in shipping container.

The shipping container is sealed with a Custody Seal to be broken upon receipt at the laboratory services supplier. The sample shipping container seals contain the following information:

- Sample collector initials.
- Date and time of sealing.

The sample shipping container is delivered to common carrier and transported to the laboratory services supplier under schedule to meet sample holding time. Project personnel implement corrective action as needed to address issues that may occur in sample transportation.

Prior to sample shipment, the Field Operations Manager or designee contacts the laboratory to inform them of incoming sample shipping container, sample lot size, expected arrival time, and any special handling procedures. Samples are shipped to the laboratory on a schedule to meet sample holding time restriction prior to analysis.

The laboratory services supplier provides electronic notice to appropriate project parties upon receipt of sample shipping container, and identifies any issues that may have occurred with samples in transit e.g. broken sample vial, temperature exceedance). In the event the integrity of the sample is compromised or otherwise unusable for analysis, arrangements are made with the laboratory to resample as necessary.

4.9 Investigation Derived Waste

Monitoring well purge water and equipment decontamination solution are the only IDW generated from the current scope of groundwater monitoring activities conducting at the Site. The procedures used in managing Investigation Derived Waste (IDW) generated in implementing groundwater monitoring activities at the Site are summarized below.

- The monitoring well purge water collected during monitoring well sampling is collected in a closed lid container and labeled non-hazardous, based on historical analytical results of groundwater samples.
- Decontamination solution generated from the decontamination of sample equipment is collected in a closed lid container and labeled non-hazardous, based on historical results of constituents contained in Site groundwater samples.

- Upon completion of the monitoring event, the accumulated IDW is managed in accordance with applicable requirements for proper disposition.
- In the event the scope of O&M phase activities conducted at the Site are expanded and results in the generation of IDW material, other than identified above, appropriate measures will be implemented to manage the material with applicable regulatory guidance.

4.10 Health and Safety

Health and safety aspects associated with ongoing Site O&M activities are more fully addressed in the site-wide Health and Safety Plan. The health and safety hazards that have been identified to be associated with the performance of groundwater monitoring activities at the Site under the O&M phase of the remedy and the hazard evaluation for identified groundwater monitoring task hazards are summarized in the following table.

Groundwater Monitoring O&M Task Hazard Analysis

Task	Health & Safety Hazard	Hazard Evaluation
Groundwater Monitoring	Physical: Weather exposure, slips- trips-falls.	Low: Physical activity limited to ground level on mostly level surface.
Monitoring well purging and sample collection	Biological: Animal bites, insect bites.	Moderate: Presence of animals or insects in certain monitoring well locations is likely.
	Chemical: Exposure to chemical compounds identified to occur in groundwater monitoring wells (notably near Site source areas) by ingestion, inhalation and dermal absorption.	Low: Historical analysis of groundwater media from all Site monitoring wells have shown concentrations of compounds that may pose a health hazard to be present below respective exposure limits.

5.0 DOCUMENTATION and RECORDKEEPING

The key information generated during implementation of groundwater monitoring events at the Site are recorded, organized and managed in accordance with applicable elements of the Site UFP-QAPP document. The UFP-QAPP procedures applicable to monitoring event documentation and recordkeeping are identified in Section 4.0 of the FSP and discussed in the following sections of the FSP.

Documentation and recordkeeping practices used to memorialize groundwater monitoring events at the Site involve the following elements. Examples of relevant forms used in documenting Site monitoring events are provided in **Appendix E** and discussed further in the following sections.

Monitoring Event Record Summary

Item	Description
Sample Report	A written record of relevant site conditions and observations (e.g. weather, well condition, etc.), summary of field work performed, and QA/QC sample identification for each monitoring event is generated by Field Operations Manager and distributed to appropriate parties for use in completing monitoring event reporting.
Field Report	Electronic record of monitoring location specific data (e.g. well ID, well arrangement), and sample - specific collection information (e.g. well stabilization data, sample container and preservative used) is generated by the Field Operations Manager for each Site monitoring location.
Chain Of Custody	A written record presenting sample collection individual(s), sample collection data (e.g., date – time) and sample instruction for laboratory analysis submitted with the sample shipping container to the project analytical laboratory.
Sample Acknowledgment	The laboratory services supplier provides notice of sample receipt to designated project representatives and submits sample acknowledgment form to designated project representatives noting the samples received, analytical method to be used, and analyte list for each sample.
Monitoring Event Report	Analytical results for collected samples are provided by the laboratory to designated project representatives, which are subsequently organized in a monitoring event report submitted to USEPA and IEPA. Laboratory analytical data is provided to USEPA and IEPA in a separate submittal in electronic data deliverable (EDD) format.

5.1 Sample Report

The field activities and information pertinent to a specific monitoring event are recorded in the Sample Report. The field reporting activity is performed by the Field Operation Manager and remain in their custody for the duration of the sampling event. The information recorded in the monitoring event Sample Report is presented below:

- Sample collection date and start time.
- Weather conditions.
- Field personnel present.
- Site visitors present, their respective affiliation and purpose of visit.
- Description of work.
- Name of the person making the entry.

5.2 Field Report

Monitoring location specific data (e.g. well ID, well arrangement), and sample - specific collection information (e.g. well stabilization data, sample container and preservative used) are recorded on the monitoring event Field Report in electronic format for each Site monitoring location. The specific information provided on the monitoring event Field Report for each sampled location is as follows:

- Location of sampling or measurement activity
- Name of sample collection party
- Data and time of sample collection
- Name(s) and title(s) of site visitors.
- Type of sampled or measured media (e.g., groundwater)
- Sample collection or measurement method(s)
- Number and volume of sample(s) collected
- Sample point specific information (e.g. monitoring well arrangement)
- Sample preservative (if necessary)
- Sample distribution (e.g., laboratory)
- Field observations/comments
- Groundwater stabilization criteria (pH, temperature, DO, ORP, conductivity.

5.3 Chain of Custody

A Chain of Custody (CoC) form is completed and accompanies each sample shipment to establish the documentation necessary to trace sample possession from the time of sample collection at the Site through sample analysis. The CoC record for each sample shipment will be enclosed in a sealed, waterproof envelope attached to the inside of the cooler lid and will be sent with the samples to the laboratory. The CoC form contains the following information:

- Project name
- Sample identification number(s)
- Laboratory identification
- Site identification
- Signature of chain of custody parties
- Date and time of sample collection
- Sample location
- Sampling technique
- Sample type (media sampled)
- Sample preservation
- Requested analysis
- Container type

When transferring samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the form. This form will be used to document sample custody transfer from the sampler to other sampling team members (if necessary), and to the laboratory. The CoC can be maintained through the shipper by having its agent sign the CoC form or by incorporating the shipping forms (e.g., courier air bill) as part of the sample shipping record.

The laboratory portion of the CoC form is to be completed by the designated laboratory sample custodian and will contain the following:

- Name of person receiving the samples
- Date and time of sample receipt by the laboratory
- Sample condition and temperature.

5.4 Sample Acknowledgment

The laboratory services supplier provides notice of sample receipt to designated project representatives and submits sample acknowledgment form to designated project representatives documenting the following items:

- Samples received.
- Analyte list for each sample
- Analytical method to be used to quantify constituent concentrations.

5.5 Monitoring Event Report

The analytical results for samples collected during each Site monitoring event are provided by the laboratory to designated project representatives, which are subsequently organized in a monitoring event report submitted to USEPA and IEPA. Laboratory analytical data is provided to USEPA and IEPA in a separate submittal in electronic data deliverable (EDD) format to data transfer web site: https://www.epa.gov/superfund/region-5-superfund-electronic-data-submission.

The groundwater monitoring event report documents the following information:

- Monitoring event description.
- Deviations or issues encountered and necessary corrective action.
- Analytical results for current monitoring event and cumulative results for the site to date.
- Monitoring data evaluation identifying tends in groundwater elevation and COC concentrations.
- Monitoring network operation and maintenance summary.

6.0 LABORATORY ANALYSIS

The following measures are utilized for the analysis of groundwater samples collected at the Site during a scheduled groundwater monitoring event or as otherwise implemented at the Site.

- Ground water samples are collected and preserved for shipment to the laboratory services supplier in accordance with the reference instructions provided in the companion UFP-QAPP 2.0 document.
- Samples collected during the performance of the remedy will be analyzed for the compounds identified in reference instructions provided in the companion UFP-QAPP 2.0 document.
- Field and laboratory QA/QC check samples will be collected and performed in accordance with the reference instructions provided in the companion UFP-QAPP 2.0 document.
- The laboratory will analyze the collected samples and will provide Contract Laboratory Procedure (CLP) equivalent analyses and Level IV data packages, in accordance with method-specific standard operating procedures (SOPs) for non-CLP methods as provided in the applicable reference instructions provided in the companion UFP-QAPP 2.0 document.

7.0 ACRONYMS and ABBREVIATIONS

amsl	above mean sea level
CD	Consent Decree
CLP	Contract Laboratory Procedure
COC	Chemicals of Concern
CoC	Chain of Custody
DO	Dissolved Oxygen
EDD	Electronic Data Deliverable
FS	Feasibility Study
FSP	Field Sampling Plan
GAC	Granular Activated Carbon
IDPH	Illinois Department of Public Health
IDW	Investigation Derived Waste
IEPA	Illinois Environmental Protection Agency
ISWS	Illinois State Water Survey
ORP	Oxidation Reduction Potential
OU2	Operable Unit 2
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA	Quality Assurance
QC	Quality Control
RAR	Remedial Action Report
RI	Remedial Investigation
Site	Southeast Rockford Groundwater Contamination Site
SOP	Standard Operating Procedure
SOW	Scope of Work
SVOC	Semi-volatile Organic Compound
TOC	Top of Casing
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
USEPA	United States Environmental Protection Agency
USDOT	United Sates Department of Transportation
VOC	Volatile Organic Compound

8.0 REFERENCES

U.S. Environmental Protection Agency, 1995, Record of Decision, Southeast Rockford GroundwaterContamination Site, Second Operable Unit

U.S. Environmental Protection Agency, 1997, Consent Decree, Southeast Rockford GroundwaterContamination Site, Second Operable Unit

U.S. Environmental Protection Agency, Region 4, March 2018, Pump Operation.

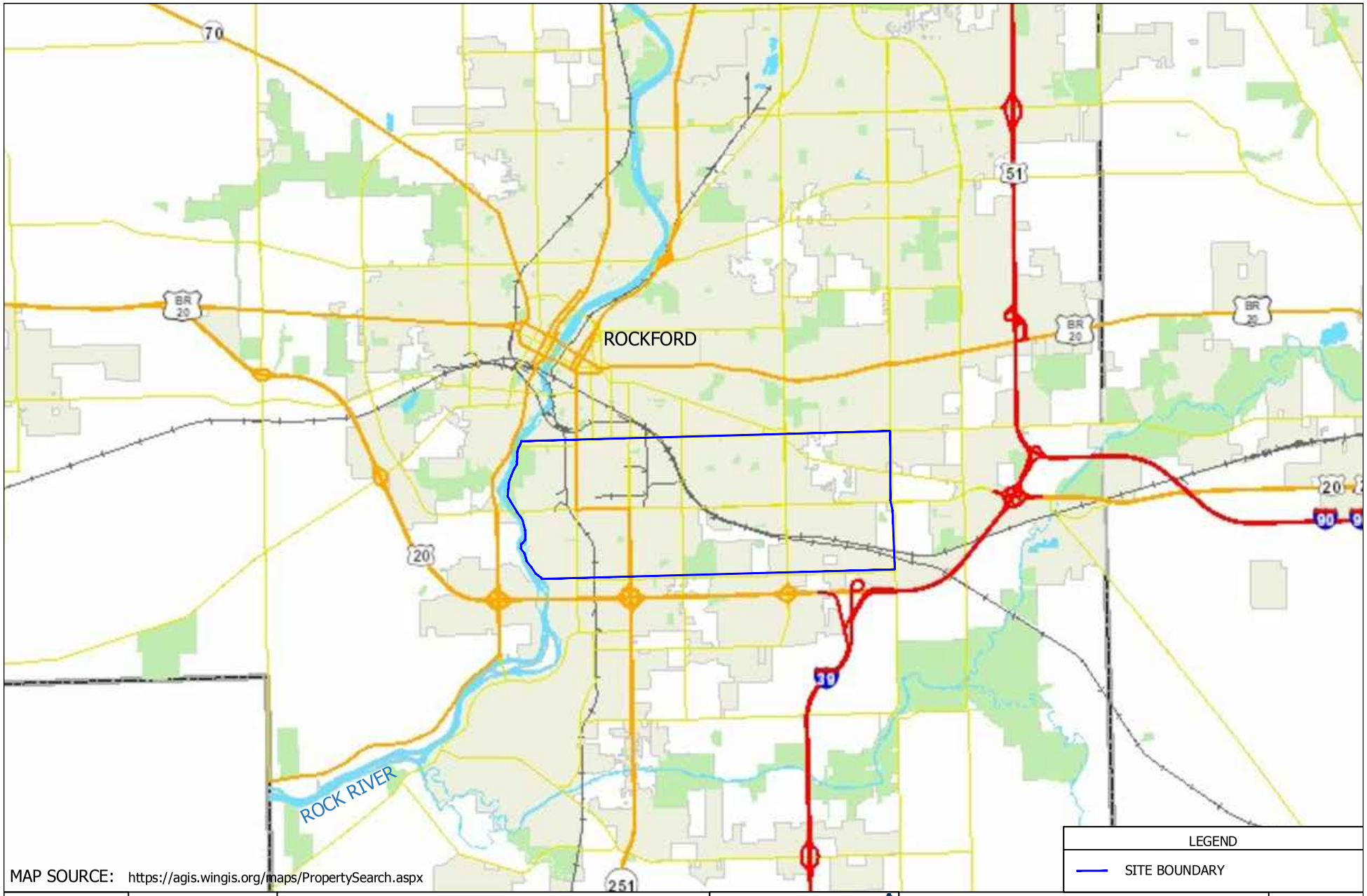
U.S. Environmental Protection Agency, Region 4, May 2020, Groundwater Level and Well Depth Measurement.

U.S. Environmental Protection Agency, Region 4, May 2020, Management of Investigation Derived Waste.

U.S. Environmental Protection Agency, Region 4, June 2020, Field Equipment Cleaning and Decontamination.

U.S. Environmental Protection Agency, Region 5, May 2021, Low Flow Standard Operating Procedure.

FIGURES



MAP SOURCE: https://agis.wingis.org/maps/PropertySearch.aspx

NORTH

CHECKED BY:
M. MANDELL

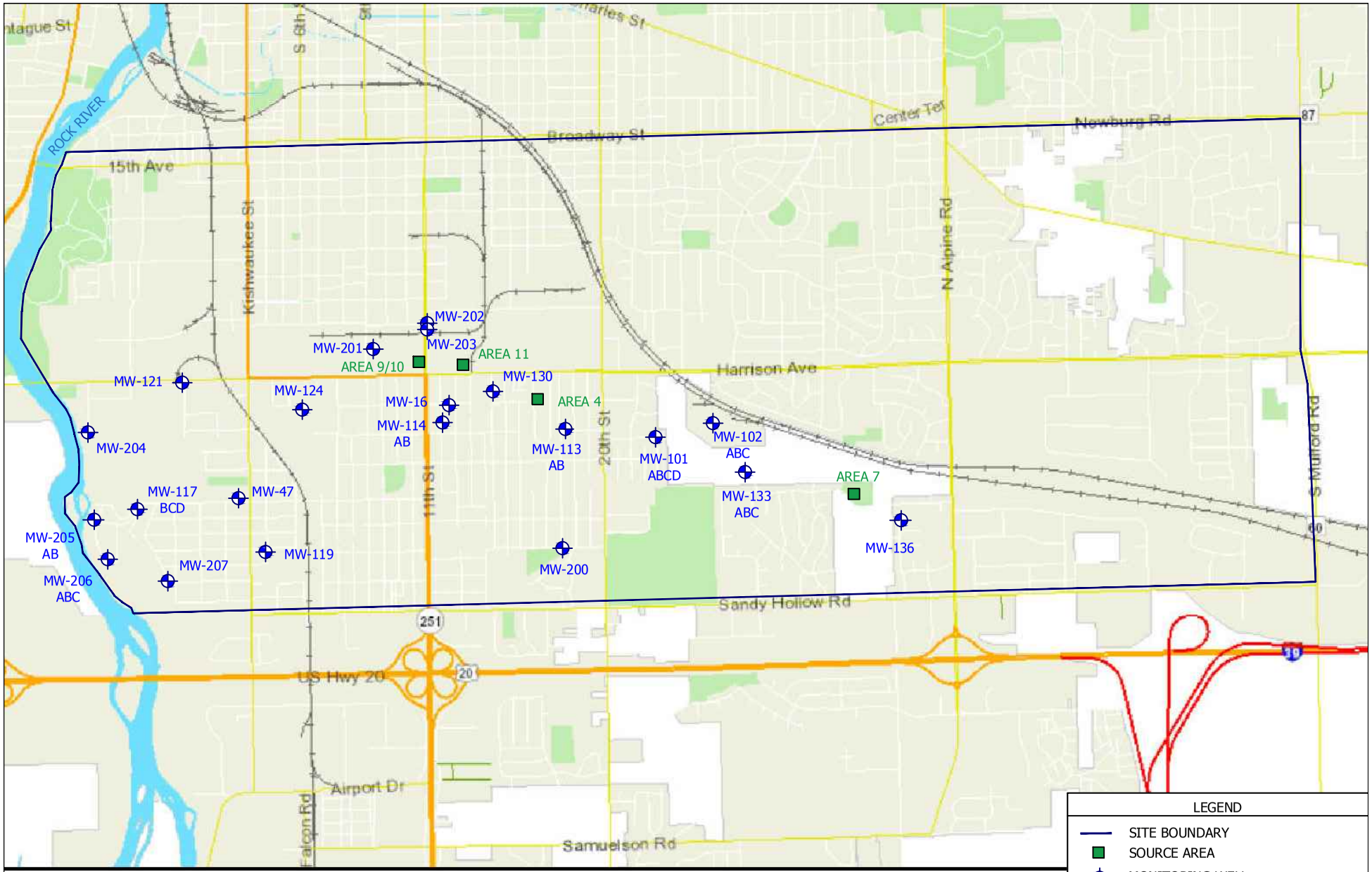
E.W.I. # 192080
DRAWN BY: MLH
July 25, 2021

SCALE IN FEET
0 5,000 10,000
APPROXIMATE

LOCATION MAP

SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SITE
WINNEBAGO COUNTY, ILLINOIS

FIGURE
1.0



MAP SOURCE: https://agis.wingis.org/maps/PropertySearch.aspx

NORTH

CHECKED BY:
M. MANDELL

E.W.I. # 192080
DRAWN BY: MLH
July 22, 2021

SCALE IN FEET
0 1500 3000
APPROXIMATE

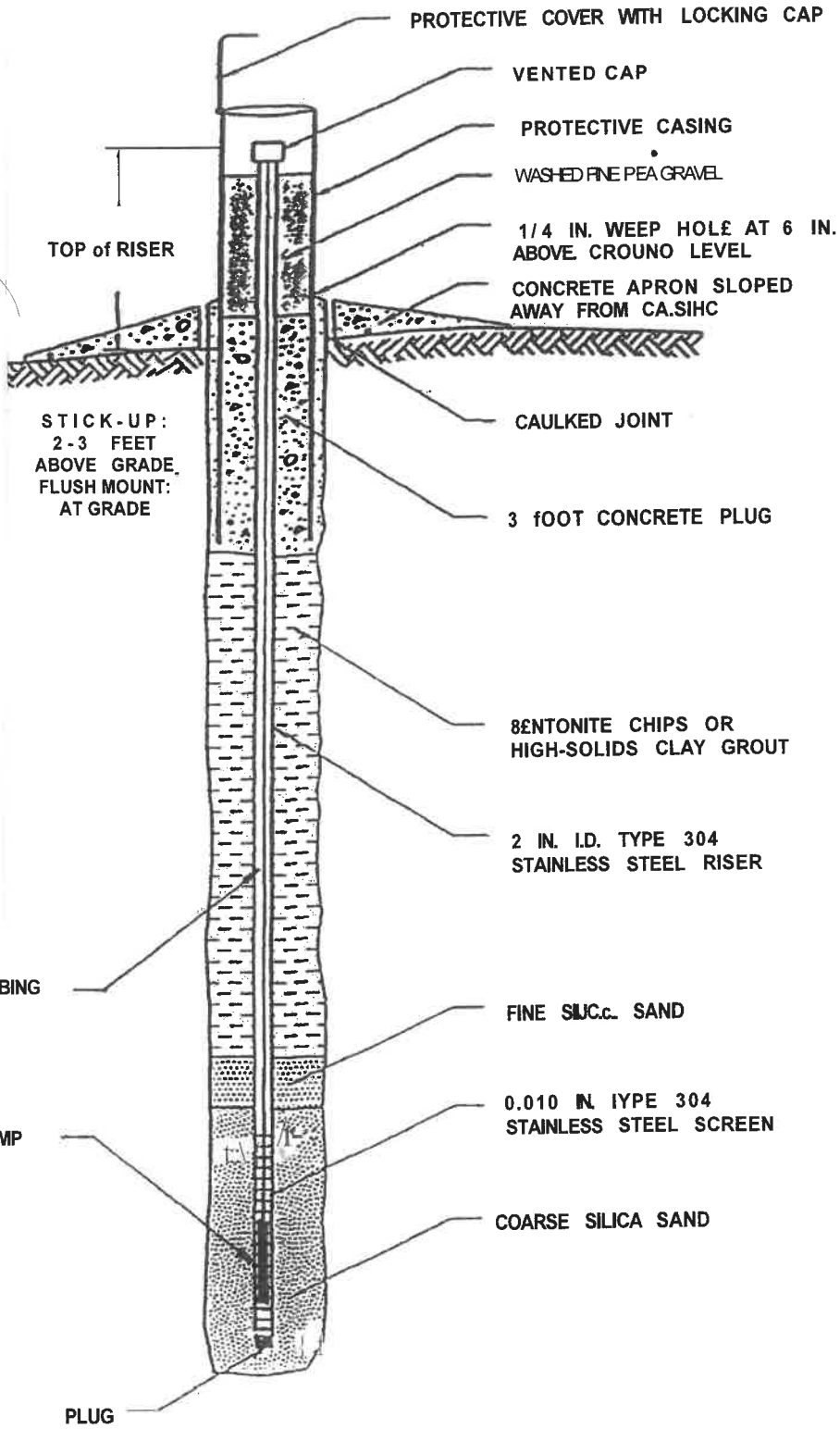
GROUNDWATER MONITORING WELL NETWORK AND SOURCE AREAS

SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SITE
WINNEBAGO COUNTY, ILLINOIS

FIGURE
2.0

Figure 3
Groundwater Monitoring Well
Construction Schematic (Typ.)

Monitor Well	TOC Elevation (ft amsl)	Total Depth (ft TOC)	Screen Length (ft)
MW-16	725.57	62.25	5.00
MW-47	735.23	54.16	5.00
MW-101A	765.62	90.35	10.00
MW-101B	766.62	153.74	10.00
MW-101C	766.48	174.89	10.00
MW-101D	764.96	212.72	10.00
MW-102A	782.69	34.69	10.00
MW-102B	783.01	97.70	10.00
MW-102C	783.13	183.85	10.00
MW-113A	766.54	104.50	15.00
MW-113B	766.65	155.26	10.00
MW-114A	725.15	94.70	10.00
MW-114B	725.24	219.84	10.00
MW-117B	696.26	89.50	10.00
MW-117C	696.11	158.31	10.00
MW-117D	696.10	200.00	10.00
MW-119	718.97	62.41	10.00
MW-121	716.98	67.55	10.00
MW-124	731.30	102.76	5.00
MW-130	727.95	38.17	10.00
MW-133A	780.18	37.85	10.00
MW-133B	780.33	61.49	10.00
MW-133C	780.29	98.49	10.00
MW-136	834.77	44.33	5.00
MW-200	760.16	89.93	10.00
MW-201	728.51	49.80	10.00
MW-202	729.62	50.01	10.00
MW-203	729.09	49.35	10.00
MW 204	717.21	88.96	10.00
MW-205A	696.69	112.90	10.00
MW-205B	696.92	150.31	10.00
MW-206A	693.70	90.24	10.00
MW-206B	693.26	129.94	10.00
MW-206C	693.53	249.34	10.00
MW-207	724.17	90.81	10.00



TABLES

Table 1 - Southeast Rockford Groundwater Contamination Site
Groundwater Monitoring Network

Table 4:	Easting	Northing	TOC Elevation (ft amsl)	Ground Surface Elevation (ft amsl)	Total Depth (ft TOC)[2]	Location Description
MW-16	2593475.34	2030401.25	725.57	725.68	62.25	East of Kinsey Street, north of drain canal
MW-47	2588765.03	2028342.66	735.23	735.56	54.16	Brooke Rd. 1/2 Block West of Kishwaukee Intersection. In shoulder on North side of road.
MW-101A	2598084.40	2029683.41	765.62	764.10	90.35	Northeast corner of Laude and 24th Street
MW-101B	2598093.32	2029682.50	766.62	764.10	153.74	
MW-101C	2598076.01	2029675.69	766.48	764.00	174.89	
MW-101D	2598066.94	2029682.19	764.96	763.90	212.72	
MW-102A	2599371.95	2029982.56	782.69	783.01	34.69	South of RR tracks, east of Laude Street (Owens-Corning Property)
MW-102B	2599380.00	2029990.00	783.01	783.31	97.70	
MW-102C	2599388.00	2029999.00	783.13	783.58	183.85	
MW-113A	2596096.44	2029869.64	766.54	767.00	104.50	West of Willis and 18th Street
MW-113B	2596088.18	2029873.56	766.65	766.40	155.26	
MW-114A	2593333.10	2030016.18	725.15	725.45	94.70	Corner of Willis and Kinsey Street
MW-114B	2593338.00	2030023.51	725.24	725.41	219.84	
MW-117B	2586515.64	2028092.93	696.26	696.40	89.50	Brooke Rd meridian. West of Grant Park Blvd.
MW-117C	2586522.28	2028099.95	696.11	696.40	158.31	
MW-117D	2586502.42	2028081.65	696.10	696.40	200.00	
MW-119	2589374.24	2027137.22	718.97	716.50	62.41	Corner of Sawyer and South 4th Street
MW-121	2587523.45	2030898.78	716.98	714.50	67.55	Corner of Harrison Ave. and Olsen Street
MW-124	2590224.67	2030300.32	731.30	729.00	102.76	South of Park Court, west of railroad track
MW-130	2594440.11	2030701.27	727.95	728.00	38.17	Corner of Alton Ave. and Sewell Street
MW-133A	2600083.74	2028900.38	780.18	777.60	37.85	West end of Balsam Lane
MW-133B	2600084.59	2028906.98	780.33	777.50	61.49	
MW-133C	2600090.11	2028901.64	780.29	777.70	98.49	
MW-136	2603572.26	2027821.67	834.77	834.90	44.33	North end of New England Drive
MW-200	2595998.62	2027199.13	760.16	759.01	89.93	Southeast corner of 17th Street and Sawyer
MW-201	2591771.57	2031653.69	728.51	728.71	49.80	Northeast Corner of Rockford Products Parking lot on the East side of 9th St, North of Harrision Ave.
MW-202	2592985.38	2032213.06	729.62	729.94	50.01	West of 11th Street, South of Harrison Ave./23rd Street (Abe Pekarsky property, parking lot)
MW-203	2592993.40	2032079.04	729.09	729.67	49.35	West of 11th Street, South of Harrison Ave./23rd Street (Abe Pekarsky property, parking lot)
MW 204	2585435.61	2029789.39	717.21	717.21	88.96	South end of Falund Street
MW-205A	2585564.99	2027820.78	696.69	694.30	112.90	North of Brooke Road, east of Rock River
MW-205B	2585567.66	2027827.74	696.92	696.60	150.31	
MW-206A	2585871.82	2026940.34	693.70	694.06	90.24	Between River Blvd. and the Rock River
MW-206B	2585856.13	2026938.65	693.26	693.71	129.94	
MW-206C	2585860.69	2026940.21	693.53	694.19	249.34	
MW-207	2587190.96	2026478.18	724.17	724.47	90.81	Corner of Martin Road & Grant Park Blvd.

Table 2
Field Sampling Equipment Summary

Item	Equipment (Make-Model)	Function
Sample Collection Equipment*		
1	Electronic Water Level Indicator Solinst M101 Water Level Meter	Measure groundwater level in monitoring well.
2	Flow-through Cell Analyzer YSI 556 MSP	Measure groundwater stabilization parameters (pH, temperature, DO, ORP, conductivity) in monitoring well.
3	Turbidity Meter LaMotte 2020we	Measure groundwater stabilization parameters (turbidity) in monitoring well prior to sample collection.
4	Flow Controller QED M10	Regulate groundwater purge rate in monitoring well prior to sample collection.
5	Bladder Pump QED Model T1200M	Dedicated well pump for extracting groundwater from monitoring well
6	Bladder Pump QED Sample Pro	Portable well pump for extracting groundwater from monitoring well used in instance when dedic well pump is inoperable.
Sample Collection Support Equipment		
7	Portable Gas Analyzer RKI GX-2012 Multi-Gas Meter	Measure explosive gas levels in wellhead space
8	Photoionization Detector RAE Systems MiniRAE 3000	Monitor VOC concentrations in wellhead space
9	Air Compressor CAT-2010A	Provide energy source to operate well pump.
10	Portable Generator Honda EM5500 CX	Provide electric power source for applicable sample equipment.

**Operation and maintenance instructions for sample collection equipment is presented in Appendix A to the FSP.*

APPENDICES

Appendix A

Sampling Equipment Operation & Maintenance

Electronic Water Level Indicator - Solinst M101

Flow-through Cell Analyzer - YSI 556 MSP

Turbidity Meter - LaMotte 2020we

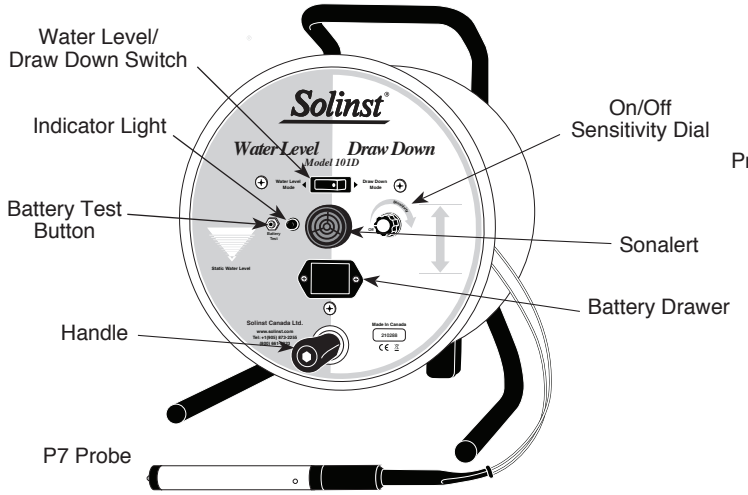
Flow Controller - QED M10

Sample Pump - QED Sample Pro

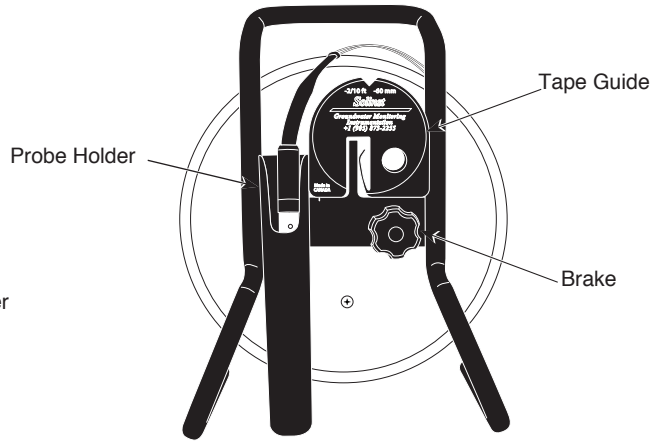
Electronic Water Level Indicator - Solinst M101

Solinst® Water Level DrawDown Meter Operating Instructions

Model 101D



Front View



Back View

Water Level Mode: light and buzzer activate when probe is submersed.
Draw Down Mode: light and buzzer activate when probe is in air.

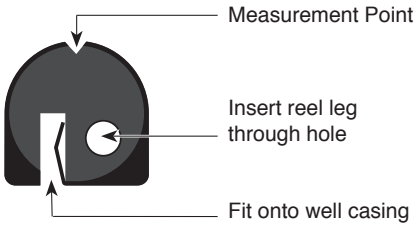
Equipment Check

1. Ensure the meter is in Water Level mode. Turn the sensitivity dial **fully clockwise**.

Notes: 1. Clockwise rotation of the sensitivity dial turns the meter on and increases sensitivity.
2. Always set switch to highest sensitivity position, then decrease if necessary.

2. Depress the battery test button to test the battery and main circuitry (does not test the tape or probe). Light and buzzer will activate.
3. Submerse the probe in tap water. This completes the circuit and activates the buzzer and light.
4. Switch to Draw Down mode. The buzzer and light will turn off when the probe is submersed.
5. Remove the probe from water to activate the buzzer and light. Depress battery test button and light and buzzer will turn off.

The Tape Guide



1. Fit the small end of the Tape Guide onto the edge of well casing 2" (50 mm) diameter or larger.
2. For small reels only, insert the leg into the hole in the Tape Guide and rest the reel on the side of the well casing.
3. To store the Tape Guide, simply clip it onto the support bracket located on the back of the reel.

Routine Care

1. After use, the tape should be carefully rewound onto the reel, the probe wiped dry and placed into the probe holder.
2. The probe, tape and reel can be wiped clean with phosphate free (non-abrasive) detergent and warm water. Do not submerge the reel.
3. Use of a Carrying Bag adds to the service life of the meter.
4. Use of the Tape Guide adds to the life of the tape.

Probe Care and Cleaning

1. The P7 Probe should be wiped clean after each use.
2. Remove any dirt or water from around the central sensor pin.
3. If the central sensor pin is corroded or coated, use emery cloth to polish it.
4. After cleaning, place probe back in its holder.

Battery Replacement

- Battery type - alkaline, 9 volt.

1. The battery is housed in a convenient battery drawer located in the faceplate of the Water Level Drawdown Meter.
2. To replace the battery, simply press the drawer in, lift then pull.
3. The battery drawer will slide out enough to pull it out.
4. Note the polarity (positive (+) terminal should be towards the small notch in the end of the drawer) and place new battery in the drawer and slide it back into the faceplate.

Replacement Parts

The following parts can be provided should they become lost or damaged.

1. Probes
2. Tape with Tape Seal Plug, Tape Seal Plug on shorter lengths of tape (3 ft or 1 m) and splice kit
3. Lights, switches, etc.
4. Reels

Water Level and Drawdown Measurements

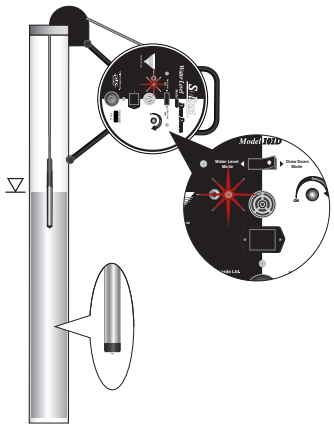
- The P7 Probe zero measurement point is located near the tip of the probe.
- For ease of operation the Tape Guide can be used to support the reel. Feed the tape into and out of the well using the groove in the top of the Tape Guide.
- When using the Tape Guide, the measuring point is offset from the top of casing. To adjust your measurements to the top of the casing, simply subtract the amount indicated on the front of the Tape Guide (i.e. 6 cm or 2/10 ft).

Water Level Measurement

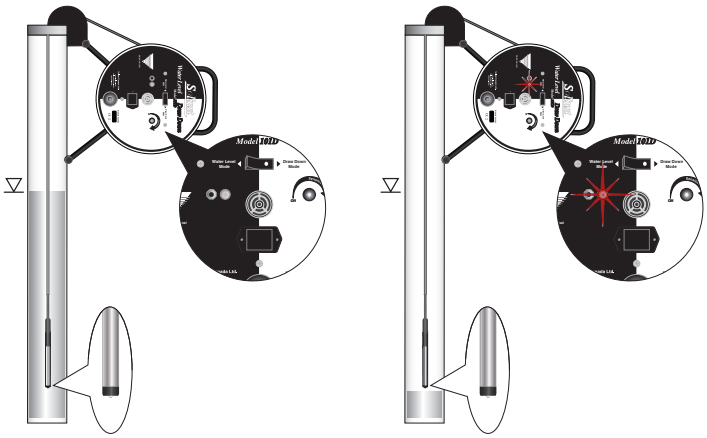
1. Ensure the meter is in Water Level mode.
2. Lower the probe. The light and buzzer activate when the black Delrin tip is submerged and the zero point is reached. To ensure accuracy, lower and raise the probe a few times and then record the depth measurement from the tape at the top of the well.

Drawdown Measurement

1. With the meter in Water Level mode, lower the probe to the desired drawdown depth.
2. Once you have submersed the probe at the desired depth, switch to Draw Down mode. The light and buzzer will shut off.
3. While conducting your pumping/sampling application, the light and buzzer will activate if the probe exits the water.



Water Level Mode



Draw Down Mode

Troubleshooting

SYMPTOM	CAUSE	REMEDY
In Water Level mode: no sound when probe immersed in water.	Dead battery.	Replace with 9V Alkaline.
	Water Conductivity is very low.	Increase sensitivity switch setting (turn clockwise) or call Solinst for assistance.
	Disconnected wires on circuit board.	Check all connections inside hub of reel for loose/disconnected wires – solder or reconnect.
	Broken wire in tape.	Locate break in tape – splice and seal, or replace. (Contact Solinst)
	Disconnected wire inside probe.	Contact Solinst to obtain parts/repair instructions.
In Water Level mode: instrument continuously sounds after being immersed in water.	Water in probe. Probe may be dirty which could interfere with the circuit connection.	Remove the probe. If sounding stops, check/replace o-ring. If sounding continues, check connection of electronics and wiring in reel. If sounding continues, contact Solinst for assessment or replace probe with new probe.

For further information contact: Solinst Canada Ltd.
Fax: +1 (905) 873-1992; (800) 516-9081 Tel: +1 (905) 873-2255; (800) 661-2023
35 Todd Road, Georgetown, Ontario Canada L7G 4R8
Web Site: www.solinst.com E-mail: instruments@solinst.com

Solinst®

Flow-through Cell Analyzer - YSI 556 MSP

YSI **Environmental**

YSI 556 MPS

Multi Probe System

Operations Manual

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1. Safety

1.1 General Information

Read all safety information in this manual carefully before using the YSI 556 Multi-Probe System (MPS). Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review Appendix D Health and Safety.

⚠ **WARNING**

Warnings are used in this manual when misuse of the instrument could result in death or serious injury to a person.

⚠ **CAUTION**

Cautions are used in this manual when misuse of the instrument could result in mild or serious injury to a person and/or damage to equipment.

⚠ **IMPORTANT SAFETY INSTRUCTIONS!**

⚠ **SAVE THESE INSTRUCTIONS!**

⚠ In essence, the most important safety rule for use of the YSI 556 MPS is to utilize the instrument ONLY for purposes documented in this manual. This is particularly true of the YSI 6117 rechargeable battery pack that contains nickel metal hydride (NiMH) batteries. The user should be certain to read all of the safety precautions outlined below before using the instrument.

⚠ Batteries

⚠ This instrument is powered by alkaline or optional nickel-metal hydride batteries, which the user must remove and dispose of when the batteries no longer power the instrument. Disposal requirements vary by country and region, and users are expected to understand and follow the battery disposal requirements for their specific locale.

The circuit board in this instrument contains a manganese dioxide lithium "coin cell" battery that must be in place for continuity of power to memory devices on the board. This battery is not user serviceable or replaceable.

When appropriate, an authorized YSI service center will remove this battery and properly dispose of it, per service and repair policies.

⚠YSI Rechargeable Battery Pack Safety Information

⚠Restrictions on Usage

1. Never dispose of the battery pack in a fire.
2. Do not attempt to disassemble the YSI 6117 battery pack
3. Do not tamper with any of the electronic components or the batteries within the battery pack. Tampering with either the electronic circuitry or the batteries will result in the voiding of the warranty and the compromising of the system performance, but, more importantly, can cause safety hazards which result from overcharging such as overheating, venting of gas, and loss of corrosive electrolyte.
4. Do not charge the battery pack outside the 0–40°C temperature range.
5. Do not use or store the battery at high temperature, such as in strong direct sunlight, in cars during hot weather, or directly in front of heaters.
6. Do not expose the battery pack to water or allow the terminals to become damp.
7. Avoid striking or dropping the battery pack. If the pack appears to have sustained damage from these actions or malfunctions after an impact or drop, the user should not attempt to repair the unit. Instead, contact YSI Customer Service. Refer to *Appendix E Customer Service.*
8. If the battery pack is removed from the YSI 556 MPS, do not store it in pockets or packaging where metallic objects such as keys can short between the positive and negative terminals.

⚠Precautions for Users with Small Children.

Keep the battery pack out of reach of babies and small children.

⚠Danger Notifications – Misuse creates a STRONG possibility of death or serious injury.

FAILURE TO CAREFULLY OBSERVE THE FOLLOWING PROCEDURES AND PRECAUTIONS CAN RESULT IN LEAKAGE OF BATTERY FLUID, HEAT GENERATION, BURSTING, AND SERIOUS PERSONAL INJURY.

1. Never dispose of the battery pack in a fire or in heat.
2. Never allow the positive and negative terminals of the battery pack to become shorted or connected with electrically conductive materials. When the battery pack has been removed from the YSI 556 MPS, store it in a heavy plastic bag to prevent accidental shorting of the terminals.
3. Never disassemble the battery pack and do not tamper with any of the electronic components or the batteries within the battery pack. The battery pack is equipped with a variety of safety features. Accidental deactivation of any of these safety features can cause a serious hazard to the user.
4. The NiMH batteries in the battery pack contain a strong alkaline solution (electrolyte). The alkaline solution is extremely corrosive and will cause damage to skin or other tissues. If any fluid from the battery pack comes in contact with a user's eyes, immediately flush with clean water and consult a physician immediately. The alkaline solution can damage eyes and lead to permanent loss of eyesight.

⚠ Warning Notifications – Misuse creates a possibility of death or serious injury

1. Do not allow the battery pack to contact freshwater, seawater, or other oxidizing reagents that might cause rust and result in heat generation. If a battery becomes rusted, the gas release vent may no longer operate and this failure can result in bursting.
2. If electrolyte from the battery pack contacts the skin or clothing, thoroughly wash the area immediately with clean water. The battery fluid can irritate the skin.

⚠ Caution Notifications – Misuse creates a possibility of mild or serious injury or damage to the equipment.

1. Do not strike or drop the battery pack. If any impact damage to the battery pack is suspected, contact YSI Customer Service. Refer to *Appendix E Customer Service*.

2. Store the battery pack out of reach of babies and small children.
3. Store the battery pack between the temperatures of -20 and 30°C.
4. Before using the battery pack, be sure to read the operation manual and all precautions carefully. Then store this information carefully to use as a reference when the need arises.

⚠YSI 616 Cigarette Lighter Charger Safety Information

1. This section contains important safety and operating instructions for the YSI 556 MPS cigarette lighter battery charger (YSI 616; RadioShack Number 270-1533E). BE SURE TO SAVE THESE INSTRUCTIONS.
2. Before using the YSI 616 cigarette lighter charger, read all instructions and cautionary markings on battery charger, battery pack, and YSI 556 MPS.
3. Charge the YSI 6117 battery pack with the YSI 616 cigarette lighter charger ONLY when the YSI 6117 is installed in the YSI 556 MPS.
4. Do not expose charger to rain, moisture, or snow.
5. Use of an attachment not recommended or sold by the battery charger manufacturer may result in a risk of fire, electric shock, or injury to persons.
6. To reduce risk of damage to cigarette lighter and cord, pull by cigarette lighter rather than cord when disconnecting charger.
7. Make sure that the cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.
8. Do not operate charger with damaged cord or cigarette lighter connector – replace it immediately.
9. Do not operate charger if it has received a sharp blow, been dropped, or otherwise damaged in any way; contact YSI Customer Service. Refer to *Appendix E Customer Service*.
10. Do not disassemble charger other than to change the fuse as instructed. Replace the part or send it to YSI Product Service if repair is required (refer to *Appendix E Customer Service*). Incorrect reassembly may result in a risk of electric shock or fire.

11. To reduce risk of electric shock, unplug charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.

⚠ YSI 556 MPS Water Leakage Safety Information

The YSI 556 MPS has been tested and shown to comply with IP67 criterion, i.e. submersion in 1 meter of water for 30 minutes with no leakage into either the battery compartment or the main case. However, if the instrument is submersed for periods of time in excess of 30 minutes, leakage may occur with subsequent damage to the batteries, the rechargeable battery pack circuitry, and/or the electronics in the main case.

If leakage into the battery compartment is observed when using alkaline C cells, remove batteries, dispose of batteries properly, and dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

If leakage into the battery compartment is observed when using the YSI rechargeable battery pack, remove the battery assembly and set aside to dry. Return the battery pack to YSI Product Service for evaluation of possible damage. Finally dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** If water has contacted the rechargeable battery pack, do not attempt to reuse it until it has been evaluated by YSI Product Service (refer to Appendix E Customer Service). Failure to follow this precaution can result in serious injury to the user.

If it is suspected that leakage into the main cavity of the case has occurred, remove the batteries immediately and return the instrument to YSI Product Service for damage assessment. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** Under no circumstances should the user attempt to open the main case.

2. General Information

2.1 Description

The rugged and reliable YSI 556 MPS (Multi-Probe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multi-parameter system. Featuring a waterproof, impact-resistant case, the YSI 556 MPS simultaneously measures dissolved oxygen, conductivity, temperature, and optional pH and ORP. A simple cellular phone style keypad and large display make the instrument easy to use. The YSI 556 MPS is compatible with YSI EcoWatch™ for Windows™ software.

The YSI 556 MPS assists the user in conforming to Good Laboratory Practice (GLP) standards which help ensure that quality control/quality assurance methods are followed. Battery life is displayed with a fuel gauge, and the user can choose standard alkaline batteries or an optional rechargeable battery pack.

The 1.5 MB memory can store more than 49,000 data sets. Other options include a flow cell and barometer. The internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure.

Features

- Waterproof -meets IP67 specifications
- Field-replaceable DO electrode module; pH and pH/ORP sensors
- Compatible with EcoWatch™ for Windows™ data analysis software
- Assists with Good Laboratory Practice Standards (GLP)
- Choice of DO membrane material for different applications
- Easy-to-use, screw-on cap DO membranes
- User-upgradeable software from YSI website
- Three-year warranty on the instrument; one-year on the probe modules
- Available with 4,10, and 20 m cable lengths
- Stores over 49,000 data sets, time and date stamped

- Auto temperature compensating display contrast
- Optional barometer
- Optional rechargeable battery pack or standard alkaline batteries

2.2 Unpacking the Instrument

1. Remove the instrument from the shipping box. Note that the probe module and sensors are shipped in a separate box and will be unpacked later in Section *3.2 Unpacking the Probe Module*

   NOTE: Do not discard any parts of supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

   NOTE: If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to Appendix E Customer Service or www.ysi.com.

2.3 Features of the YSI 556 Multi-Probe System

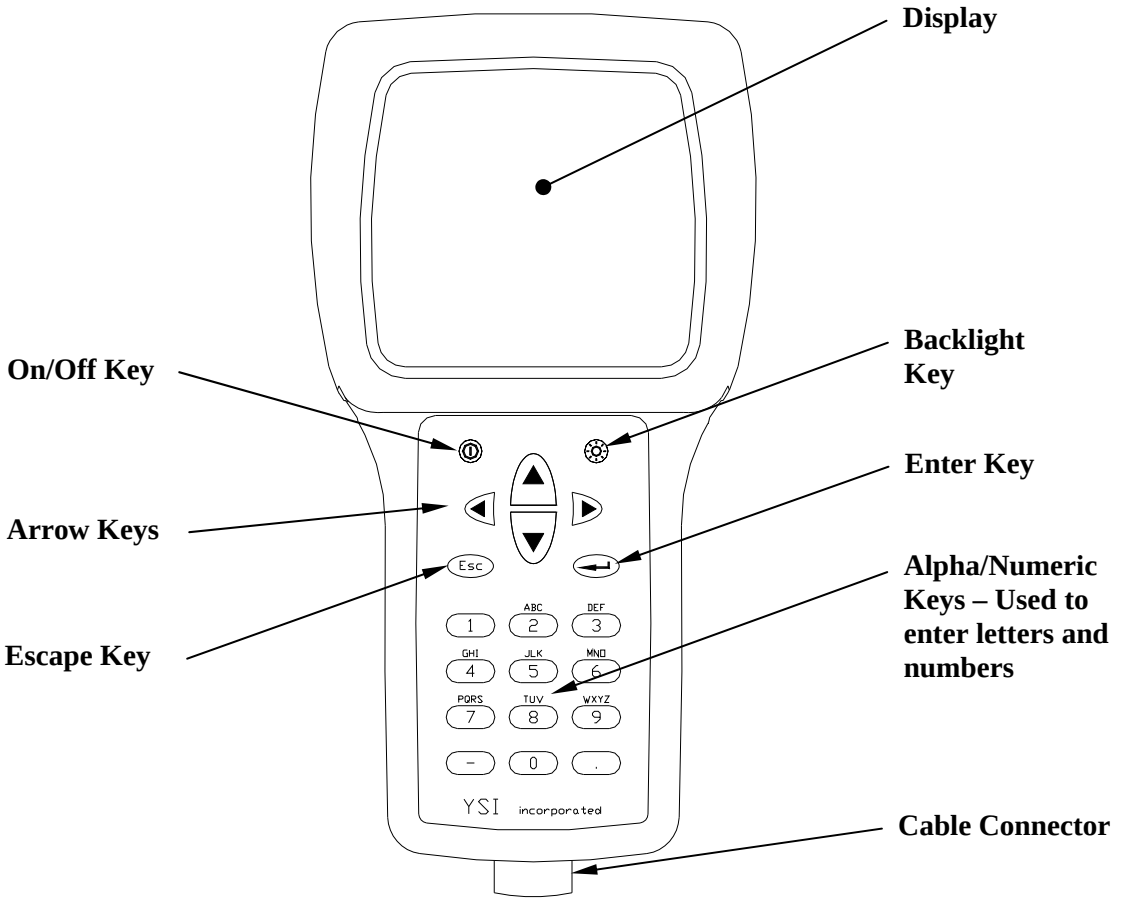


Figure 2.1 Front View of YSI 556 MPS

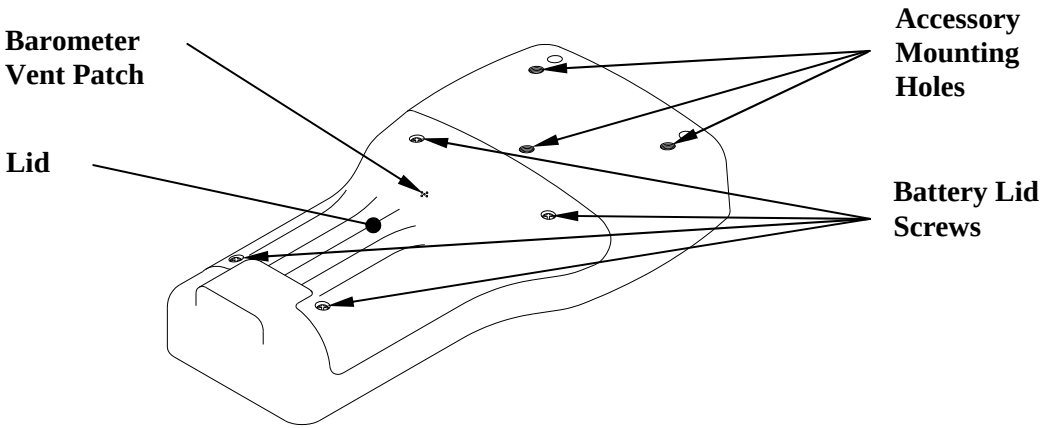


Figure 2.2 Back View of YSI 556 MPS

2.4 Batteries

2.4.1 Battery Life

Standard Alkaline Batteries

With the standard battery configuration of 4 alkaline C cells, the YSI 556 MPS will operate continuously for approximately 180 hours. Assuming a standard usage pattern when sampling of 3 hours of “on time” in a typical day, the alkaline cells will last approximately 60 days.

Optional Rechargeable Battery Pack

When fully charged, the optional rechargeable battery pack will provide approximately 50 hours of battery life.

2.4.2 Inserting 4 C Batteries

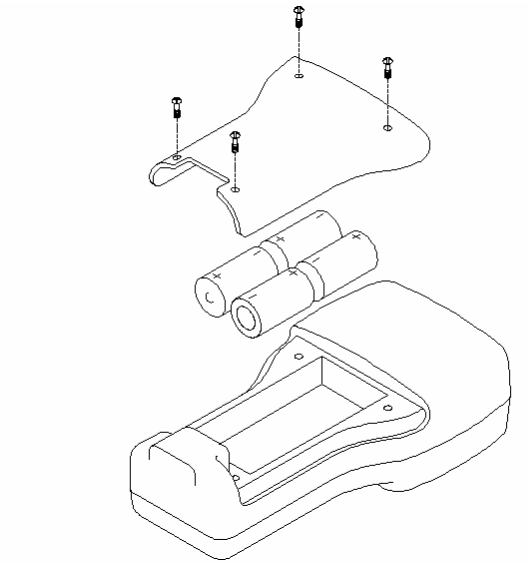


Figure 2.1 Inserting C Cells

⚠ **CAUTION: Install batteries properly to avoid damage to the instrument**.

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.
2. Remove the battery lid.
3. Insert four C batteries between the clips following the polarity (+ and -) labels on the bottom of the battery compartment.
4. Check gasket for proper placement on the battery lid.
5. Replace the battery lid and tighten the 4 screws securely and evenly.

NOTE: Do not over-tighten the screws.

2.4.3 Inserting Optional Rechargeable Battery Pack

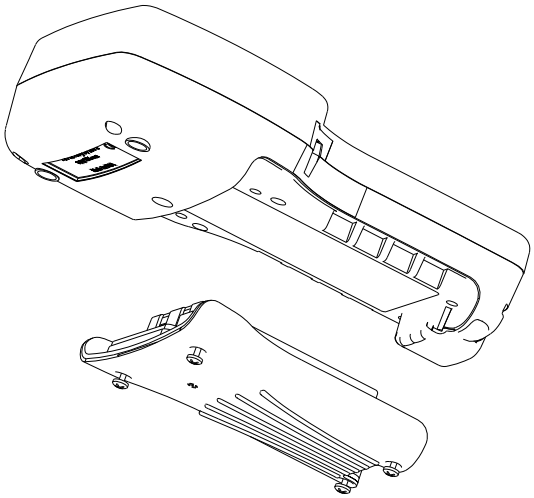


Figure 2.2 Inserting Battery Pack

⚠ **CAUTION: Read all cautions and warning that come with the battery pack before using the battery pack.**

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.

2. Remove the C battery lid and store for future use. Remove C batteries, if installed.

3. Install the rechargeable battery pack and lid and tighten the 4 screws securely and evenly.

NOTE: Do not over tighten the screws.

2.4.4 Charging the Optional Rechargeable Battery Pack

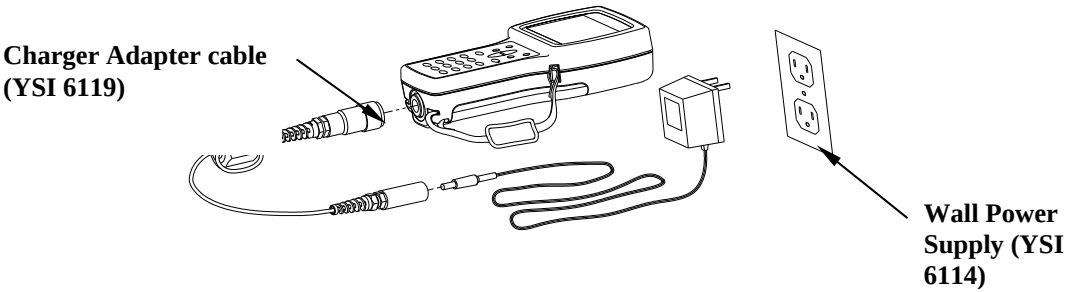


Figure 2.3 Charging the Battery Pack

⚠ **CAUTION: Do not use or store the battery pack at extreme temperatures such as in strong direct sunlight, in cars during hot weather or close to heaters.**

1. Install the rechargeable battery pack into the instrument as described in Section *2.4.3 Inserting Optional Rechargeable Battery Pack*.

2. Attach the charger adapter cable (YSI 6119) to the instrument.

NOTE: Wall power supplies for use in countries outside the US and Canada can be found in *Appendix B Instrument Accessories.*

3. Insert the barrel connector of the wall power supply into the barrel of the adapter cable.

⚠ **CAUTION: Do not charge the battery pack continuously for more than 48 hours.**

⚠ **CAUTION: Do not drop or expose to water.**

⚠ **CAUTION: Do no charge the battery pack at temperatures below 0°C or above 40°C.**

4. Plug the wall power supply into an AC power outlet for approximately 2 hours to obtain an 80% to 90% charge for 6 hours to get a full charge.

NOTE: The battery pack can be recharged whether the instrument is on or off.

2.4.5 Storing the Battery Pack

Remove the battery pack from the instrument when the instrument will not be used for extended periods of time to prevent over discharge of the battery pack.

Store the battery pack in a heavy plastic bag to prevent accidental shorting of the terminals. Store between –20 and 30°C.

2.4.6 Optional Cigarette Lighter Charger

⚠ **CAUTION: Read all warnings and cautions that come with the charger before using the charger.**

⚠ **CAUTION: Only use cigarette lighter charger when rechargeable battery pack is inserted into instrument.**

⚠ **CAUTION: Do not mishandle cigarette lighter charger. Do not expose to moisture.**

1. Plug the barrel connector of the cigarette lighter charger into the mating end of the YSI 6119 Charger Adapter Cable.

2. Attach the MS-19 end of the YSI 6119 Charger Adapter Cable to the instrument.

3. Make one of the following modifications to the other end of the charger:

Slide the adapter ring off the plug to use the device with an American or Japanese vehicle.

.

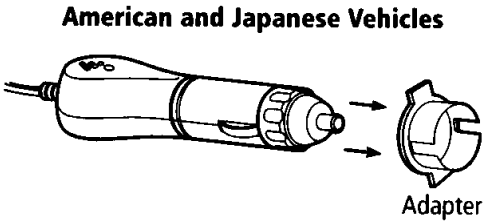


Figure 2.1 Charger Plug Adapter Use

Leave the adapter ring on the plug and position it so that the slots on the adapter ring line up with the plug's spring clips to use the device on a European vehicle.

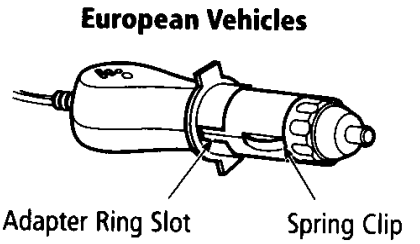


Figure 2.2 European Charger Plug Adapter Use

NOTE: If the charger stops working properly, refer to Section 13 *Troubleshooting.*

2.5 Power On

Press and release the on/off button in the upper left corner of the instrument keypad to turn the instrument on or off. See Figure2.1 Front View of YSI 556 MPS.

2.6 Setting Display Contrast

The display contrast automatically compensates for temperature changes. However, under extreme temperature conditions you may wish to optimize the display by manual adjustment as follows:

1. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “up” arrow to increase (darken) the contrast.

2. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “down” arrow to decrease (lighten) the contrast.

2.7 Backlight

Press and *release* the backlight key in the upper right corner of the keypad to turn the backlight on or off. See Figure 2.1 Front View of YSI 556 MPS.

NOTE: The backlight turns off automatically after two minutes of non-use.

2.8 General Screen Features

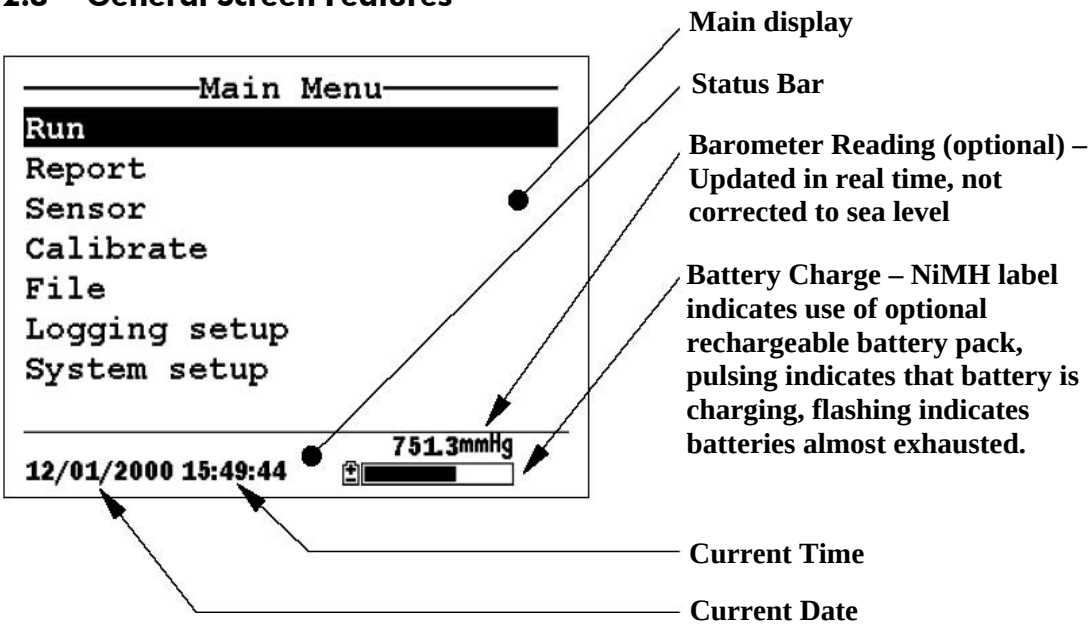


Figure 2.4 Main Screen Menu

2.9 Keypad Use

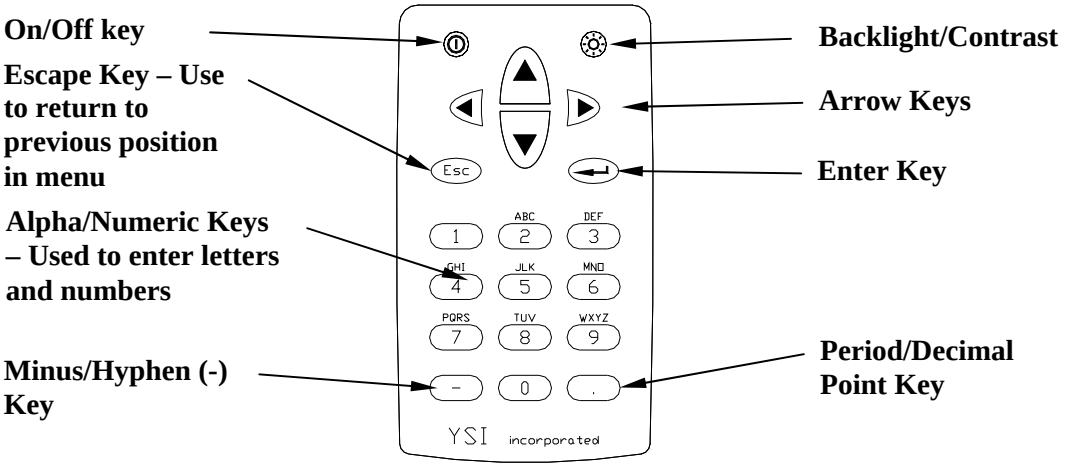


Figure 2.5 Keypad Features

KEY	LETTER/NUMBER
1	1
2	ABC2abc3
3	DEF3def3
4	GHI4ghi4
5	JKL5jkl5
6	MNO6mno6
7	PQRS7pqrs7
8	TUV8tuv8
9	WXYZ9wxyz9
0	0

Figure 2.6 Keypad Features

1. See Figure 2.10 Keypad Letters & Numbers and press the appropriate key repeatedly until letter or number desired appears in display.

NOTE: Press the key repeatedly in rapid succession to get to the desired letter or number. If you pause for more than a second, the cursor automatically scrolls to the right to prepare for the next input.

EXAMPLE 1: Press the **6** key *once* and *release* to display an uppercase “M”.

EXAMPLE 2: Press the **6** key *four times* and *release* to display the number “6”.

EXAMPLE 3: Press the **6** key *five times* and *stop* to display a lowercase “m”.

2. Press the left arrow key to go back and reenter a number or setter that needs to be changed.

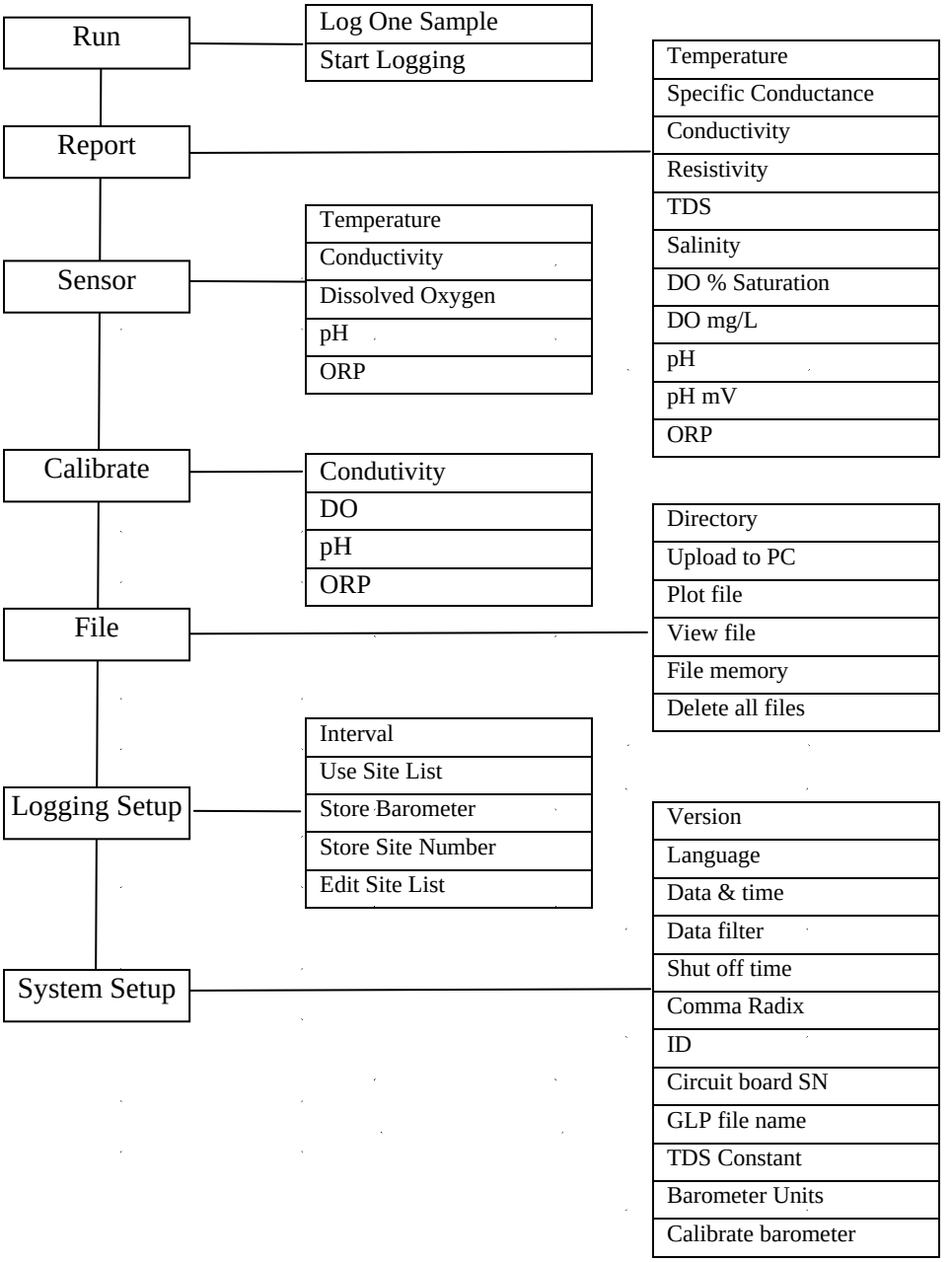
   Press the **Enter** key when your entry is complete.

   NOTE: The instrument software permits only numeric entries in many instances, such as when setting the clock or entering calibration parameters.

2.10 Instrument Reset

The YSI 556 MPS is characterized by sophisticated software that should provide trouble-free operation. However, as with all high-capability software packages, it is always possible that the user will encounter circumstances in which the instrument does not respond to keypad entry. If this occurs, the instrument function can easily be restored by removing and then reapplying battery power. Simply remove either your C-cells or rechargeable battery pack from the battery compartment, wait 30 seconds and then replace the batteries. See Section *2.4 Batteries* for battery removal/reinstallation instructions.

2.11 Menu Flowchart



3. Probe Module

3.1 Introduction

The YSI 5563 Probe module is used for measuring dissolved oxygen, temperature, conductivity, and optional pH and ORP. The probe module is rugged, with the sensors enclosed in a heavy duty probe sensor guard with attached sinking weight. A 4, 10 or 20 meter cable is directly connected to the probe module body making it waterproof. An MS-19 connector at the end of the cable makes the YSI 5563 fully compatible with the YSI 556 Multi-Probe System.

3.2 Unpacking the Probe Module

1. Remove the YSI 5563 Probe Module from the shipping boxes.

   NOTE: Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

NOTE: If any parts are missing or damaged, contact a YSI representative immediately. Refer to: *Appendix E Customer Service* o visit www.ysi.com.

3.3 Features of the YSI 5563 Probe Module

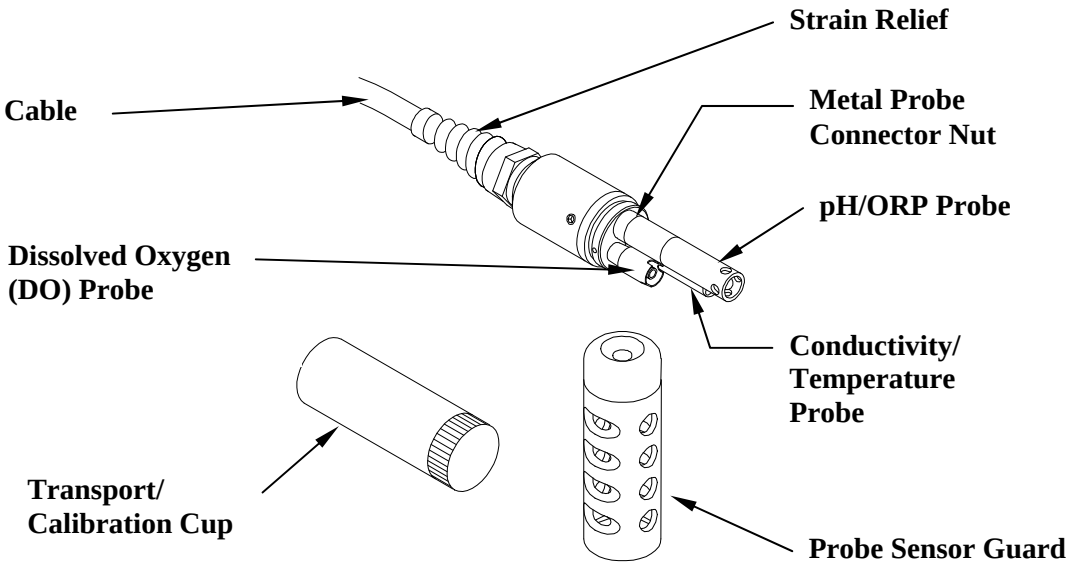


Figure 3.1 Probe Module

3.4 Preparing the Probe Module

To prepare the probe module for calibration and operation, you need to install the sensors into the connectors on the probe module bulkhead. In addition to sensor installation, you need to install a new DO membrane cap.

3.4.1 Sensor Installation

Whenever you install, remove or replace a sensor, it is extremely important that the entire probe module and all sensors be thoroughly dried prior to the removal of a sensor or a sensor port plug. This will prevent water from entering the port. Once you remove a sensor or plug, examine the connector inside the probe module sensor port. If any moisture is present, use compressed air to completely dry the connector. If the connector is corroded, return the probe module to your YSI Distributor or directly to YSI Customer Service. Refer to *Appendix E Customer Service*.

Conductivity/Temperature and pH, pH/ORP Sensor Installation

1. Unscrew and remove the probe sensor guard.

2. Using the sensor installation tool supplied in the YSI 5511 maintenance kit, unscrew and remove the sensor port plugs.

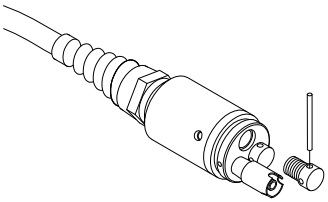


Figure 3.2 Port Plug Removal

3. Locate the port with the connector that corresponds to the sensor that is to be installed.

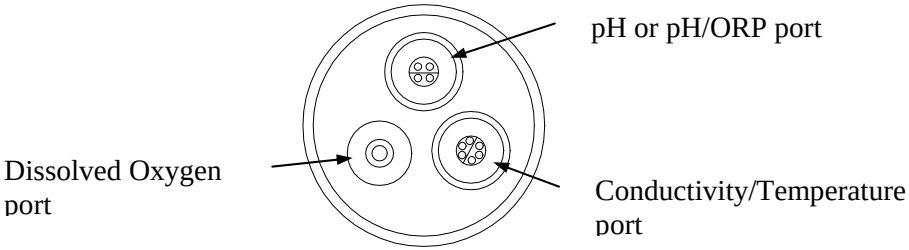


Figure 3.3 Sensor Port Identification

4. Apply a thin coat of o-ring lubricant (supplied in the YSI 5511 maintenance kit) to the o-rings on the connector side of the sensor (see Figure 3.4 O-ring Lubrication).

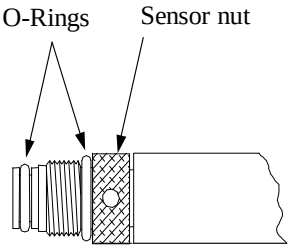


Figure 3.4 O-ring Lubrication

⚠ **CAUTION:** Make sure that there are NO contaminants between the o-ring and the sensor. Contaminants that are present under the o-ring may cause the o-ring to leak.

5. Be sure the probe module sensor port is free of moisture and then insert the sensor into the correct port. Gently rotate the sensor until the two connectors align.

6. With the connectors aligned, screw down the sensor nut using the sensor installation tool.

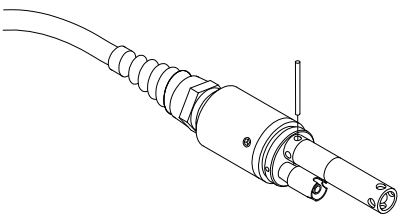


Figure 3.5 Sensor Installation

⚠ **CAUTION:** Do not cross thread the sensor nut. Tighten the nut until it is flush with the face of the probe module bulkhead. Do not over tighten.

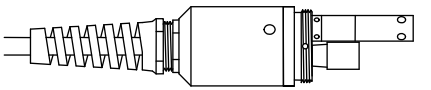


Figure 3.6 Bulkhead Seating

7. Repeat steps 3-6 for any other sensors.

8. Replace the probe sensor guard.

Dissolved Oxygen Sensor Installation

The YSI 5563 comes with the DO sensor already installed. Refer to Section *11.1.2 DO Sensor Replacement* for instructions on installing the YSI 559 Replaceable DO Module Kit.

3.4.2 Membrane Cap Selection

The YSI 5563 is shipped with a YSI 5909 kit that contains membrane caps made with 2 mil polyethylene (PE), a material which should be ideal for most field applications of the 556. However, YSI also offers membrane caps made with two other materials (1 mil polyethylene and 1 mil Teflon) which some users may also prefer. All membranes available for the 556/5563 system provide comparable accuracy if used properly. The difference between the two thicknesses of PE is found in the trade-off of flow dependence and response time as described below. Teflon is offered because some users may prefer to continue using the traditional membrane material used by YSI. To avoid confusion, the membrane caps are color coded as described below and can be ordered in kits as noted:

1 mil Teflon – Black Caps (Kit = YSI 5906)
1 mil Polyethylene (PE) – Yellow Caps (Kit = YSI 5908)
2 mil Polyethylene (PE) – Blue Caps (Kit = YSI 5909)

The 1 mil Teflon caps will offer traditional, reliable performance for most dissolved oxygen applications. The 1 mil PE caps will provide a significantly faster dissolved oxygen response (as long as your 556 Data Filter is set correctly as described below in Sections 10.2 and 10.3.1) while also giving readings which are significantly less flow dependent than the 1 mil Teflon caps. Finally, 2 mil PE caps will show a large reduction in flow dependence over 1 mil Teflon while not significantly increasing the response time. Generally, one of the PE caps is likely to provide better performance for your application.

IMPORTANT: No matter which type of membrane cap you select, you will have to confirm your selection in the 556 software from the Sensor menu as described in Section *4 Sensors*.

3.4.3 Membrane Cap Installation

NOTE: The YSI 5563 DO sensor (already installed in the probe module) was shipped dry. A shipping membrane was installed to protect the electrode. **A new membrane cap must be installed before the first use.**

1. Unscrew and remove the probe sensor guard.
2. Unscrew, remove, and discard the old membrane cap.
3. Thoroughly rinse the sensor tip with distilled water.
4. Prepare the electrolyte according to the directions on the electrolyte solution bottle.
5. Hold the new membrane cap and fill it at least ½ full with the electrolyte solution.
6. Screw the membrane cap onto the sensor moderately tight. A small amount of electrolyte should overflow.

⚠ **Caution:** Do not touch the membrane surface.

7. Screw the probe sensor guard on moderately tight.

3.5 Transport/Calibration Cup

The YSI 5563 Probe module has been supplied with a convenient transport/calibration cup. This cup is an ideal container for calibration of the different sensors, minimizing the amount of solution needed. Refer to Section *6 Calibrate*.

3.5.1 Transport/Calibration Cup Installation

1. Remove probe sensor guard, if already installed.

2. Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body.

3. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not over tighten as this could cause damage to the threaded portions.

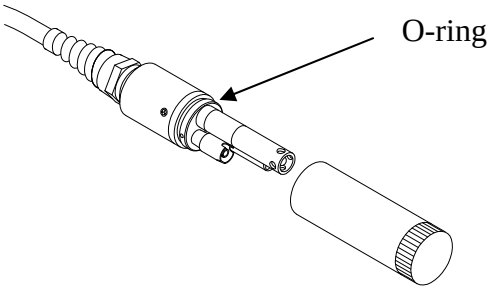


Figure 3.7 Transport/Calibration Cup Installation

3.6 Instrument/Cable Connection

Attach the cable to the instrument as follows:

1. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 556 instrument. See Figure 2.1 Front View of YSI 556 MPS.

2. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.

Remove the cable from the instrument by turning the cable connector counterclockwise until the cable disengages from the instrument.

4. Sensors

The Sensors screen allows the user to enable or disable each of the sensors and select which membrane material will be used for the dissolved oxygen sensor. Disabled sensors will not be displayed on the screen in real time or logged to files.

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

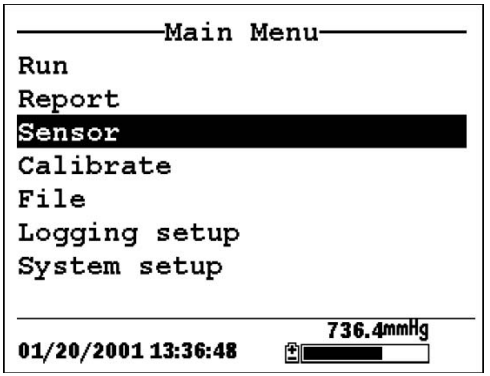


Figure 4.1 Main Menu Screen

3. Use the arrow keys to highlight the **Sensor** selection.

4. Press the **Enter** key to display the sensors enabled screen.

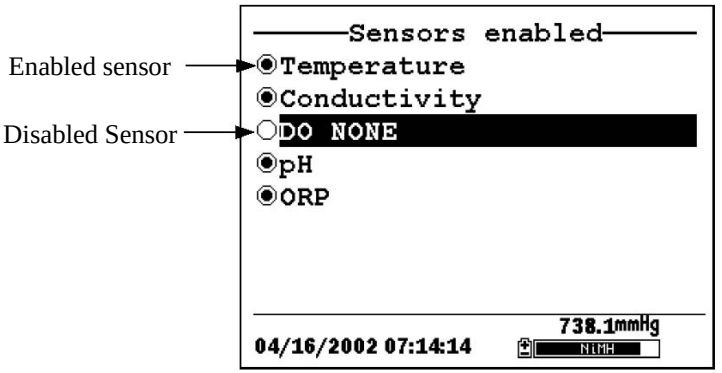


Figure 4.2 Sensors Enabled Screen Before DO Membrane Selection

A black dot to the left of a sensor indicates that sensor is enabled. Sensors with an empty circle are disabled.

Highlight the “DO None” entry as shown above and press **Enter** to display the membrane choice screen. Consult Section *3.4.2 Membrane Cap Selection* for information on the advantages of each type of membrane material. Blue membrane caps using 2 mil polyethylene (PE) were shipped with your YSI 5563 and are likely to be the best choice for most 556 field applications.

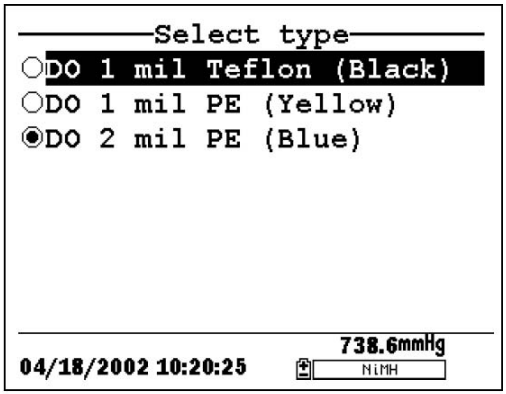


Figure 4.3 Membrane Selection Screen

Highlight the desired membrane choice – in this case, 2 mil PE - and press Enter to activate your selection with a dot to the left of the screen. Then press **Escape** to return to the Sensor menu that now shows your DO membrane selection.

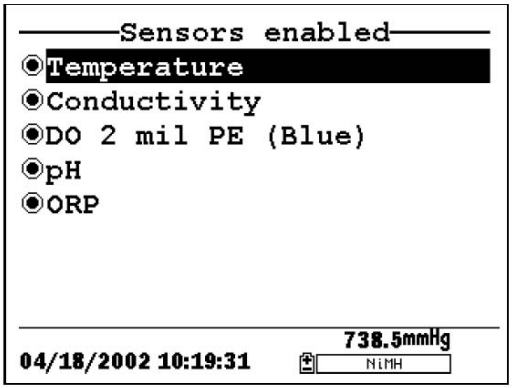


Figure 4.4 Sensors Enabled Screen After DO Membrane Selection

NOTE: The Temperature sensor cannot be disabled. Most other sensors require temperature compensation for accurate readings. In addition, the conductivity sensor must be activated in order to obtain accurate dissolved oxygen mg/L readings.

5. Use the arrow keys to highlight the sensor you want to change, then press the Enter key to enable or disable it.

6. Repeat step 5 for each sensor you want to change.

7. Press the Escape key to return to the main menu screen.

5. Report

The Report Setup screen allows the user to select which sample parameters and units the YSI 556 MPS will display on the screen. It does NOT determine which parameters are logged to memory. Refer to Section *4 Sensors.*

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

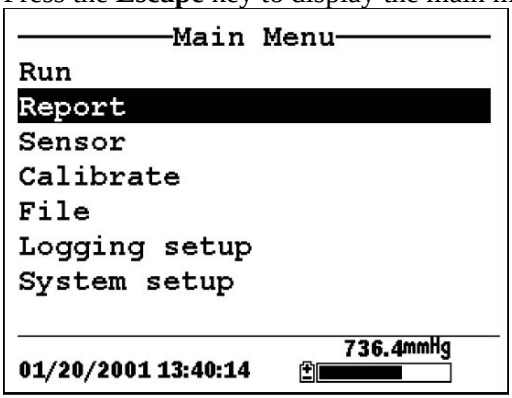


Figure 5.1 Main Menu

3. Use the arrow keys to highlight the **Report** selection.

4. Press the **Enter** key to display the report setup screen.

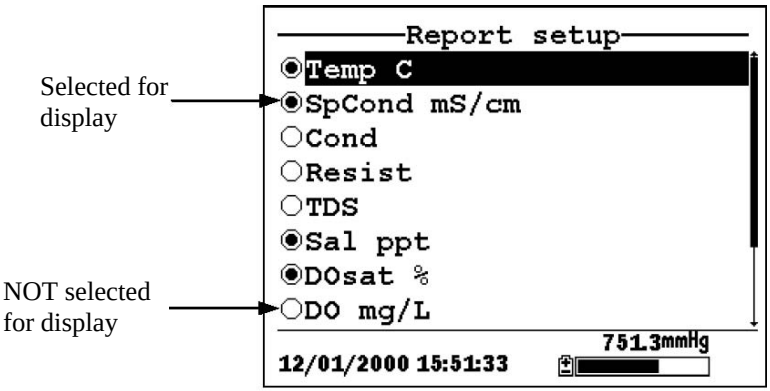


Figure 5.2 Report Setup Screen

NOTE: A black dot to the left of a parameter indicates that parameter is selected for display. Parameters with an empty circle will not be displayed.

NOTE: You may have to scroll down past the bottom of the screen to see all the parameters.

5. Use the arrow keys to highlight the parameter you want to change, then press the **Enter** key. If you can't find the parameter you want, even after scrolling down past the bottom of the screen, the sensor used for that parameter is disabled. Refer to Section *4 Sensors*.

6. If you selected Temperature, Specific Conductivity, Conductivity, Resistance or Total Dissolved Solids, the Units screen will appear.

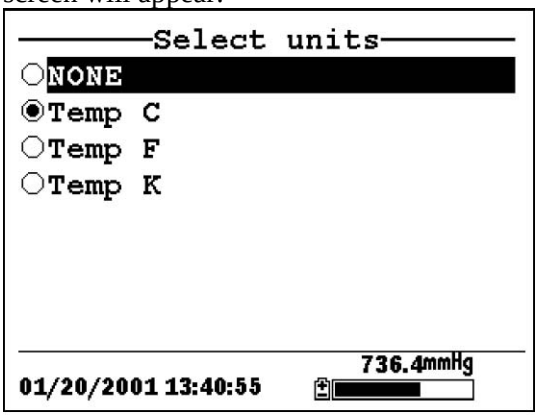


Figure 5.3 Units Screen

7. Use the arrow keys to select the units desired, then press the **Enter** key to return to the report setup screen.

8. Repeat steps 5 and 6 for each parameter you want to change.

NOTE: Specific Conductance (temperature compensated conductivity) is notated on the Run screen with a small ‘c’ after the units of measure.

All parameters may be enabled at the same time.

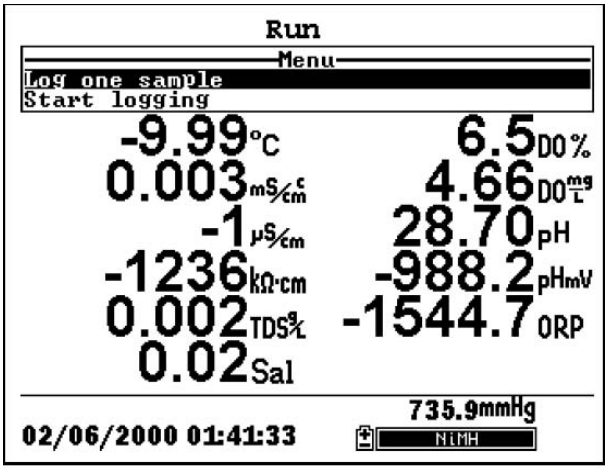


Figure 5.4 All Parameters Displayed

9. Press the **Escape** key to return to the Main menu screen.

6. Calibrate

All of the sensors, except temperature, require periodic calibration to assure high performance. You will find specific calibration procedures for all sensors that require calibration in the following sections. If a sensor listed is not installed in your probe module, skip that section and proceed to the next sensor until the calibration is complete.

⚠ **CAUTION:** Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review *Appendix D Health and Safety*. Some calibration standard solutions may require special handling.

6.1 Getting Ready to Calibrate

6.1.1 Containers Needed to Calibrate the Probe Module

The transport/calibration cup that comes with your probe module serves as a calibration chamber for all calibrations and minimizes the volume of calibration reagents required.

Instead of the transport/calibration cup, you may use laboratory glassware to perform calibrations. If you do not use the transport/calibration cup that is designed for the probe module, you are cautioned to do the following:

- ✓ Perform all calibrations with the Probe Sensor Guard installed. This protects the sensors from possible physical damage.
- ✓ Use a ring stand and clamp to secure the probe module body to prevent the module from falling over. Most laboratory glassware has convex bottoms.
- ✓ Ensure that all sensors are immersed in calibration solutions. Many of the calibrations factor in readings from other sensors (e.g., temperature sensor). The top vent hole of the conductivity sensor must also be immersed during some calibrations.

6.1.2 Calibration Tips

1. If you use the Transport/Calibration Cup for dissolved oxygen (DO) calibration, make certain to loosen the seal to allow pressure equilibration before calibration. The DO calibration is a water-saturated air calibration.

2. When calibrating pH, always calibrate with buffer 7 first, regardless if performing a 1, 2, or 3 point calibration

3. The key to successful calibration is to ensure that the sensors are completely submersed when calibration values are entered. Use recommended volumes when performing calibrations.

4. For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the probe module. You may wish to save old calibration standards for this purpose.

5. Fill a bucket with ambient temperature water to rinse the probe module between calibration solutions.

6. Have several clean, absorbent paper towels or cotton cloths available to dry the probe module between rinses and calibration solutions. Shake the excess rinse water off of the probe module, especially when the probe sensor guard is installed. Dry off the outside of the probe module and probe sensor guard. Making sure that the probe module is dry reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration.

7. If you are using laboratory glassware for calibration, you do not need to remove the probe sensor guard to rinse and dry the sensors between calibration solutions. The inaccuracy resulting from simply rinsing the sensor compartment and drying the outside of the guard is minimal.

8. If you are using laboratory glassware, remove the stainless steel weight from the bottom of the probe sensor guard by turning the weight counterclockwise. When the weight is removed, the calibration solutions have access to the sensors

without displacing a lot of fluid. This also reduces the amount of liquid that is carried between calibrations.

9. Make certain that port plugs are installed in all ports where sensors are not installed. It is extremely important to keep these electrical connectors dry.

6.1.3 Recommended Volumes

Follow these instructions to use the transport/calibration cup for calibration procedures.

- ✓ Ensure that an o-ring is installed in the o-ring groove of the transport/calibration cup bottom cap, and that the bottom cap is securely tightened.

  NOTE: Do not over-tighten as this could cause damage to the threaded portions.

- ✓ Remove the probe sensor guard, if it is installed.
- ✓ Remove the o-ring, if installed, from the probe module and inspect the installed o-ring on the probe module for obvious defects and, if necessary, replace it with the extra o-ring supplied.
- ✓ Some calibrations can be accomplished with the probe module upright or upside down. A separate clamp and stand, such as a ring stand, is required to support the probe module in the upside down position.
- ✓ To calibrate, follow the procedures in the next section, Calibration Procedures. The approximate volumes of the reagents are specified below for both the upright and upside down orientations.
- ✓ When using the Transport/Calibration Cup for dissolved oxygen % saturation calibration, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly and that approximately 1/8 inch (3 cm) of water is present in the cup.

Sensor to Calibrate	Upright	Upside Down
Conductivity	55ml	55ml
pH/ORP	30ml	60ml

Table 6.1 Calibration Volumes

6.2 Calibration Procedures

6.2.1 Accessing the Calibrate Screen

1. Press the **On/off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **Calibrate** selection.

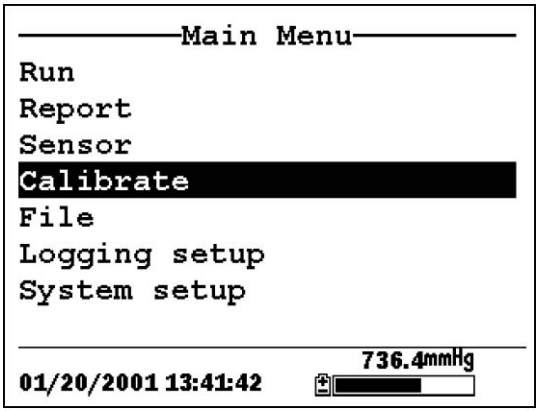


Figure 6.1 Main Menu

4. Press the **Enter** key. The Calibrate screen will be displayed.

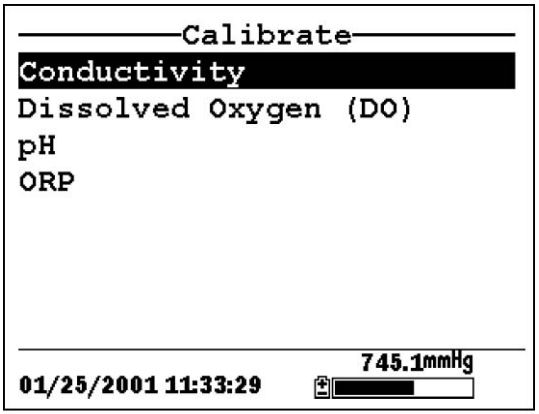


Figure 6.2 Calibrate Screen

6.2.2 Conductivity Calibration

This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

1. Go to the calibrate screen as described in Section *6.2.1Accessing the Calibrate Screen.*.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The Conductivity Calibration Screen is displayed.

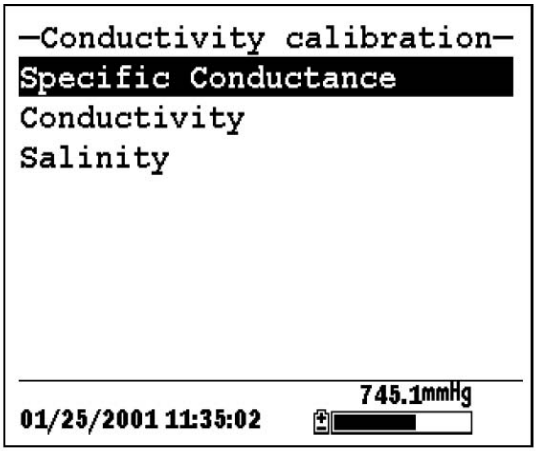


Figure 6.3 Conductivity Calibration Selection Screen

4. Use the arrow keys to highlight the Specific Conductance selection.

5. Press **Enter**. The Conductivity Calibration Entry Screen is displayed.

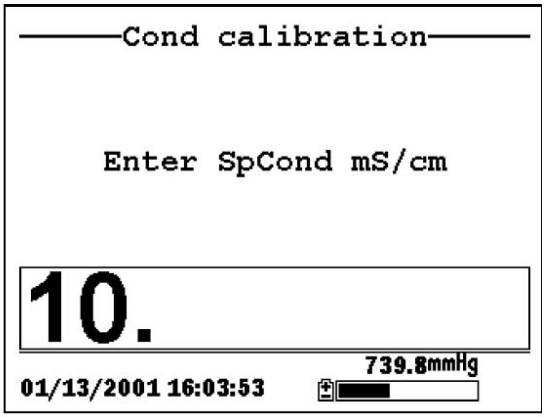


Figure 6.4 Conductivity Calibration Selection Screen

6. Place the correct amount of conductivity standard (see Table 6.1 Calibration Volumes) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the conductivity standard you choose should be within the same conductivity range as the samples you are preparing to measure. However, we do not recommend using standards less than 1 mS/cm. For example:

- ✓ For fresh water use a 1 mS/cm conductivity standard.
- ✓ For brackish water use a 10 mS/cm conductivity standard.
- ✓ For seawater use a 50 mS/cm conductivity standard.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that you avoid cross-contamination of solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP sensors, particularly if you are employing standards of low conductivity.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the vent hole is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not over tighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the standard you are using.

NOTE: Be sure to enter the value in **mS/cm at 25°C**.

11. Press **Enter**. The Conductivity Calibration Screen is displayed.

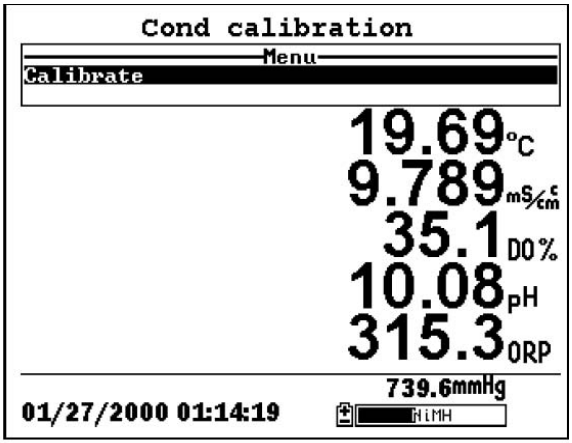


Figure 6.5 Conductivity Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

13. Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

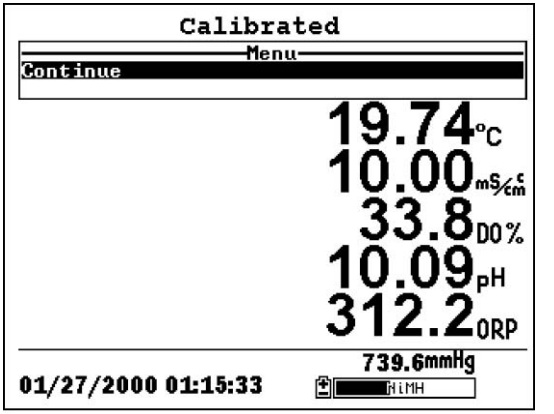


Figure 6.6 Calibrated

14. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen..

15. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen .

16. Rinse the probe module and sensors in tap or purified water and dry.

6.2.3 Dissolved Oxygen Calibration

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

NOTE: The instrument must be on for at least 10 - 15 minutes to polarize the DO sensor before calibrating.

2. Use the arrow keys to highlight the **Dissolved Oxygen** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The dissolved oxygen calibration screen is displayed.

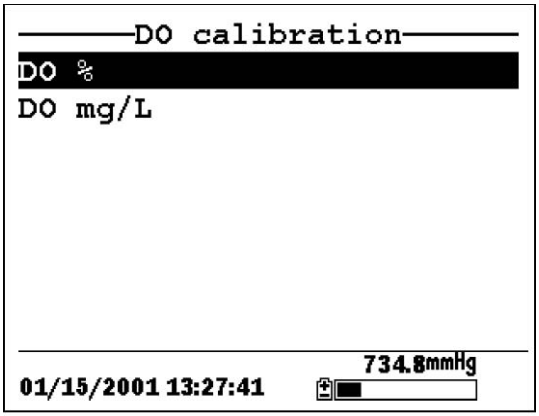


Figure 6.7 DO Calibration Screen

DO Calibration in % Saturation

1. Use the arrow keys to highlight the DO% selection.

2. Press **Enter**. The DO Barometric Pressure Entry Screen is displayed.

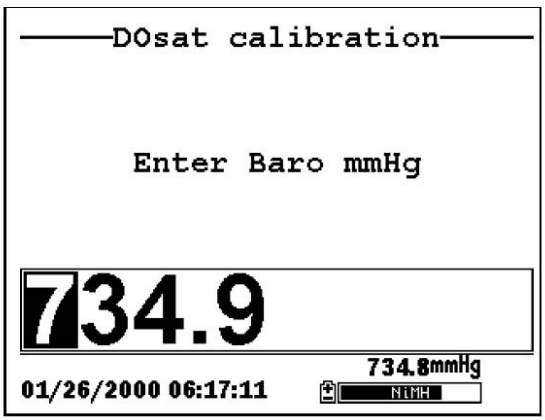


Figure 6.8 DO Barometric Pressure Entry Screen

3. Place approximately 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup.

4. Place the probe module into the transport/calibration cup.

NOTE: Make sure that the DO and temperature sensors are **not** immersed in the water.

5. Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.

6. Use the keypad to enter the current local barometric pressure.

NOTE: If the unit has the optional barometer, no entry is required.

NOTE: Barometer readings that appear in meteorological reports are generally corrected to sea level and must be uncorrected before use (refer to Section *10.10 Calibrate Barometer, Step 2*).

7. Press **Enter**. The DO% saturation calibration screen is displayed.

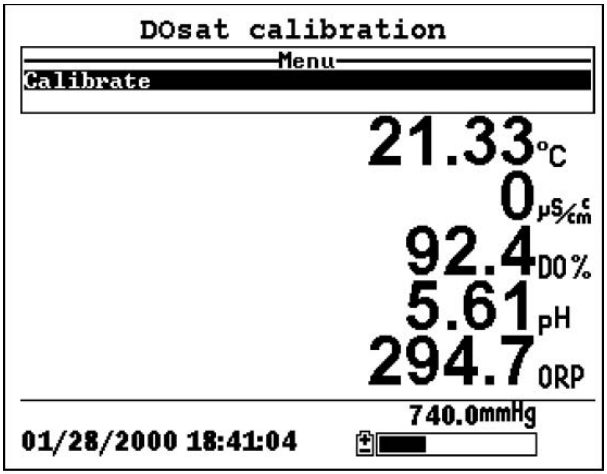


Figure 6.9 DO Sat Calibration Screen

8. Allow approximately ten minutes for the air in the transport/calibration cup to become water saturated and for the temperature to equilibrate before proceeding.

9. Observe the reading under DO %. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue. See Figure 6.6 Calibrated.

10. Press **Enter**. This returns you to the DO calibration screen, See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

DO Calibration in mg/L

DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).

1. Go to the DO calibrate screen as described in Section *6.2.3 Dissolved Oxygen Calibration*, steps 1 through 3.

2. Use the arrow keys to highlight the **DO mg/L** selection.

3. Press **Enter**. The DO mg/L Entry Screen is displayed.

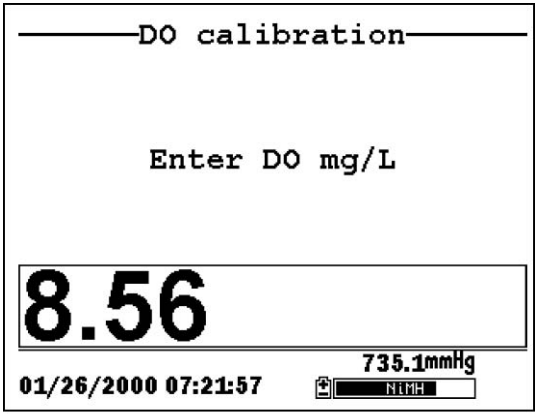


Figure 6.10 DO mg/L Entry Screen

4. Place the probe module in water with a known DO concentration.

NOTE: Be sure to completely immerse all the sensors.

5. Use the keypad to enter the known DO concentration of the water.

6. Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.

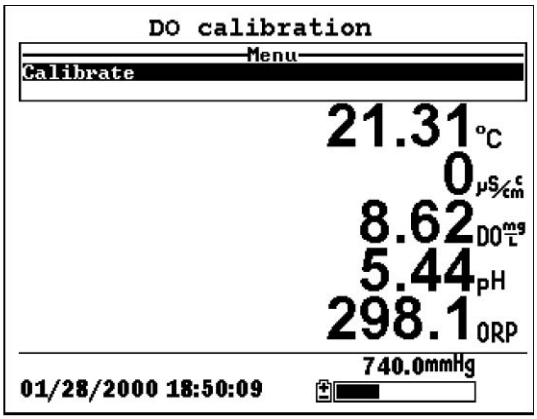


Figure 6.11 DO mg/L Calibration Screen

7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.

8. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

10. Press **Enter**. This returns you to the DO calibration screen. See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

6.2.4 pH Calibration

1. Go to the calibrate screen as described in *Section 6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **pH** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The pH calibration screen is displayed.

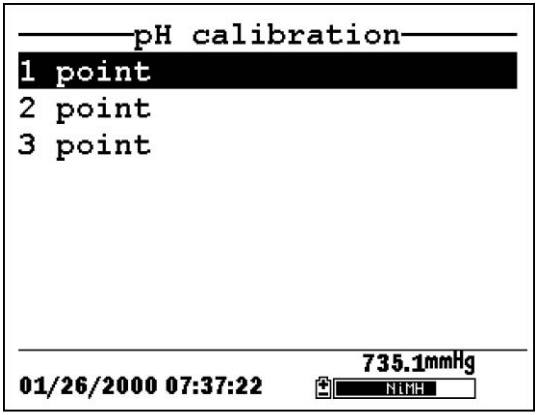


Figure 6.12 pH Calibration Screen

- Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
- Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
- Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.

4. Use the arrow keys to highlight the **2-point** selection.

5. Press **Enter**. The pH Entry Screen is displayed.

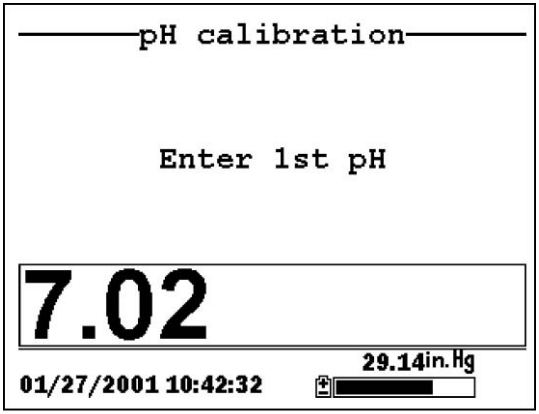


Figure 6.13 pH Entry Screen

6. Place the correct amount (see Table 6.1 Calibration Volumes) of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

NOTE: Always calibrate with buffer 7 first, regardless if performing a 1, 2, or 3 point calibration.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten

NOTE: Do not over tighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

11. Press **Enter**. The pH calibration screen is displayed.

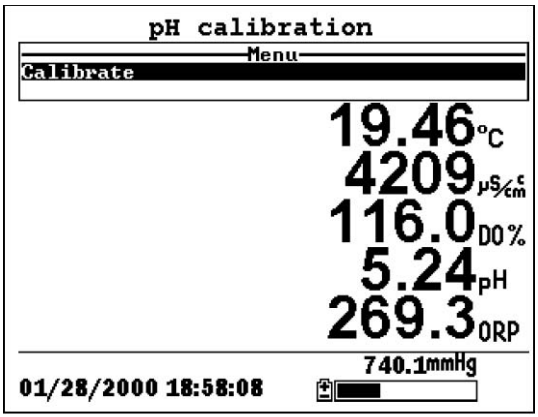


Figure 6.14 pH Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

13. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**.

The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

14. Press **Enter**. This returns you to the specified pH Calibration Screen, See Figure 6.13 pH Entry Screen.

15. Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.

16. Repeat steps 6 through 13 above using a second pH buffer.

17. Press **Enter**. This returns you to the pH Calibration Screen, See Figure 6.12 pH Calibration Screen.

18. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

19. Rinse the probe module and sensors in tap or purified water and dry.

6.2.5 ORP Calibration

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **ORP** selection. See Figure 6.2 Calibrate Screen..

3. Press **Enter**. The ORP calibration screen is displayed.

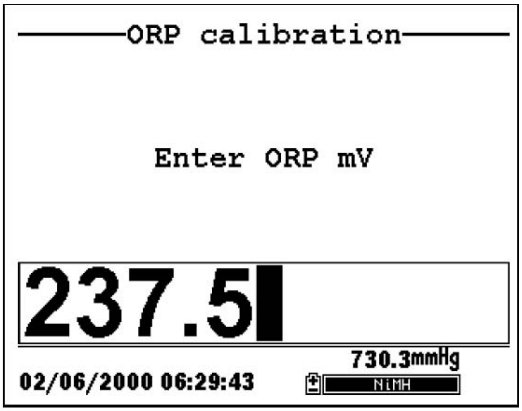


Figure 6.15 Specified ORP Calibration Screen

4. Place the correct amount (see Table 6.1 Calibration Volumes) of a known ORP solution (we recommend Zobell solution) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.

5. Carefully immerse the sensor end of the probe module into the solution.

6. Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes should ensure that the sensor is covered.

7. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not over tighten as this could cause damage to the threaded portions.

8. Use the keypad to enter the correct value of the calibration solution you are using at the current temperature. Refer to Table 6.2 Zobell Solution Values.

Temperature °C	Zobell Solution Value, mV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5
45	205.0
50	198.5

Table 6.2 Zobell Solution Values

9. Press **Enter**. The ORP calibration screen is displayed.

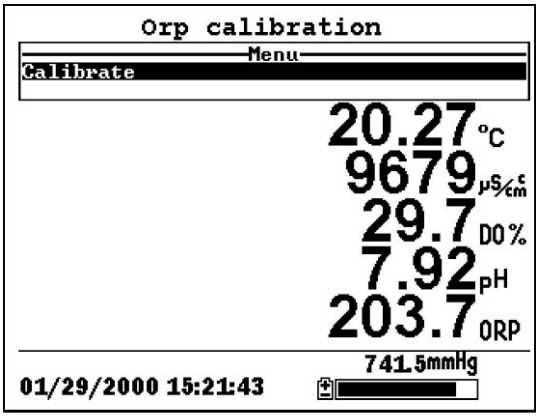


Figure 6.16 DO Cal Screen

10. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

NOTE: Verify that the temperature reading matches the value you used in Table 6.2 Zobell Solution Values.

11. Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

12. Press **Enter**. This returns you to the Calibrate Screen. See Figure 6.2 Calibrate Screen.

13. Rinse the probe module and sensors in tap or purified water and dry.

6.3 Return to Factory Settings.

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

   NOTE: We will use the Conductivity sensor as an example; however, this process will work for any sensor.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed. See Figure 6.3 Conductivity Calibration Selection Screen.

4. Use the arrow keys to highlight the **Specific Conductance** selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed. See Figure 6.4 Conductivity Calibration Entry Screen.

6. Press and hold the **Enter** key down and press the **Escape** key.

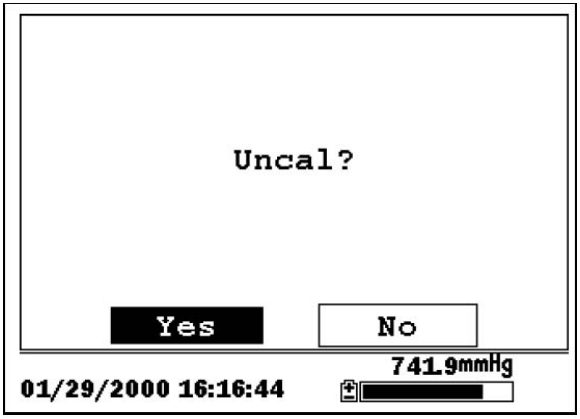


Figure 6.17 ORP Calibration Screen

7. Use the arrow keys to highlight the **YES** selection.

CAUTION: This returns a sensor to the factory settings. For example, in selecting to return specific conductance to the factory setting, salinity and conductivity will automatically return to their factory settings.

8. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen. .

9. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

7. Run

The Run screen displays data from the sensors in real-time and allows the user to log sample data to memory for later analysis. Refer to Section *9 Logging* for details on logging sample data.

7.1 Real-Time Data

NOTE: Before measuring samples you must prepare the probe module (refer to Section *3.4 Preparing the Probe Module*), attach the probe module to the instrument (refer to Section *3.6 Instrument/Cable Connection*) and calibrate the sensors (refer to Section *6 Calibrate*).

1. Press the On/off key.

OR select Run from the main menu to display the run screen.

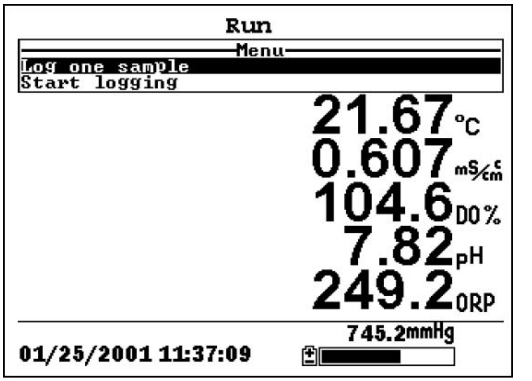


Figure 7.1 Run Screen

2. Make sure the probe sensor guard is installed.

3. Place the probe module in the sample. Be sure to completely immerse all the sensors.

4. Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.

5. Watch the readings on the display until they are stable.

6. Refer to Section *9 Logging* for instructions on logging sample data.

8. File

The File menu allows the user to view, upload or delete sample data and calibration record files stored in the YSI 556 MPS.

8.1 Accessing the File Screen

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

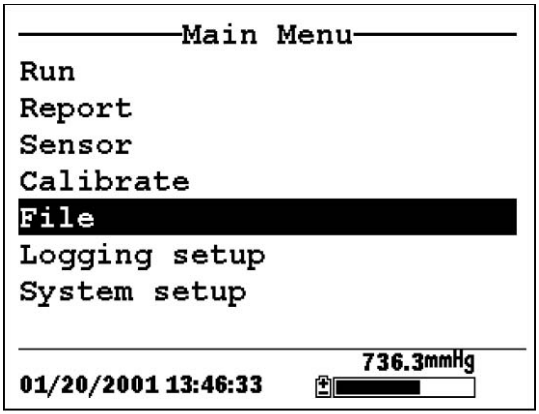


Figure 8.1 Main Menu Screen

3. Use the arrow keys to highlight the **File** selection.

4. Press the **Enter** key. The file screen is displayed.

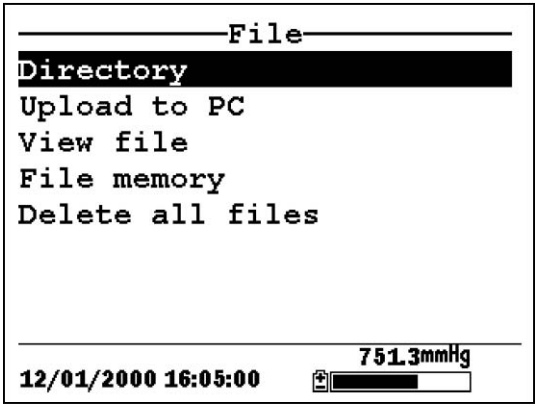


Figure 8.2 File Screen

8.2 Directory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Directory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file list screen is displayed.

NOTE: Files are listed in the order in which they are logged to memory. Sample Data files have the file extension **.dat**, while Calibration Record files have the file extension **.glp**.

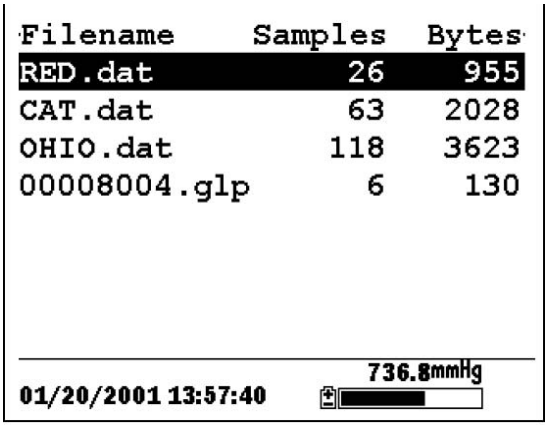


Figure 8.3 File List Screen

4. Use the arrow keys to highlight a file.

5. Press the **Enter** key. The file details screen is displayed.

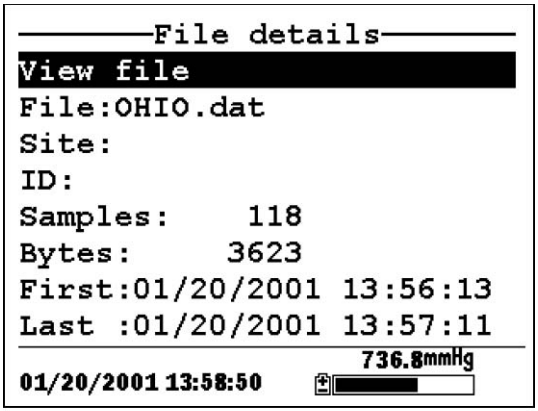


Figure 8.4 File Details Screen

6. Press the **Enter** key to view the file data. Refer to Section *8.3 View File* for details.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.3 View File

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*. See Figure 8.2 File Screen.

2. Use the arrow keys to highlight the **View file** selection.

3. Press the **Enter** key. A list of files is displayed. See Figure 8.3 File List Screen.

4. Use the arrow keys to highlight an individual file.

   NOTE: You may have to scroll down to see all the files.

5. Press the **Enter** key. The file data is displayed with the file name at t8e top of the display.

   NOTE: If no file name was specified, the data is stored under the default name NONAME1.dat.

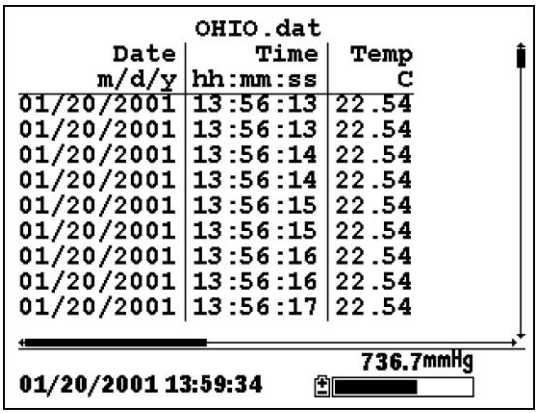


Figure 8.5 File Data Screen

6. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.4 Upload to PC

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. Refer to *Appendix G EcoWatch* for more information. EcoWatch for Windows® is available at no cost via a download from the YSI Web Site (www.ysi.com) or by contacting YSI Customer Support. Refer to *Appendix E Customer Service.*

8.4.1 Upload Setup

1. Disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

2. Connect the YSI 556 MPS to a serial (Comm) port of your computer via the 655173 PC Interface cable as shown in the following diagram:

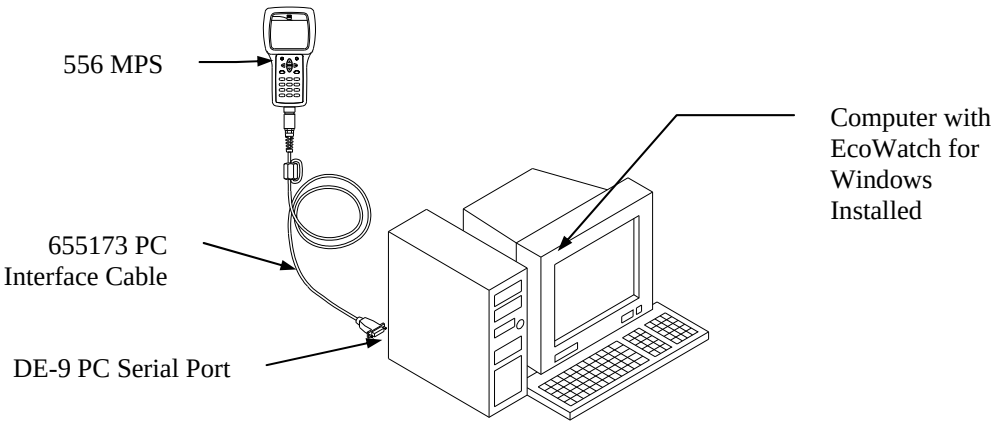


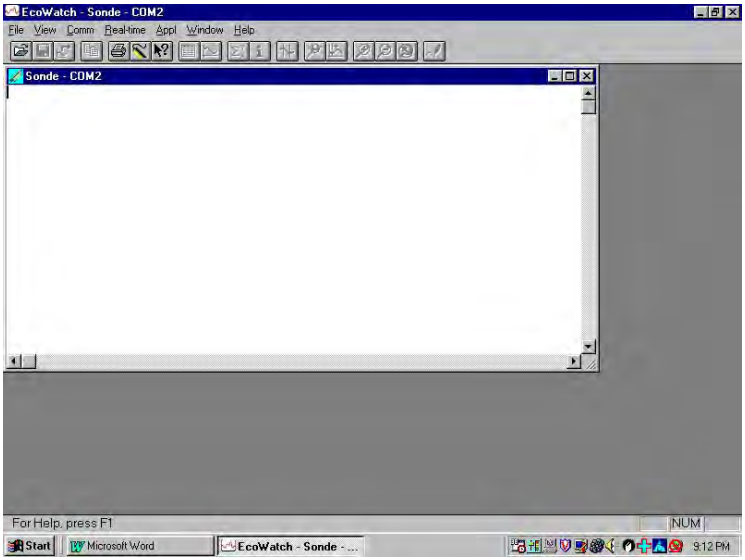
Figure 8.2 Computer/Instrument Interface

3. Open EcoWatch for Windows on your computer.

   NOTE: See *Appendix G EcoWatch* for installation instructions.

4. Click on the sonde/probe icon in the upper toolbar.

5. Set the Comm port number to match the port the YSI 556 MPS is connected to. After this setup procedure, the following screen will be present on your PC monitor:



8.4.2 Uploading a .DAT File

1. Setup the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section *8.1 Accessing the File Screen.*

3. Use the arrow keys to highlight the **Upload to PC** selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the DAT file that you wish to transfer and press **Enter**, both the YSI 556 MPS and PC displays show the progress of the file transfer.

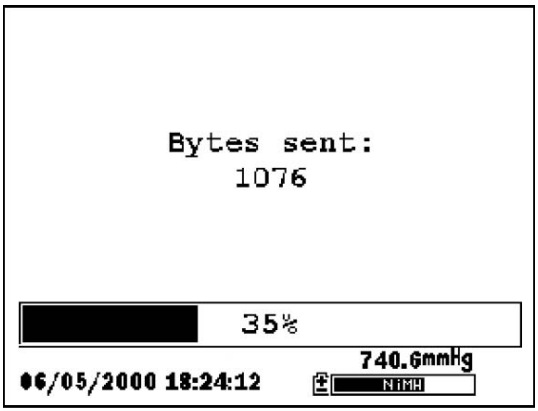
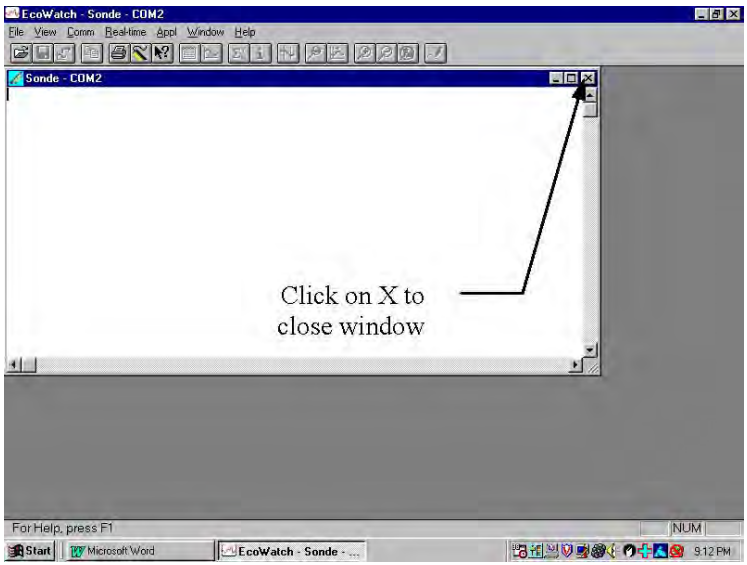


Figure 8.3 File Transfer Progress Screen

NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with a .DAT extension.

6. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the "X" at its upper right corner.



7. Press the **Escape** key on the YSI 556 MPS repeatedly to return

to the main menu screen.

8.4.3 Uploading a Calibration Record (.glp) File

For more information on the calibration record, refer to *Appendix H Calibration Record Information*.

1. Setup up the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section

3. Use the arrow keys to highlight the Upload to PC selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the calibration record file that you wish to transfer and press **Enter.**

6. You will then be given a choice of uploading the file in three formats; **Binary, Comma & “” Delimited, and ASCII Text**.

   NOTE: The binary format is reserved for future YSI software packages.

7. Choose an option and press Enter, both the YSI 556 and PC displays show the progress of the file transfer.

   NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with the appropriate file extension.

   NOTE: To view the Calibration Record data after upload, simply open the .txt file in a general text editor such as Wordpad or Notepad.

8. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the “X” at its upper right corner.

9. Press the **Escape** key repeatedly to return to the main menu screen.

8.5 File Memory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **File memory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file bytes used screen is displayed.

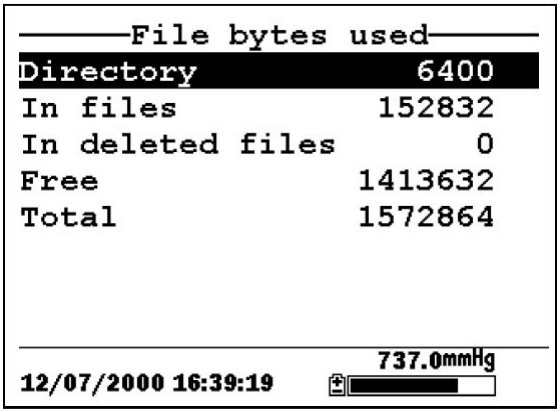


Figure 8.4 File Bytes Used Screen

4. The amount of free memory is listed in line 4 of the file bytes used screen.

   NOTE: If the amount of free memory is low, it may be time to delete all files (after first uploading all data to a PC). Refer to Section *8.6 Delete All Files*.

5. Press the **Escape** key repeatedly to return to the main menu screen.

8.6 Delete All Files

NOTE: It is not possible to delete individual files in order to free up memory. The only way to free up memory is to delete ALL files present. Take care to transfer all files to your computer (refer to Section 8.4 Upload to PC) before deleting them.

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Delete all files** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The Delete all Files screen is displayed.

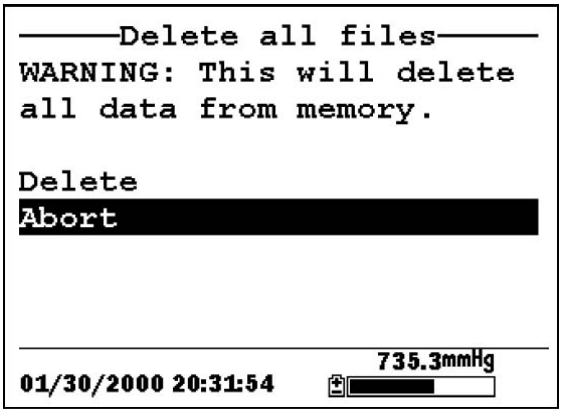


Figure 8.5 Delete All Files Screen

4. Use the arrow keys to highlight the **Delete** selection.

5. Press the **Enter** key.

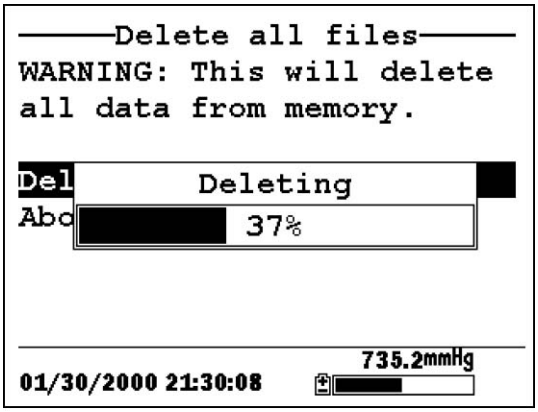


Figure 8.10 Deleting

The progress of file deletion is displayed in bar graph format.

NOTE: Deleting all files in the directory will not change any information in the site list.

6. Press the Escape key repeatedly to return to the main menu screen.

9. Logging

9.1 Accessing the Logging Setup Screen

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

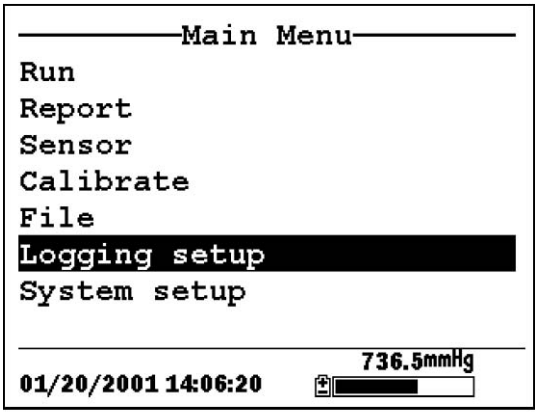


Figure 9.1 Main Menu

3. Use the arrow keys to highlight the **Logging setup** selection.

4. Press the **Enter** key. The logging setup screen is displayed.

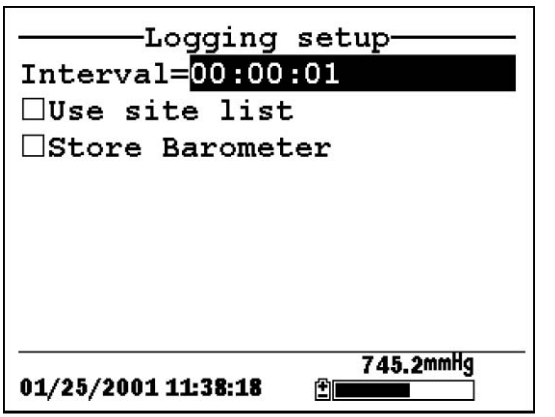


Figure 9.2 Setup Screen

9.2 Setting Logging Interval

Follow steps below to set the interval for logging a data stream.

NOTE: If you do not specify an interval, the instrument will use a default interval setting of 1 second.

NOTE: It is not necessary to set a logging interval when logging a single sample.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the keypad to enter an interval between 1 second and 15 minutes. Refer to Section *2.9 Keypad Use*.

   NOTE: The interval field has hour, minute and second entry fields. Any entry over 1 hour will change automatically to a 15-minute setting.

3. Press the **Enter** key. The data stream interval is set.

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.3 Storing Barometer Readings

NOTE: The **Store barometer** option is only available on instruments that are equipped with the optional barometer.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Store barometer** selection. See Figure 9.2 Logging Setup Screen.

3. Press the **Enter** key until a check mark is entered in the box next to the store barometer selection if you want to log barometric readings.

OR press the **Enter** key until the box next to the barometer selection is empty if you do not want to log barometric readings.

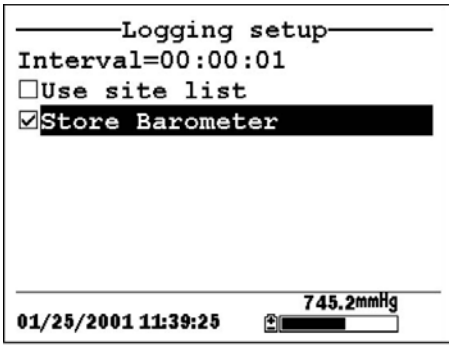


Figure 9.3 Store Barometer

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.4 Creating a Site List

The site list option allows you to define file and site descriptions in the office or laboratory before moving to field logging studies. This is usually more convenient than entering the information at the site and is particularly valuable if you are visiting certain sites on a regular basis. The following section describes how to set up site lists which contain entries designated "Site Descriptions" that will be instantly available to the user in the field to facilitate the logging of data with pre-established naming of files and sites. There are two kinds of **Site Descriptions** available for use in Site lists:

• **Site Descriptions** associated with applications where data from a single site is always logged to a single file. This type is referred to as a "Single-Site Description" and is characterized by two parameters – a file name and a site name. Files logged to YSI 556 MPS memory under a **Single-Site Description** will be characterized primarily by the file name, but will also have the Site name attached, so that it is viewable in either the YSI 556 MPS **File directory** or in EcoWatch for Windows after upload to a PC

• **Site Descriptions** associated with applications where data from multiple sites are logged to a single file. This type is referred to as a "Multi-site Description" and is characterized by three parameters – a file name, a site name, and a site number. Files logged to YSI 556 MPS memory under a

Multi-site Description are characterized by a file name, but not a site name, since multiple sites are involved. However, each data point has a Site Number attached to it so that the user can easily determine the sampling site when viewing the data from the YSI 556 MPS **File** menu or processing the data in EcoWatch for Windows after upload to a PC.

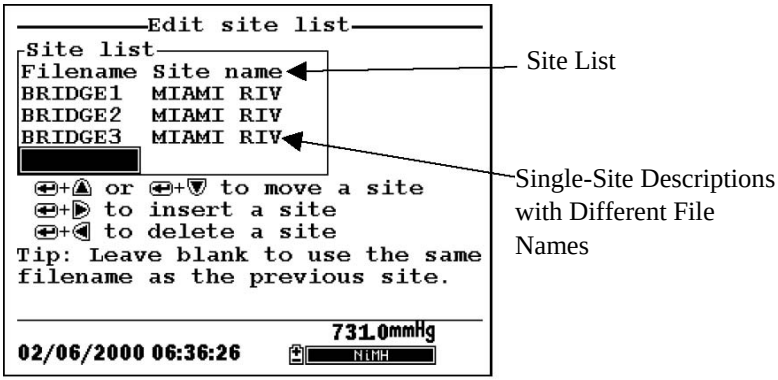


Figure 9.4 Single-Site Descriptions

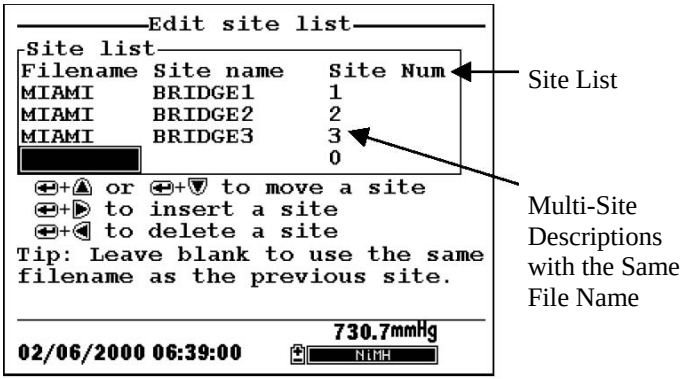


Figure 9.5 Multiple-Site Descriptions

NOTE: Site lists containing Single Site Descriptions are usually input with the designation **Store Site Number** INACTIVE in the YSI 556 MPS **Logging setup** menu. Thus, no site numbers appear in the first **Site list** example. Conversely, **Site lists** containing **Multi-Site Descriptions** MUST be input with the **Store Site Number** selection ACTIVE as shown in the second example.

To create a site list:

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Use site list** selection.

3. Press the **Enter** key. A check mark is entered in the box next to the use site list selection *and* two new entries appear on the logging setup screen. See Figure 9.6 Logging Setup Screen.

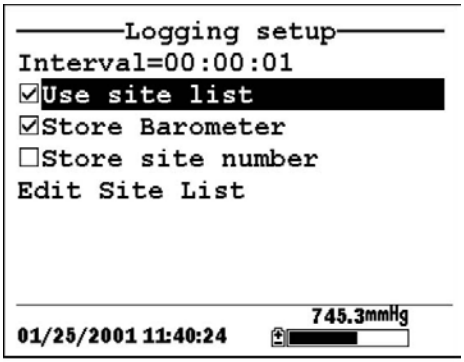


Figure 9.6 Logging Setup Screen

4. Use the arrow keys to highlight the **Store site number** selection.

5. If you are creating Multi-Site Descriptions (which require that the site **number** be stored in your data files), press the **Enter** key until a check mark appears in the box next to the store site number selection.

OR Press the **Enter** key until the box next to the store site number selection is empty, to create Single-Site Descriptions. The site **name** will be stored in the header of your data files.

6. Use the arrow keys to highlight the **Edit site list** selection.

7. Press the **Enter** key. The edit site list screen is displayed. See Figure 9.7 Edit Site List Screen. The **Filename** field is ready for input.

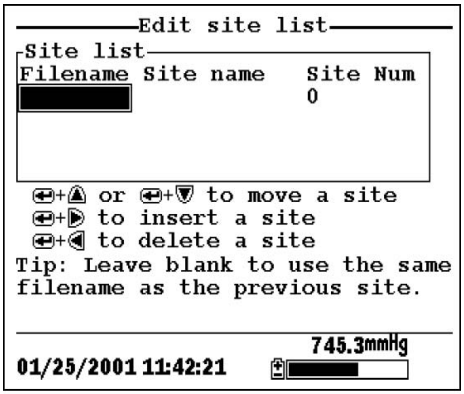


Figure 9.7 Edit Site List Screen

8. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.

9. Press the **Enter** key. The cursor moves to the right for the entry of a **Site name**.

10. Use the keypad to enter a site name up to 11 characters in length. Refer to Section *2.9 Keypad Use*.

NOTE: If the store site number selection is *not* checked, skip to Step 13.

11. Press the **Enter** key. The cursor moves to the site number entry position.

12. Use the keypad to enter a site number up to 7 characters in length. Refer to Section *2.9 Keypad Use*.

13. Press **Enter**. The cursor moves to the next filename entry position.

14. Repeat Steps 8 to 13 until all filenames and sites have been entered.

15. Press **Escape** repeatedly to return to the main menu screen.

9.5 Editing a Site List

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Edit Site List** selection. See Figure 9.6 Logging Setup Screen.

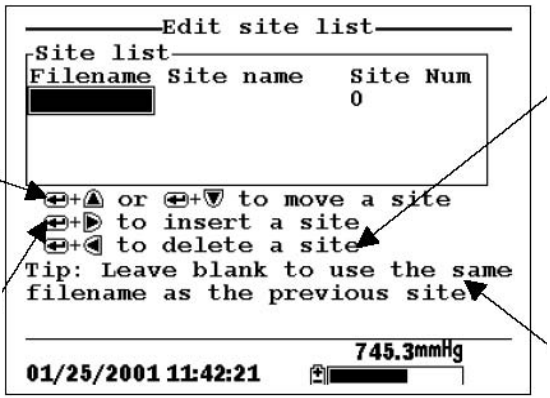
3. Press the **Enter** key. The edit site list screen is displayed.

4. Edit the site list using the keystrokes described below.

NOTE: Editing the site list will not have any effect on files stored in the instrument memory.

To MOVE a site:
Use the arrow keys to highlight a site. Press the Up or Down arrow key while holding down the Enter key.

To INSERT a site above another site:
Use the arrow keys to highlight the site. Press the Right arrow key while holding down the Enter key. Use keypad to input letters. Refer to Section 2.9 *Keypad Use.*



To DELETE a site:
Use the arrow keys to highlight a site. Press the Left arrow key while holding down the Enter key.

To use the same file name as the previous site: **Leave the filename blank**

Figure 9.1 Keystrokes for Editing Site List

9.6 Logging Data Without a Site List

1. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

2. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged.

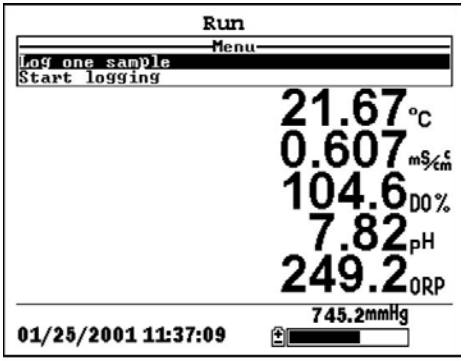


Figure 9.9 Run Screen

3. Press the **Enter** key. The Enter information screen is displayed.

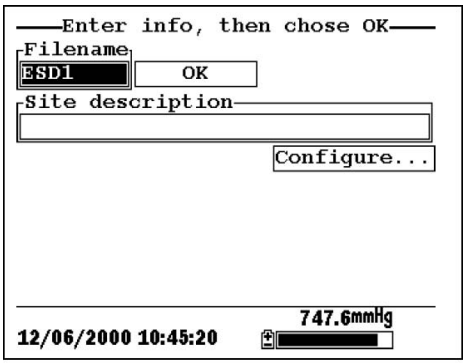


Figure 9.10 Enter Information Screen

NOTE: The last filename used will be displayed.

4. Use the keypad to enter a file name. Refer to Section *2.9 Keypad Use*.

NOTE: The instrument will assign a default file name of NONAME if no file name is specified.

5. Press the **Enter** key to input the file name.

6. Use the arrow keys to highlight the **Site description** field in the enter information screen.

   NOTE: Entering a Site Description is optional. You may leave the Site Description blank and skip to Step 9.

7. Use the keypad to enter a site description name. Refer to Section *2.9 Keypad Use*.

8. Press the **Enter** key to input the site description.

   NOTE: If you want to change the logging setup, such as sampling interval or storing the barometer reading, use the arrow keys to highlight the **Configure** field, press the **Enter** key, then refer to Section *9.2 Setting Logging Interval* or *9.3 Storing Barometer Readings* for details.

9. Use the arrow keys to highlight the **OK** field in the center of the information screen.

10. Press the **Enter** key to start logging.

    NOTE: If the parameter mismatch screen is displayed, refer to Section *9.8 Adding Data to Existing Files*.

11. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. Skip to Step

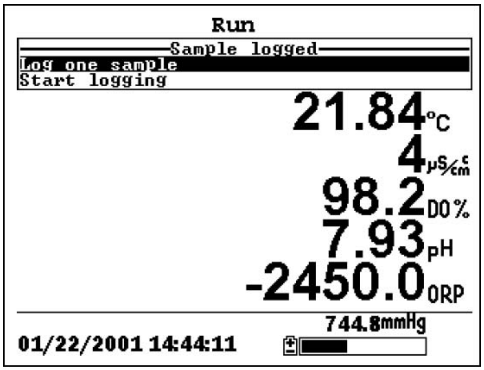


Figure 9.11 Sample Logged Screen

If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**.

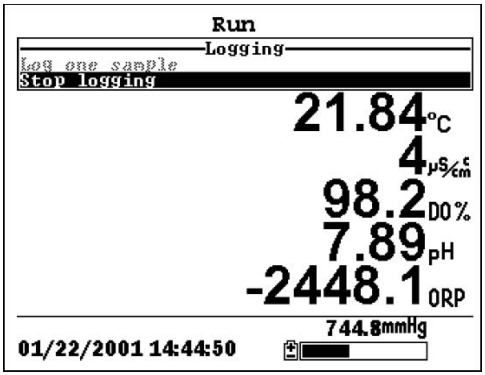


Figure 9.12 Logging Screen

12. At the end of the logging interval, press **Enter** to stop logging.

13. Refer to Section *8.3 View File* to view the data on the instrument display.

9.7 Logging Data with a Site List

1. If you have not already created a site list, refer to Section *9.4 Creating a Site List*.

2. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

3. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged. See Figure 9.9 Run Screen.

4. Press the **Enter** key. The Pick a site screen is displayed.

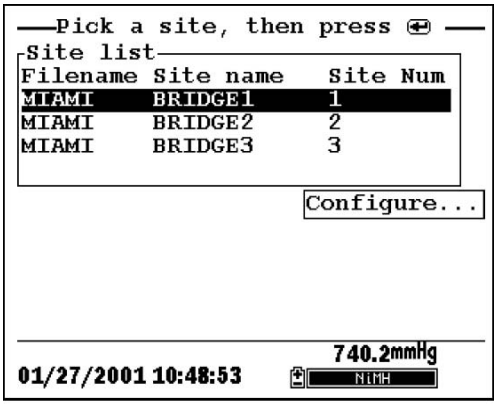


Figure 9.13 Pick a Site Screen

5. Use the arrow keys to highlight the **site** of your choice.

   NOTE: If the site of your choice is grayed out in the site list, refer to Section *9.8 Adding Data to Existing Files*.

   NOTE: Refer to Section *9.5 Editing a Site List* if you want to edit the site list.

6. Press the **Enter** key to start logging.

   NOTE: If the parameter mismatch screen is displayed, refer to Section 9.8 Adding Data to Existing Files.

7. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. See Figure 9.11 Sample Logged Screen. Skip to Step 9.

   If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**. See Figure 9.12 Logging Screen.

8. At the end of the logging interval, press **Enter** to stop logging.

9. Refer to Section *8.3 View File* to view the data on the instrument display.

9.8 Adding Data to Existing Files

In order to add new data to an existing file, the current logging and sensor setup must be *exactly* the same as when the file was created. The following settings must be the same:

- **Sensors enabled** (refer to Section *4 Sensors*)
- **Store Barometer** (refer to Section *9.3 Storing Barometer Readings*)
- **Store Site Number** (refer to Section *9.4 Creating a Site List*)

If the current logging setup is not exactly the same as when the file was created, a parameter mismatch screen is displayed.

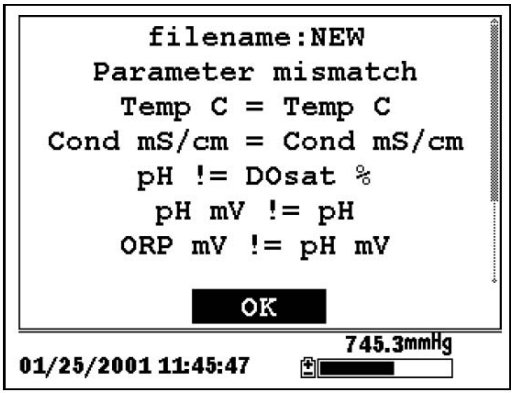


Figure 9.14 Parameter Mismatch Screen

NOTE: The right column shows parameters used when the file was created. The left column shows current parameters.

1. Press the **Down Arrow** key to scroll down and find the mismatch(es).

2. Use the following chart to resolve the mismatch(es).

Mismatch	**Action**	**Reference**
Sensor(s) missing from left column	Enable the missing sensor(s)	Section *4 Sensors*
Extra sensor(s) listed in left column	Disable the extra sensor(s)	Section *4 Sensors*
Barometer missing from left column, but present in right column	Enable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Barometer present in left column, but missing from right column	Disable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Store Site Number missing from left column, but present in right column	Enable the Store Site Number setting	Section *9.4 Creating a Site List*
Store Site Number present in left column, but missing from right column	Disable the Store Site Number setting	Section *9.4 Creating a Site List*

3. Return to Section *9.6 Logging Data without a Site List* or *9.7 Logging Data with a Site List*.

10. System Setup

The YSI 556 MPS has a number of features that are user-selectable or can be configured to meet the user's preferences. Most of these choices are found in the **System setup** menu.

10.1 Accessing the System Setup Screen

1. Press the **On/off** key to display the run screen. See Figure Front View of YSI 556 MPS.

2. Press the **Escape** key to display the main menu screen.

3. Use the arrow keys to highlight the **System setup** selection.

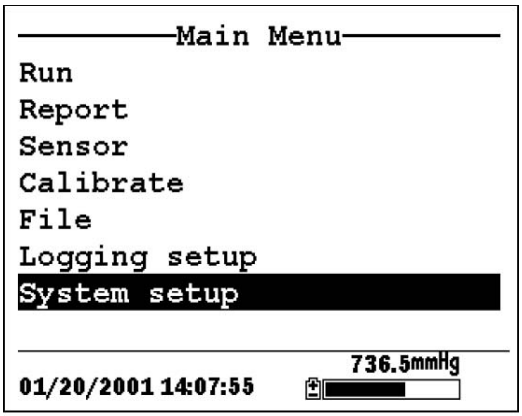


Figure 10.1 Main Menu

4. Press the **Enter** key. The system setup screen is displayed.

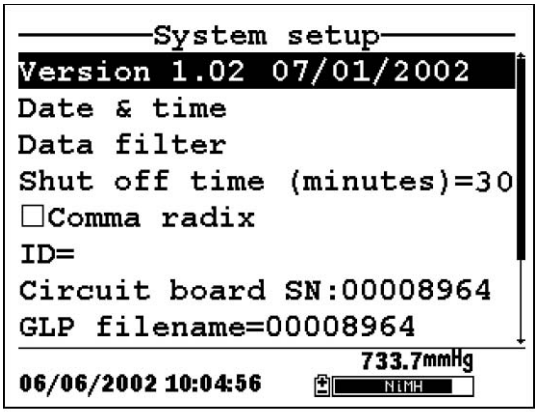


Figure 10.2 System Setup Screen

NOTE: The first line of the **System setup** menu shows the current software version of your YSI 556 MPS. As software enhancements are introduced, you will be able to upgrade your YSI 556 MPS from the YSI Web site. Refer to Section *11.2 Upgrading YSI 556 MPS* Software for details.

10.2 Language Setting

1. Go to the System Setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight **Language** on the System Setup screen. Press **Enter** to open the Language screen. .

3. Use the arrow keys to highlight your desired **Language**. Press **Enter**.

4. Press the Escape key repeatedly to return to the Main men

10.3 Date and Time Setup

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Date & time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press **Enter**. The date and time setup screen is displayed.

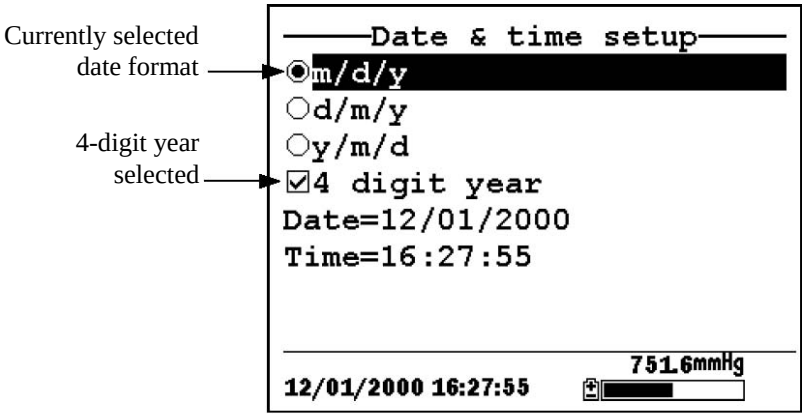


Figure 10.3 Date Setup Screen

NOTE: A black dot to the left of a date format indicates that format is selected.

4. Use the arrow keys to highlight your desired date format.

5. Press **Enter**.

6. Use the arrow keys to highlight the 4-digit year selection.

7. Press **Enter**. A check mark appears in the check box next to the 4-digit year selection.

   NOTE: If unchecked, a 2-digit year is used.

8. Use the arrow keys to highlight the **Date** selection.

9. Press **Enter**. A cursor appears over the first number in the date.

10. Enter the proper number from the keypad for the highlighted date digit. The cursor moves automatically to the next date digit. Refer to Section *2.9 Keypad Use* for more keypad information.

11. Repeat Step 10 until all date digits are correct.

12. Press **Enter** to input the specified date.

13. Use the arrow keys to highlight the **Time** selection.

14. Press **Enter**. A cursor appears over the first number in the time selection.

15. Enter the proper number from the keypad for the highlighted time digit. The cursor moves automatically to the next time digit.

    NOTE: Use military format when entering time. For example, 2:00 PM is entered as 14:00.

16. Repeat Step 15 until all time digits are correct.

17. Press **Enter** to input the correct time.

18. Press the **Escape** key repeatedly to return to the Main menu screen.

10.4 Data Filter

The Data Filter is a software filter that eliminates sensor noise and provides more stable readings.

NOTE: YSI recommends using the default values for the data filter for most field applications.

However, users who are primarily interested in a fast response from their dissolved oxygen sensor should consider a change of the default time constant setting of 8 seconds to one of 2 seconds. This change can be made according to the instructions in Section *10.3.1 Changing the Data Filter Settings* below. The disadvantage of lowering the time constant is that field pH readings may appear somewhat noisy if the cable is in motion.

10.4.1 Changing the Data Filter Settings

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Data filter** selection. See Figure 10.1 Main Menu.

3. Press the **Enter** key. The Data filter setup screen is displayed.

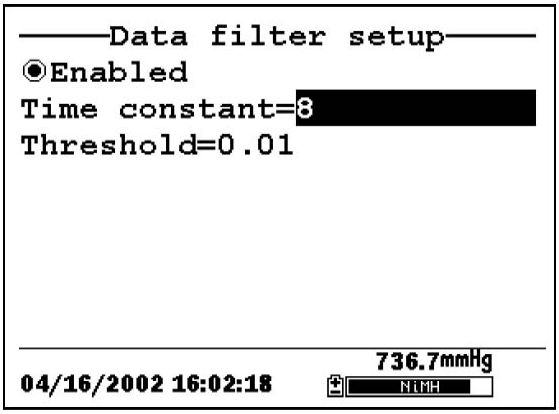


Figure 10.4 Data Filter Screen

4. With Enabled highlighted, press the **Enter** key to Enable or Disable the data filter. A black dot to the left of the selection indicates the data filter is enabled.

5. Use the arrow keys to highlight the **Time constant** field.

   NOTE: This value is the time constant in seconds for the software data filter. Increasing the time constant will result in greater filtering of the data, but will also slow down the apparent response of the sensors.

6. Use the keypad to enter a value. The default value is 8 and this value is ideal for most 556 field applications. As described in Section *10.3 Data Filter* above, users who wish to decrease the response time of the DO readings at the expense of some noise for the pH readings determined

concurrently, should change the Time Constant to a value of 2.

7. Press the **Enter** key to enter the time constant.

8. Use the arrow keys to highlight the **Threshold** field.

   NOTE: This value determines when the software data filter will engage/disengage, speeding the response to large changes in a reading. When the difference between two consecutive readings is larger than the threshold, then the reading is displayed unfiltered. When the difference between two consecutive readings drops below the threshold, readings will be filtered again.

9. Use the keypad to enter a value. The default value is 0.01.

10. Press the **Enter** key to enter the threshold.

11. Press the **Escape** key repeatedly to return to the Main menu screen.

10.5 Shutoff Time

The YSI 556 MPS shuts off automatically after 30 minutes of inactivity. The shut off time may be changed as described below.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Shutoff time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Use the keypad to enter a value from 0 to 60 minutes. The default value is 30.

   NOTE: To disable the automatic shutoff feature, enter a zero (0).

4. Press the **Enter** key to enter the correct shutoff time.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.6 Comma Radix

The user can toggle between a period (default) and comma for the radix mark by selecting this item and pressing the **Enter** key as follows:

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Comma radix** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press the **Enter** key. A check mark appears in the check box next to the comma radix selection indicating that the radix mark is a comma.

10.7 ID

This selection allows you to enter an identification name/number for your YSI 556 MPS. This ID name/number is logged in the header of each file.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **ID** selection. See Figure 10.1 Main Menu.

3. Use the keypad to enter an alphanumeric ID up to 15 characters in length. Refer to Section *2.9 Keypad Use*.

4. Press the **Enter** key to enter the ID.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.8 GLP Filename

This selection allows you to enter a different filename for the YSI 556 MPS Calibration Record file.

NOTE: The default filename is the “556 PC board Serial Number.glp.”

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.
2. Use the arrow keys to highlight the **GLP Filename** selection. See Figure 10.1 Main Menu.
3. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.
4. Press the **Enter** key to enter the new filename.
5. Press the **Escape** key repeatedly to return to the main menu screen.

10.9 TDS Constant

This selection allows you to set the constant used to calculate Total Dissolved Solids (TDS). TDS in g/L is calculated by multiplying this constant times the specific conductance in mS/cm.

10.9.1 Changing the TDS Constant

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.
2. Use the arrow keys to highlight the **TDS Constant** selection. See Figure 10.1 Main Menu.
3. Use the keypad to enter a value. Refer to Section *2.9 Keypad Use*. The default value is 0.65.
4. Press the **Enter** key to enter the correct TDS constant.
5. Press the **Escape** key repeatedly to return to the main menu screen.

10.10 Barometer Units

The following information is only for instruments with the barometer option.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Barometer units** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press the **Enter** key. The Barometer units screen will appear.

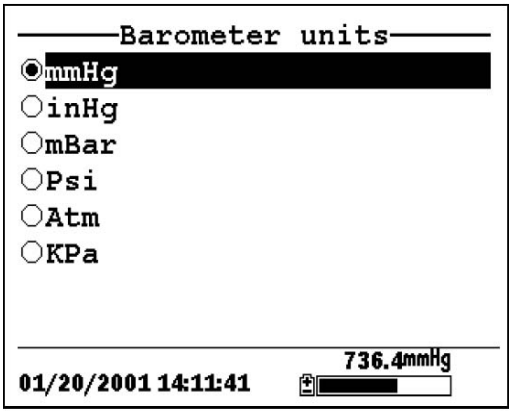


Figure 10.5 Data Filter Screen

A black dot indicates the currently selected units.

4. Use the arrow keys to highlight your desired barometric unit.

5. Press the **Enter** key to select your choice. A black dot will appear in the circle next to your selected units.

6. Press the **Escape** key repeatedly to return to the main menu screen.

10.11 Calibrate Barometer

The optional barometer has been factory calibrated to provide accurate readings. However, some sensor drift may occur over time, requiring occasional calibration by the user, as follows:

1. Determine your local barometric pressure from an independent laboratory barometer or from your local weather service.

2. If the barometric pressure (BP) reading is from your local weather station, reverse the equation that corrects it to sea level.

   NOTE: For this equation to be accurate, the barometric pressure units must be in mmHg.

   True BP = (Corrected BP) – [2.5 * (Local Altitude/100)]

3. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

4. Use the arrow keys to highlight the **Calibrate barometer** selection on the system setup screen. See Figure 10.2 System Setup Screen.

5. Press the **Enter** key. The Calibrate Barometer screen is displayed.

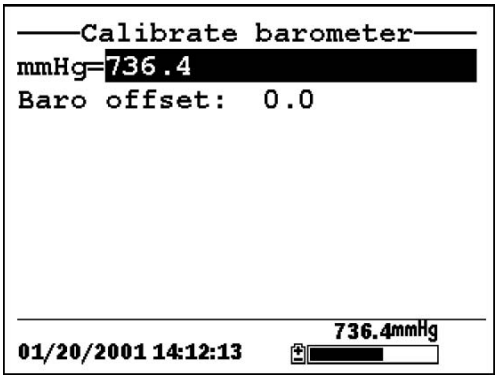


Figure 10.6 Barometer Calibration Screen

6. Use the keypad to input the known barometric pressure value as determined in Step 2.

7. Press the **Enter** key. The new barometer reading is displayed as well as the approximate offset from the factory reading.

   NOTE: To return the sensor to the factory setting, subtract the offset amount from the current setting and repeat Steps 5 to 7.

8. Press the **Escape** key repeatedly to return to the main menu screen.

11. Maintenance

11.1 Sensor Care and Maintenance

Once the sensors have been properly installed, remember that periodic cleaning and DO membrane changes are required.

11.1.1 DO Sensor

For best results, we recommend that the KCl solution and the membrane cap be changed at least once every 30 days.

1. It is important to recognize that oxygen dissolved in the sample is consumed during sensor operation. It is therefore essential that the sample be continuously stirred at the sensor tip. If stagnation occurs, your readings will be artificially low. Stirring may be accomplished by mechanically moving the sample around the sensor tip, or by rapidly moving the sensor through the sample. The rate of stirring should be at least 1 foot per second.

2. Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than 1/8" diameter) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, you should replace the membrane and the electrolyte solution. The average replacement interval is two to four weeks.

3. If the membrane is coated with oxygen consuming (e.g. bacteria) or oxygen producing organisms (e.g. algae), erroneous readings may occur.

4. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the sensor. If you suspect erroneous readings, it may be necessary to determine if these gases are the cause.

5. Avoid any environment that contains substances that may attack the probe module and sensor materials. Some of these substances are concentrated acids, caustics, and strong solvents. The sensor materials that come in contact

with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the PVC cable covering.

6. It is possible for the silver anode, which is the entire silver body of the sensor, to become contaminated. This will prevent successful calibration. To restore the anode, refer to Section *11.1.1 DO Sensor, Silver Anode Cleaning.*

7. For correct sensor operation, the gold cathode must always be bright. If it is tarnished (which can result from contact with certain gases), or plated with silver (which can result from extended use with a loose or wrinkled membrane), the gold surface must be restored. To restore the cathode, refer to Section *11.1.1 DO Sensor, Gold Cathode Cleaning.*

8. To keep the electrolyte from drying out, store the sensor in the transport/calibration cup with at least 1/8″ of water.

Silver Anode Cleaning

After extended use, a thick layer of AgCl builds up on the silver anode reducing the sensitivity of the sensor. The anode must be cleaned to remove this layer and restore proper performance. The cleaning can be chemical or mechanical:

Chemical Cleaning: Remove the membrane cap and soak the entire anode section in a 14% ammonium hydroxide solution for 2 to 3 minutes, followed by a thorough rinsing with distilled or deionized water. The anode should then be thoroughly wiped with a wet paper towel to remove the residual layer from the anode.

Mechanical Cleaning: Sand off the dark layer from the silver anode with 400 grit wet/dry sandpaper. Wrap the sandpaper around the anode and twist the sensor. Rinse the anode with clean water after sanding, followed by wiping thoroughly with a wet paper towel.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are still unable to calibrate, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

Gold Cathode Cleaning

For correct sensor operation, the gold cathode must be textured properly. It can become tarnished or plated with silver after extended use. The gold cathode can be cleaned by using the adhesive backed sanding disc and tool provided in the YSI 5238 Probe Reconditioning Kit.

Using the sanding paper provided in the YSI 5238 Probe Reconditioning Kit, wet sand the gold with a twisting motion about 3 times or until all silver deposits are removed and the gold appears to have a matte finish. Rinse the cathode with clean water after sanding, followed by wiping thoroughly with a wet paper towel. If the cathode remains tarnished, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

11.1.2 DO Sensor Replacement

1. Remove the probe sensor guard.

⚠ **CAUTION:** Thoroughly dry the sensor so that no water enters the probe module sensor port when the sensor is removed.

2. Insert the long end of the hex key wrench into the small hole in the side of the probe module bulkhead. Turn the wrench counterclockwise and remove the screw. (You do not have to remove the screw all the way to release the sensor.)

3. Pull the old DO sensor module straight out of the probe module body.

   NOTE: The DO sensor is not threaded, it is keyed, so it cannot be removed by twisting.

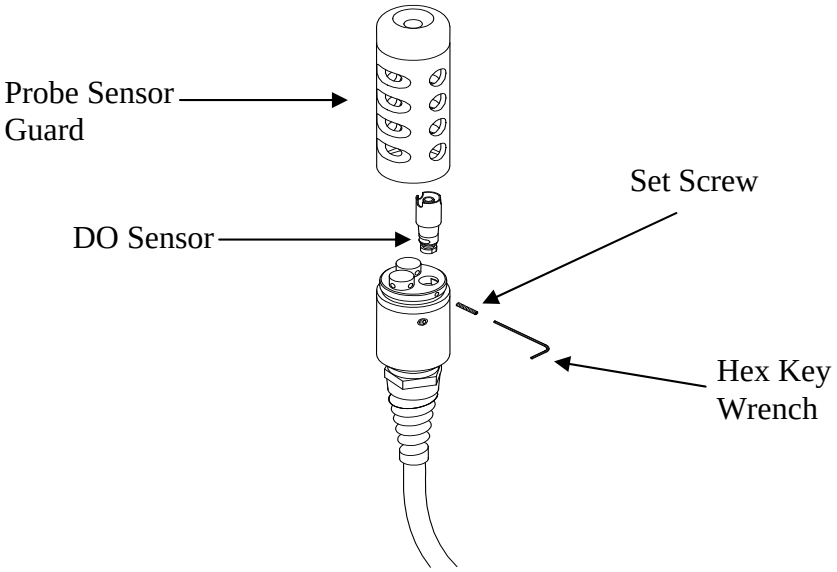


Figure 11.1 DO Sensor Replacement

4. Insert the new DO sensor module. Make sure that the inside of the probe module sensor port and the o-ring on the sensor are clean, with no contaminants, such as grease, dirt, or hair. The DO sensor is keyed, or has a flat side, so that it cannot be aligned improperly.

NOTE: Make sure the DO sensor bottoms out before the set screw is inserted.

5. Insert the set screw into the small hole in the side of the probe module bulkhead, and turn clockwise to rethread.

⚠ **CAUTION**: Make sure that you do not cross-thread the set screw. Use the hex key wrench to tighten the screw in properly, making sure that the screw does not stick out of the side of the probe module bulkhead. The probe sensor guard will not thread on properly and damage may result if the screw is allowed to stick out.

NOTE: The YSI 5563 DO sensor is shipped dry. A shipping membrane was installed to protect the electrode. A new membrane cap must be installed before the first use. Refer to Section 3.4.1 Sensor Installation.

11.1.3 YSI 5564 pH and 5565 Combination pH/ORP Sensor Cleaning

Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these sensors or when the response of the sensor becomes slow.

1. Remove the sensor from the probe module.

2. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb (YSI 5564 and YSI 5565) and platinum button (YSI 5565). Then use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor.

⚠ **CAUTION:** When using a cotton swab with the YSI 5564 or YSI 5565, be careful NOT to wedge the swab tip between the guard and the glass sensor. If necessary, remove cotton from the swab tip, so that the cotton can reach all parts of the sensor tip without stress.

NOTE: If good pH and/or ORP response is not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 10-15 minutes in clean water containing a few drops of commercial dishwashing liquid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the cleaning solution.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water.

   NOTE: If good pH and/or ORP response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 30-60 minutes in one molar (1 M) hydrochloric acid (HCl). This reagent can be purchased from most distributors. Be sure to follow the safety instructions included with the acid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the acid.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water. To be certain that all traces of the acid are removed from the sensor crevices, soak the sensor in clean water for about an hour with occasional stirring.

   NOTE: If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

1. Soak the sensor for approximately 1 hour in a 1 to 1 dilution of commercially available chlorine bleach.

2. Rinse the sensor with clean water and then soak for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. (If possible, soak the sensor for period of time longer than 1 hour in order to be certain that all traces of chlorine bleach are removed.) Then re-rinse the sensor with clean water and retest.`

11.1.4 Temperature/Conductivity Sensor Cleaning

The single most important requirement for accurate and reproducible results in conductivity measurement is a clean cell. A dirty cell will change the conductivity of a solution by contaminating it. The small cleaning brush included in the YSI 5511 Maintenance Kit is ideal for this purpose.

To clean the conductivity cell:

1. Dip the brush in clean water and insert it into each hole 1520 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

NOTE: In the event that deposits have formed on the electrodes, perform the following additional procedure:

1. Use a mild detergent solution in combination with the brush. Dip the brush in the solution and insert it into each hole 1520 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

   NOTE: After cleaning, check the response and accuracy of the conductivity cell with a calibration standard.

   NOTE: If this procedure is unsuccessful, or if sensor performance is impaired, it may be necessary to return the sensor to a YSI authorized service center for service, Refer to *Appendix E Customer Service*.

   The temperature portion of the sensor requires no maintenance.

11.2 Upgrading YSI 556 MPS Software

1. Access the YSI Environmental Software Downloads page as described in *Appendix G EcoWatch* Step 1 through 3.

2. Click on the **YSI Instruments Software Updates** link (or scroll down until you see YSI 556 MPS).

3. Click on the file icon to the right of the **YSI 556 MPS** listing and save the file to a temporary directory on your computer.

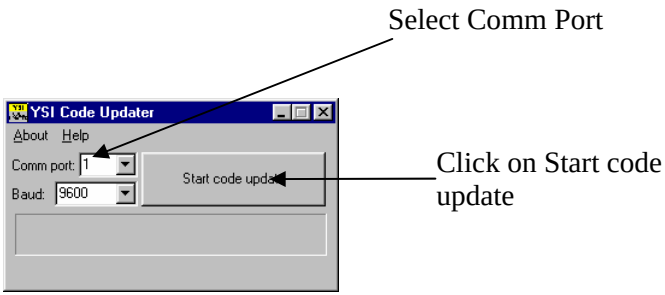
4. After the download is complete, run the file (that you just downloaded) and follow the on screen instructions to install the YSI Code Updater on your computer. If you encounter difficulties, contact YSI customer service for advice. Refer to *Appendix E Customer Service*.

5. If necessary, disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

6. Connect the YSI 556 MPS to a serial port of your computer via the 655173 PC interface cable. See Figure 8.6 Computer/Instrument Interface.

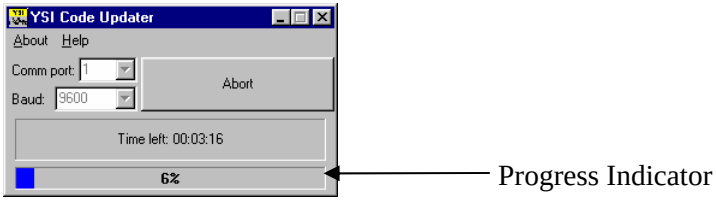
7. Press the **On/off** key on the YSI 556 MPS to display the run screen.

8. Run the YSI Code Updater software that you just installed on your computer. The following window will be displayed:



9. Set the Comm port number to match the port that you connected the 655173 PC Interface Cable to, then click on the Start Code Update button.

The YSI 556 MPS screen will blank out and a progress indicator will be displayed on the PC.



When the update is finished (indicated on the PC screen), the YSI 556 MPS will return to the Run screen. See Figure 7.1 Run Screen.

10. Close the YSI Code Updater window (on the PC) by clicking on the "X" in the upper right corner of the window.

11. Disconnect the YSI 556 MPS from the 655173 PC interface cable and reconnect it to the YSI 5563 Probe Module. Refer to Section *3.6 Instrument/Cable Connection*.

12. Storage

Proper storage between periods of usage will not only extend the life of the sensors, but will also ensure that the unit will be ready to use as quickly as possible in your next application.

12.1 General Recommendations for Short Term Storage

No matter what sensors are installed in the instrument, it is important to keep them moist without actually immersing them in liquid. Immersing them could cause some of them to drift or result in a shorter lifetime.

YSI recommends that short term storage of all multi-parameter instruments be done by placing approximately 1/2 inch of tap water in the transport/calibration cup that was supplied with the instrument, and by placing the probe module with all of the sensors installed into the cup. The use of a moist sponge instead of a 1/2 inch of tap water is also acceptable, as long as its presence does not compromise the attachment of the cup to the probe module. The transport/calibration cup should be sealed to prevent evaporation.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

⚠ **CAUTION**: The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

NOTE: If the storage water (tap water) is accidentally lost during field use, environmental water can be used.

12.2 General Recommendations for Long Term Storage

12.2.1 Probe Module Storage

1. Remove the pH or pH/ORP sensor from the probe module and store according to the individual sensor storage instructions found in Section *12.2.2 Sensor Storage*.

2. Seal the empty port with the provided port plug.

   NOTE: Leave the conductivity/temperature sensor and

dissolved oxygen sensor, with membrane cap still on, in the probe module.

3. Place 1/2″ of water, deionized, distilled or tap, in the transport/calibration cup.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

4. Insert the probe module into the cup.

   NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

12.2.2 Sensor Storage

Temperature/Conductivity Sensor

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with the thermistor and conductivity electrodes are not corrosive (for example, chlorine bleach). However, it is recommended that the sensor be cleaned with the provided brush prior to long term storage. Refer to Section *11.1.4 Temperature/Conductivity Sensor Cleaning.*

pH and Combination pH/ORP Sensor

The key to sensor storage is to make certain that the reference electrode junction does not dry out. Junctions which have been allowed to dry out due to improper storage procedures can usually be rehydrated by soaking the sensor for several hours (overnight is recommended) in a solution which is 2 molar in potassium chloride. If potassium chloride solution is not available, soaking the sensor in tap water or commercial pH buffers may restore sensor function. However in some cases the sensor may have been irreparably damaged by the dehydration and will require replacement.

⚠ **CAUTION:** Do not store the sensor in distilled or deionized water as the glass sensor may be damaged by exposure to this medium.

1. Remove the pH or pH/ORP sensor from the probe module.

2. Seal the empty port with the provided port plug.

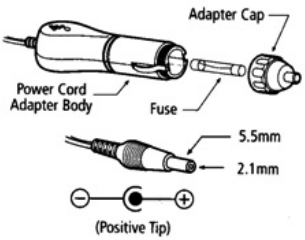
3. Place the sensor in the storage vessel (plastic boot or bottle) which was on the sensor at delivery. The vessel should contain a solution which is 2 molar in potassium chloride.

   NOTE: Make certain that the vessel is sealed to prevent evaporation of the storage solution.

13. Troubleshooting

The following sections describe problems you may encounter when using the YSI 556 MPS and provides suggestions to overcome the symptom.

PROBLEM	POSSIBLE SOLUTION
Display Problems	
No display is visible after pressing the on/off key.	If C cells are used, make certain that they are installed properly with regard to polarity and that good batteries are used. If a rechargeable battery pack is used, place the pack in the instrument and charge for 30 minutes.
Instrument software appears to be locked up as evidenced by no response to keypad entries or display not changing.	First, attempt to reset the instrument by simply turning off and then on again. If this fails, remove battery power from the instrument for 30 seconds and then reapply power. When using C cells, remove the battery lid and one of the batteries; when using the rechargeable battery pack, remove the pack completely from the instrument. After 30 seconds replace the battery or battery pack and check for instrument function.
The 556 display flashes and the instrument speaker makes a continuous clicking sound.	The battery voltage is low. Change to new C cells or recharge the 6117 battery pack.
Water Damage to Instrument	
Leakage detected in battery compartment when using C cells.	Dispose of batteries properly. Dry the battery compartment using compressed air if possible. If corrosion is present on battery terminals, contact YSI Customer Service.
Water has contacted rechargeable battery pack.	Remove battery pack immediately. Send battery pack to YSI Product Service for evaluation. **CAUTION**: DO NOT REUSE BATTERY PACK UNTIL YSI PRODUCT SERVICE HAS EVALUATED IT.
Leakage suspected into the main cavity of the instrument case.	Remove the batteries immediately. Return the instrument to YSI Product Service.

PROBLEM	POSSIBLE SOLUTIONS
Optional Cigarette Lighten Charger	
Power cord fuse blown. 	1. Unscrew adapter's cap, remove tip and pull out fuse. 2. Replace fuse with a new 2-amp fast-blow fuse from an electronics store such as Radio Shack. 3. Reassemble the adapter and securely screw the cap back onto the adapter body.
File Problems	
Upload of files from YSI 556 MPS to PC fails	1. Make sure that cable is connected properly to both 556 and PC. 2. Make certain that the proper Comm port is selected in EcoWatch for Windows.
Barometer data is not stored with sensor data file.	Make sure **Store barometer** is active in the 556 **Logging setup** menu.
Site Descriptions in the **Site List** are "grayed-out" and not available for appending files with additional data.	There is a parameter mismatch between the current 556 setup and that initially used. Change the current logging and sensor setup to match the setup that was initially used to create the file.
Sensor Problems	
Dissolved Oxygen reading is unstable or inaccurate. Out of Range message appears during calibration.	Sensor not properly calibrated. Follow DO cal procedures.
	Membrane not properly installed or may be punctured. Replace membrane cap.
	DO sensor electrodes require cleaning. Follow DO cleaning procedure. Use 5511 Maintenance kit.
	Water in sensor connector. Dry connector; reinstall sensor.
	Algae or other contaminant clinging to DO sensor. Rinse DO sensor with clean water.
	Barometric pressure entry is incorrect. Repeat DO cal procedure.
	Calibrated at extreme temperature. Recalibrate at (or near) sample temperature.
	DO sensor has been damaged. Replace sensor.
	Internal failure. Return probe module for service.

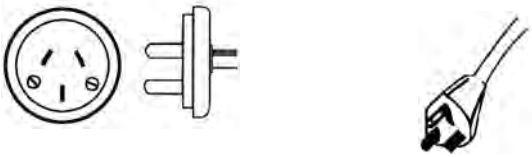
PROBLEM	POSSIBLE SOLUTIONS
Sensor Problems	
pH or ORP readings are unstable or inaccurate. Out of Range message appears during calibration.	Sensor requires cleaning. Follow sensor cleaning procedure.
	Sensor requires calibration. Follow cal procedures.
	pH sensor reference junction has dried out from improper storage. Soak sensor in tap water or buffer 4 until readings become stable.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace sensor.
	Calibration solutions out of spec or contaminated with other solution. Use new calibration solutions
	ORP fails Zobell check. Take into account temperature dependence of Zobell solution readings.
	Internal failure. Return probe module for service.
Conductivity unstable or inaccurate. Out of Range message appears during calibration	Conductivity improperly calibrated. Follow calibration procedure.
	Conductivity sensor requires cleaning. Follow cleaning procedure.
	Conductivity sensor damaged. Replace sensor.
	Calibration solution out of spec or contaminated. Use new calibration solution.
	Internal failure. Return probe module for service.
	Calibration solution or sample does not cover entire sensor. Immerse sensor fully.
Temperature, unstable or inaccurate	Water in connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace the 5560 sensor.
Installed sensor has no reading	The sensor has been disabled. Enable sensor.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace sensor.
	Report output improperly set up. Set up report output.
	Internal failure. Return probe module for service.

If these guidelines and tips fail to correct your problem or if any other symptoms occur, contact YSI Customer Service for Advice. Refer to *Appendix E Customer Service*.

14. Appendix A YSI 556 MPS Specifications

For the most recent product specifications, please visit the YSI website: www.ysi.com

15. Appendix B Instrument Accessories

ITEM #	ACCESSORY
5563-4	4m Cable with DO/temp/conductivity
5563-10	10m Cable with DO/temp/conductivity
5563-20	20m Cable with DO/temp/conductivity
5564	pH Kit
5565	pH/ORP Kit
6118	Rechargeable Battery Pack Kit for use in US
5094	Rechargeable Battery Pack Kit with universal charger and three adapter cables for use in international applications
5095	Rechargeable Battery Pack Kit with universal charger and two adapter cables for use in international applications 
5083	Flow Cell – probe module is secured in the flow cell and groundwater is pumped through it. Displaced volume approx. 475 ml
3059	Flow Cell, low volume. Displaced volume approx. 200 ml
116505	Battery Lid
616	Charger, Cigarette Lighter – used to power up the instrument from a car's cigarette lighter
4654	Tripod
614	Ultra Clamp, C Clamp –used to clamp the instrument to a table top or car dashboard
6081	Large Carrying Case, Hard-sided
5085	Hands-free Harness
5065	Carrying Case, Form-fitted, for use in the field – has a clear vinyl window, shoulder strap, belt loop strap and hand strap

16. Appendix C Required Federal Communications Notice

The Federal Communications Commission defines this product as a computing device and requires the following notice.

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No.0004-000-00345-4.

17. Appendix D Health Safety

YSI Conductivity Solutions: 3161, 3163, 3165, 3167, 3168, 3169

INGREDIENTS:
- Iodine
- Potassium Chloride
- Water

WARNING: INHALATION MAY BE FATAL

⚠ ***CAUTION:*** **AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY EVOLVE TOXIC FUMES IN FIRE.**

Harmful if ingested or inhaled. Skin or eye contact may cause irritation. Has a corrosive effect on the gastro-intestinal tract, causing abdominal pain, vomiting, and diarrhea. Hyper-sensitivity may cause conjunctivitis, bronchitis, skin rashes etc. Evidence of reproductive effects.

FIRST AID:
INHALATION: Remove victim from exposure area. Keep warm and rest. In severe cases seek medical attention.
SKIN CONTACT: Remove contaminated cloth immediately. Wash affected area thoroughly with large amounts of water. In severe cases seek medical attention.
EYE CONTACT: Wash eyes immediately with large amounts of water, (approx. 10 minutes). Seek medical attention immediately.
INGESTION: Wash out mouth thoroughly with large amounts of water. Seek medical attention immediately.

YSI pH 4.00, 7.00, y 10.00: 3821, 3822, 3823

pH 4 INGREDIENTS:

- Potassium Hydrogen Phthalate
- Formaldehyde
- Water

pH 7 INGREDIENTS:

- Sodium Phosphate, Dibasic
- Potassium Phosphate, Monobasic
- Water

pH 10 INGREDIENTS:

- Potassium Borate, Tetra
- Potassium Carbonate
- Potassium Hydroxide
- Sodium (di) Ethylenediamine Tetraacetate
- Water

⚠ **CAUTION -AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

Inhalation may cause severe irritation and be harmful. Skin contact may cause irritation; prolonged or repeated exposure may cause Dermatitis. Eye contact may cause irritation or conjunctivitis. Ingestion may cause nausea, vomiting and diarrhea.

FIRST AID:
INHALATION – Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.
SKIN CONTACT – Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.
EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION – If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

YSI Zobell Solution: 3682

INGREDIENTS:

- Potassium Chloride
- Potassium Ferrocyanide Trihydrate
- Potassium Ferricyanide

⚠ **CAUTION -AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

May be harmful by inhalation, ingestion, or skin absorption. Causes eye and skin irritation. Material is irritating to mucous membranes and upper respiratory tract. The chemical, physical, and toxicological properties have not been thoroughly investigated.

Ingestion of large quantities can cause weakness, gastrointestinal irritation and circulatory disturbances.

FIRST AID:
INHALATION – Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.
SKIN CONTACT – Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.
EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.
INGESTION – If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

18. Appendix E Customer Service

18.1 Ordering and Technical Support

Telephone:	800 897 4151 (US)
	+1 937 767 7241 (Globally)
	Monday through Friday, 8:00 AM to 5:00 ET
Fax:	+1 937 767 9353 (orders)
	+1 937 767 1058 (technical support)
Email:	environmental@ysi.com or proseries@ysi.com
Mail:	YSI Incorporated
	1725 Brannum Lane
	Yellow Springs, OH 45387 USA
Website:	www.ysi.com

18.2 YSI Authorized Service Centers

YSI has authorized service centers throughout the United States and Internationally. For the nearest service center information, please visit www.ysi.com and click ‘Support’ or contact YSI Technical Support directly at 800-897-4151.

When returning a product for service, include the Product Return form with cleaning certification. The form must be completely filled out for a YSI Service Center to accept the instrument for service. The form may be downloaded from www.ysi.com by clicking on the ‘Support” tab, then the Product Return Form button.

18.3 Cleaning Instructions

Equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected before being serviced. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with wastewater. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential

biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at a YSI Service Center, the following steps must be taken to ensure the safety of service personnel.

- In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4-cup bleach to 1-gallon tap water is suitable for most disinfecting. Instruments used with wastewater may be disinfected with .5% Lysol if this is more convenient to the user.
- The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.
- If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
- Any product being returned to the YSI Repair Center should be packed securely to prevent damage.
- Cleaning must be completed and certified on any product before returning it to YSI.

18.4 Packing Procedure

- Clean and decontaminate items to ensure the safety of the handler.
- Complete and include the Cleaning Certificate.
- Place the product in a plastic bag to keep out dirt and packing material.
- Use a large carton, preferably the original, and surround the product completely with packing material.
- Insure for the replacement value of the product.

18.5 Warranty

The instrument is warranted for three years against defects in workmanship and materials when used for its intended purposes and maintained according to instructions. The probe module and cables are warranted for one year. The dissolved oxygen, temperature/conductivity, pH, and pH/ORP combination sensors are warranted for one year. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI'S LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

19. Appendix F Ferrite Bead Installation

⚠ **WARNING:** If you are using your YSI 556 in a European Community (CE) country or in Australia or New Zealand, you must attach a ferrite bead to the 655173 PC Interface Cable and the YSI 6117 Charger Adapter Cable in order to comply with the Residential, Commercial and Light Industrial Class B Limits for radio-frequency emissions specified in EN55011 (CISPR11) for Industrial, Scientific and Medical laboratory equipment. These ferrite assemblies are supplied as part of cable kits.

1. Make a small loop (approximately 5 cm in diameter) in the cable near the YSI 556 MS-19 connector.

2. Lay the open ferrite bead assembly under the loop with the cable cross-over position within the cylinder of the ferrite bead.

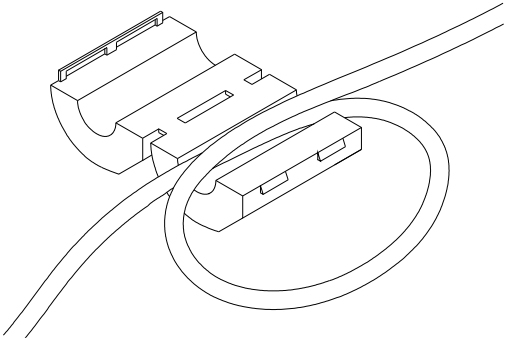


Figure 19.1 Ferrite Bead Installation

3. Snap the two pieces of the bead together making certain that the tabs lock securely.

4. When the installation is complete, the 655173 and 6117 cables should resemble the following drawings.

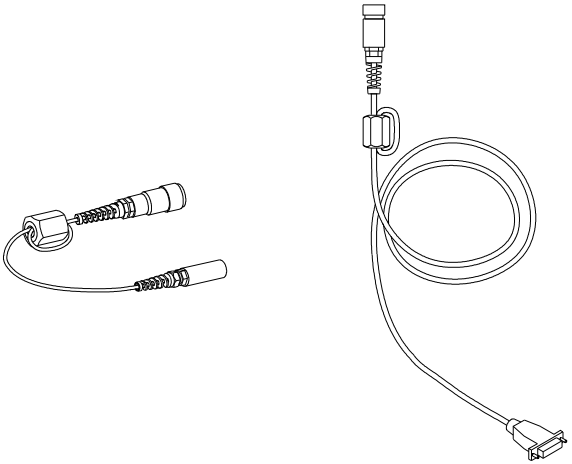


Figure 19.2 Cables with Ferrite Beads

20. Appendix G EcoWatch

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. EcoWatch is a powerful tool that can also be used with YSI 6-series sondes. Many features of the software will only be utilized by advanced users or are not relevant to the 556 MPS at all. This section is designed in tutorial format to familiarize you with the commonly used features of EcoWatch so that it will be possible to:

- Upload data from a 556 MPS to a PC
- Assemble plots and reports of your data
- Zoom in on certain segments of the plots of your data to facilitate analysis
- Show statistical data for your studies
- Export data in spreadsheet-compatible formats
- Print plots and reports

The advanced features of EcoWatch can be explored by downloading a 6-series manual from the YSI Web Site (www.ysi.com), purchasing a hard copy of the manual through YSI Customer Service (Item # 069300), or utilizing the on-line help feature of the software.

20.1 Installing EcoWatch for Windows

EcoWatch for Windows is available at no cost via a download from the YSI Web Site – www.ysi.com

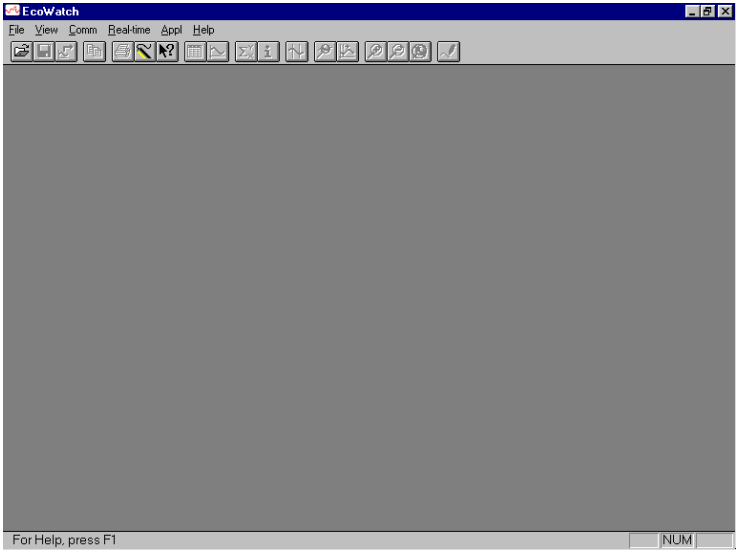
20.2 EcoWatch Tutorial

This EcoWatch tutorial is designed to teach you the commonly used operations associated with the software when used with your 556 MPS.

After you have uploaded a file, Refer to Section 8.4 Upload to PC, you will see two files in the C:\ECOWWIN\DATA directory; the file you transferred and a file supplied by YSI designated SAMPLE.DAT. This SAMPLE.DAT file is referred to in the remainder of this tutorial section. After following the instructions below for the analysis of SAMPLE.DAT, you apply the same analysis to the data file which was uploaded from your 556 MPS to assure that you are familiar with the basic features and capabilities of EcoWatch for Windows.

To start the analysis of the SAMPLE.DAT file, note that a shortened menu

bar is visible and many of the tools in the toolbar appear dimmed or “grayed out” before any file is opened (see below).

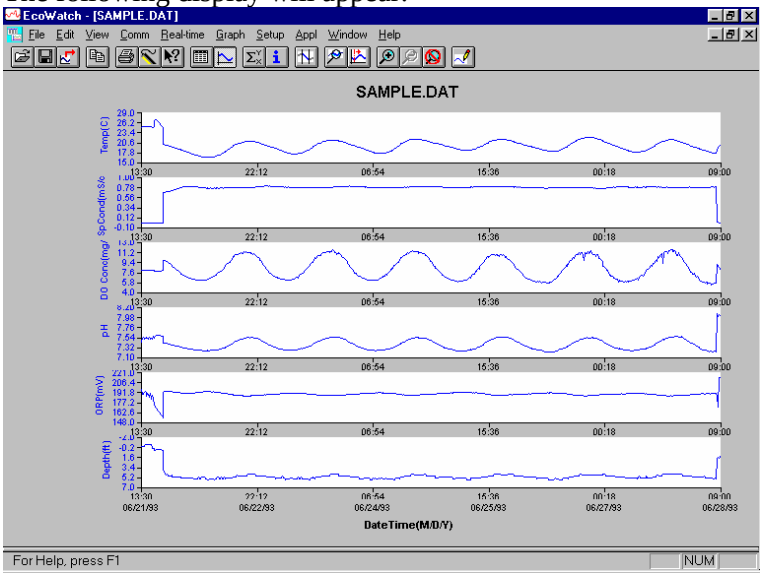


Full activation of EcoWatch features will be realized after a file is opened.

To open the sample data file:

1. Click the **File** menu button in the toolbar.
2. Select the **SAMPLE.DAT** file.
3. Click **OK** to open the file.

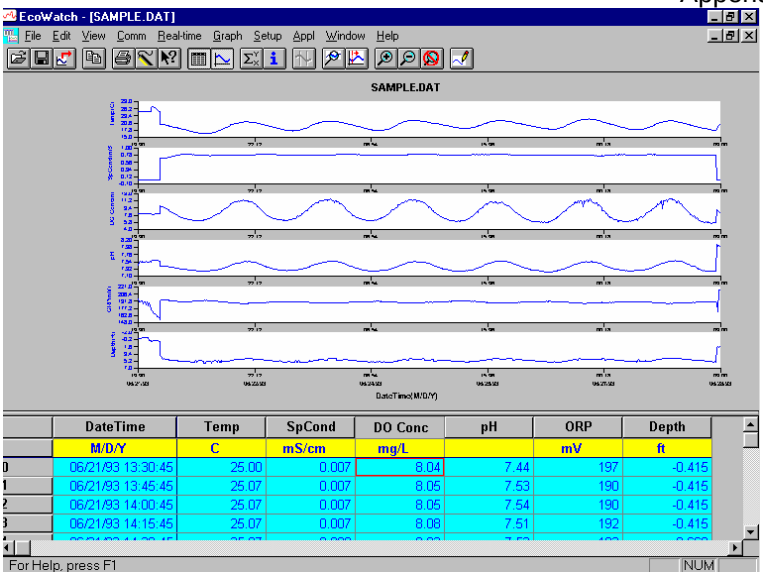
The following display will appear:



Note that the data in this file appears as a graph of temperature, specific conductance, dissolved oxygen, pH, ORP, and depth, all versus time. The graphs are scaled automatically so that all data fits comfortably on the computer screen. Note also that this data file was obtained with a 6-series sonde for which a depth sensor is available. Depth is NOT a current parameter for the 556 MPS.

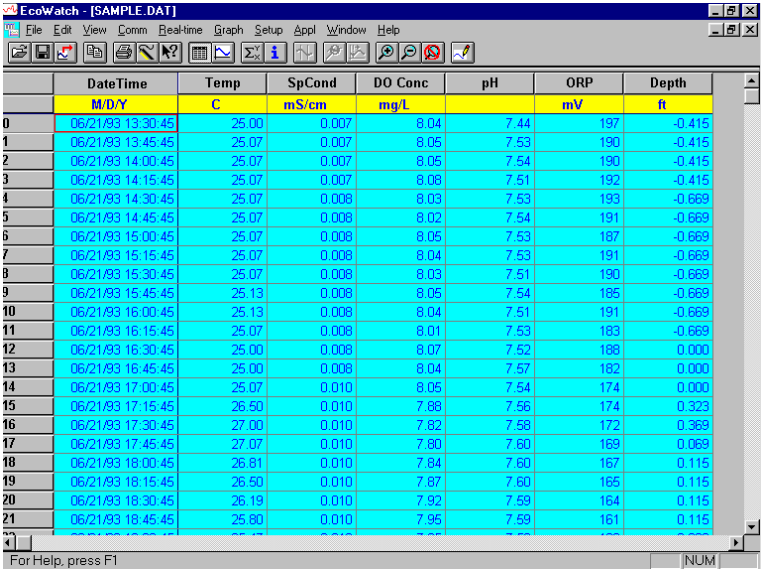
The **Table** and **Graph** buttons on the toolbar are on/off switches that are used to display or hide the graph and table pages respectively. When displaying a graph and a table at the same time, you can control the relative size of the two pages by placing the cursor over the small bar that separates them and

then dragging it to the desired location. Click the **Table** button to generate the following dual display of data.



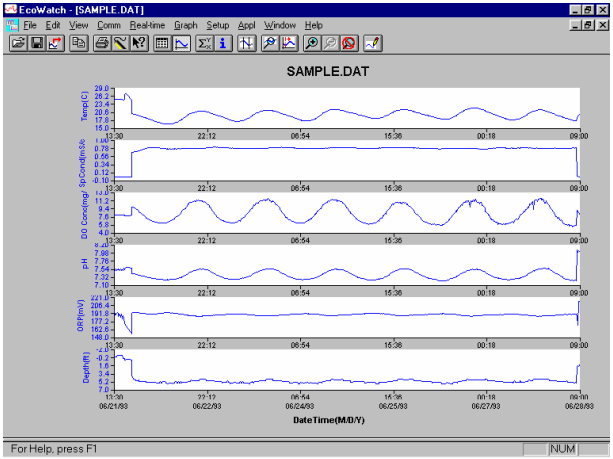
	DateTime	Temp	SpCond	DO Conc	pH	ORP	Depth
	M/D/Y	C	mS/cm	mg/L		mV	ft
0	06/21/93 13:30:45	25.00	0.007	8.04	7.44	197	-0.415
1	06/21/93 13:45:45	25.07	0.007	8.05	7.53	190	-0.415
2	06/21/93 14:00:45	25.07	0.007	8.05	7.54	190	-0.415
3	06/21/93 14:15:45	25.07	0.007	8.08	7.51	192	-0.415

Now click the **Graph** button (turn it off) to display only a report of your data as shown below. Note that the size of the report can be varied by clicking on the and buttons in the Toolbar.

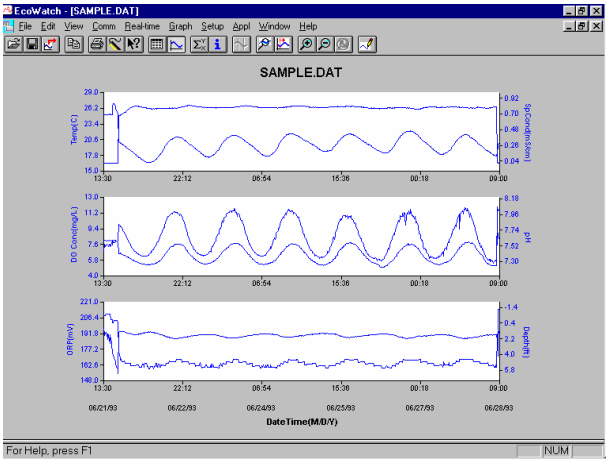


	DateTime	Temp	SpCond	DO Conc	pH	ORP	Depth
	M/D/Y	C	mS/cm	mg/L		mV	ft
0	06/21/93 13:30:45	25.00	0.007	8.04	7.44	197	-0.415
1	06/21/93 13:45:45	25.07	0.007	8.05	7.53	190	-0.415
2	06/21/93 14:00:45	25.07	0.007	8.05	7.54	190	-0.415
3	06/21/93 14:15:45	25.07	0.007	8.08	7.51	192	-0.415
4	06/21/93 14:30:45	25.07	0.008	8.03	7.53	193	-0.669
5	06/21/93 14:45:45	25.07	0.008	8.02	7.54	191	-0.669
6	06/21/93 15:00:45	25.07	0.008	8.05	7.53	187	-0.669
7	06/21/93 15:15:45	25.07	0.008	8.04	7.53	191	-0.669
8	06/21/93 15:30:45	25.07	0.008	8.03	7.51	190	-0.669
9	06/21/93 15:45:45	25.13	0.008	8.05	7.54	185	-0.669
10	06/21/93 16:00:45	25.13	0.008	8.04	7.51	191	-0.669
11	06/21/93 16:15:45	25.07	0.008	8.01	7.53	183	-0.669
12	06/21/93 16:30:45	25.00	0.008	8.07	7.52	188	0.000
13	06/21/93 16:45:45	25.00	0.008	8.04	7.57	182	0.000
14	06/21/93 17:00:45	25.07	0.010	8.05	7.54	174	0.000
15	06/21/93 17:15:45	26.50	0.010	7.88	7.56	174	0.323
16	06/21/93 17:30:45	27.00	0.010	7.82	7.58	172	0.369
17	06/21/93 17:45:45	27.07	0.010	7.80	7.60	169	0.069
18	06/21/93 18:00:45	26.81	0.010	7.84	7.60	167	0.115
19	06/21/93 18:15:45	26.50	0.010	7.87	7.60	165	0.115
20	06/21/93 18:30:45	26.19	0.010	7.92	7.59	164	0.115
21	06/21/93 18:45:45	25.80	0.010	7.95	7.59	161	0.115

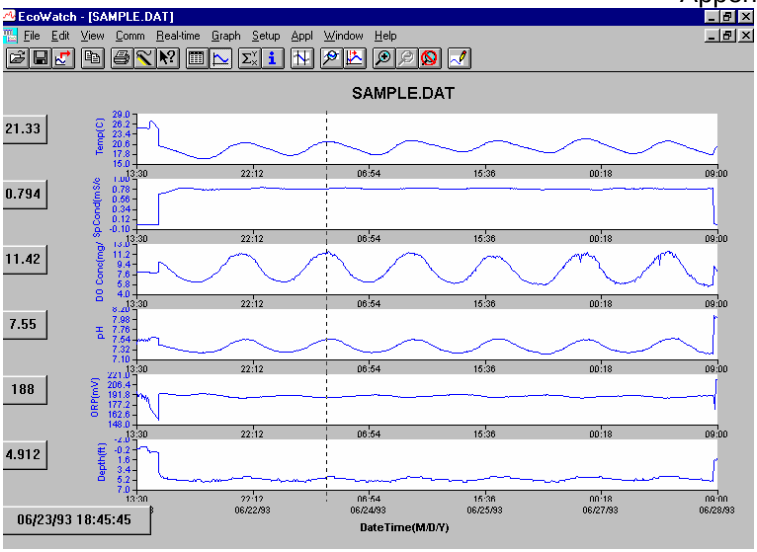
Now return to the original graphic display by toggling the **Table** button “off” and **Graph** button “on”.



From the **Setup** menu, click **Graph**. Click **2 Traces per Graph** and notice that the parameters are now graphed in pairs for easy comparison of parameters.

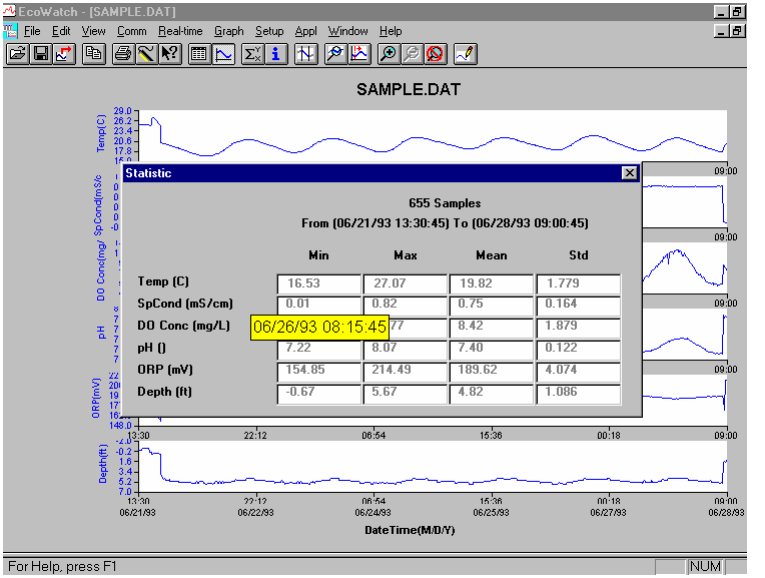


Click **1 Trace per Graph** to return the display to the original setting. Move the cursor to any position in the graph, then click and hold the right mouse button.



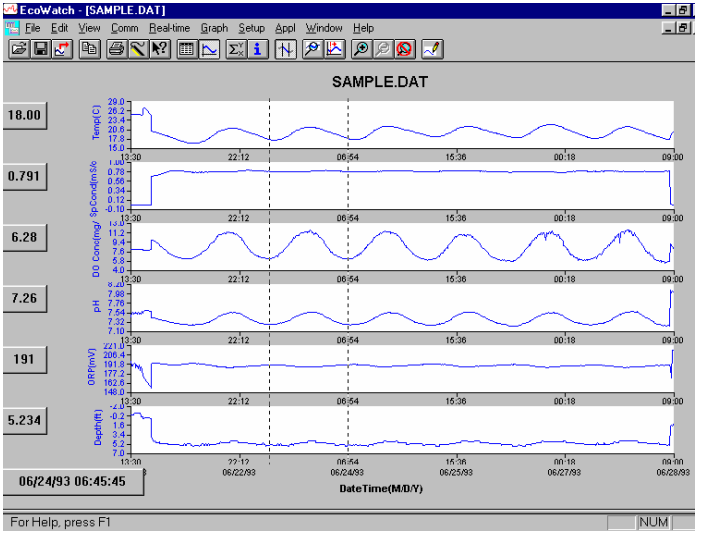
Note that the exact measurements for this point in time are displayed to the left of the graph. While holding down the right mouse button, move to another area on the graph. Notice how the measurements change as you move. When you release the mouse button, the display returns to normal.

To view statistical information for the study, click the **Statistics** button on the toolbar. On the statistics window, click on any min or max value to display the time when it occurred.

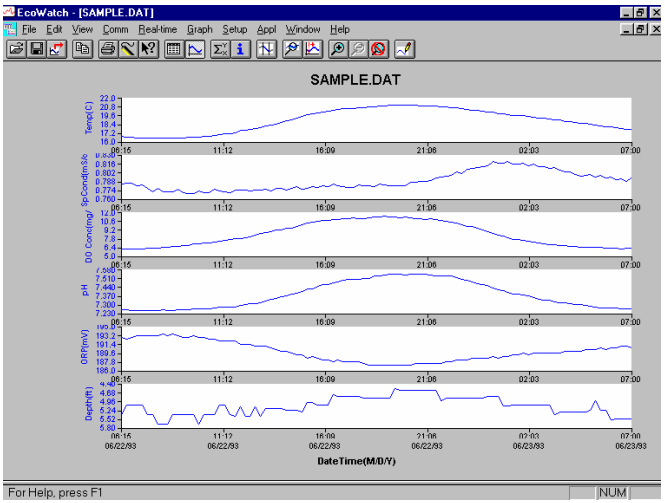


After viewing statistics, click the “x” at the upper right to close the window and return to the normal display.

Now click on the delimiter icon in the toolbar and then move the displayed icon to the graph. Click at the two points shown by dotted lines in the display below, being sure that the first click is to the left of the second.

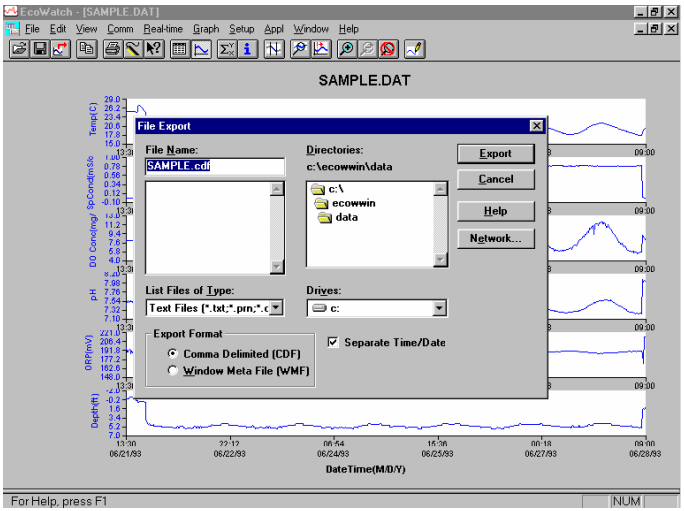


The data between the two selected points will then be graphed in higher resolution as shown below.

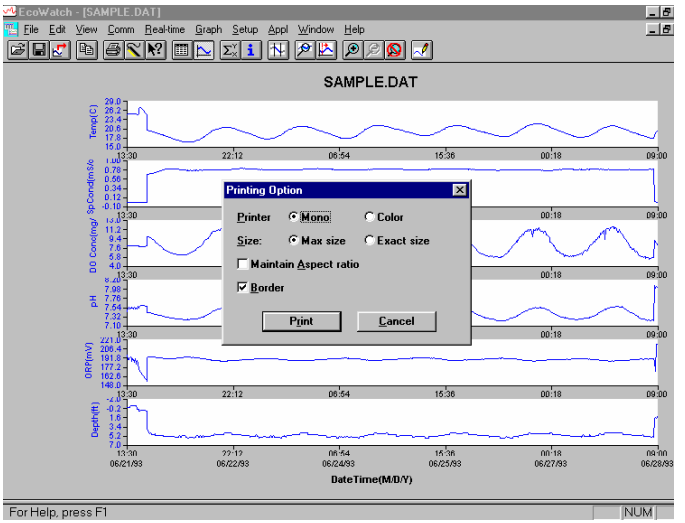


To return to the complete data set, select **Graph** from the toolbar and then click **Cancel Limits**.

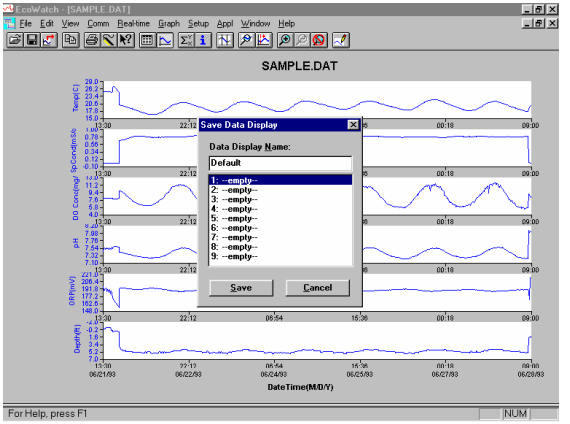
Now select the icon from the Toolbar to create a new data file which will allow your data to be imported into spreadsheets. Select the default export settings for a Comma Delimited File (.CDF) and click OK. A new spreadsheet-importable file (SAMPLE.CDF) is now present in the same folder as the SAMPLE.DAT file.



Now select the icon from the toolbar to print the plot. Accept the default settings and click OK to complete the printing operation.



Finally, end the tutorial by saving the **Data Display** in the format shown. From the File menu, click **Save Data Display**.



Then type “Default” for the file name and click **Save**. The parameters, colors, format, and x-axis time interval associated with the current display are now saved and can be accessed any time in the future. Nine different data displays may be saved for any data file. You can easily switch between various displays of the data. The data files can be accessed by clicking **Load Data Display** from the file menu and then selecting the desired presentation.

20.2.1 Summary of Toolbar Capability

The EcoWatch toolbar includes buttons for some of the most common commands in EcoWatch, such as **File Open**. To display or hide the toolbar,

open the **View** menu and click on the **Toolbar** command. A check mark appears next to the menu item when the toolbar is displayed.

The toolbar is displayed across the top of the application window, below the menu bar.

Click to:

Open an existing data file (.DAT). EcoWatch displays the **Open** dialog box, in which you can locate and open the desired file.

Save the working Data Display of the active data file. EcoWatch displays the **Save Data Display** dialog box in which you can overwrite existing Data Display or save to a new one.

Export data as a graph in Window Meta File (.WMF) format or as data in Comma Delimited (.CDF) format.

Copy the whole graph page or data from the selection on the table to the clipboard.

Print the active graph page or table page depending on which one is currently active.

Open a new terminal window to communicate with the sonde.

Access context sensitive help (Shift+F1).

Toggle table window during file processing.

Toggle graph window during file processing.

Display study statistics.

Display study info.

Limit the data to be processed.

Enlarge a selective portion of graph.

Center the graph under the cursor.

Enlarge graph of table 20%.

Reduce graph of table 20%.

Return graph or table to its normal size (unzoom).

Redraw the graph.

20.2.2 Other capabilities

The above tutorial and function list for the toolbar provide basic information to allow you to view and analyze the field data which was stored in your 556 MPS. Some of the other commonly used capabilities of EcoWatch which the user may want to explore are listed below:

- Customize the units for each parameter, e.g., report uS/cm instead of mS/cm for conductivity.
- Customize the order of parameters in each plot or report.
- Customize the colors and fonts of each data display.
- Manually scale the y-axis sensitivity for each parameter.
- Merging of two or more data files with compatible parameter formats
- View information about the study such as number of points, instrument serial number, etc. which was stored in the 556 with the data.
- Print data reports in different statistical formats.
- Create plots of parameter vs. parameter rather than parameter vs. time.

These additional features of EcoWatch for Windows are explained in detail in the YSI 6-series manual (which can be downloaded at no cost from the YSI Web Site as described above) and the Help selection in the EcoWatch menu bar. To purchase a hard copy of the 6-series manual, contact YSI Customer Service using the contact information in *Appendix E Customer Service*.

21. Appendix H Calibration Record Information

When your YSI 556 MPS sensors are initially calibrated, relevant information about the sensors will be stored in a separate file in the YSI 556 MPS memory.

NOTE: This file, by default, will have the name "556 Circuit Board Serial Number.glp." The circuit board serial number is assigned at the factory and has a hexadecimal format such as 000080A4. Thus the default calibration record file would be designated 00080A4.glp. Refer to Section *10.7 GLP Filename* to change the filename.

The information in the calibration record will track the sensor performance of your instrument and should be particularly useful for programs operating under Good Laboratory Practices (GLP) protocols.

21.1 Viewing the Calibration Record (.glp) File

NOTE: Make certain that you have performed a calibration on at least one of the sensors associated with your YSI 556 MPS.

Follow the procedures outlined in Section *8.3 View File*.

21.2 Uploading the Calibration Record (.glp) File

NOTE: Make certain that you have performed a calibration on at least one of the sensors associated with your YSI 556 MPS.

Follow the procedures outlined in Section *8.4 Upload to PC*.

21.3 Understanding the Calibration Record (.glp) File

1. Open a calibration record file. Refer to Section 8.3 View File.
2. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

00008003.glp

m/d/y	hh:mm:ss	S/N
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:25:40	00008003
01/24/2001	08:25:40	00008003

735.9mmHg

01/24/2001 08:39:53

Figure 21.1Calibration Record Screen 1

00008003.glp

Type	Value
Conductivity gain	1.000000
DO gain	1.000000
pH gain (pH-7)*K/mV	-5.05833
pH offest (pH-7)*K	0.000000
ORP offset mV	0.000000
TDS constant	0.650000
Barometer offset PSI	0.000000
DO gain	1.110250
pH gain (pH-7)*K/mV	-5.05833
pH offest (pH-7)*K	-12.2899

735.9mmHg

01/24/2001 08:39:19

Figure 21.2 Calibration Record Screen 2

NOTE: Each sensor (not parameter) is characterized by either 1 line (Conductivity, Dissolved Oxygen, ORP, TDS, or Barometer (Optional)) or 2 lines (pH) of calibration documentation.

The left hand portion of each calibration entry shows the date and time that a calibration of a particular sensor was performed. In addition, each calibration entry is characterized by the instrument serial number, as defined by YSI. See Figure 21.1 Calibration Record Screen 1. The right hand portion shows the YSI designation of the calibration constants and their values after their calibration has been performed. A more detailed description of the calibration constants is provided below:

- **Conductivity Gain** – A relative number which describes the sensitivity of the sensor. Basically, the value represents the calculated cell constant divided by the typical value of the cell constant (5 cm^{-1}).
- **DO Gain** – A relative number which describes the sensitivity of the sensor. Basically, the value represents the sensor current at the time of calibration divided by the typical value of the sensor current (15 uA).
- **pH Gain** – A number which basically represents the sensitivity of the pH sensor. To remove the effect of temperature on the slope of the relationship of probe output in mv versus pH, the value of pH/mv is multiplied by the temperature in degrees Kelvin (K).
- **pH Offset** – A number which basically represents the offset (or intercept) of the relationship of probe output in mv versus pH, the value of pH is multiplied by the temperature in degrees Kelvin (K).

Anytime you perform a calibration, information concerning the calibration constants will be logged to the Calibration Record file (.glp file). However, if the **Delete All Files** command is used, Refer to Section *8.6 Delete All Files*, the Calibration Record file will also be lost. It is critical that this file should be uploaded to your PC prior to issuing a **Delete All Files** command. Refer to Section *8.4 Upload to PC.*

Turbidity Meter - LaMotte 2020we

For Sales & Service Contact
geotech
2650 E. 40th Ave. • Denver, CO 80205
Phone 303-320-4764 • Fax 303-322-7242
1-800-833-7958
www.geotechenv.com

LaMotte

2020we/wi TURBIDIMETER

1970-EPA
1970-ISO

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2020we/wi QUICK START GUIDE

Factory Settings

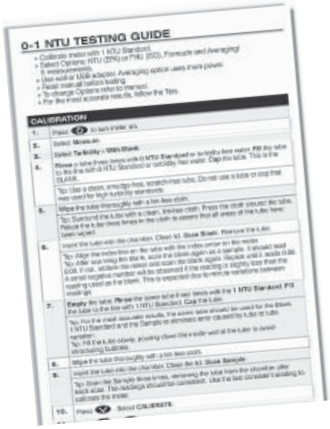
Averaging	Disabled
Turbidity Units	NTU
Turbidity Calibration	Formazin
Date Format	MM/DD/YYYY
Power Save	5 minutes
Backlight	10 seconds
Language	English

Calibration

Perform a calibration over the smallest range possible. Use a standard that will bracket the sample range. Calibrate meter daily.

1. Press to turn meter on.
2. Select Measure.
3. Select Turbidity – With Blank.
4. Rinse tube. Fill with BLANK. Dry tube.
5. Scan Blank.
6. Rinse tube. Fill with STANDARD. Dry tube.
7. Scan Sample.
8. Press and select Calibrate.
9. Press to adjust display to match standard value.
10. Press to accept the calibration.
11. Press to set the calibration.

Refer to the Quick Start Guide for simplified Calibration and Analysis procedures.


0-1 NTU TESTING GUIDE

- Calibrate meter with 1 NTU Standard.
- Select Options: NTU (25%) or FNU (ISO), Formazin and Averaging/ 6 measurements.
- Use wall or USB adapter. Averaging option uses more power.
- Read manual before testing.
- To change Options refer to manual.
- For the most accurate results, follow the Tips.

CALIBRATION

1. Press to turn meter on.
2. Select Measure.
3. Select Turbidity – With Blank.
4. Rinse a tube three times with 0 NTU Standard or turbidity free water. Fill the tube to the line with 0 NTU Standard or turbidity free water. Cap the tube. This is the BLANK.
   Tip: Use a clean, smudge-free, scratch-free tube. Do not use a tube or cap that was used for high turbidity standards.
5. Wipe the tube thoroughly with a lint-free cloth. Press the cloth around the tube. Rotate the tube three times in the cloth to ensure that all areas of the tube have been wiped.
6. Insert the tube into the chamber. Close lid. Scan Blank. Remove the tube.
   Tip: Align the index line on the tube with the index center on the meter.
   Tip: After scanning the blank, wait the blank again as a sample. It should read 0.00. If not, repeat the select and scan the blank again. Repeat until it reads 0.00. A small negative number will be obtained if the reading is slightly less than the reading used as the blank. This is expected due to minor variations between vials/glass.
7. Empty the tube. Rinse the sample tube 2 or 3 times with the 1 NTU Standard. Fill the tube to the line with 1 NTU Standard. Cap the tube.
   Tip: For the most accurate results, the same tube should be used for the blank, 1 NTU Standard and the Sample to eliminate error caused by tube to tube variation.
   Tip: Fill the tube slowly, pouring down the inside wall of the tube to avoid introducing bubbles.
8. Wipe the tube thoroughly with a lint-free cloth.
9. Insert the tube into the chamber. Close the lid. Scan Sample.
   Tip: Scan the Sample three times, removing the tube from the chamber after each scan. This helps to minimize consistent calibrations. Use the last consistent reading to calibrate the meter.
10. Press Select CALIBRATE.

Refer to the Testing Guide for detailed Calibration and Analysis procedures for improving the accuracy of low range turbidity measurements.

INTRODUCTION

■ TURBIDITY

What is Turbidity?

Turbidity is an aggregate property of the solution, which is water in most cases. Turbidity is not specific to the types of particles in the water. The particles could be suspended or colloidal matter, and they can be inorganic, organic or biological. At high concentrations, turbidity is perceived as cloudiness, haze or an absence of clarity in the water. Turbidity is an optical property that results when light passing through a liquid sample is scattered. The scattering of light results in a change in the direction of the light passing through the liquid. This is most often caused when the light strikes particles in solution and is scattered backward, sideways and forward. If the turbidity is low, much of the light will continue in the original direction. Light scattered by the particles allows the particle to be ”seen” or detected in solution just as sunlight allows dust particles in the air to be seen.

In the past 10 years, turbidity has become more than just a measure of water clarity. Because of the emergence of pathogens such as Cryptosporidium and Giardia, turbidity now holds the key to assuring proper water filtration. In 1998, the EPA published the IESWTR (interim enhanced surface water treatment rule) mandating turbidities in combined filter effluent to read at or below 0.3 NTU. By doing so, the EPA hoped to achieve a 2 log (99%) removal of Cryptosporidium. There is presently consideration to lower this to 0.1 NTU. The trend has been to check the calibration of on-line turbidimeters with hand-held field units. The optical design and low detection limit of the 2020we/wi allows very accurate readings for such calibrations.

The meter also allows the user to choose the units of measure for expressing turbidity. While nephelometric turbidity unit (NTU) has been the standard for years, FNU (formazin nephelometric unit) and FAU (formazin attenuation unit) are now being used in ISO 7027 units. American Society of Brewing Chemists (ASBC) units and European Brewery Convention (EBC) units allow the brewing industry to check process waters.

How is Turbidity Measured?

Turbidity is measured by detecting and quantifying the scattering of light in water (solution). Turbidity can be measured in many ways. There are visual methods and instrumental methods. Visual methods are more suitable for samples with high turbidity. Instrumental methods can be used on samples with both high and low levels of turbidity.

Two visual methods are the Secchi Disk method and the Jackson Candle method. The Secchi Disk method is often used in natural waters. A black and white Secchi Disk is lowered into the water until it can no longer be seen. It is then raised until it can be seen again. The average of these two distances is known as the “Secchi Depth”. The Jackson Candle method uses a long glass tube over a standard candle. Water is added or removed from the tube until the candle flame becomes

indistinct. The depth of the water measured with a calibrated scale is reported as Jackson Turbidity Units (JTU). The lowest turbidity that can be determined with this method is about 25 NTU. There are two common methods for instruments to measure turbidity. Instruments can measure the attenuation of a light beam passing through a sample and they can measure the scattered light from a light beam passing through a sample. In the attenuation method, the intensity of a light beam passing through a turbid sample is compared with the intensity passing through a turbidity-free sample at 180° from the light source. This method is good for highly turbid samples. The most common instrument for measuring scattered light in a water sample is a nephelometer. A nephelometer measures light scattered at 90° to the light beam. Light scattered at other angles may also be measured, but the 90° angle defines a nephelometric measurement. The light source for nephelometric measurements can be one of two types to meet EPA or ISO specifications. The EPA specifies a tungsten lamp with a color temperature of 2,200–3,000 K. The units of measurement for the EPA method are nephelometric turbidity units (NTU). The ISO specifies a light emitting diode (LED) with a wavelength of 860 ± 30 nm and a spectral bandwidth less than or equal to 60 nm. The units of measurement for the ISO method are formazin nephelometric units (FNU). The 2020we meets the EPA specification and the 2020wi meets the ISO specification. The nephelometric method is most useful for low turbidity.

The 2020we/wi is a nephelometer that is capable of measuring turbidity by both the attenuation method and the nephelometric method. It uses a detector placed at 180° to the light source for high turbidity samples. It uses a detector placed at 90° to the light source for the nephelometric method for low turbidity samples. The 2020we/wi has a signal averaging option to improve the stability of readings on low turbidity samples.

The 2020we/wi has two different turbidity calibrations, formazin and Japan Standard. The formazin calibration is the EPA and ISO approved method of calibrating nephelometers. This calibration can be used with user prepared formazin standards or commercially purchased formazin standards. LaMotte Company approved AMCO™ standards labeled for use with the 2020we/wi can also be used with the formazin calibration. Stablcal® standards below 50 NTU should not be used to calibrate the 2020we/wi.

The Japan Standard calibration is a calibration for a Japanese Water Works standard. It is based on Japanese formulated polystyrene turbidity standards. This calibration should only be used to meet Japanese Water Works requirements. The Japanese polystyrene standards can only be purchased in Japan. Formazin, AMCO and Stablcal® standards cannot be used with this calibration.

Taking Turbidity Water Samples

Clean plastic or glass containers may be used for turbidity samples. Ideally, samples should be tested soon after collection and at the same temperature as when collected.

■ SAMPLE DILUTION TECHNIQUES

If a test result is out of the range of the meter, it must be diluted. The test should then be repeated on the diluted sample. The following table gives quick reference guidelines for dilutions of various proportions.

Amount of Sample	Deionized Water to Bring Final Volume to 10 mL	Multiplication Factor
10 mL	0 mL	1
5 mL	5 mL	2
2.5 mL	7.5 mL	4
1 mL	9 mL	10
0.5 mL	9.5 mL	20

All dilutions are based on a final volume of 10 mL, so several dilutions will require small volumes of the water sample. Graduated pipets should be used for all dilutions. If volumetric glassware is not available, dilutions can be made with the colorimeter tube. Fill the tube to the 10 mL line with the sample and then transfer it to another container. Add 10 mL volumes of deionized water to the container and mix. Transfer 10 mL of the diluted sample to the colorimeter tube and follow the test procedure. Repeat the dilution and testing procedures until the result falls within the range of the calibration. Multiply the test result by the dilution factor. For example, if 10 mL of the sample water is diluted with three 10 mL volumes of deionized water, the dilution factor is four. The test result of the diluted sample should be multiplied by four.

OPTIONS & SET UP

■ FACTORY DEFAULT SETTINGS

Settings that have user options have been set at the factory to default settings.

The factory default settings are:

Averaging	Disabled
Turbidity Units	NTU
Turbidity Calibration	Formazin
Date Format	MM-DD-YYYY
Power Save	5 minutes
Backlight	10 seconds
Language	English

■ AVERAGING

The averaging option allows the user to average multiple readings. This option will improve the accuracy of samples with readings that may tend to drift with time. When the two, five or ten measurement option has been selected the final average is displayed. The averaging option is available only for turbidity. The default setting is disabled. To change the setting:

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ∨ to scroll to **Options**.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
3. Press ENTER to select **Options**.	Options Menu Averaging Turbidity Options Set Clock Set PWR Save 12:00:00 001/500
4. Press ENTER to select **Averaging**.	Averaging Menu Disabled 2 Measurements 5 Measurements 10 Measurements 12:00:00 001/500

5. Press ⌃ or ⌄ to scroll to the desired option.	Averaging Menu Disabled 2 Measurements 5 Measurements 10 Measurements 12:00:00 001/500
6. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Options Menu**.	Options Menu Averaging Turbidity Options Set Clock Set PWR Save 12:00:00 001/500

NOTE: When the **Averaging** option is enabled, more time will be required to display a reading and more power will be used.

■ TURBIDITY OPTIONS

The default units are NTU and the default calibration curve is formazin. To change the settings:

Selecting Turbidity Units

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ▼ to scroll to **Options**.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
3. Press ENTER to select **Options**. Press ▼ to scroll to **Turbidity Options**.	Options Menu Averaging Turbidity Options Set Clock Set PWR Save 12:00:00 001/500
4. Press ENTER to select **Turbidity Options**.	Turbidity Options Turbidity Units Turbidity Calibration 12:00:00 001/500

5. Press ENTER to select **Turbidity Units**.	Set Turbidity Units NTU ASBC EBC 12:00:00 001/500

Available units are:
NTU (Nephelometric Turbidity Units)(2020we only)
FNU (Formazin Nephelometric Units) (2020wi only)
ASBC (American Society of Brewing Chemists)
EBC (European Brewery Convention)
NOTE: The meter will automatically switch to the attenuation mode above approximately 600 NTU or FNU. Measurements will be made with the 180° detector as indicated by AU or FAU on the display.

6. Press ^ or v to scroll to the desired units.	Set Turbidity Units NTU ASBC EBC 12:00:00 001/500

7. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Turbidity Options** menu. Press EXIT to return to a previous menu.	Turbidity Options Turbidity Units Turbidity Calibration 12:00:00 001/500

Selecting a Turbidity Calibration Curve

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500

2. Press ▼ to scroll to **Options**.

Main Menu
Measure
Data Logging
Options
Run PC Link
12:00:00 001/500

3. Press ENTER to select **Options**. Press ▼ to scroll to **Turbidity Options**.

Options Menu
Averaging
Turbidity Options
Set Options
Set PWR Save
12:00:00 001/500

4. Press ENTER to select **Turbidity Options**.

Turbidity Options
Turbidity Units
Turbidity Calibration
12:00:00 001/500

5. Press ▼ to scroll to **Turbidity Calibration**.

Turbidity Options
Turbidity Units
Turbidity Calibration
12:00:00 001/500

6. Press ENTER to select **Turbidity Calibration**.

Turbidity Calibration
Formazin
Japan Standard
12:00:00 001/500

7. Scroll to the desired calibration option. Select a calibration option based on the composition of the standards that will be used to calibrate the meter.	Turbidity Calibration Formazin Japan Standard 12:00:00 001/500

NOTE: Stablcal® standards below 50 NTU should not be used to calibrate the 2020we/wi. The diluent has a different refractive index than traditional formazin standards and will affect the results.

8. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Turbidity Options** menu. Press EXIT to return to a previous menu.	Turbidity Options Turbidity Units Turbidity Calibration 12:00:00 001/500

■ SETTING THE CLOCK

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.

Main Menu
Measure
Data Logging
Options
Run PC Link
12:00:00 001/500

2. Press ∨ to scroll to **Options**.

Main Menu
Measure
Data Logging
Options
Run PC Link
12:00:00 001/500

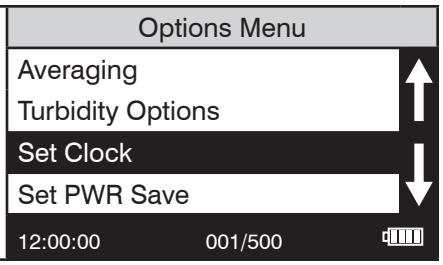
3. Press ENTER to select **Options**. Press ∨ to scroll to **Set Clock**.

Options Menu
Averaging
Turbidity Options
Set Clock
Set PWR Save
12:00:00 001/500

4. Press ENTER to select **Set Clock**. The date is displayed as month-day-year. The time is displayed as hours:minutes:seconds AM/PM. Press ∧ or ∨ to the appropriate character and press ENTER to select. The cursor will move to the next character. Set all characters in the same manner. This is a scrolling menu.

Set Time
Date: 07-09-2010
Time: 02:09:08 PM
12:00:00 001/500

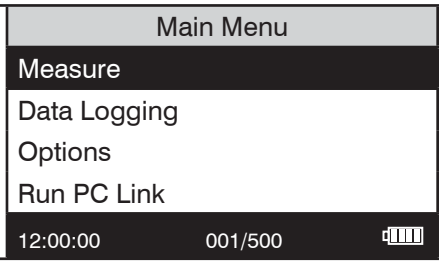
5. Press ENTER to select the final character. The time and date will be saved and the screen will return to the **Options Menu**.



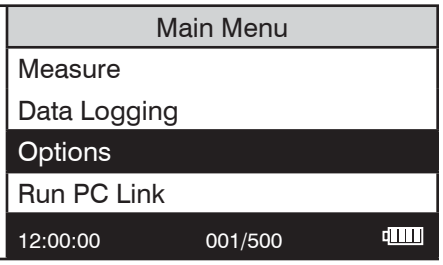
■ SETTING POWER SAVE

The power saving Auto Shutoff feature will turn the meter off when a button has not been pushed for a set amount of time. The default setting is disabled. To change the setting:

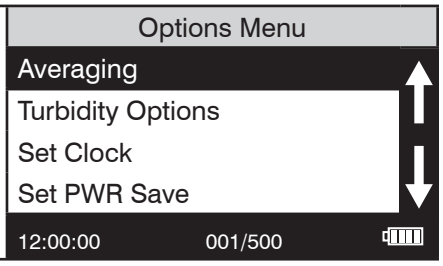
1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.



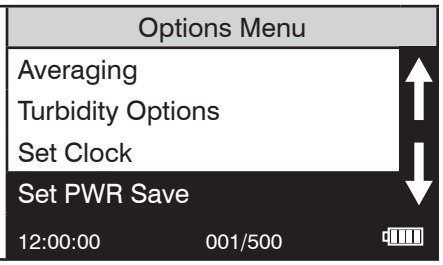
2. Press ▼ to scroll to **Options**.



3. Press ENTER to select **Options**.



4. Press ▼ to scroll to **Set PWR Save.**



5. Press ENTER to select **PWR Save**.

Auto Shutoff
Disable
5 Minutes
15 Minutes
30 Minutes
12:00:00 001/500

6. Press ∨ ∨ to scroll to desired setting.

Auto Shutoff
Disable
5 Minutes
15 Minutes
30 Minutes
12:00:00 001/500

7. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Options Menu**.

Options Menu
Averaging
Turbidity Options
Set Clock
Set PWR Save
12:00:00 001/500

■ SETTING THE BACKLIGHT TIME

The backlight illuminates the display for enhanced viewing. If Button Control is chosen the backlight button on the key pad will act as an on/off switch and the backlight will remain on or off when the meter is being used. When one of the other settings – 10, 20 or 30 seconds – is chosen, the display will be illuminated for the specified amount of time after any button is pressed. As a precaution, the backlight will not illuminate during turbidity measurements to avoid interference from stray light.

NOTE: The backlight feature uses a significant amount of power. The longer the backlight is on, the more frequently the battery will have to be charged if the USB/Wall Charger is not being used.

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ∨ to scroll to **Options**.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
3. Press ENTER to select **Options**.	Options Menu Averaging Turbidity Options Set Clock Set PWR Save 12:00:00 001/500

4. Press ▼ to scroll to **Set Backlight Time.**

Options Menu
Turbidity Options
Set Clock
Set PWR Save
Set Backlight Time
12:00:00 001/500

5. Press ENTER to select **Set Backlight Time.**

Backlight Time
Button Control
10 Seconds
20 Seconds
30 Seconds
12:00:00 001/500

6. Press ▼ ▼ to scroll to desired setting.

Backlight Time
Button Control
10 Seconds
20 Seconds
30 Seconds
12:00:00 001/500

7. Press ENTER to save the selection. The screen will display **Storing...** for about 1 second and return to the **Options Menu**.

Options Menu
Turbidity Options
Set Clock
Set PWR Save
Set Backlight Time
12:00:00 001/500

■ FACTORY RESET

Performing a Factory Reset will restore the factory default settings. All user-level calibrated settings will be lost.

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ▼ to scroll to **Options**.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
3. Press ENTER to select **Options**.	Options Menu Averaging Turbidity Options Set Clock Set PWR Save 12:00:00 001/500
4. Press ▼ to scroll to **Factory Reset.**	Options Menu Set Clock Set PWR Save Set Backlight Time Factory Reset 12:00:00 001/500
5. Press ENTER to select to **Factory Reset.**	Options Menu <Enter> Continue <Exit> to Abort 12:00:00 001/500

6. Press ENTER to complete the Factory Reset. The screen will momentarily display **Writing**. The screen will display **Done** and return to the **Options Menu.** To retain the current user level calibration settings, press EXIT to abort the Factory Reset.	Options Menu Done <Enter> Continue 12:00:00 001/500

7. Press ENTER to return to the **Options Menu.**	Options Menu Set Clock Set PWR Save Set Backlight Time Factory Reset 12:00:00 001/500

■ SELECTING A LANGUAGE

There are seven languages available in the 2020we/wi: English, Spanish, French, Portuguese, Italian, Chinese, and Japanese (Kana).

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.

Main Menu
Measure
Data Logging
Options
Run PC Link
12:00:00 001/500

2. Press ▼ to scroll to **Options**.

Main Menu
Measure
Data Logging
Options
Run PC Link
12:00:00 001/500

3. Press ENTER to select **Options**.

Options Menu
Averaging
Turbidity Options
Set Clock
Set PWR Save
12:00:00 001/500

4. Press ▼ to scroll to **Select Language.**

Options Menu
Set PWR Save
Set Backlight Time
Factory Reset
Select Language
12:00:00 001/500

5. Press ENTER to select to **Select Language**.

Select Language
English
Spanish
French
Portuguese
12:00:00 001/500

6. Press ^ or v to scroll to desired language.	Select Language English Spanish French Portuguese 12:00:00 001/500
7. Press ENTER to select desired language. The screen will momentarily display, **Storing...**for about 1 second and return tot the **Options Menu**.	Options Menu Set PWR Save Set Backlight Time Factory Reset Select Language 12:00:00 001/500

NOTE: If the meter unintentionally switches to another language, use the procedure above to reset the meter to the desired language. For example, to reset the meter to English:

1. Turn the meter on.
2. Press down arrow twice. Press ENTER.
3. Press down arrow seven times. Press ENTER.
4. Press ENTER.

DATA LOGGING

The default setting for the data logger is enabled. The meter will log the last 500 data points. The counter in the center bottom of the display will show how many data points have been logged.

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ▼ to scroll to **Data Logging**.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
3. Press ENTER to select **Data Logging**.	Logging Display Test Log Enable Logging Disable Logging Erase Log 12:00:00 001/500
4. Press ENTER to display the last data point and the time that it was logged.	Record Number 2 Turbidity - WB (F) 655 AU 12:26:58 PM 08-03-2010 12:00:00 001/500

5. Press ^ or v to scroll through the data points in the log.	Record Number 1 Turbidity - WB (F) 95.4 NTU 12:26:44 PM 08-03-2010 12:00:00 001/500
6. Press EXIT to return to the **Logging** menu. Press ^ or v to scroll to disable the logging options or erase the log. Press ENTER to select the option. The screen will display **Storing...** for about 1 second and return to the **Logging Menu**.	Logging Display Test Log Enable Logging Disable Logging Erase Log 12:00:00 001/500

■ CALIBRATION

Turbidity Standards

Only use AMCO or formazin standards with the 2020we/wi. StablCal® standards below 50 NTU should not be used to calibrate the 2020we/wi. The diluent used in the StablCal® standards has a different refractive index than traditional formazin standards and will affect the results. The concentration of the calibration standard should be similar to the expected concentration of sample that will be tested. The following standards are available from LaMotte Company:

1480 0 NTU Standard, 60 mL (EPA or ISO)

1450 1 NTU Standard, 60 mL (EPA)

1453 1 NTU Standard, 60 mL (ISO)

1451 10 NTU Standard, 60 mL (EPA)

1454 10 NTU Standard, 60 mL (ISO)

1452 100 NTU Standard, 60 mL (EPA)

1455 100 NTU Standard, 60 mL (ISO)

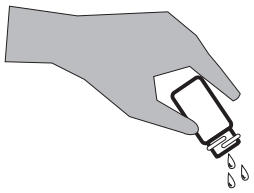
Turbidity Calibration Procedure

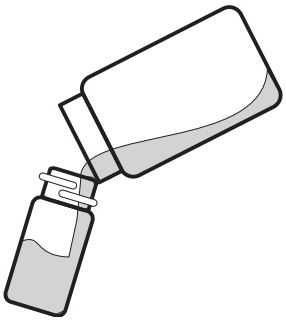
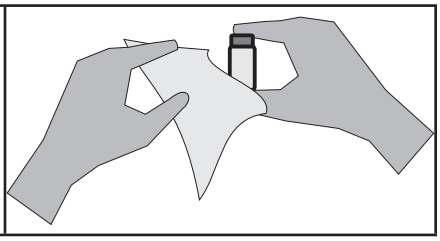
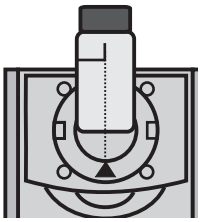
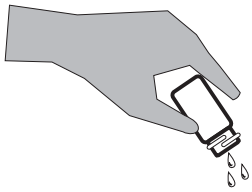
The default units are NTU and the default calibration curve is formazin as indicated by (F) in the Menu bar. For the most accurate results, a user calibration should be performed. The Japan Standard calibration mode, as indicated by (J) in the Menu bar, should be used only with Japanese Polystyrene Standards (0-100 NTU). To change the settings see the Set Up Instructions on page 9.

For the most accurate results, perform a calibration over the smallest range possible. Use a calibration standard that, along with the blank, brackets the range of samples that will be tested. For example, if the samples that are to be tested are expected to be below 1 NTU, more accurate results will be obtained by calibration with a blank and a 1 NTU standard as opposed to a blank and a 100 NTU standard.

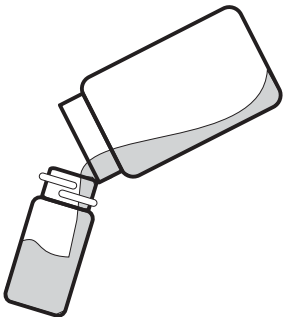
It is recommended that the meter be calibrated daily.

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500

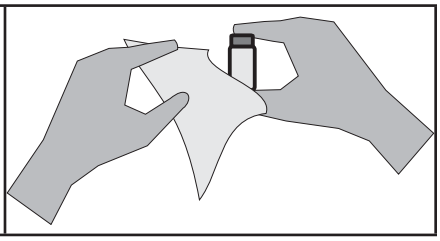
2. Press ENTER to select **Measure**.	Measure Menu Turbidity - No Blank Turbidity - With Blank 12:00:00 001/500
3. Press ∨ to scroll to **Turbidity - With Blank**.	Measure Menu Turbidity - No Blank Turbidity - With Blank 12:00:00 001/500
4. Press ENTER to select **Turbidity - With Blank.**	Turbidity WB (F) Scan Blank Scan Sample 12:00:00 001/500
5. Rinse a clean tube (0290) three times with the blank. If samples are expected to read below 1 NTU the meter should be blanked with a 0 NTU Primary Standard or prepared turbidity-free (<0.1 NTU) water. For the most accurate results, use the same tube for the blank and the sample.	

6. Fill the tube to the fill line with the blank. Pour the blank down the inside of the tube to avoid creating bubbles. Cap the tube.	
7. Wipe the tube thoroughly with a lint-free cloth.	
8. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.	
9. Press ENTER to scan the blank. The screen will display **Blank Done** for about 1 second and then return to the **Turbidity - With Blank Menu**.	Turbidity WB (F) Scan Blank Scan Sample 12:00:00 001/500
10. Rinse a clean tube (0290), or the same tube, three times with the standard.	

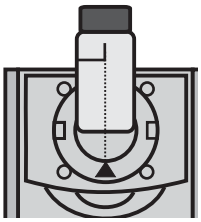
11. Fill the tube to the fill line with the standard. Pour the standard down the inside of the tube to avoid creating bubbles. Cap the tube.



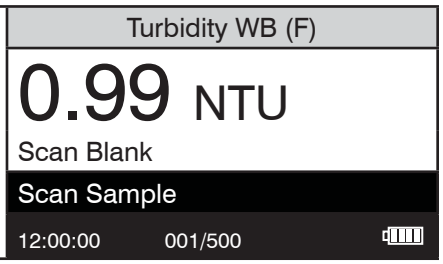
12. Wipe the tube thoroughly with a lint-free cloth.



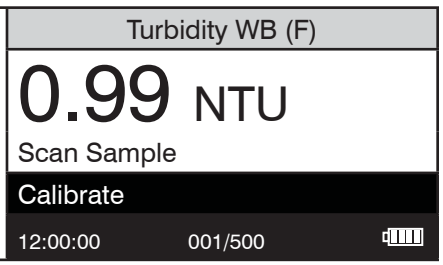
13. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.



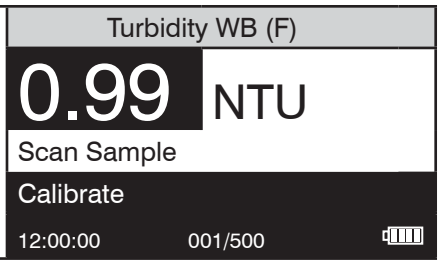
14. Press ENTER to scan the standard. The screen will display **Reading** for about 1 second. The result will appear on the screen.



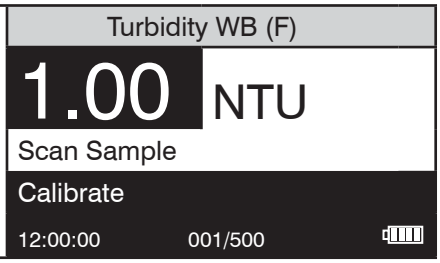
15. Press ▼ to scroll to **Calibrate**.



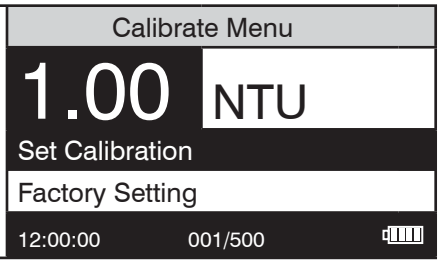
16. Press ENTER to select **Calibrate**. A reverse font (dark background with light characters) will appear to indicate that the reading can be adjusted.



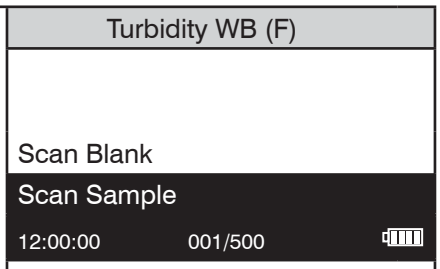
17. Press ⌃ or ⌄ to scroll to the concentration of the standard, 1.00 in the example. Note: The allowable adjustment is ±10%.



18. Press ENTER to select **Caibrate**. Two menu choices will be offered, **Set Calibration** and **Factory Setting**.



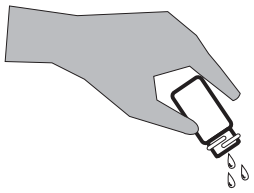
19. Press ENTER to select **Set Calibration** and save the calibration. Press ⌃ or ⌄ to scroll and select **Factory Setting** to revert to the factory calibration. The meter will momentarily display **Storing...** and return to the **Turbidity -Without Blank** menu. The calibration has now been saved and the meter can be used for testing.



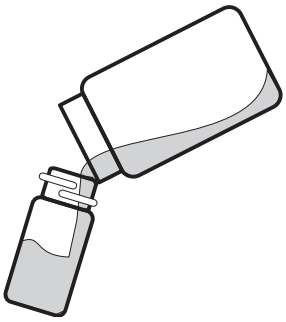
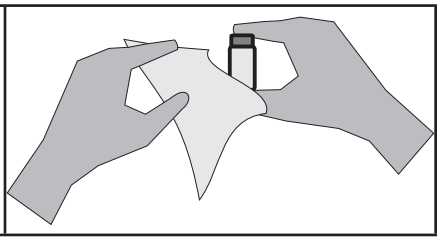
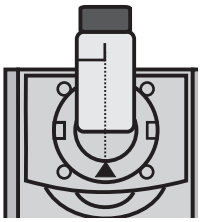
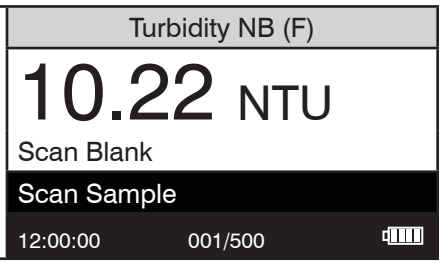
NOTE: For the greatest accuracy during the calibration procedure, be sure that after the meter is blanked and the blank is scanned as a sample, the reading is 0.00. If not, reblank the meter and scan the blank again until it reads 0.00. When scanning the calibration standards as the sample, scan the calibration standard three times removing the tube from the chamber after each scan. The readings should be consistent. Use the last consistent reading to calibrate the meter. If the readings are not consistent, avoid using an aberrant reading to calibrate the meter.

■ ANALYSIS WITHOUT BLANKING PROCEDURE

To obtain the most accurate results the meter should be blanked before measuring a sample. The blanking step is not as critical for samples above 10 NTU. The meter should always be blanked before reading samples below 10 NTU.

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ENTER to select **Measure**.	Measure Menu Turbidity - No Blank Turbidity - With Blank 12:00:00 001/500
3. Press ENTER to select **Turbidity - No Blank**.	Turbidity NB (F) Scan Blank Scan Sample 12:00:00 001/500
4. Rinse a clean tube (0290) three times with the sample.	

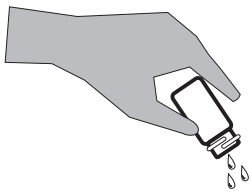
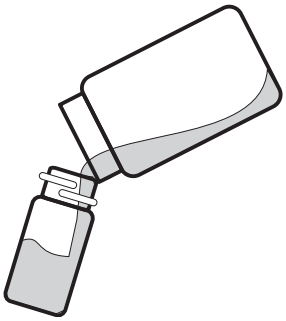
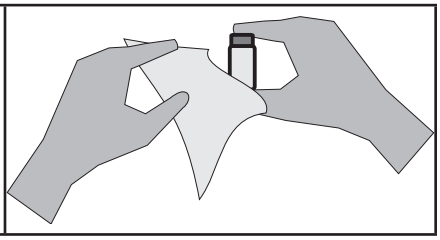
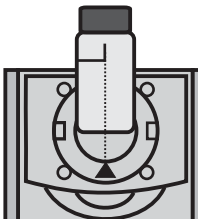
Analysis

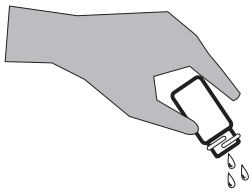
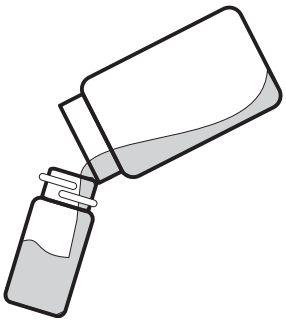
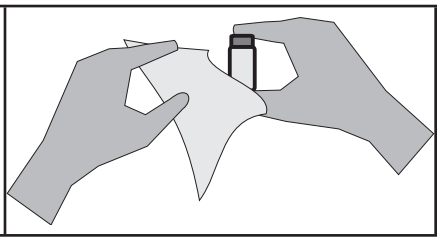
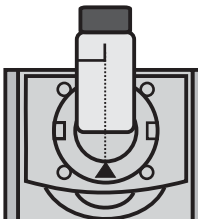
5. Fill the tube to the fill line with the sample. Pour the sample down the inside of the tube to avoid creating bubbles. Cap the tube.	
6. Wipe the tube thoroughly with a lint-free cloth.	
7. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.	
8. Press ENTER to select **Scan Sample**. The screen will display **Reading** for about 1 second. The result will appear on the screen.	

■ ANALYSIS WITH BLANKING PROCEDURE

To obtain the most accurate results the meter should be blanked before measuring a sample. The blanking step is not as critical for samples above 10 NTU. The meter should always be blanked before reading samples below 10 NTU.

1. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.	Main Menu Measure Data Logging Options Run PC Link 12:00:00 001/500
2. Press ENTER to select **Measure**.	Measure Menu Turbidity - No Blank Turbidity - With Blank 12:00:00 001/500
3. Press ∨ to scroll to **Turbidity - With Blank**.	Measure Menu Turbidity - No Blank Turbidity - With Blank
4. Press ENTER to select **Turbidity - With Blank**.	Turbidity WB (F) Scan Blank Scan Sample 12:00:00 001/500

5. Rinse a clean tube (0290) three times with the blank. If samples are expected to read below 1 NTU the meter should be blanked with a 0 NTU Primary Standard or prepared turbidity-free (<0.1 NTU) water. For the most accurate results, use the same tube for the blank and the sample.	
6. Fill the tube to the fill line with the blank. Pour the blank down the inside of the tube to avoid creating bubbles. Cap the tube.	
7. Wipe the tube thoroughly with a lint-free cloth.	
8. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.	

9. Press ENTER to scan the blank. The screen will display **Blank Done** for about 1 second and then return to the **Turbidity - With Blank** menu.	Turbidity WB (F) Scan Blank Scan Sample 12:00:00 001/500
10. Rinse a clean tube (0290), or the same tube, three times with the sample.	
11. Fill the tube to the fill line with the standard. Pour the standard down the inside of the tube to avoid creating bubbles. Cap the tube.	
12. Wipe the tube thoroughly with a lint-free cloth.	
13. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.	

14. Press ENTER to scan the standard. The screen will display **Reading** for about 1 second. The result will appear on the screen.	Turbidity WB (F) 0.99 NTU Scan Blank Scan Sample 12:00:00 001/500

NOTE: The meter will remember the last scanned blank reading. It is not necessary to scan a blank each time the test is performed. To use the previous blank reading, instead of scanning a new one, scroll to Scan Sample and proceed. For the most accurate results, the meter should be blanked before each test and the same tube should be used for the blank and the reacted sample.

■ DILUTION PROCEDURES

If a sample is encountered that is more than 4000 NTU, a careful dilution with 0 NTU or very low turbidity water will bring the sample into an acceptable range. However, there is no guarantee that halving the concentration will exactly halve the NTU value. Particulates often react in an unpredictable manner when diluted.

Turbidity-Free Water

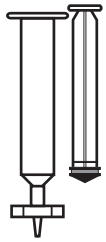
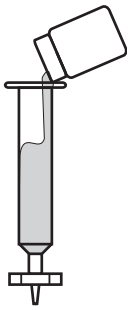
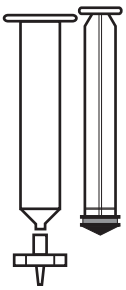
The definition of low turbidity and turbidity-free water has changed as filter technology has changed and nephelometric instruments have become more sensitive. At one time turbidity-free water was defined as water that had passed through a 0.6 micron filter. Now 0.1 micron filters are available and higher purity water is possible. Water that has been passed through a 0.1 micron filter could be considered particle free and therefore turbidity free, 0 NTU water. Turbidity is caused by scattered light. Therefore, low turbidity water is water without any particles that scatter a measurable amount of light. But water that passed through a 0.1 micron filter may still have detectable light scatter with modern instruments. This light scattering can be the result of dissolved molecules or sub-micron sized particles that can not be filtered out of the water. Because there may still be a small amount of scattered light from dissolved molecules, high purity water is often called low turbidity water and assigned a value of 0.01 or 0.02 NTU. However, because this water is used as a baseline to compare to sample water, the difference between the sample and the low turbidity or turbidity-free water will be the same whether it is called 0.00 NTU or 0.02 NTU. For design simplicity the 2020we/wi uses the term turbidity-free water and the value of 0.00 NTU.

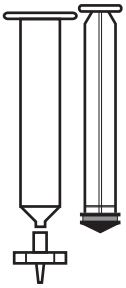
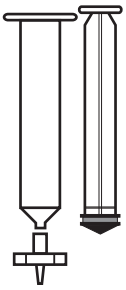
■ PREPARATION OF TURBIDITY-FREE WATER

A 0 NTU Standard (Code 1480) is included with the meter. An accessory package (Code 4185) is available for preparing turbidity-free water for blanking the meter and dilution of high turbidity samples.

The preparation of turbidity-free water requires careful technique.

Introduction of foreign matter will affect the turbidity reading. A filtering device with a special membrane filter is used to prepare turbidity-free water. The filter, filter holder and syringe must be conditioned by forcing at least two syringes full of deionized water through the filtering apparatus to remove foreign matter. The first and second rinses should be discarded. Turbidity-free water as prepared with the following procedure may be stored in the dark at room temperature in a clean glass bottle with a screw cap and used as required. The storage container should be rinsed thoroughly with filtered deionized water before filling. The water should be periodically inspected for foreign matter in bright light.

1. Remove the plunger from the syringe (0943). Attach the filter to the bottom of the syringe.	
2. Pour approximately 50 mL of deionized water into the barrel of the syringe. Insert the plunger. Exert pressure on the plunger to slowly force the water through the filter. Collect water in the clean storage container. Rinse walls of the container then discard this rinse water.	
3. Remove the filter from the syringe. Remove the plunger from the barrel. (This step is required to prevent rupturing the filter by the vacuum that would be created when the plunger is removed.)	

4. Replace the filter and repeat step 2 for a second rinse of the syringe and storage container.	
5. Remove the filter from the syringe. Remove the plunger from the barrel. Replace the filter and fill the syringe with approximately 50 mL of deionized water. Filter the water into the storage container and save this turbidity-free water.	
6. Repeat Step 5 until the desired amount of turbidity-free water has been collected.	

TESTING TIPS

1. Samples should be collected in a clean glass or polyethylene container.
2. Samples should be analyzed as soon as possible after collection.
3. Gently mix sample by inverting before taking a reading but avoid introducing air bubbles.
4. For the most precise results, follow the recommended procedure for wiping a filled tube before placing it in the meter chamber. Invert tube very slowly and gently three times to mix the sample. Surround the tube with a clean, lint-free cloth. Press the cloth around the tube. Rotate the tube in the cloth three times to assure that all areas of the tube have been wiped.
5. Discard tubes that have significant scratches and imperfections in the light pass zones. (Central zone between bottom and fill line).
6. When reading very low turbidity samples, do not use tubes or caps that have been used previously with high turbidity samples.
7. Use the averaging option for low level measurements of turbidity.

8. The meter should be placed on a surface that is free from vibrations. Vibrations can cause high readings.
9. Turbidity readings will be affected by electric fields around motors.
10. Carbon in the sample will absorb light and cause low readings.
11. Excessive color in a sample will absorb light and cause low readings. The user should verify if a certain level of color will cause a significant error at the level of turbidity being tested.
12. Observe shelf life recommendations for turbidity standards.
13. Do not use silicone oil on tubes when testing turbidity with the 2020we/wi.
14. When testing at low concentrations use the same tube for the blank and the sample.
15. Always insert tube into the meter chamber with the same amount of pressure and to the same depth.
16. Occasionally clean the chamber with a damp lint-free wipe, followed by a Windex® dampened wipe. A clean chamber and tubes are essential for reliable results.
17. For the greatest accuracy during the calibration procedure, be sure that after the meter is blanked and the blank is scanned as a sample, the reading is 0.00. If not, reblank the meter and scan the blank again until it reads 0.00. When scanning the calibration standards as the sample, scan the calibration standard three times removing the tube from the chamber after each scan. The readings should be consistent. Use the last consistent reading to calibrate the meter. If the readings are not consistent, avoid using an aberrant reading to calibrate the meter.
18. Calibrate the meter daily.
19. Calibrate the meter with a 1.0 NTU Standard if samples are expected to be 1.0 NTU or less. Calibrate the meter with a 10.0 NTU Standard if samples are expected to be 1.0 NTU or greater.

TROUBLESHOOTING GUIDE

■ TROUBLESHOOTING

PROBLEM	*REASON*	*SOLUTION*
“Blank?”	Sample is reading lower than the blank.	With samples of very low concentration reblank or record as zero. On samples of higher concentration reblank and read again.
Flashing	Low battery. Readings are reliable.	Charge battery or use USB wall/computer charger.
“Low Battery”	Battery voltage is very low. Readings are not reliable.	Charge battery or use USB wall/computer charger.
“Shut Down Low Batt” Shut Down	Battery is too low to operate the unit.	Charge battery or use USB wall/computer charger.
“Over range”	Sample is outside of acceptable range.	Dilute sample and test again.
“Error1”	High readings with 90° and 180° detectors.	Dilute sample by at least 50% and retest.
Lost in meter menus	Reset to factory default settings.	Follow Procedure on page 9 or page 26.
Unusually large negative or positive readings when performing calibration	Incorrect standards used to calibrate meter.	Use fresh 0.0 standard in clean tube. Reset meter to factory default settings. Recalibrate meter.

■ STRAY LIGHT

The accuracy of readings on the 2020we/wi should not be affected by stray light. Make sure that the sample compartment lid is always fully closed when taking readings. The backlight will interfere with turbidity readings. The meter will temporarily disable the backlight while turbidity measurements are being taken.

GENERAL OPERATING INFORMATION

■ OVERVIEW

The 2020we/wi is a portable, microprocessor controlled, direct reading nephelometer. Turbidity is measured directly by either EPA Method 180.1 or ISO Method 7027. It has a graphical liquid crystal display and 6 button keypad. These allow the user to select options from the menu driven software, to directly read test results or to review stored results of previous tests in the data logger. The menus can be displayed in seven different languages.

The 2020we/wi uses a state of the art, multi-detector optical configuration that assures long term stability of calibrations, high precision and accuracy and low detection limits. All readings are determined by sophisticated digital signal processing algorithms, minimizing fluctuations in readings and enabling rapid, repeatable measurements. The microprocessor and optics enable a dynamic range and auto-ranging over several ranges. Energy efficient LED light sources are used for ISO turbidity. EPA turbidity uses a tungsten filament light source that meets or exceeds EPA specifications and is designed for a uniform light spot image and stable output.

A USB computer/wall charger or Lithium battery powers the 2020we/wi.

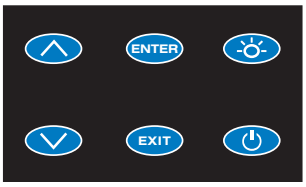
A USB port on the back of the meter allows an interface of the meter with a Windows-based computer for real-time data acquisition and data storage using a PC. The 2020we/wi may be interfaced with any Windows-based computer by using the LaMotte SMARTLink 3 Program.

GENERAL OPERATING INFORMATION

The operation of the 2020we/wi is controlled by the menu driven software and user interface. A menu is a list of choices. This allows a selection of various tasks for the 2020we/wi to perform, such as, scan blank and scan sample. The keypad is used to make menu selections that are viewed on the display.

■ The Keypad

^	This button will scroll up through a list of menu selections.
ENTER	The button is used to select choices in a menu viewed in the display.
☼	This button controls the backlight on the display.
v	This button will scroll down through a list of menu selections.
EXIT	This button exits to the previous menu.
⏻	This button turns the meter on or off.

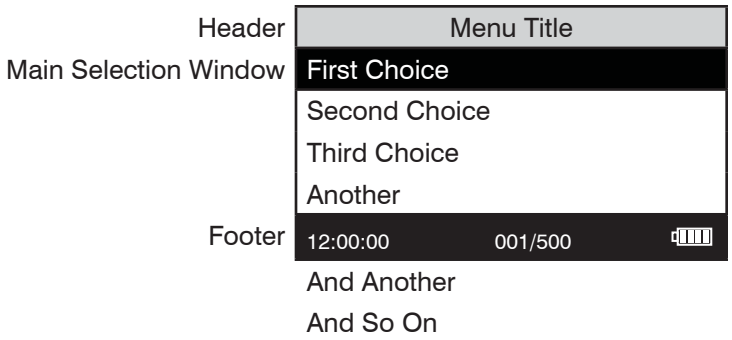


■ THE DISPLAY & MENUS

The display allows menu selections to be viewed and selected. These selections instruct the 2020we/wi to perform specific tasks. The menus are viewed in the display using two general formats that are followed from one menu to the next. Each menu is a list of choices or selections.

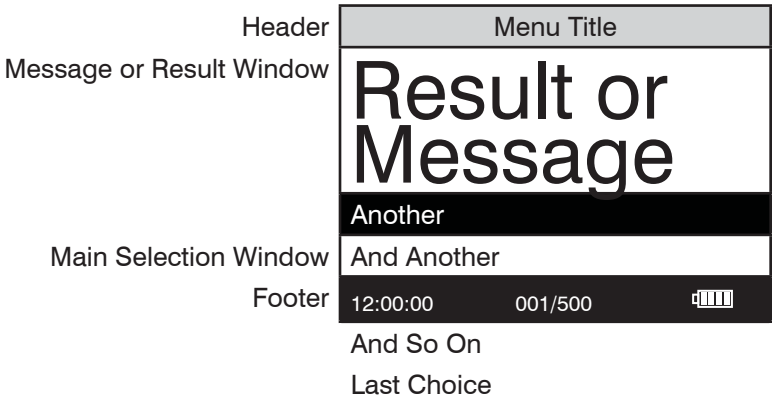
The display has a header line at the top and a footer line at the bottom. The header displays the title of the current menu. The footer line displays the time and the date, the data logger status and the battery status. The menu selection window is in the middle of the display between the header and the footer.

The menu selection window displays information in two general formats. In the first format only menu selections are displayed. Up to 4 lines of menu selections may be displayed. If more selections are available they can be viewed by pressing the arrow buttons ^ v to scroll the other menu selections into the menu selection window. Think of the menu selections as a vertical list in the display that moves up or down each time an arrow button ^ v is pressed. Some menus in the 2020we/wi are looping menus. The top and bottom menu choices are connected in a loop. Scrolling down past the bottom of the menu will lead to the top of the menu. Scrolling up past the top of the menu will lead to the bottom of the menu.



A black bar will indicate the menu choice. As the menu is scrolled through, the black bar will highlight different menu choices. Pressing the ENTER button will select the menu choice that is indicated by the black bar.

In the second format the menu choice window takes advantage of the graphical capabilities of the display. Large format graphic information, such as test results or error messages or the LaMotte logo is displayed. The top two lines of the display are used to display information in a large, easy to read format. The menus work in the same way as previously described but two lines of the menu are visible at the bottom of the display.



As described previously, the EXIT button allows an exit or escape from the current menu and a return to the previous menu. This allows a rapid exit from an inner menu to the main menu by repeatedly pushing the EXIT button. Pushing ⏻ at any time will turn the 2020we/wi off.

The display may show the following messages:

	Battery Status
↑ ↓	More choices are available and can be viewed by scrolling up and/or down through the display.
Header	Identifies the current menu and information on units and reagent systems if applicable.
Footer	In the data logging mode the number of the data point is displayed and the total number of data points in the memory will be shown. The footer also shows current time and battery status

■ NEGATIVE RESULTS

There are always small variations in readings with analytical instruments. Often these variations can be observed by taking multiple readings of the same sample. These variations will fall above and below an average reading. Repeated readings on a 0.00 sample might give readings above and below 0.00. Therefore, negative readings are possible and expected on samples with concentrations at or near zero. This does not mean there is a negative concentration in the sample. It means the sample reading was less than the blank reading. Small negative readings can indicate that the sample was at or near the detection limit. This is a normal variation that results in a negative reading. A large negative reading, however, is not normal and indicates a problem. Some instruments are designed to display negative readings as zero. In this type of instrument, if the meter displayed zero when the result was actually a large negative number there would be no indication that a problem existed. For this reason, the 2020we/wi displays negative numbers for turbidity.

■ TUBES

The 2020we/wi uses one type of tube (Code 0290). There is no need for a special turbidity tube.

The handling of the tubes is of utmost importance. Tubes must be clean and free from lint, fingerprints, dried spills and significant scratches, especially the central zone between the bottom and the sample line.

Scratches, fingerprints and water droplets on the tube can cause stray light interference leading to inaccurate results when measuring turbidity. Scratches and abrasions will affect the accuracy of the readings. Tubes that have been scratched in the light zone through excessive use should be discarded and replaced with new ones.

Tubes should always be washed on the inside and outside with mild detergent prior to use to remove dirt or fingerprints. The tubes should be

allowed to air-dry in an inverted position to prevent dust from entering the tubes. Dry tubes should be stored with the caps on to prevent contamination.

After a tube has been filled and capped, it should be held by the cap and the outside surface should be wiped with a clean, lint-free absorbent cloth until it is dry and smudge-free. Handling the tube only by the cap will avoid problems from fingerprints. Always set the clean tube aside on a clean surface that will not contaminate the tube. It is imperative that the tubes and light chamber be clean and dry. The outside of the tubes should be dried with a clean, lint-free cloth or disposable wipe before they are placed in the meter chamber.

Tubes should be emptied and cleaned as soon as possible after reading a sample to prevent deposition of particulates on the inside of the tubes. When highly accurate results are required, reduce error by designating tubes to be used only for very low turbidity and very high turbidity testing.

Variability in the geometry of the glassware and technique is the predominate cause of variability in results. Slight variations in wall thickness and the diameter of the tubes may lead to slight variations in the test results. To eliminate this error the tubes should be placed in the chamber with the same orientation each time.

COMPUTER CONNECTION

■ PC LINK

The 2020we/wi may be interfaced with any Windows-based computer by using the LaMotte SMARTLink 3 Program and USB Cable. The program will store test information and results in a database.

■ OUTPUT

USB

■ COMPUTER CONNECTION

USB Type A, USB mini B, Order Cable Code 1720.

BATTERY OPERATION

The 2020we/wi may be operated on battery power or using a computer/ AC wall adapter. If using the meter as a bench top unit, use the AC wall adapter if possible to extend the battery life. The meter will remain on when the USB adapter is used.

The battery icon will show no bars and flash when the unit first turns on. Then the indicator will indicate the battery status by showing 0, 1, 2, 3 or 4 bars.

It will take 5 hours to fully change a low battery. The battery icon will flash when the battery is charging. The battery icon will show four bars and stop flashing when it is fully charged. The charging circuit will automatically switch to a float charge when the battery is fully charged. The charger may remain connected. Some computers will NOT supply

power to their USB ports during standby operation. The wall charger will charge the unit continuously.

The battery icon will show no bars and continuously flash if the battery is getting low but the unit will still operate normally. A “Low Battery” message on the status bar of the display will replace the time when the battery voltage is too low for proper operation and accuracy may be degraded. A “Shutdown Low Batt” message on the display will appear for a few seconds before the power is switched off when the battery is too low to operate the unit.

To extend the battery life:

- Shut down the unit with the power switch when not taking measurements or use the power save option to have the unit automatically turn off after 5 minutes.
- Store the unit in a cool dry place.
- Fully charge the battery before storing the unit for extended periods of time.
- Limit backlight use. The unit consumes 3X normal power with the backlight on. Set the backlight time option to 10 seconds, or select “Button Control” and keep the backlight off.

MAINTENANCE

■ CLEANING

Clean the exterior housing with a damp, lint-free cloth. Do not allow water to enter the light chamber or any other parts of the meter. To clean the light chamber and optics area, point a can of compressed air into the light chamber and blow the pressurized air into the light chamber. Use a cotton swab dampened with Windex® window cleaner to gently swab the interior of the chamber. Do not use alcohol; it will leave a thin residue over the optics when dry.

■ REPAIRS

Should it be necessary to return the meter for repair or servicing, pack the meter carefully in a suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 800-344-3100 (US only) or 410-778-3100, faxing 410-778-6394, or emailing tech@lamotte.com. Often a problem can be resolved over the phone or by email. If a return of the meter is necessary, attach a letter with the return authorization number, meter serial number, a brief description of problem and contact information including phone and FAX numbers to the shipping carton. This information will enable the service department to make the required repairs more efficiently.

■ METER DISPOSAL

Waste Electrical and Electronic Equipment (WEEE)

Natural resources were used in the production of this equipment. This equipment may contain materials that are hazardous to health and the environment. To avoid harm to the environment and natural resources, the use of appropriate take-back systems is recommended. The crossed out wheeled bin symbol on the meter encourages the use of these systems when disposing of this equipment.

Take-back systems will allow the materials to be reused or recycled in a way that will not harm the environment. For more information on approved collection, reuse, and recycling systems contact local or regional waste administration or recycling services.

GENERAL INFORMATION

■ PACKAGING AND DELIVERY

Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered in transportation of shipments.

After the product leaves LaMotte Company, all responsibility for safe delivery is assured by the transportation company. Damage claims must be filed immediately with the transportation company to receive compensation for damaged goods.

■ GENERAL PRECAUTIONS

READ THE INSTRUCTION MANUAL BEFORE ATTEMPTING TO SET UP OR OPERATE THE METER. Failure to do so could result in personal injury or damage to the meter. The meter should not be used or stored in a wet or corrosive environment. Care should be taken to prevent water from wet tubes from entering the meter chamber.

NEVER PUT WET TUBES IN THE METER.

■ SAFETY PRECAUTIONS

Read the label on all reagent containers. Some labels include precautionary notices and first aid information. Certain reagents are considered potential health hazards and are designated with a * in the instruction manual. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by e-mail, phone or FAX. Additional information for all LaMotte reagents is available in the United States, Canada, Puerto Rico, and the US Virgin Islands from Chem-Tel by calling 1-800-255-3924. For other areas, call 813-248-0585 collect to contact Chem-Tel's International access number. Each reagent can be identified by the four-digit number listed on the upper left corner of the reagent label, in the contents list and in the test procedures.

■ LIMITS OF LIABILITY

Under no circumstances shall LaMotte Company be liable for loss of life, property, profits, or other damages incurred through the use or misuse of their products.

■ SPECIFICATIONS - 2020we/wi

Instrument Type:	Nephelometer
Standard:	EPA 180.1, 2020we; ISO7027, 2020wi
Units of Measure:	NTU (Nephelometric Turbidity Units) (2020we only) FNU (Formazin Nephelometric Units) (2020wi only) ASBC (American Society of Brewing Chemists) EBC (European Brewery Convention)
Range:	0-4000 NTU, 0-4000 FNU, 0-10,500 ASBC, 0-150 EBC
Range Selection:	Automatic
Resolution: (display)	0.01 NTU, 0–10.99 NTU Range 0.1 NTU, 11.0–109.9 NTU Range 1 NTU, 110–4000 NTU Range
Accuracy:	From 0-2.5 NTU the accuracy is ±0.05 NTU. From 2.5-100 NTU the accuracy is ±2%. Above 100 NTU the accuracy is ±3%.
Detection Limit:	0.05 NTU
Light Source:	Tungsten lamp 2300°C ±50 °C, 2020we; IR LED 850 nm ±10 nm, spectral bandwidth 50 nm, 2020wi
Detector	Photodiode, centered at 90°, maximum peak 400-600 nm, TC-3000we Photodiode, centered at 90°, TC-3000wi
Response Time:	<2 seconds
Signal Averaging:	Yes
Sample Chamber:	Accepts 25 mm flat-bottomed test tubes
Sample:	10 mL in capped tube
Display:	Graphic Liquid Crystal Display
Software:	*Auto Shut-off:* 5, 10, 30 min, disabled *Calibration:* Field adjustable, 2-points *Data Logging:* 500 points
Languages:	English, Spanish, French, Portuguese, Italian, Chinese, Janpanese (Kana)
Temperature:	Operation: 0–50 °C; Storage: -40–60 °C

Operation Humidity Range:	0–90 % RH, non-condensing
Auto Shut-off:	5, 10, 30 min, disabled
Waterproof:	IP67
Power Source†:	USB computer/wall charger or Lithiun ion rechargeable battery 2200 mAH, 3.7V
Battery Life:	~380 tests (backlight on) to 1000 tests (backlight off) (with signal averaging disabled)
Dimensions:	(W x L x H) 8.84 x 19.05 x 6.35 cm; 3.5 x 7.5 x 2.2 inches
Weight:	362 g, 13 oz (meter only)
USB Interface	mini B

†CE Mark: The device complies to the product specifications for the Low Voltage Directive.

■ STATISTICAL & TECHNICAL DEFINITIONS RELATED TO PRODUCT SPECIFICATIONS

Method Detection Limit (MDL): "The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte."[1] Note that, "As Dr. William Horwitz once stated, 'In almost all cases when dealing with a limit of detection or limit of determination, the primary purpose of determining that limit is to stay away from it.'"[2]

Accuracy: Accuracy is the nearness of a measurement to the accepted or true value.[3] The accuracy can be expressed as a range, about the true value, in which a measurement occurs (i.e. ±0.5 ppm). It can also be expressed as the % recovery of a known amount of analyte in a determination of the analyte (i.e. 103.5 %).

Resolution: Resolution is the smallest discernible difference between any two measurements that can be made.[4] For meters this is usually how many decimal places are displayed. (i.e. 0.01). Note that the resolution many change with concentration or range. In some cases the resolution may be less than the smallest interval, if it is possible to make a reading that falls between calibration marks. A word of caution, that resolution has very little relationship to accuracy or precision. The resolution will always be less than the accuracy or precision but it is not a statistical measure of how well a method of analysis works. The resolution can be very, very good and the accuracy and precision can be very bad! This is not a useful measure of the performance of a test method.

Repeatability: Repeatability is the within-run precision.[5] A run is a

single data set, from set up to clean up. Generally, one run occurs on one day. However, for meter calibrations, a single calibration is considered a single run or data set, even though it may take 2 or 3 days.

Reproducibility: Reproducibility is the between-run precision.[6]

Detection Limit (DL): The detection limit (DL) for the 2020we/wi is defined as the minimum value or concentration that can be determined by the meter, which is greater than zero, independent of matrix, glassware, and other sample handling sources of error. It is the detection limit for the optical system of the meter.

[1] CFR 40, part 136, appendix B

[2] Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 31.

[3] Skoog, D.A., West, D. M., *Fundamental of Analytical Chemistry*, 2nd ed., Holt Rinehart and Winston, Inc, 1969, p. 26.

[4] Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 34.

[5] Jeffery G. H., Basset J., Mendham J., Denney R. C., *Vogel's Textbook of Quantitative Chemical Analysis*, 5th ed., Longman Scientific & Technical, 1989, p. 130.

[6] Jeffery G. H., Basset J., Mendham J., Denney R. C., *Vogel's Textbook of Quantitative Chemical Analysis*, 5th ed., Longman Scientific & Technical, 1989, p. 130

■ CONTENTS & ACCESSORIES

	2020we Kit EPA Version Code 1970-EPA	2020wi Kit ISO Version Code 1970-ISO
Contents	*Code*	*Code*
0 NTU Standard, 60 mL	1480	1480
1 NTU Standard, 60 mL	1450	1453
10 NTU Standard, 60 mL	1451	1454
Water Sample Bottle, 60 mL	0688	0688
Tubes, 4	—	—
Cable, USB, 3 ft.	1720	1720
USB Wall Plug	1721	1721

Accessories	
Code	*Description*
1452	100 NTU Standard, 60 mL (EPA)
1455	100 NTU Standard, 60 mL (ISO)
0290-6	Tubes, Code 0290, Set of 6
4185	Turbidity-Free Water Kit
2-2097	Filters, 0.1 micron, Pack of 50
1901-CD	SMARTLink 3 Software

■ EPA COMPLIANCE

The 2020we meter meets or exceeds EPA design specifications for NPDWR and NPDES turbidity monitoring programs as specified by the USEPA method 180.1.

■ ISO Compliance

This 2020wi meter meets or exceeds ISO design criteria for quantitative methods of turbidity using optical turbidimeters as specified by ISO 7027.

■ CE COMPLIANCE

The 2020we and 2020wi meters have been independently tested and have earned the European CE Mark of compliance for electromagnetic compatibility and safety. To view certificates of compliance, go to the LaMotte website at www.lamotte.com.

NOTE: The device complies to the product specifications for the Low Voltage Directive.

■ WARRANTY

LaMotte Company warrants this instrument to be free of defects in parts and workmanship for 2 years from the date of shipment. If it should become necessary to return the instrument for service during or beyond the warranty period, contact our Technical Service Department at 1-800-344-3100 for a return authorization number or visit www.lamotte.com for troubleshooting help. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. LaMotte Company specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. LaMotte Company's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.

Flow Controller - QED M10

MICRO PURGE® basics

QED

MODEL MP10H CONTROLLER

PATENT PENDING

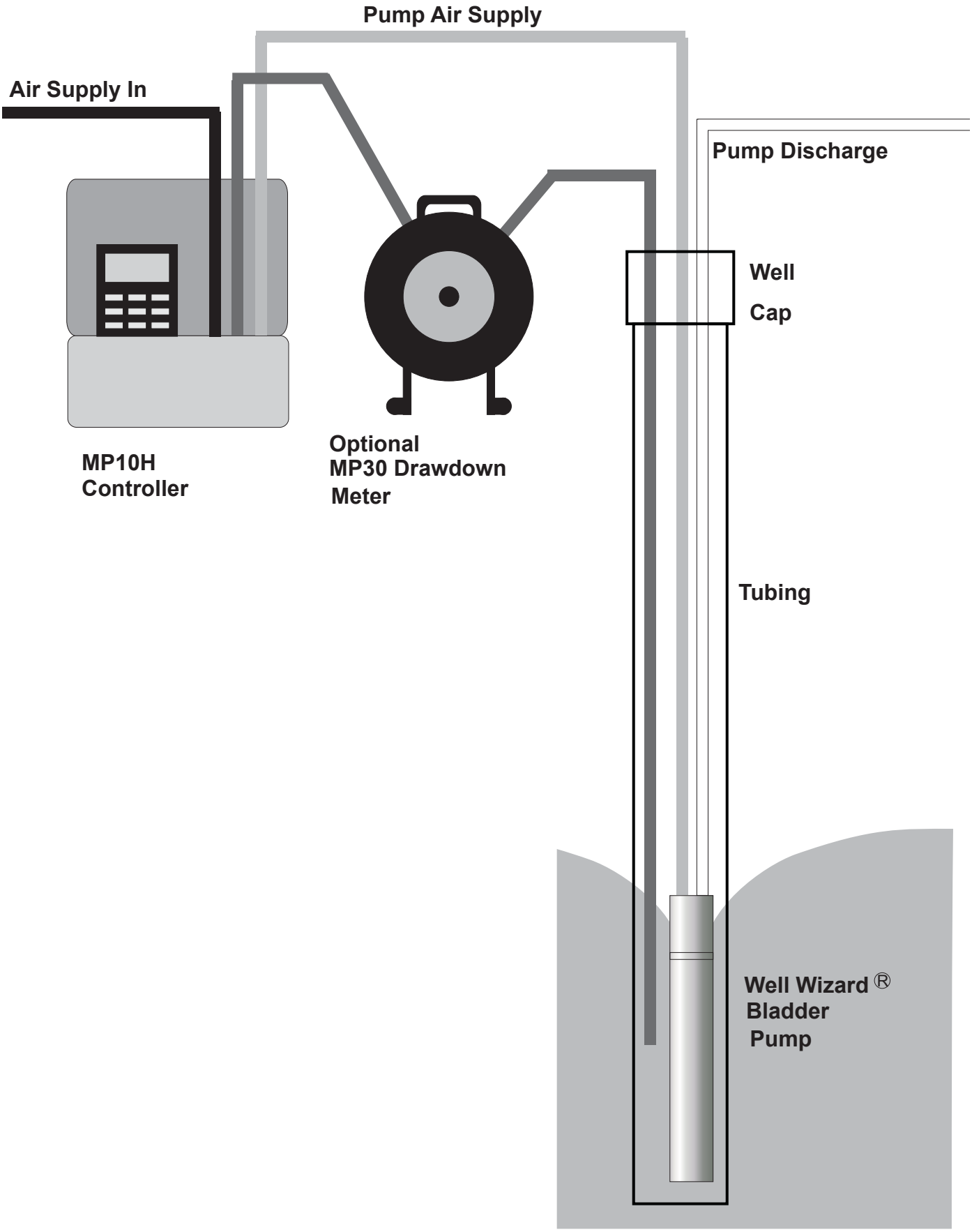
Instruction Manual

Part No. 95195 6-17-10

QED Environmental Systems

P.O. Box 3726 Ann Arbor, MI 48106-3726 USA
1-800-624-2026 Fax (734) 995-1170
info@qedenv.com www.qedenv.com

MP10H Basic Setup



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Safety warnings

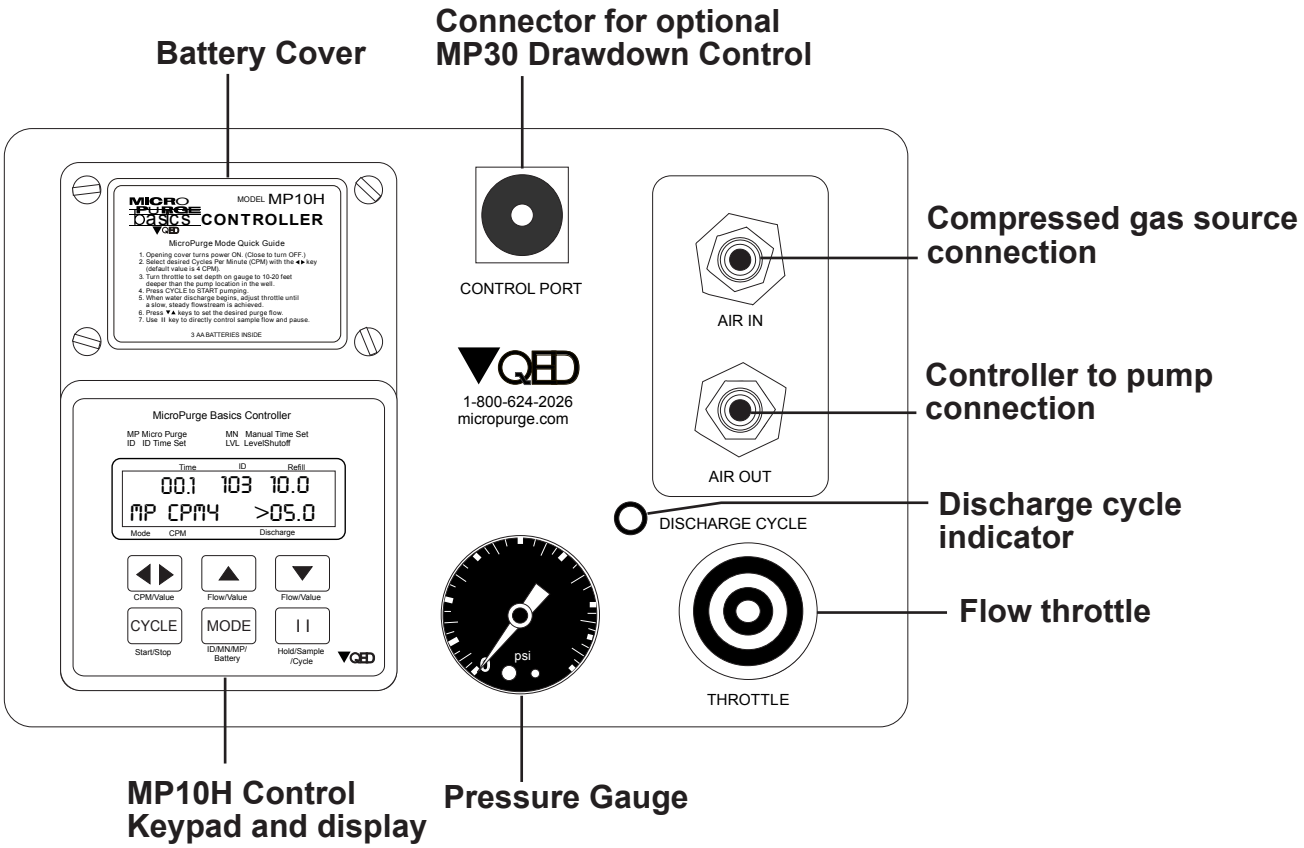
Compressed air - Use caution when working with compressed air or gas. Compressed gas cylinders are under extreme pressure and can cause unrestrained hoses to whip about dangerously. Do not over pressurize your controller. Failure to operate the controller within the pressure limits could result in failure. Read all operating instructions before operating the MP10H controller.

Warning! - Do not disassemble the pneumatic pump while it is connected to a compressed gas source. Dangerous pressures could cause injury.

Warning! The MP10H Controller is designed to operate on high air pressure, up to 300 PSI. Read all instructions before operating and follow all safety guidelines! ***Failure to do so may cause serious injury or death***.

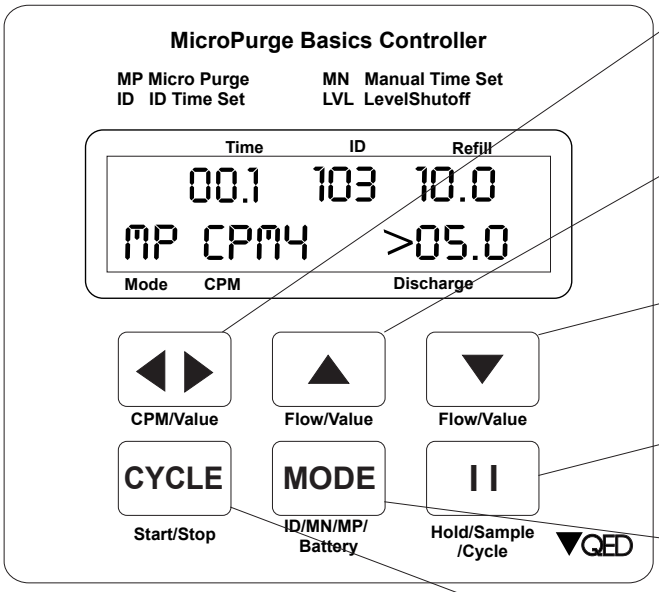
Use only the hoses and connecting fittings supplied with the MP10H and accessories from QED - **DO NOT MODIFY OR SUBSTITUTE THE FITTINGS OR HOSES**. Do not supply the MP10H with compressed gas at pressures greater than 300 PSI. Be certain of the gas supply source pressure before you connect it to the MP10H. Do not modify the fittings on any well caps to allow connection of the MP10H to sampling pump systems not intended for use with the MP10H; applying higher pressure than intended to sampling pumps can damage the pumps and tubing and cause injury or death to persons nearby. Connect the MP10H only to pumps located within the well in their normal operating position; **DO NOT** use the MP10H to operate pumps outside the well.

MP10H Panel Layout:



Diagrams and Conventions used in the Text (cont.)

MP10H Control Keys:

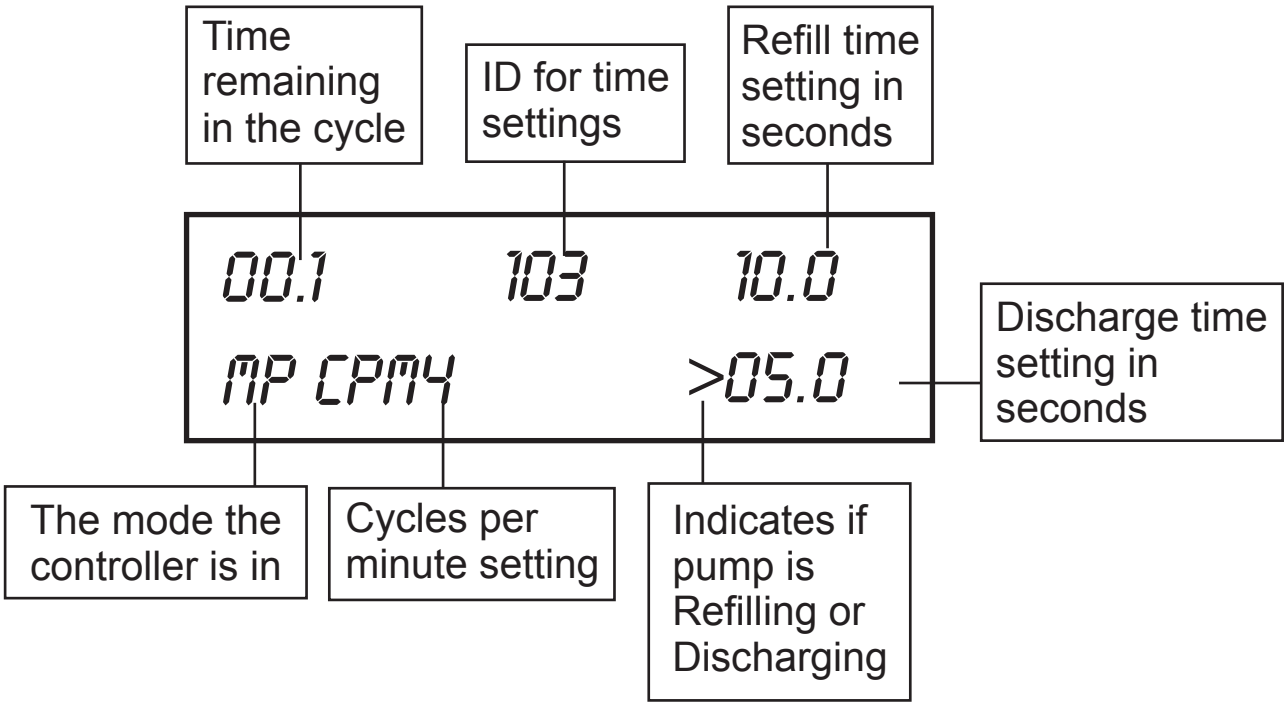


In MP Mode	In Other Modes
Cycle Per Minute key - Changes cycle per minute	Scrolls cursor
Faster key - Speeds up flow	Changes a value at the cursor location
Slower key - Slows down flow	Changes a value at the cursor location
Pause key - Pauses flow for sampling	
Mode key -Selects the operation mode. Also battery check	
Cycle key -Selects Start and Stop of pump cycling	

◀ ▶	CPM Button (also scroll for item selects)	CYCLE	CYCLE Button
▲	UP Button, faster pumping (also increase item)	MODE	MODE Button (also battery check)
▼	DOWN Button, slower pumping (also decrease item)	II	PAUSE Button (also manual sample)

Diagrams and Conventions used in the Text (cont.)

MP10H Display:



Abbreviations:

CPM	Cycles Per Minute
MP	MicroPurge Mode
ID	ID Time Set Mode
HELD	Held In A Cycle
MN	Manual Time Set Mode
BAT	Battery
LVL	Level Pause
>	Indicates Refill Or Discharge Cycle

Introduction / Quick start

Introduction: The MP10H Micro Purge Basics Controller is used to operate QED Well Wizard™ bladder sampling pumps to purge and sample ground water. The MP10H has specific design features to make MicroPurge ™ sampling easier. These features include:

- **MicroPurge Mode Operation** Simple Increase / Decrease keys allow you to easily set the flow rate you need for each well.
- **ID Time Set Mode Operation** Quickly recalls pre-determined settings for each well by specifying a 3-digit ID.
- **Level Delay Interface** The controller plugs into the optional MP30 MicroPurge Draw-down / Water Level Meter to provide direct feedback of well drawdown and to pause pump operation until the level recovers.

The optional MP30 MicroPurge Drawdown / Water Level Meter plugs into the MP10H to provide water level feedback. The MP30 uses a standard conductivity probe to detect the ground water surface and a marked tape allowing the user to measure the depth. When the meter is set in MicroPurge mode, the probe is lowered a specific distance below the static water level and fixed in this position. During well sampling if the water level drops below the user-set probe position, the MP10H is paused which prevents further drawdown by the pump. Once the level recovers the MP10H begins pump operation again, starting in the pump refill cycle. Use of the MP10H with the MP30 is detailed later in this manual.

Insert Batteries: Remove the battery cover on the top of the MP10. Insert 3, AA alkaline batteries into the battery holder and carefully replace the holder in the carrier. Replace the battery cover and tighten the 4 screws. Batteries should last for about 6-8 weeks of typical full-time field use. If the MP10H will be stored longer than about 3 months, the alkaline batteries should be removed to prevent leakage.

Quick Start: Connect the light blue coiled pump hose to the fitting labeled *AIR OUT* on the MP10H. Connect the red (or black, depending on your air source) air supply hose to a compressed air or gas source and connect it to the fitting labeled *AIR IN* on the MP10H. Supply up to 125 psi compressed air or gas to the controller. Turn the controller throttle until the gauge reads the approximate depth of the sample pump (See Page 6).
Follow instructions on the battery panel:

Opening the MP10H case turns power on.

Note: It may take up to 20 seconds for the unit to power up.

For pump depths greater than 250 ft

Select manual mode (MN) with MODE key

Turn throttle to set pressure on gauge to 12-16 psi higher than the minimum requirement of 0.42 psi per foot of pump depth location in the well.

Then set *Refill* and *Discharge* times as needed to begin and optimize pumping; use initial settings of 30 seconds each for both refill and discharge for pump depths to 300 ft; for pump depths over 300 ft., use 60 seconds each for both refill and discharge.

Press Cycle to START pumping.

When water discharge begins, adjust throttle until a slow, steady flowstream is achieved. Then adjust refill and discharge times to achieve desired flow rate. To collect samples, continue purge flow, or use | | key to directly control sample flow and pause.

For pumps located at depths less than 250 ft.

Select MicroPurge mode (MP) with MODE key
Turn throttle to set pressure on gauge to 4-8 psi higher than the minimum requirement of 0.42 psi per foot of pump depth location in the well.

Select desired Cycles Per Minute (CPM) with ◀ ▶ (default value is 4 CPM, lower CPM for deeper wells, higher CPM possible with shallow wells).

Press ▼ ▲ keys to set the desired purge flow rate.

To collect samples, continue purge flow, or use | | key to directly control sample flow and pause.

Bladder Pump Operation in Low-Submergence Applications

Pump submergence is defined as the height of the static water column above the top of the pump. In wells in which this water column height is 5 feet or less, the pump is considered to be in a low-submergence application.

QED sampling bladder pumps fill by hydrostatic pressure. As the inside of the pump's bladder fills with water, the bladder expands. This filling and expanding of the bladder is referred to as the "refill" half of the pump cycle. When air pressure is applied to the outside of the bladder, the bladder is squeezed, forcing the water up the discharge tubing. This is referred to as the "discharge" half of the pump cycle. In low-submergence applications, there is less water pressure available to expand the bladder during the refill.

This can result in a smaller volume of water being pumped with each pump cycle because the bladder may not fully expand.

As a result of the lower volume per cycle, more time will be required to bring the water to the surface. An easy way to verify that the pump is working, prior to the water reaching the surface, is to submerge the pump's discharge tubing in a beaker of water. Each time the pump goes into discharge, air in the discharge tubing, which is displaced as the water level in the tubing rises, can be seen as air bubbles coming from the end of the tubing. To optimize the pumping rate, the refill time should be set long enough to achieve the maximum volume of air bubbles on each pump cycle, and the discharge time should be set long enough to ensure that the air has stopped bubbling out of the tube before the pump controller switches back into refill.

In low submergence wells, ***it is critical that the air pressure driving the pump not be more than 10-15psi higher than the minimum re-quirement of 0.42 psi per foot of pump depth.*** Higher pressures than this can cause the bladder to be squeezed too tightly during discharge, a condition which can prevent the bladder from expanding during refill. To avoid this condition in deeper wells, it is suggested that the air pressure applied to the pump be gradually increased as the water level in the pump's discharge tubing rises. It is recommended that the air pressure be set at 15 psi initially, and slowly increased in increments of 10 psi as needed until the water reaches the surface. Submerging the end of the discharge tubing under water as described above will verify whether the air pressure is set high enough.

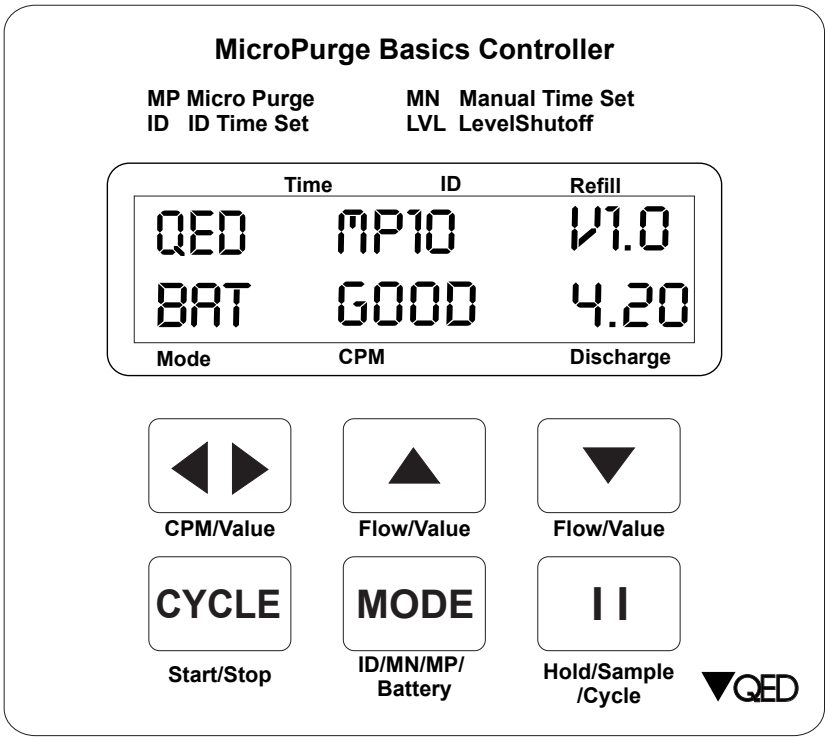
Operation

Turning the MP10H Display On - The MP10H is powered on automatically by opening the lid. The MP10H displays an opening screen for 5 seconds, after which it displays the default Micro-Purge screen. At this point the MP10H is in MicroPurge mode (MP) but not cycling the pump. This initial state allows the user to adjust time and throttle settings before the pump starts to operate. Pressing the Cycle key begins pump cycling. Times and modes may be adjusted while the pump is cycling or before. Pressing the Cycle key a second time will stop pump cycling.

Note: *all user-entered time settings are lost when the MP10 is turned off. Also, the MP10H automatically powers down when the lid is closed, so make sure the MP10H is stored with its lid closed.*

Opening Display - The opening display is shown for 5 seconds and displays the controller name, the version number and the battery voltage, (as shown in Figure 1). Figure 1 shows that the battery is GOOD, that the battery voltage is 4.20 volts and that the software version in the controller is 1.0. Battery voltage must be greater than 3.6 volts for the unit to operate. If the unit fails to cycle replace the 3-AA batteries with fresh cells. The opening screen is displayed for 5 seconds, if you wish to by pass the opening screen, hitting any key, such as the CPM key will bring you to the default MP display.

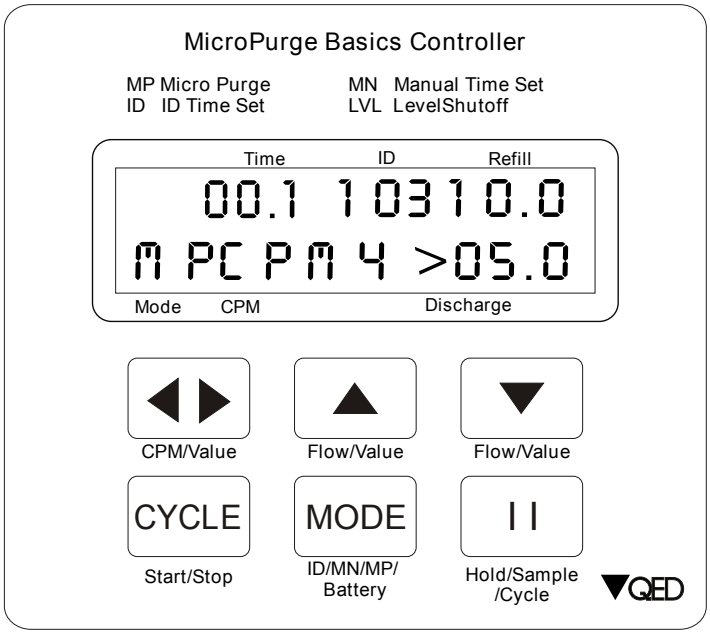
Figure 1 Opening Screen



Manual Mode For Pumps Located At Pump Depths Over 250 Feet

For deep wells manual mode (MN on the display), is useful for manually setting refill and discharge times on the controller as in traditional controllers (like previous model QED pump controllers). An example of the MP10H in Manual Mode is (shown in Figure 2). Manual Mode is also used when there are other conditions where one of the 165 possible preset times of ID and MP modes will not match your needs. MN mode is entered when the MODE key is pressed twice from the default MP mode.As shown in Figure 2, the display indicates MN mode in the lower left corner and CPM and ID are not displayed.

Figure 2 MP10H Manual Mode (MN mode)



In Manual Mode the CPM and UP, DOWN keys function differentlythan MP mode. The CPM key becomes a key used to select the digits of the refill and discharge time settings found at the rightmost positions on the display. The UP and DOWN keys are used to adjust the digit value up or down. By selecting and adjusting digits up and down a user can quickly set any time from 00.1 seconds to 999.9 seconds. Sampling in Manual Mode is the same as explained, above, for MP mode.

The MP10H does not attempt to translate a user set time into a corresponding ID or CPM. Also, any settings you have entered in MP or ID modes are lost once you press the MODE key to enter MN mode.

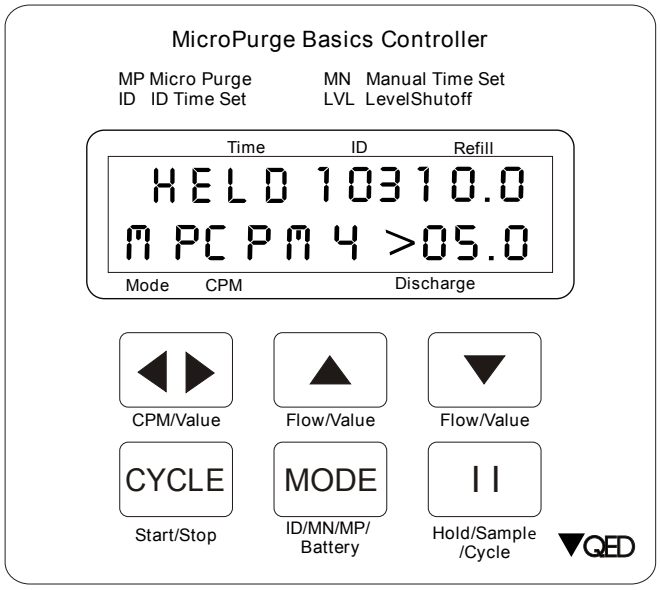
Note:changes in time settings that are entered while the controller is cycling are reflected on the next cycle change (so a long refill time of 15 seconds will time out before a new refill time becomes valid).

Sample Collection

The PAUSE key (II) is used to freeze the controller action to allow the user time to collect a sample or carry out other steps that might be difficult if the controller continued to automatically cycle and cause the pump to produce water. While the controller is cycling, pressing the PAUSE key causes the controller to immediately enter the Hold state. Drive air is vented from the pump (this is the pump refill cycle) and the pump fills and waits. Pressing the PAUSE key a second time causes the controller to immediately enter the Sample state. Drive air is directed to the pump causing the pump to discharge its volume of liquid. Bladder pumps typically hold 400-500 ml of liquid, so use of the Hold and Sample states allow the full volume of the pump to be discharged into a sample container. Pressing *PAUSE* once again returns the MP10H to its normal Automatic Cycling state. During Hold and Sample a *HELD* is displayed to remind you that the controller is in a paused state. Figure 3 shows an example of the MP10H in MP mode, but *HELD* in the Sample state.

Note: *Pressing the Cycle key also freezes controller cycling. However, using the Cycle key rather than the Pause key causes the startup screen to be displayed upon restart. Use of the Pause key is recommended for typical operation.*

Figure 3 MP10H Held State (MN mode)



Warning!: *in the HELD SAMPLE state the pump, tubing and hoses are all under pressure.* **DO NOT** *attempt to disconnect or disassemble any part of the system when it is und*er pressure. The syst*em is under prsure if the pressure gauge shows a value greater than 0 and the RED Discharge Cycle Indicator is showing.*

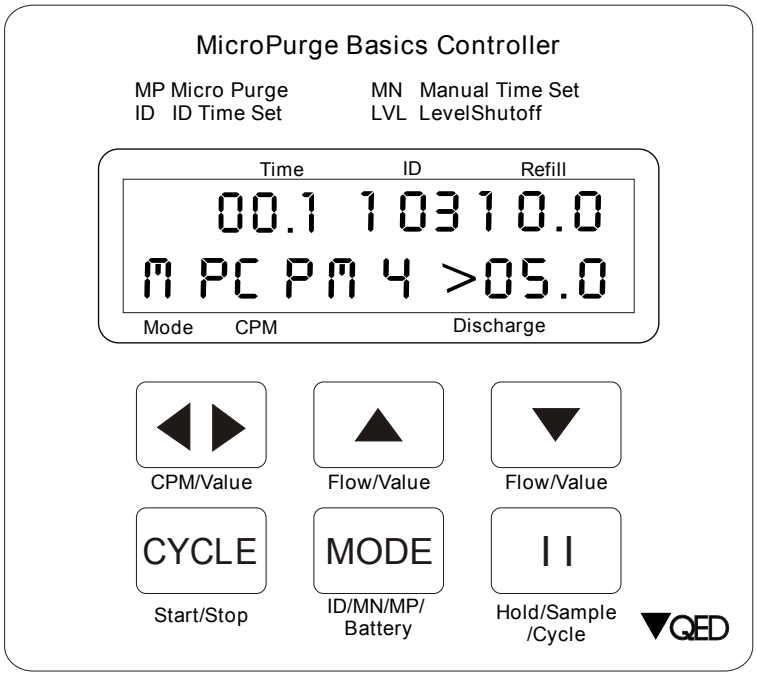
Flow Throttle Use

The flow throttle is used during sampling to regulate the pressure applied to the pump. Turning the throttle clockwise increases the pressure and counterclockwise decreases the pressure. The pressure gauge shows the approximate pressure applied to the pump. This allows easy adjustment of the throttle giving pressures that will produce gentle, non-turbulent flow (normally 5-10 psi higher than the minimum requirement of 0.42 psi per foot of pump depth). For traditional, high volume purging pressure may be increased with the throttle to maximize pump flow during well purging.

MicroPurge Mode for pumps located at depths less than 250 ft.

Most MP10H users will leave the controller in the default MicroPurge (MP) mode. See Figure 4 for an example of the MP10H in MP mode.MP mode lets you to use the UP and DOWN keys to directly increase and decrease pump flow rates.The MP10H has a broad range of other CPM settings to ensure the availability of a time setting that will match your specific conditions. MP mode also displays an ID, with a value of 1 to 165 that matches the flow settings (CPM and refill and discharge times you have set). This ID should be noted alongside the well identification (QED provides custom weatherproof ID badges for purchasers of our MP series of well caps) for quick setting of the optimal controller settings on the next visit by using the MP10H in ID mode.

Figure 4 MP10H MicroPurge Mode



Using CPM

The MP10H introduces a simpler way to control bladder pump flow rate and achieve the low-flow method used by experts. Up/down arrow keys are used to adjust pump flow even at very low rates, with excellent control and repeatability.

With previous bladder pump controllers, a leading low-flow technique called for selecting the number of pump cycles per minute, then adjusting the bladder pump discharge and refill times to achieve the desired volume per cycle. These adjustments were interrelated, complex, and varied by operator. The new MicroPurge Mode (MP) of the MP10H builds in a "cycles per minute", or CPM, method of flow control.

With this method, the number of complete pump cycles per minute is fixed, within a range of 1 to 6; 4 CPM is the default value which appears at startup. Each time the up/down arrow keys are pressed, the pump refill and discharge times are both automatically adjusted to maintain the selected CPM value. Each adjustment increases or decreases the volume pumped per cycle, and the per-minute flow rate is the volume per cycle X the CPM value.

For example, with a 4 CPM setting, 60 ml volume per cycle equates to 4 X 60 = 240 ml/min flow rate. A single press of the Flow up-arrow key could change the volume per cycle to 80 ml, for example, resulting in a new, increased flow rate of 4 X 80 = 320 ml/min. And the MP10H assigns a unique identification value to each setting, the ID value, which can be directly set during later sampling events.

"MP" displayed in the lower left corner of the display indicates MicroPurge mode.The default CPM setting of 4 cycles per minute is a good starting point for wells with depths from 25-100ft. Micro-Purge mode starts at a time setting of 10 seconds refill and 5 seconds discharge, close to optimal for many wells. This startup settings corresponds to a 4 cycles per minute setting (CPM4) and an ID setting of 103.

Using the CPM key will change the CPM setting on the controller. The range of CPM settings is CPM1 through CPM6. CPM changes like this each time you hit the CPM key: 4 5 6 1 2 3 4 5, etc. The UP and DOWN keys change the flow rate directly, by altering the refill and discharge times within a CPM setting.

Note: *changes in settings that are entered while the controller is cycling are reflected on the next cycle change (so a long refill time of 15 seconds will time out before a new refill time becomes valid).*

Here is an example of the use of the UP (faster) key:

Key Press	Refill (sec)	Discharge (sec)	ID
---	10.0	5.0	103
1	9.5	5.5	104
2	9.0	6.0	105
3	8.5	6.5	106

Each of the 165 possible ID settings corresponds to a unique ID that is associated with CPM, refill and discharge time values. For typical usage, only the UP/DOWN arrow keys are required to set flow, and the ID number is provided for easy, direct return to past settings. Appendix 1 lists all possible ID settings and the default refill and discharge time settings for each CPM. Appendix 1 also shows how the refill and discharge time will change within a CPM setting as you press the UP or DOWN keys.

Sample Collection

The PAUSE key (II) is used to freeze the controller action to allow the user time to collect a sample or carry out other steps that might be difficult if the controller continued to automatically cycle and cause the pump to produce water. While the controller is cycling, pressing the PAUSE key causes the controller to immediately enter the Hold state. Drive air is vented from the pump (this is the pump refill cycle) and the pump fills and waits. Pressing the PAUSE key a second time causes the controller to immediately enter the Sample state. Drive air is directed to the pump causing the pump to discharge its volume of liquid. Bladder pumps typically hold 400-500 ml of liquid, so use of the Hold and Sample states allow the full volume of the pump to be discharged into a sample container. Pressing PAUSE once again returns the MP10H to its normal Automatic Cycling state. During Hold and Sample a HELD is displayed to remind you that the controller is in a paused state. Figure 3 shows an example of the MP10H in MP mode, but HELD in the Sample state.

Note: *Pressing the Cycle key also freezes controller cycling. However, using the Cycle key rather than the Pause key causes the startup screen to be displayed upon restart. Use of the Pause key is recommended for typical operation.*

Flow Throttle Use

The flow throttle is used during sampling to regulate the pressure applied to the pump. Turning the throttle clockwise increases the pressure and counterclockwise decreases the pressure. The pressure gauge shows the approximate pressure applied to the pump.This allows easy adjustment of the throttle giving pressures that will produce gentle, non-turbulent flow (normally 5-10 psi higher than the minimum requirement of 0.42 psi per foot of pump depth). For traditional, high volume purging pressure may be increased with the throttle to maximize pump flow during well purging.

Use with the MP30 Automatic Drawdown Control

The MP10H may optionally be used with the MP30 MicroPurgeDrawdown / Water Level Meter. See Figure 5 for an example of the MP10H in MP mode with the controller in a level paused state enacted by an MP30 meter.

Figure 5 MP10H Level Paused State (MP mode)

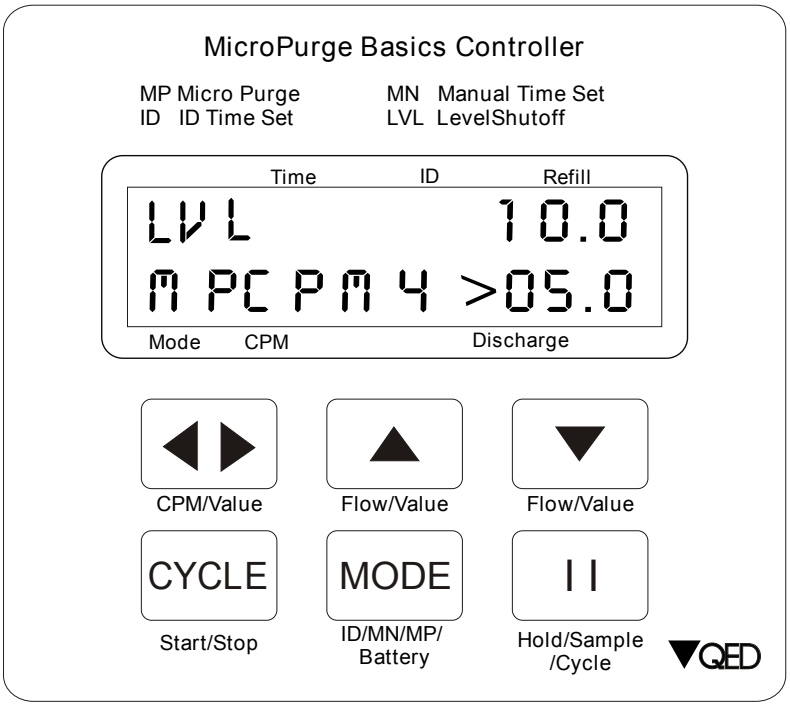


Figure 6 MP10H MP30 Use

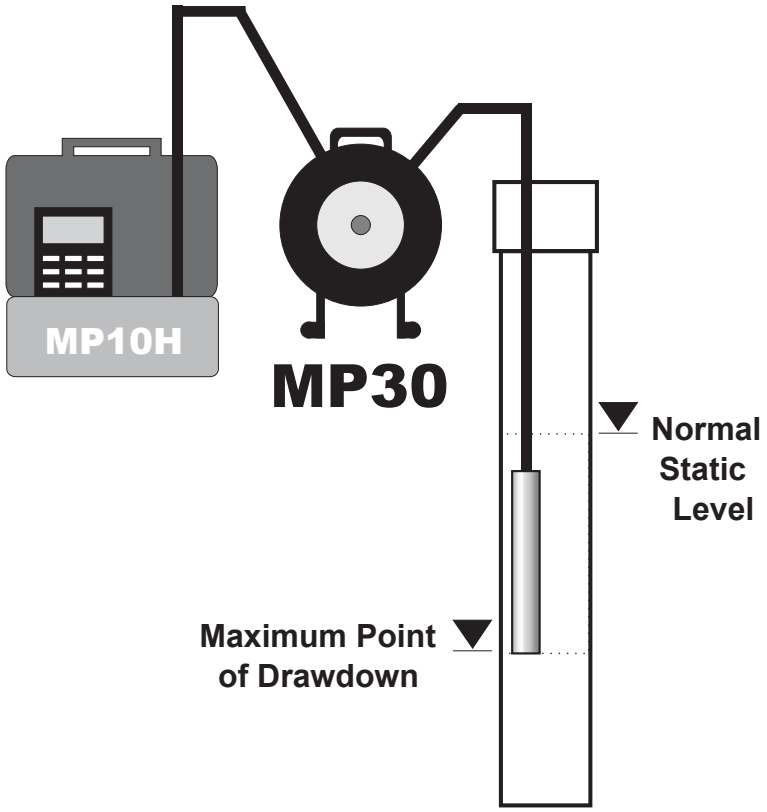
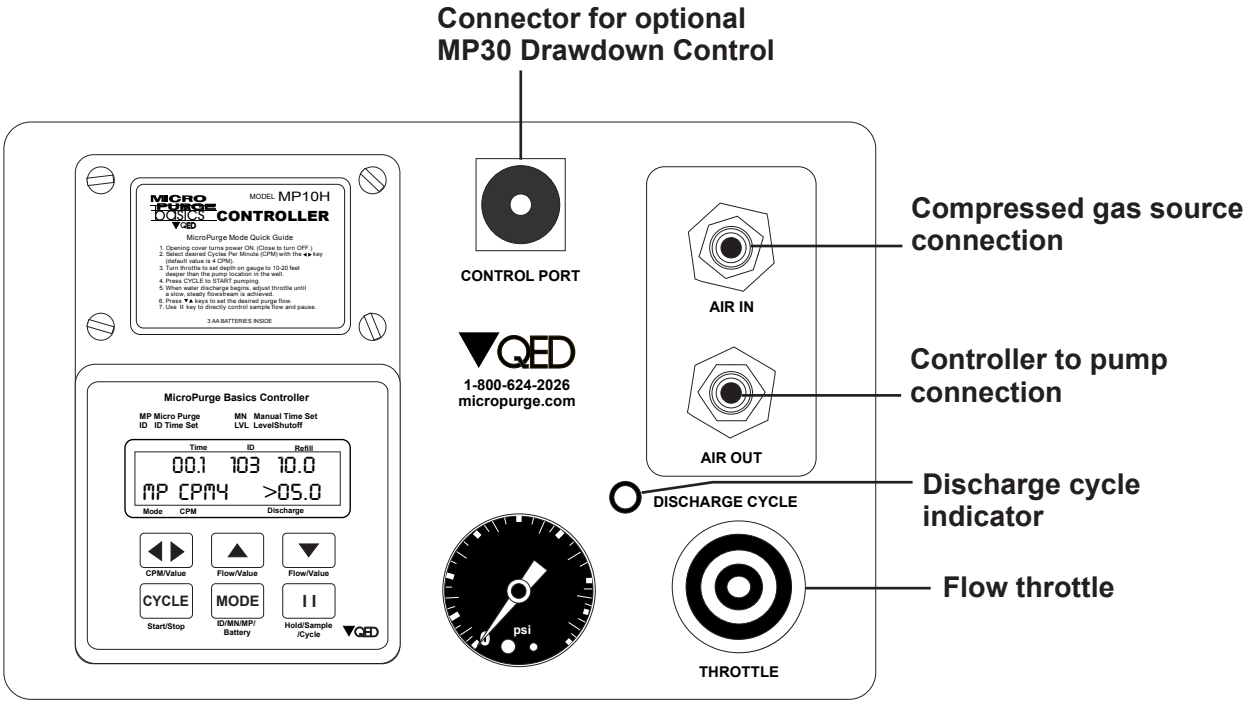


Figure 7 MP10H MP30 Use



The MP10H and MP30 are connected with a cable (see Figures 6 and 7). The MP30 is switched into mode and the water level probe is lowered to the desired maximum draw-down level. Limiting the maximum drawdown depth limits the differential head driving flow into the well and the velocity of the water flowing into the well from the surrounding formation important in MicroPurge sampling. The MP10H and MP30 work together to automatically adjust the pump operation so as to maintain drawdown at the set level. When the water level drops below the probe, the MP30 sends a signal to the MP10H to pause pumping. Both the MP10H and the MP30 give visual signals (and the MP30 emits an audio signal) that pump operation has stopped because of too much drawdown. Once the level recovers, the MP30 signals the MP10H to resume pump operation. The MP10H resumes by starting in the refill leg of the pump cycle. "DRAWDOWN CONTROL"

The normal operating mode for using the MP30 with the MP10H is:

1. Use the MP30 in standard WLM mode to determine the static water level in the well
2. Decide what the maximum drawdown for that well is during sampling
3. Lower the probe to the maximum drawdown level
4. Switch the MP30 into Drawdown Control mode
5. Begin pumping with the MP10H
6. Observe the interactions between the two devices, if the MP30 is frequently pausing the MP10H, it may be appropriate to slow the flow down (using the DOWN key in MP mode) to better match pump flow to well recharge.

When switched into MODE, the MP30 has a flashing red light and an optional (can be switched off by the user) audio alarm to indicate when the probe is in the dry state. A submerged probe in all modes is indicated by a solid green light. When the MP10H is paused by the MP30 the MP10H display indicates this as shown in Figure 5."DRAWDOWN CONTROL"

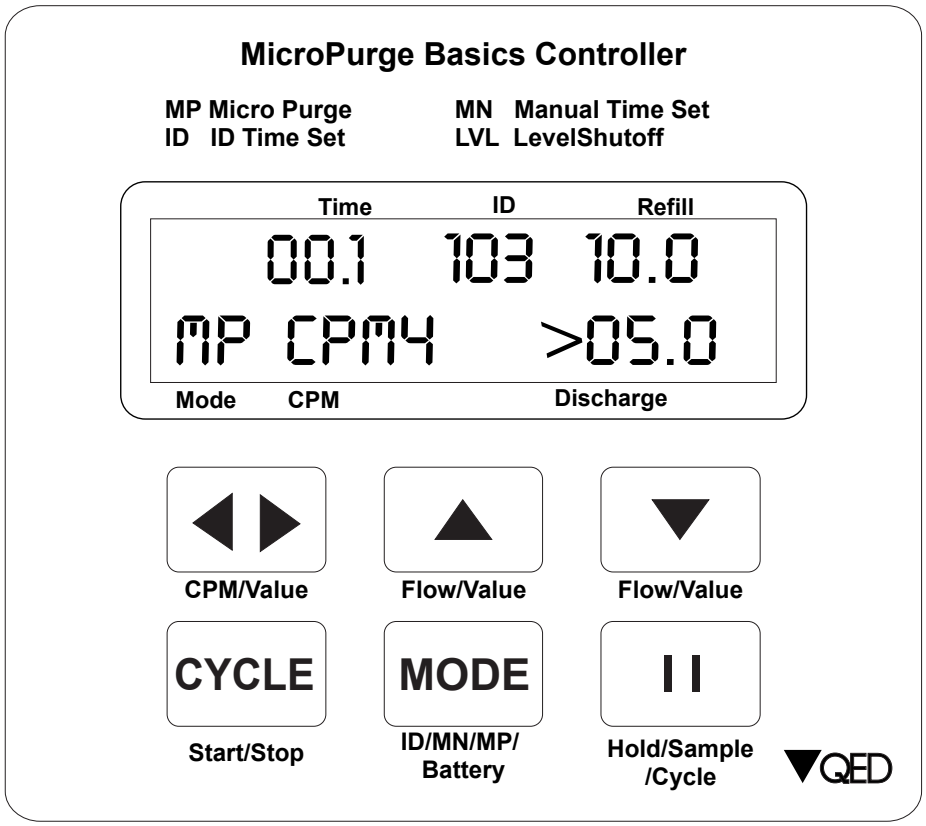
If the MP30 is signaling the MP10H too frequently, the operator can slow down the pump flow rate by using the DOWN key (effectively increasing the pump refill time period). MP30 probe position may also be varied to provide a buffer zone for your draw-down limit and gauge rate of pumping effect on water level in the well.

If the selected maximum drawdown level is being reached even with the lowest desirable pump flow rate more drawdown may be required to attain equilibration, or a passive sampling approach may be required. In passive sampling, used where well recovery is extremely slow, samples are taken after just a few pump strokes sufficient to purge the pump and tubing volumes.

Additional information on the MP30 is given in the MP30 O&M manual

ID Mode Figure 8 shows an example of the MP10H in ID time set mode. Once you've used the MP10H in MP mode and found proper settings for your wells, subsequent sampling events are speeded along by using the controller in ID mode. Once the controller is turned on, a single press of the MODE key places the controller in ID time set mode (the default initial mode is MP mode). This mode allows the user to enter a 3-digit ID, which then is translated into the correct flow settings (CPM and refill / discharge time settings) for that well.

Figure 8 MP10H ID Set Mode



In this mode the CPM and UP, DOWN keys function differently. The CPM key becomes a key used to scroll between the one's and the ten's digits of the ID.The UP and DOWN keys are used to change the ID number (the MP10H has IDs that range from 1-165) up or down in value. Sampling in ID mode is the same as explained, above, for MP mode.

Appendix 1 lists all possible ID settings and the default refill and discharge time settings for each CPM.Appendix 1 also shows how the refill and discharge time will change within a CPM setting as you press the UP or DOWN keys. As you change IDs you will see the CPM change and the refill and discharge time setting change.

Note: *changes in time settings that are entered while the controller is cycling are reflected on the next cycle change (so a long refill time of 15 seconds will time out before a new refill time becomes valid).*

MP10 Battery

The MP10H features sophisticated power-supply circuitry that optimizes battery life. A fresh set of AA batteries will provide more than 100 hours of controller operation at normal operating temperatures. As ambient temperatures drop below 15-20˚ F (-9˚ C to -6˚ C), the ability of the alkaline batteries to deliver energy is affected. Continuous operation may be difficult in extremely cold conditions. Once the batteries and MP10H warm, additional cycle capacity will be regained from a set of batteries.

Replace alkaline batteries by removing the 4 thumbscrews located on the battery cover and inserting 3 fresh **cells**. The MP10H battery holder includes space for ***3 spare AA cells*** so you should never be without power in the field. Properly dispose of the spent alkaline cells.

Note: *If you are storing the MP10H for more than 3 months, remove the AA batteries to prevent leakage. The MP10H power supply is automatically shut off by closing the lid. Make sure the lid is closed during storage.*

Troubleshooting

Use the following troubleshooting table to assist in troubleshooting the MP10H:

Symptom	Possible Cause	Action / Fix
Display not showing	Low or dead batteries Batteries installed wrong	Check battery voltage on opening display (>3.6 volts required) Replace batteries Check battery connection
Controller not cycling	Low or dead batteries	See, above
	Lid not open	Open lid
	Temperature below 10° F	Warm controller
	MP10H not STARTED with CYCLE key MP10H in HELD mode	Operate CYCLE and/or PAUSE key to return MP10H to cycling state
	MP10H in LEVEL hold	Make sure MP30 probe is submerged when in MP mode
Air not cycling through controller	Throttle turned too low	Turn throttle clockwise to produce pressure
	Air source not delivering air	Verify air source
Pump not pumping	Throttle turned too low	Turn throttle clockwise to produce pressure
	Time settings not correct	Try different CPM settings (lower CPM for deeper wells) and/or different refill and discharge time settings
	Air source pressure too low	Verify air source pressure
Battery life too short	Controller left on while strored	Turn MP10H off before storing and remove batteries when storing more than 1 month
	Temperature below 10° F	Warm controller

MP10H Specifications

Maximum Output Pressure:	300 P.S.I.
Maximum Compressed Gas Input Pressure:	300 P.S.I.
Temperature Range:	Operating range of -20º F to +150º F
Humidity:	Circuitry sealed to provide operation to 100% humidity
Protection:	Circuitry protected against transient surges introduced from improper battery installation or switch connect-ions.
Display:	LCD display, 32-character (2 lines, 16 characters, each)
Window:	Non-glare, double hardened optical acrylic
Battery type:	3 user replaceable AA alkaline cells
Drain:	Unit off: 2mA, Unit on: 4mA, Valve Cycle: 6mA
Reserve:	100 hours operating time (1sec/1sec cycles) with fresh AA alkaline cells At 65º F (approx.)
Emergency battery:	3 AA cells stored within battery compartment

For additional assistance contact QED Service at:

Phone:	1-800-624-2026 1-734-995-2547
Fax:	1-734-995-1170
E-mail:	service@qedenv.com
24-Hour Service Hot Line:	1-800-272-9559

QED Monitoring System WARRANTY

QED ENVIRONMENTAL SYSTEMS, ("**Q.E.D.**") warrants to the original purchaser of its products that, subject to the limitations and conditions provided below, the products, materials and/or workmanship shall reasonably conform to descriptions of the products and shall be free of defects in materials and workmanship. Any failure of the products to conform to this warranty will be remedied by Q.E.D. in the manner provided herein.

This warranty shall be limited to the duration and the conditions set forth below. All warranty durations are calculated from the original date of purchase.

1. ***Dedicated-Use Systems Products-*** 10 year warranty on dedicated bladder pumps equipped with Q.E.D. inlet screens, and purge pumps used in periodic, non continuous groundwater sampling (up to 52 sampling events per year.)All other components, equipment and accessories are warranted for one year.

2. ***Portable-Use Systems-*** Sample Pro Pumps, Controllers and water level meters are warranted for one year. Hose Reels, Caps and non-Sample Pro pumps are warranted for ninety (90) days. Tubing and Purge Mizers are covered by a ninety (90) day material and workmanship warranty. There will be no warranty for application on tubing and Purge Mizers when used as part of a Portable System.

3. ***Separately sold parts and Spare Parts Kits-*** Separately sold parts and spare parts kits are warranted for ninety (90) days. Repairs performed by Q.E.D. are warranted for ninety (90) days from date of repair or for the full term of the original warranty, whichever is longer.

Buyers' exclusive remedy for breach of said warranty shall be as follows: if, and only if, Q.E.D. is notified in writing within applicable warranty period of the existence of any such defect in the said products, and Q.E.D. upon examination of any such defects, shall find the same to be within the term of and covered by the warranty running from Q.E.D. to Buyer, Q.E.D. will, at its option, as soon as reasonably possible, replace or repair any such product, without charge to Buyer. If Q.E.D. for any reason, cannot repair a product covered hereby within four (4) weeks after receipt of the original Purchaser's/Buyer's notification of a warranty claim, then Q.E.D.'s sole responsibility shall be, at its option, either to replace the defective product with a comparable new unit at no charge to the Buyer, or to refund the full purchase price. In no event shall such allegedly defective products be returned to Q.E.D. without its consent, and Q.E.D.'s obligations of repair, replacement or refund are conditioned upon the Buyer's return of the defective product to Q.E.D.

IN NO EVENT SHALL Q.E.D. ENVIRONMENTAL SYSTEMS, INC. BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF SAID WARRANTY

The foregoing warranty does not apply to major sub-assemblies and other equipment, accessories and parts manufactured by others, and such other parts, accessories, and equipment are subject only to the warranties, if any, supplied by the respective manufacturers. Q.E.D. makes no warranty concerning products or accessories not manufactured by Q.E.D. In the event of failure of any such product accessory Q.E.D. will give reasonable assistance to the Buyer in obtaining from the respective manufacturer whatever adjustment is reasonable in light of the manufacturer's own warranty.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY (INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE), WHICH OTHER WARRANTIES ARE EXPRESSLY EXCLUDED HEREBY, and of any other obligations or liabilities on the part of Q.E.D.,neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with said products, materials and/or workmanship.

It is understood and agreed that Q.E.D. shall in no event be liable for incidental or consequential damages resulting from its breach of any of the terms of this agreement, nor for special damages, nor for improper selection of any product described or referred to for a particular application.

This warranty will be void in the event of unauthorized disassembly of component assemblies. Defects in any equipment that result from abuse, operation in any manner outside the recommended procedures, use and applications other than for intended use, or exposure to chemical or physical environment beyond the designated limits of materials and construction will also void this warranty. Q.E.D. shall be released from all obligations under all warranties if any product covered hereby is repaired or modified by persons other than Q.E.D.'s service personnel unless such repair by others is made with the written consent of Q.E.D.

If any product covered hereby is actually defective within the terms of this warranty, Purchaser must contact Q.E.D. for determination of warranty coverage. If the return of a component is determined to be necessary, Q.E.D. will authorize the return of the component, at owner's expense. If the product proves not to be defective within the terms of this warranty, then all costs and expenses in connection with the processing of the Purchaser's claim and all costs for repair, parts and labor as authorized by owner hereunder shall be borne by the purchaser.

RESPONSIBILITY OF THE PURCHASER

The original Purchaser's sole responsibility in the instance of a warranty claim shall be to notify Q.E.D. of the defect, malfunction, or other manner in which the terms of this warranty are believed to be violated. You may secure performance of obligations hereunder by contacting the Customer Service Department of Q.E.D. and:

1. Identifying the product involved (by model or serial number or other sufficient description that will allow Q.E.D. to determine which product is defective).
2. Specifying where, when, and from whom the product was purchased.
3. Describing the nature of the defect or malfunction covered by this warranty.
4. Sending the malfunctioning component, after authorization by Q.E.D. to:

QED Environmental Systems
6155 Jackson Rd.
Ann Arbor, Michigan 48103

Appendix 1 ID Data Table

NOTE: Bold Shaded values are default for that CPM

CYCLES / min (CPM)

1 / min			2 / min			3 / min			4 / min			5 / min			6 / min		
ID	Disch (sec)	Refill (sec)	ID	Disch (sec)	Refill (sec)	ID	Disch (sec)	Refill (sec)	ID	Disch (sec)	Refill (sec)	ID	Disch (sec)	Refill (sec)	ID	Disch (sec)	Refill (sec)
1	1	59	41	1	29	66	1	19	95	1	14	114	1	11	145	1	9
2	2	58	42	2	28	67	1.5	18.5	96	1.5	13.5	115	1.2	10.8	146	1.2	8.8
3	3	57	43	3	27	68	2	18	97	2	13	116	1.4	10.6	147	1.4	8.6
4	4	56	44	4	26	69	2.5	17.5	98	2.5	12.5	117	1.6	10.4	148	1.6	8.4
5	5	55	45	5	25	70	3	17	99	3	12	118	1.8	10.2	149	1.8	8.2
6	6	54	46	6	24	71	3.5	16.5	100	3.5	11.5	119	2	10	150	2	8
7	7	53	47	7	23	72	4	16	101	4	11	120	2.2	9.8	151	2.2	7.8
8	8	52	48	8	22	73	4.5	15.5	102	4.5	10.5	121	2.4	9.6	152	2.4	7.6
9	9	52	49	9	21	74	5	15	**103**	**5**	**10**	122	2.6	9.4	153	2.6	7.4
10	10	50	**50**	**10**	**20**	75	5.5	14.5	104	5.5	9.5	123	2.8	9.2	154	2.8	7.2
11	11	49	51	11	19	76	6	14	105	6	9	124	3	9	**155**	**3**	**7**
12	12	48	52	12	18	77	6.5	13.5	106	6.5	8.5	125	3.2	8.8	156	3.2	6.8
13	13	47	53	13	17	78	7	13	107	7	8	126	3.4	8.6	157	3.4	6.6
14	14	46	54	14	16	79	7.5	12.5	108	7.5	7.5	127	3.6	8.4	158	3.6	6.4
15	15	45	55	15	15	80	8	12	109	8	7	128	3.8	8.2	159	3.8	6.2
16	16	44	56	16	14	81	8.5	11.5	110	8.5	6.5	**129**	**4**	**8**	160	4	6
17	17	43	57	17	13	**82**	**9**	**11**	111	9	6	130	4.2	7.8	161	4.2	5.8
18	18	42	58	18	12	83	9.5	10.5	112	9.5	5.5	131	4.4	7.6	162	4.4	5.6
19	19	41	59	19	11	84	10	10	113	10	5	132	4.6	7.4	163	4.6	5.4
20	**20**	**40**	60	20	10	85	10.5	9.5				133	4.8	7.2	164	4.8	5.2
21	21	39	61	21	9	86	11	9				134	5	7	165	5	5
22	22	38	62	22	8	87	11.5	8.5				135	5.2	6.8			
23	23	37	63	23	7	88	12	8				136	5.4	6.6			
24	24	36	64	24	6	89	12.5	7.5				137	5.6	6.4			
25	25	35	65	25	5	90	13	7				138	5.8	6.2			
26	26	34				91	13.5	6.5				139	6	6			
27	27	33				92	14	6				140	6.2	5.8			
28	28	32				93	14.5	5.5				141	6.4	5.6			
29	29	31				94	15	5				142	6.6	5.4			
30	30	30										143	6.8	5.2			
31	31	29										144	7	5			
32	32	28															
33	33	27															
34	34	26															
35	35	25															
36	36	24															
37	37	23															
38	38	22															
39	39	21															
40	40	20															

Appendix 2 Micropurge Pump Specifications

Model No.	Pump Materials	Length	O.D.	Fitting Materials	*Tubing Size	Volume	Max. Lift
T1100M	Teflon®	3.3′ (1.0 m)	1.66″ (4.2 cm)	Teflon®	1/4 & 3/8″ (6 & 9 mm)	395 ml	250′ (75m)
P1101M	PVC	3.4′ (1.04 m)	1.66″ (4.2 cm)	Polypropylene	1/4 & 3/8″ (6 & 9 mm)	395 ml	300′ (90m)
P1101HM	PVC	3.3′ (1.0 m)	1.66″ (4.2 cm)	Stainless Steel	1/4 & 3/8″ (6 & 9 mm)	395 ml	600′ (180m)
ST1101PM	316 Stainless Steel	3.4′ (1.04 m)	1.66″ (4.2 cm)	Stainless Steel	1/4 & 3/8″ (6 & 9 mm)	395 ml	1,000′ (305m)
T1200M	316 S.S. and Teflon®	3.4′ (1.04 m)	1.50″ (3.8 cm)	Stainless Steel	1/4 & 3/8″ (6 & 9 mm)	495 ml	300′ (90m)
T1250	316 Stainless Steel	1.25′ (0.38 m)	1.50″ (3.8 cm)	Stainless Steel	1/4 & 1/4″ (6 & 6 mm)	100 ml	300′ (90m)
P1150	PVC, Teflon®	1.63′ (0.5 m)	1.66″ (4.2 cm)	Polypropylene	1/4 & 1/4″ (6 & 6 mm)	130 ml	300′ (90m)
T1300	316 S.S. and Teflon®	3.8′ (1.16 m)	1.00″ (2.5 cm)	Stainless Steel	1/4 & 3/8″ (6 & 9 mm)	220 ml	300′ (90m)

* To choose 1/2″ (13 mm) rather than 3/8″ (9 mm) discharge tube option, delete suffix M from pump model number.

Sample Pump - QED Sample Pro

Sample Pro

Portable MicroPurge® Pumps PATENT PENDING QED

Sample Pro Portable MicroPurge Pump

User's Guide

P/N 95181 REV. 1-24-03

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Introduction

The Portable MicroPurge®Pump, (Figure 1) is the first pump designed specifically to meet the needs of portable low-flow sampling: easy to adjust to low-flow purging rates and easy to decontaminate between sampling points. Decon is made easier by the pump having fewer parts, disassembly without tools, and quick-change, disposable bladders. The Portable MicroPurge Pump is compact, can pump from a tall 5-gallon bucket, and is offered with different tube connection sizes and methods. The pump is operated by compressed gas and a bladder pump control unit, and is ideally used with the MicroPurge **basics** models MP10 and MP15 controllers. The compressed gas is on the outside of the bladder and the pumped liquid is on the inside of the bladder, so there is no contact between the sample and the gas.

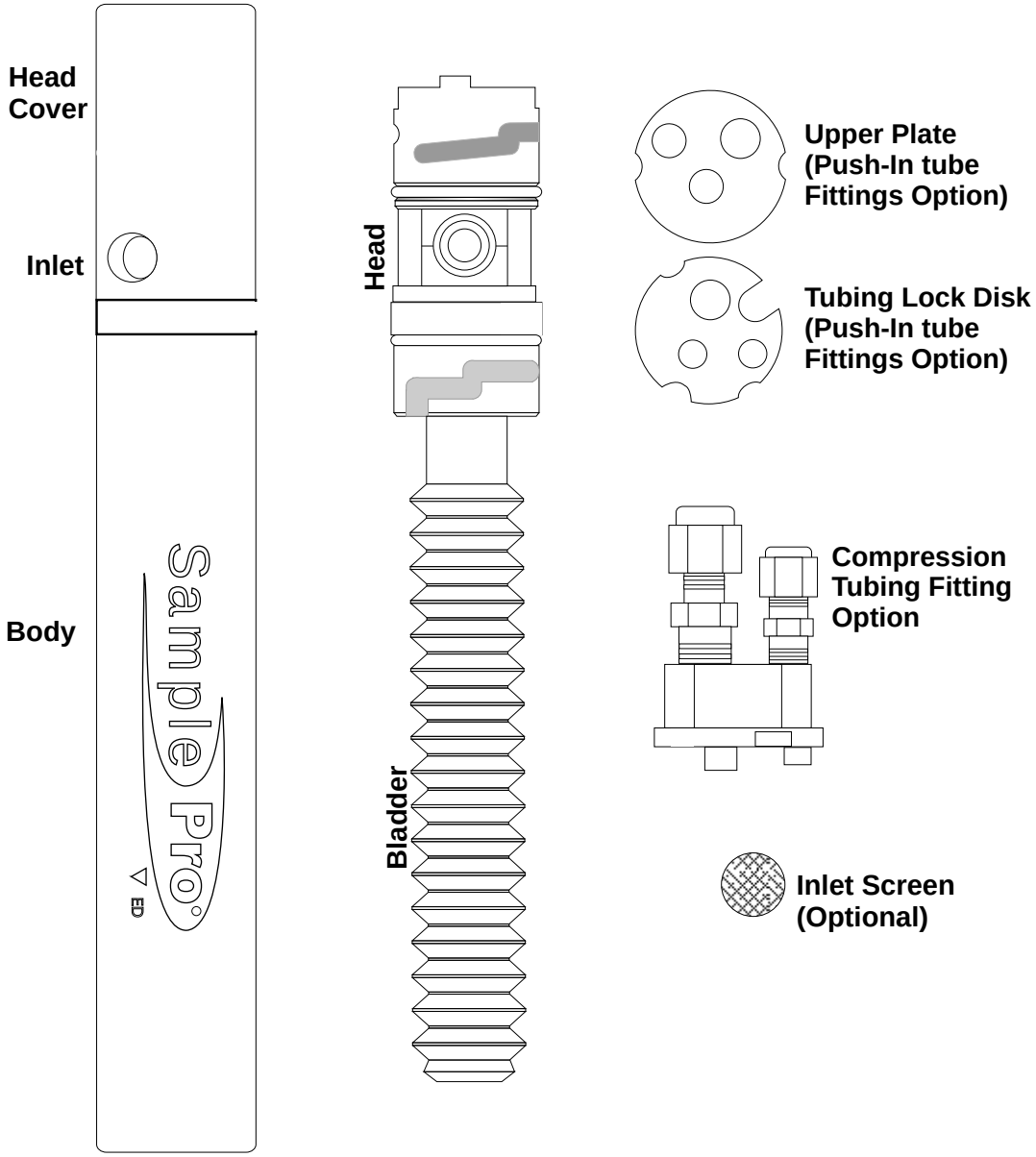


Figure 1

Description

Figure 2 (Page 3) shows the main components of the Portable MicroPurge Pump and the assembled pump. The body twists off for quick change of the bladder, which is offered in polyethylene (PE) and optional teflon versions. The PE bladder provides a leak-tight seal for most applications without the use of clamps; a bladder collar is provided for seal assurance for pump submergences over 50 ft.

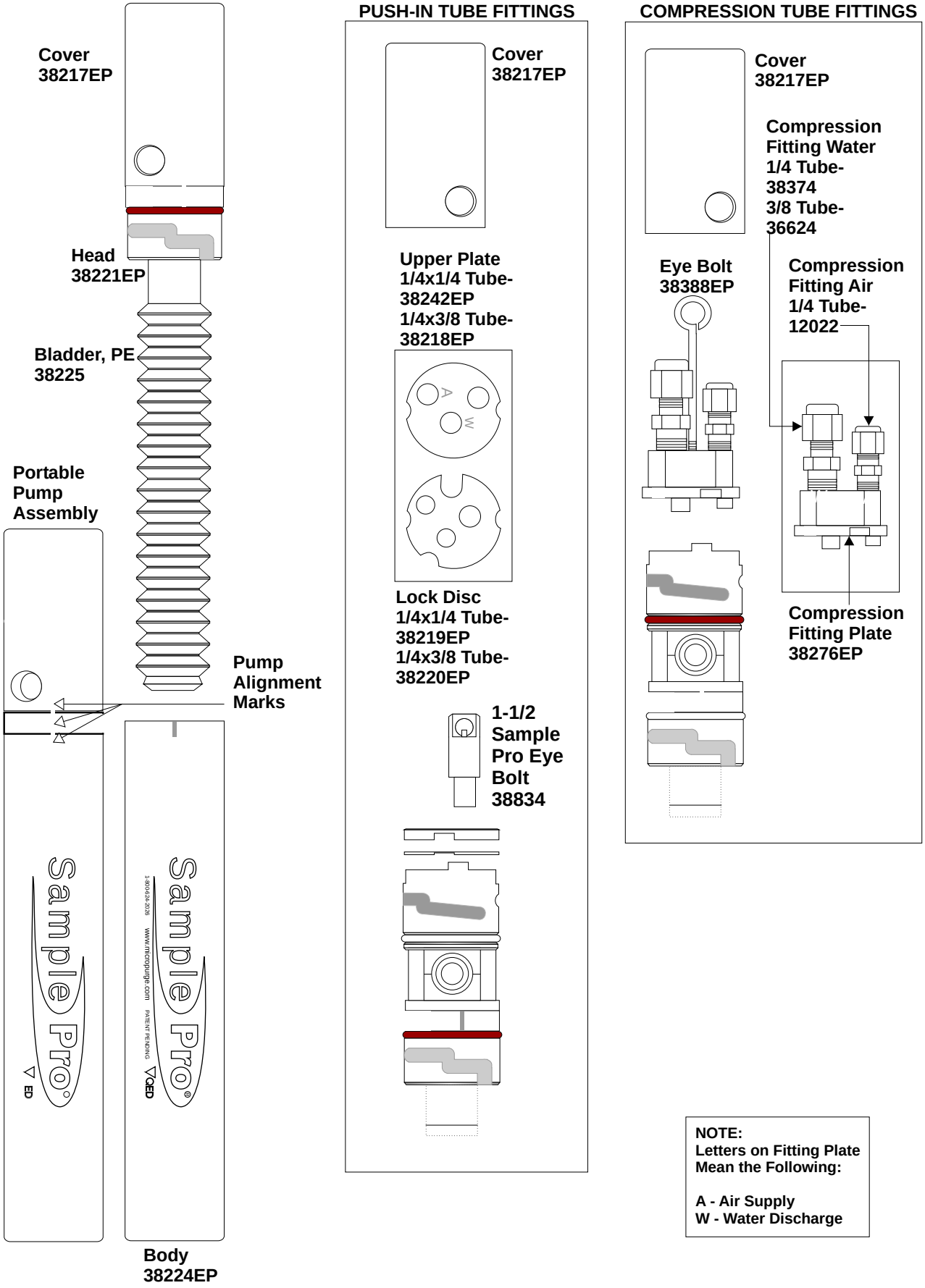
The cap of the pump twists off for full disassembly of the inlet and outlet check valves and the tubing connection components. Tubing connections are offered in two sizes in each of two types:

- Compression-type fittings for ¼" or 3/8" OD water discharge tube, and ¼" OD air supply tube.
  Pump Models MP-SP-4C 1/4" O.D. water discharge
  Pump Models MP-SP-6C 3/8" O.D. water discharge

- Push-in connections for ¼" or 3/8" OD water discharge tube, and ¼" OD air supply tube.
  Pump Models MP-SP-4P 1/4" O.D. water discharge
  Pump Models MP-SP-6P 3/8" O.D. water discharge

The push-in connection option is provided for greater ease of use in applications in which the tubing will be frequently changed. The push-in connections provide excellent pull out strength when used with QED tubing, so that use of a support cable is not required. However a connection eye is provided on the top of the push-in assembly for use of a cable when preferred. ***The push-in and compression fittings on the SamplePro pump are designed to provide at least 100 lbs. pullout strength when used with QED tubing. QED is not responsible for loss of the pump if non-QED tubing is used.***

FIGURE 2



NOTE:
Letters on Fitting Plate Mean the Following:

A - Air Supply
W - Water Discharge

Assembly

Use Figure 2, (Page 3) to identify main pump components and Figure 3, (Page 10) to identify O-ring locations. Full exploded drawings for each pump model are shown on pages 11 to 14; detailed exploded view drawings for each tubing connection configuration are shown on pages 15 to 18.

1. See figure 3 (page 10) to identify locations where O-rings are to be installed and install all O-rings.
2. Connect the bladder to the pump head. The PE bladder pushes onto the pump head barb until the bladder fully covers the barb. A clamping collar (white ring) is provided for pump submergences over 50 ft, to assure a leak tight seal of the bladder. Use the clamp collar by putting it over the pump head barb before pushing the bladder on, then pulling the collar back down firmly over the bladder and barb. The teflon bladder cartridge is installed by inserting the cartridge nipple into the center hole in the bottom of the pump head barb.
3. Attach the pump head to the body by engaging the bayonet dimples into the grooves and twisting them together until the engagement snap is felt and head and body alignment marks line up.
4. With the pump on its side, insert the inlet check ball (same as the discharge check ball) into the side of the pump head, then press in the inlet valve seat by pushing and twisting with your thumb.
5. With the pump vertical, insert the discharge check ball into the top of the pump head, then press in the discharge ball seat by pushing and twisting with your thumb.
6. For the push-in tubing fittings, place the thin metal lock disk in the "TOP" up position on the top of the pump head, with the lock disk edge slots lined up with the posts on the pump head. Then place the thick, upper plate on top of the lock disk, again with the slots and posts lined up. Finally, twist the pump cap onto the pump head until the engagement snap is felt and the hole in the side of the pump cap lines up with the inlet port. Cover and body alignment marks will line up.
7. For the compression nut fittings, place the compression fitting plate onto the top of the pump head, with slots and posts lined up. The fitting nuts may need to be rotated or removed to allow the pump cap to be placed over the compression fitting assembly. Then twist the pump cap onto the pump head until the engagement snap is felt and the hole in the side of the pump cap lines up with the inlet port. Cover and body alignment marks will line up.

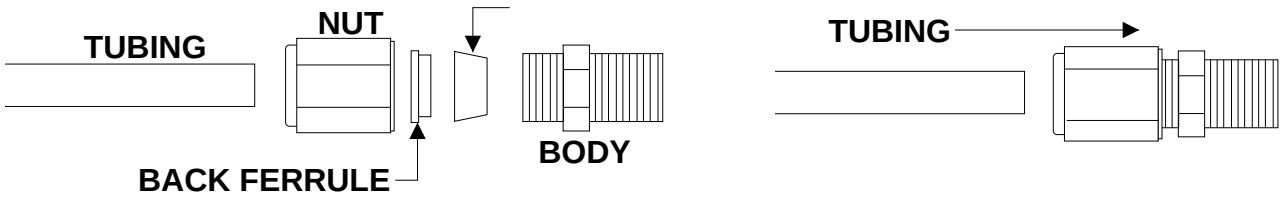
Attaching Tubing

Push-in Fittings

1. Following the previous assembly instructions, use a new lock plate and freshcut end of QED tubing to ensure proper pull-out strength of tubing connection. Re-use of the lock plate or old tube-end and/or use of other brands of tubing may significantly reduce pull-out strength and cause loss of pump in the well.
2. The upper plate is marked "W" for the water discharge tube and "A" for the air supply tube. With QED tubing, the air supply tube is shaded gray to distinguish it from the water discharge tube.
3. Insert each tube separately into the proper opening in the pump head, pushing firmly so that the tube penetrates beyond first resistance at least ½-inch into the pump. As a check on proper assembly, pull back on each tube to see that it is gripped securely.

Compression Fittings

1. Insert tubing insert into I.D. of tubing (if required).
2. Insert tubing into fitting making sure that the tubing rests firmly on the shoulder of the fitting and that the nut is finger tight.
3. Tighten nut to secure tubing in fitting (approximately 1-1/4 turns beyond finger tight).



Disassembly

Use Figure 2, (Page 3) to identify main pump components and Figure 3, (Page 10) to identify O-ring locations.

1. Reverse assembly sequence, taking care to position pump to retain check balls during removal of valve seats and stops. A coin or screwdriver can be used if necessary to remove the inlet valve seat and discharge check ball stop.
2. Pull the PE bladder off of the pump head barb by pulling firmly, then discard.

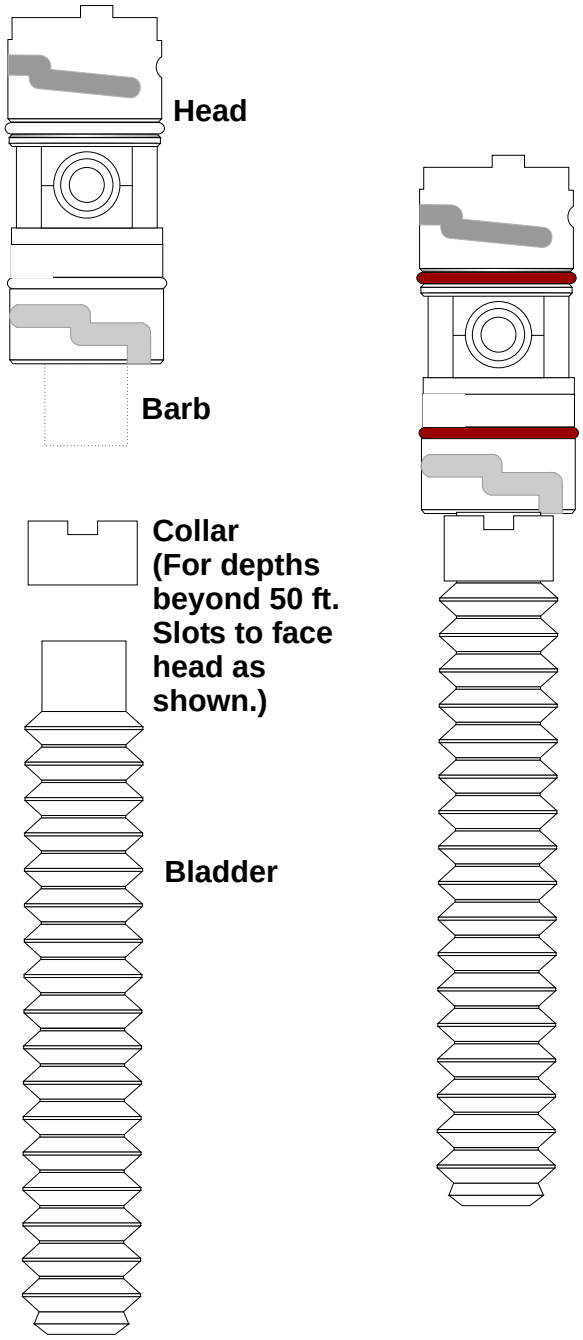
Cleaning / Decontamination Note

If it is desired to operate the pump outside the well, such as in a pail for decontamination purposes, the operating pressure of the pump should be reduced to 35 PSI or less to avoid rupturing the bladder

Standard Bladder Replacement

Connect the bladder to the pump head. The PE bladder pushes onto the pump head barb until the bladder fully covers the barb. A clamping collar (white ring) is provided for pump submergences over 50 ft, to assure a leak tight seal of the bladder. Use the clamp collar by putting it over the narrow, neck section of the bladder, slot side facing toward the pump head; then push the bladder neck fully onto the pump head barb by pushing on the bottom of the bladder, collapsing the bladder. After the bladder neck is in proper position, push the clamp collar up over the bladder and barb. The collar will seal the bladder sufficiently when moderate force (5-10 lbs) is used; excessive force will make later removal difficult.

NOTE: For reasons of contamination and leak integrity, these bladders are designed for one-time use only. QED cannot be held responsible for cross contamination or leakage failures if bladders are reused.

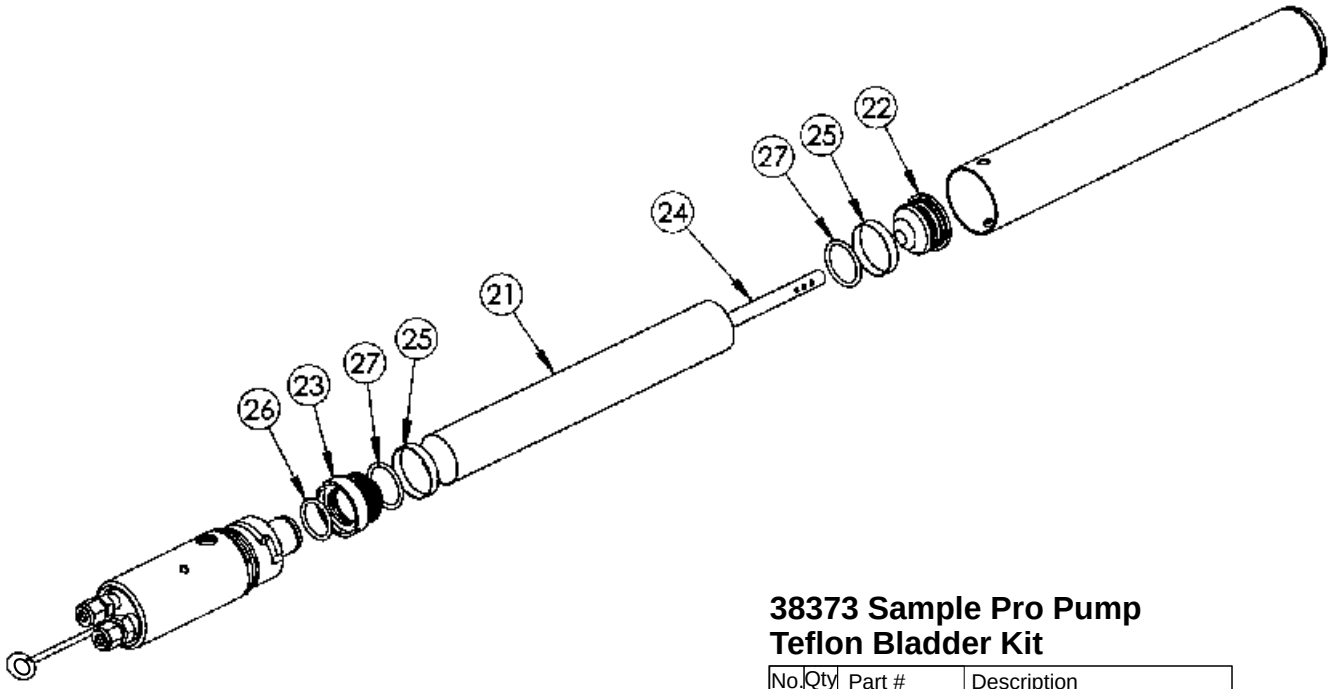


Teflon Bladder Replacement

WARNING: Excessive drive gas pressures can damage the bladder. For normal operation, only 10-15 PSI over the pump depth (hydrostatic head, equivalent to .43 PSI per foot of depth) is sufficient to operate the pump. For pump depths over 200 ft (86 PSI hydrostatic head), it is recommended that initial pumping be performed with approximately 75 PSI drive gas pressure to move approximately 500 ml, equivalent to about 5 full bladder volumes, up into the discharge tubing to provide pumping resistance. Thereafter, full drive gas pressure can be applied. The drive gas pressure gauge on the **basics** controller is marked in both PSI and feet of hydrostatic head.

NOTE: For reasons of contamination and leak integrity, these bladders are designed for one-time use only. QED cannot be held responsible for cross contamination or leakage failures if bladders are reused.

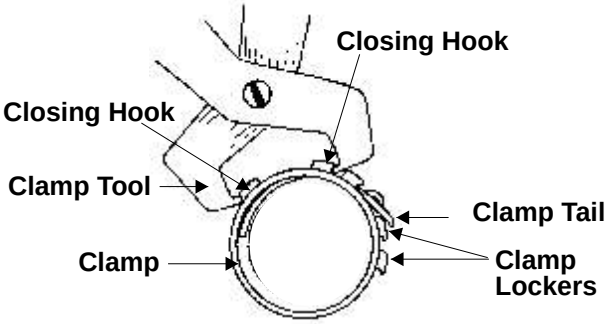
1. Identify the components as shown below.



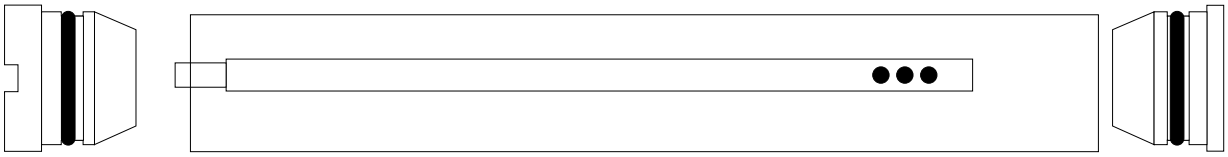
38373 Sample Pro Pump Teflon Bladder Kit

No.	Qty	Part #	Description
21	1	38372	Teflon Bladder
22	1	38371EP	Bottom Spool
23	1	38370EP	Top Spool
24	1	38369EP	Dip Tube
25	2	38016	Clamp 030.2-505R S.S.
26	1	38378	O-Ring 2-118
27	2	38379	O-Ring 2-220

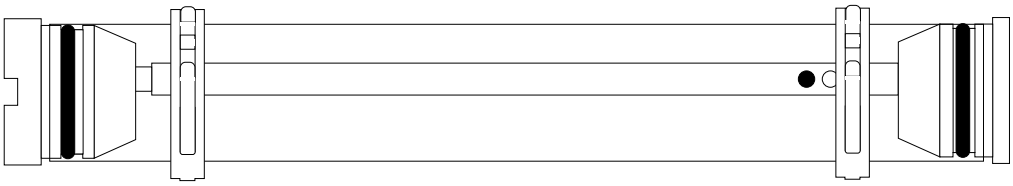
2. Change the teflon bladder by using the clamp tool to remove the bladder clamps.



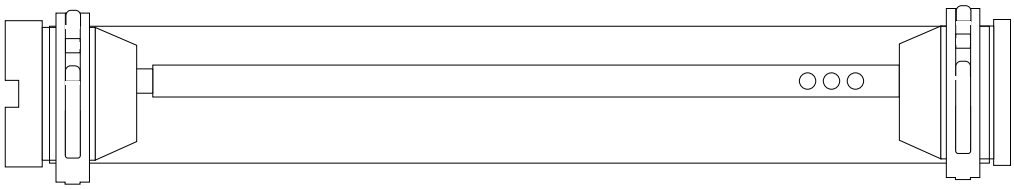
3. Pull apart the cartridge end pieces. Clean cartridge components as desired.



4. Install a new teflon bladder by placing the clamps loosely over the ends of the bladder, pushing the spool ends, with O-rings in place, onto each end of the center rod.

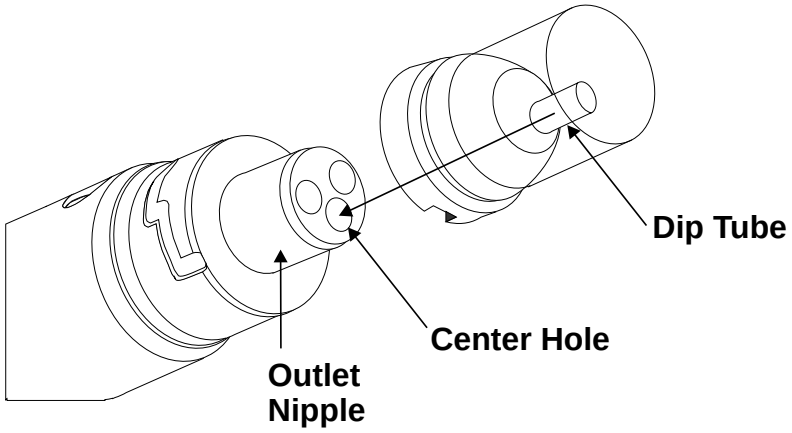


5. Position the clamps directly over the o-rings and then using the clamp tool, clamp the bladder into position onto the cartridge, as shown.



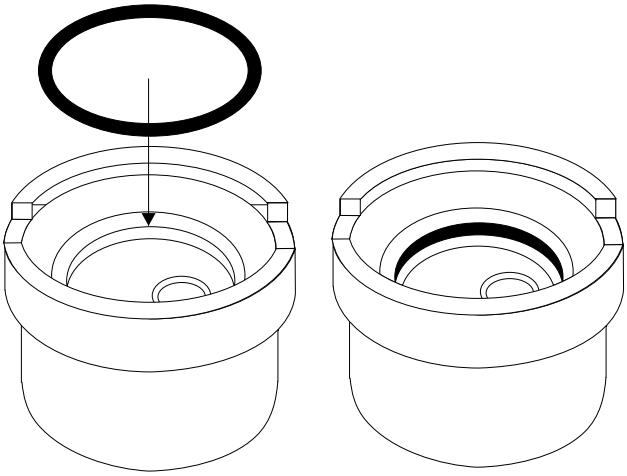
NOTE: *Before clamping clamps down make sure the bladder is visible above the clamp all the way around the clamp.*

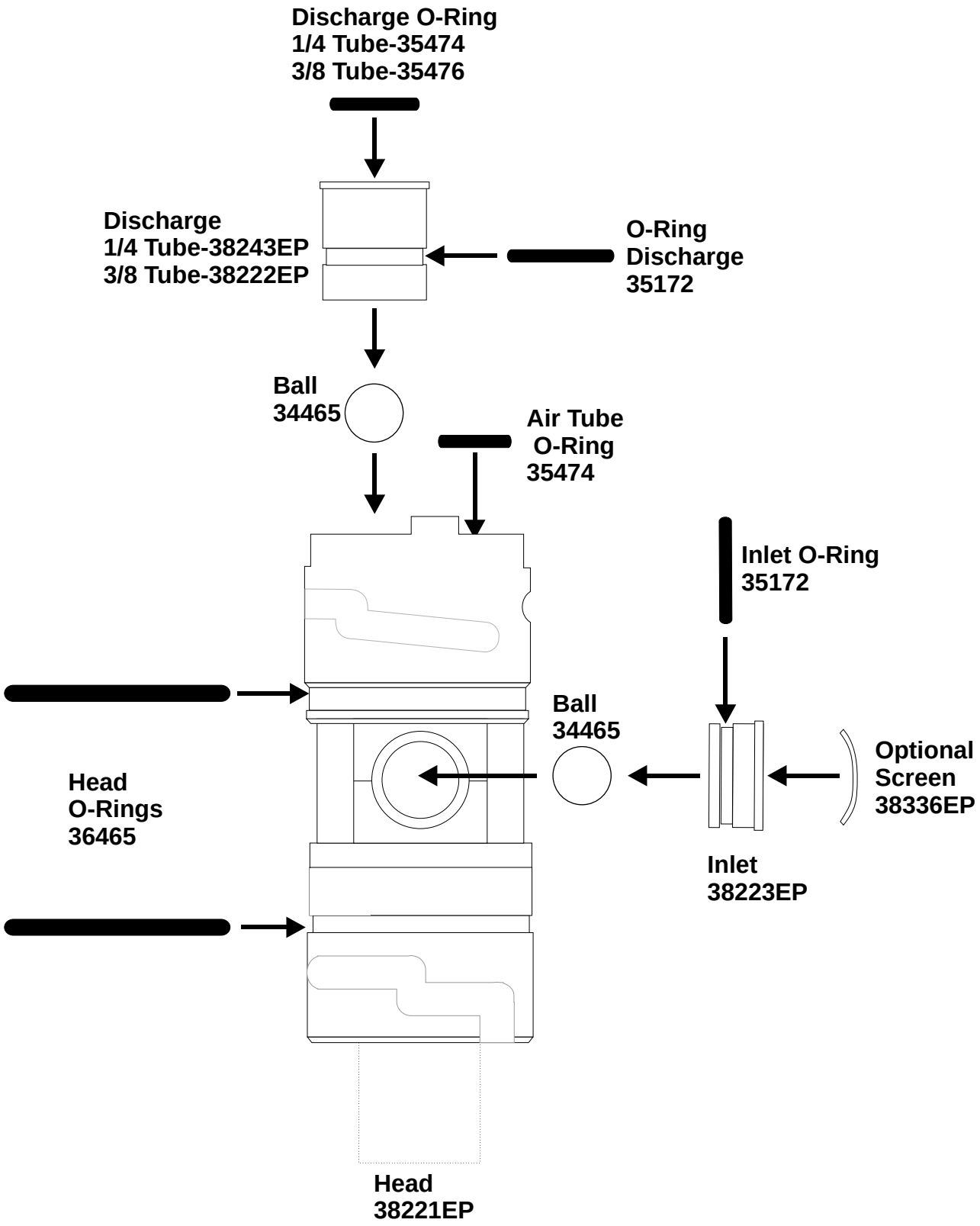
6. Insert the outlet nipple from the upper spool piece into the center hole on the bottom of the pump head, as shown.

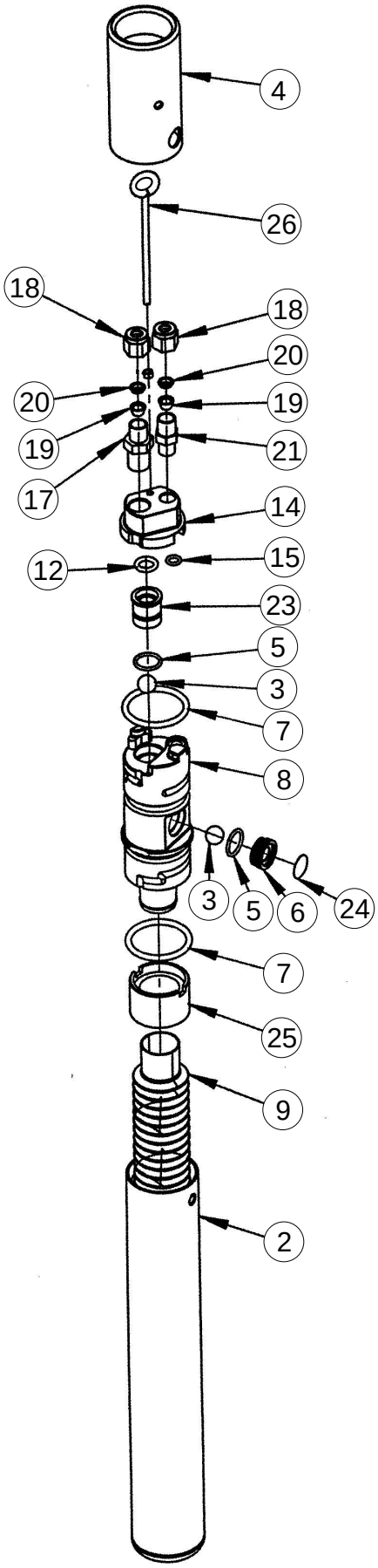


O-ring Replacement

1. Inspect o-rings with each disassembly and replace as needed. Replacement of Top Spool, inner o-ring replacement shown below.

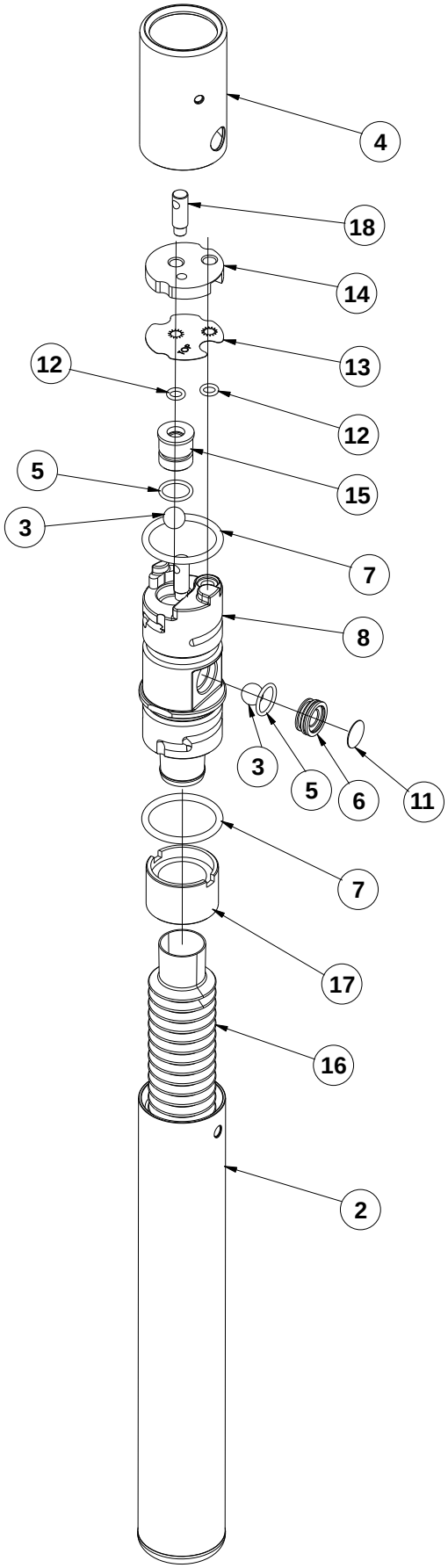



Discharge O-Ring
1/4 Tube-35474
3/8 Tube-35476
Discharge
1/4 Tube-38243EP
3/8 Tube-38222EP
O-Ring
Discharge
35172
Ball
34465
Air Tube
O-Ring
35474
Inlet O-Ring
35172
Ball
34465
Optional
Screen
38336EP
Head
O-Rings
36465
Inlet
38223EP
Head
38221EP



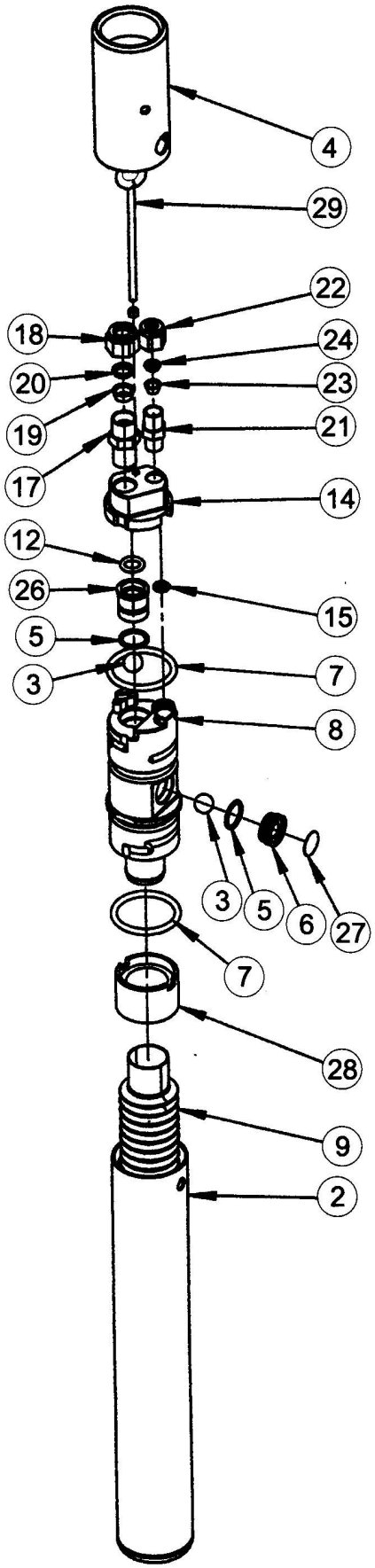
MP-SP-4C SamplePro Pump Assembly

No.	Qty	Part #	Description
2	1	38224EP	Body
3	2	34465	Ball Teflon 7/16 Dia.
4	1	38217EP	Cover
5	2	35172	O-Ring Viton 2-015
6	1	38223EP	Inlet
7	2	36465	O-Ring Viton 2-220
8	1	38221EP	Head
9	1	38225	Bladder PE
12	1	35476	O-Ring Viton 2-110
14	1	38267EP	Compression Fitting Plate
15	1	35474	O-Ring Viton 2-010
17	1	38374	Connector 1/4"T x 1/4" MPT SS
18	2	34954	Nut 1/4" T SS
19	2	34477	Ferrule 1/4" Lower SS
20	2	34476	Ferrule 1/4" Upper SS
21	1	12022	Connector 1/4"T x 1/8" MPT SS
23	1	38222EP	Discharge Tube 3/8"
24	1	38336	Inlet Screen
25	1	38340	Collar
26	1	38388EP	Eye Bolt with Nut



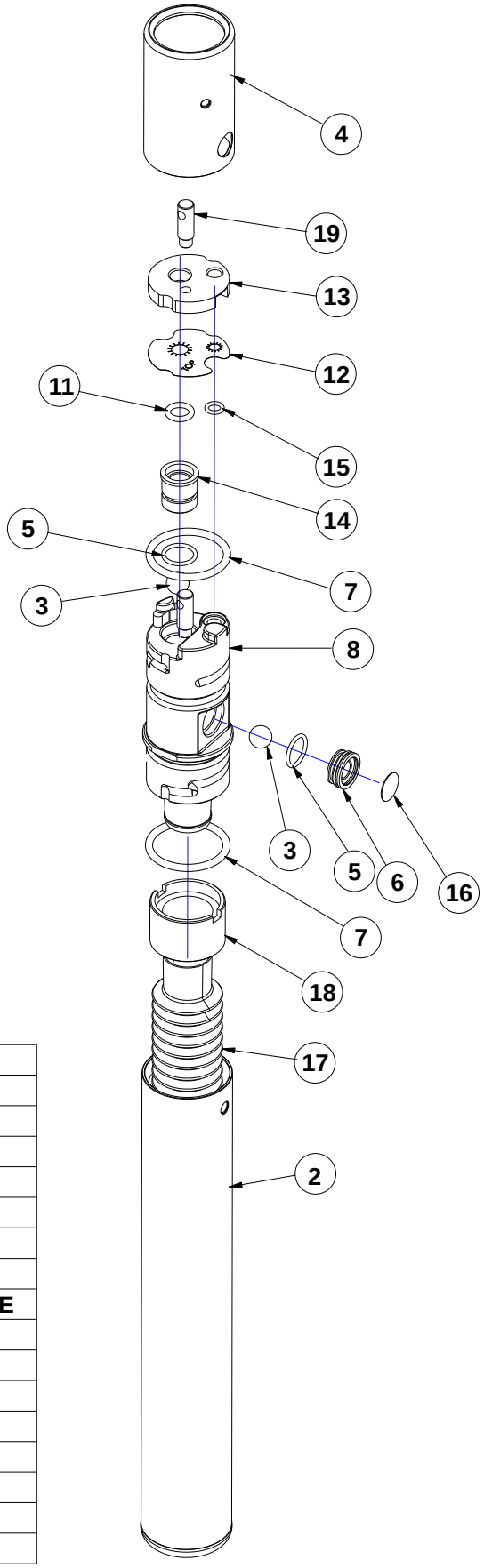
MP-SP-4P SAMPLE PRO PUMP ASSY

ITEM NO.	QTY.	PART NO.	DESCRIPTION
2	1	38224EP	BODY
3	2	34465	BALL TEFLON 7/16 DIA
4	1	38217EP	COVER
5	2	35172	O-RING VITON 2-015
6	1	38223EP	INLET
7	2	36465	O-RING VITON 2-220
8	1	38221EP	HEAD
11	1	38336	INLET SCREEN
12	2	35474	O-RING VITON 2-010
13	1	38219	GRABEPLATE 1/4" TUBE X 1/4" TUBE
14	1	38242EP	PLATE 1/4" TUBE X 1/4" TUBE
15	1	38243EP	DISCHARGE 1/4" TUBE
16	1	38225	BLADDER PE
17	1	38340	COLLAR
18	2	38834	1 1/2 SAMPLE PRO EYE BOLT



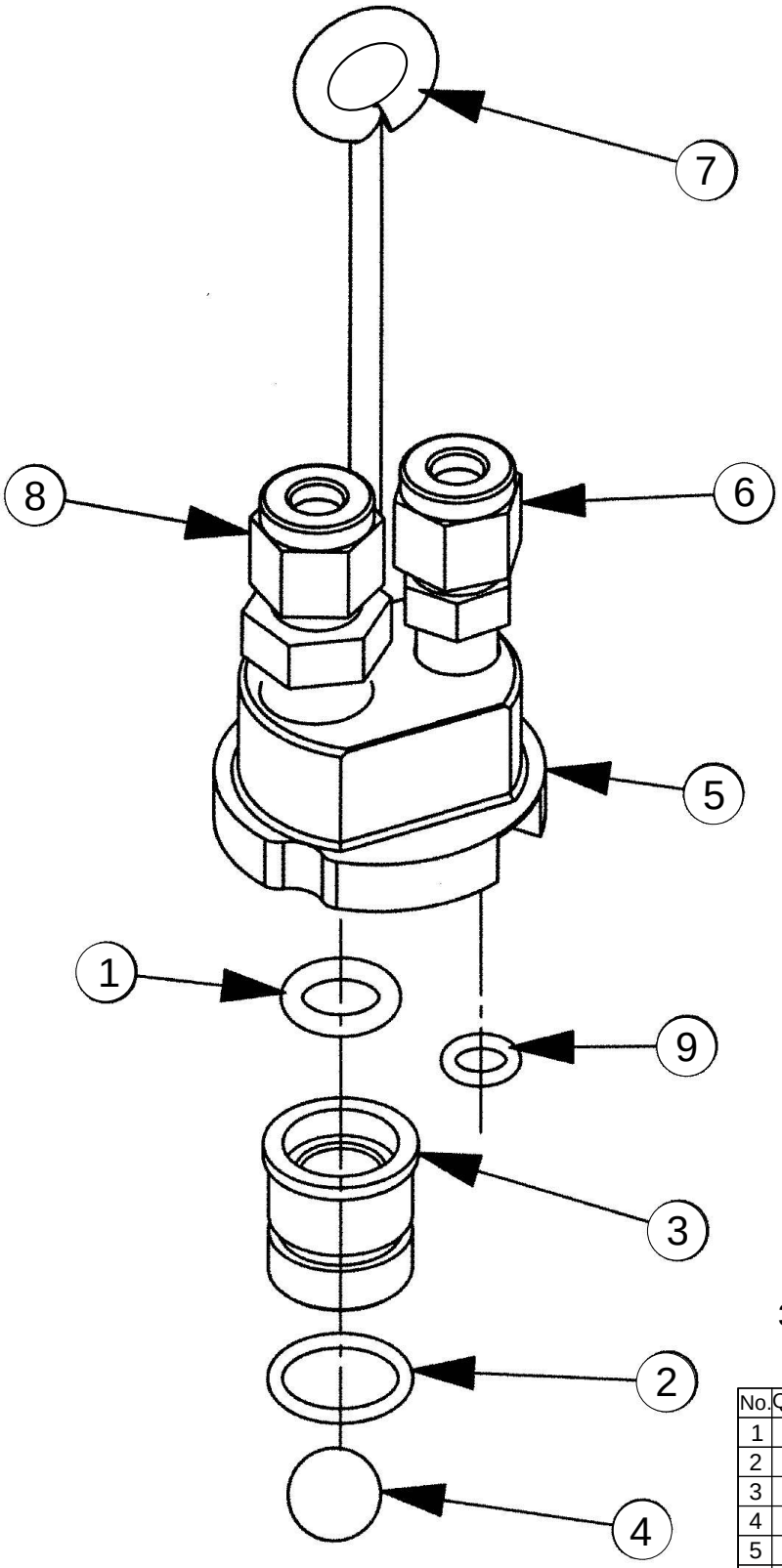
MP-SP-6C SamplePro Pump Assembly

No.	Qty	Part #	Description
2	1	38224EP	Body
3	2	34465	Ball Teflon 7/16 Dia.
4	1	38217EP	Cover
5	2	35172	O-Ring Viton 2-015
6	1	38223EP	Inlet
7	2	36465	O-Ring Viton 2-220
8	1	38221EP	Head
9	1	38225	Bladder PE
12	1	35476	O-Ring Viton 2-110
14	1	38267	Compression Fitting Plate
15	1	35474	O-Ring Viton 2-010
17	1	36624	Connector 3/8"T x 1/4" MPT SS
18	1	37984	Nut 3/8" T SS
19	1	34479	Ferrule 3/8" Lower SS
20	1	34478	Ferrule 3/8" Upper SS
21	1	12022	Connector 1/4"T x 1/8" MPT SS
22	1	34954	Nut 1/4" T SS
23	1	34477	Ferrule 1/4" Lower SS
24	1	34476	Ferrule 1/4" Upper SS
26	1	38222EP	Discharge Tube 3/8"
27	1	38336	Inlet Screen
28	1	38340	Collar
29	1	38388EP	Eye Bolt with Nut



MP-SP-6P SamplePro Pump Assembly

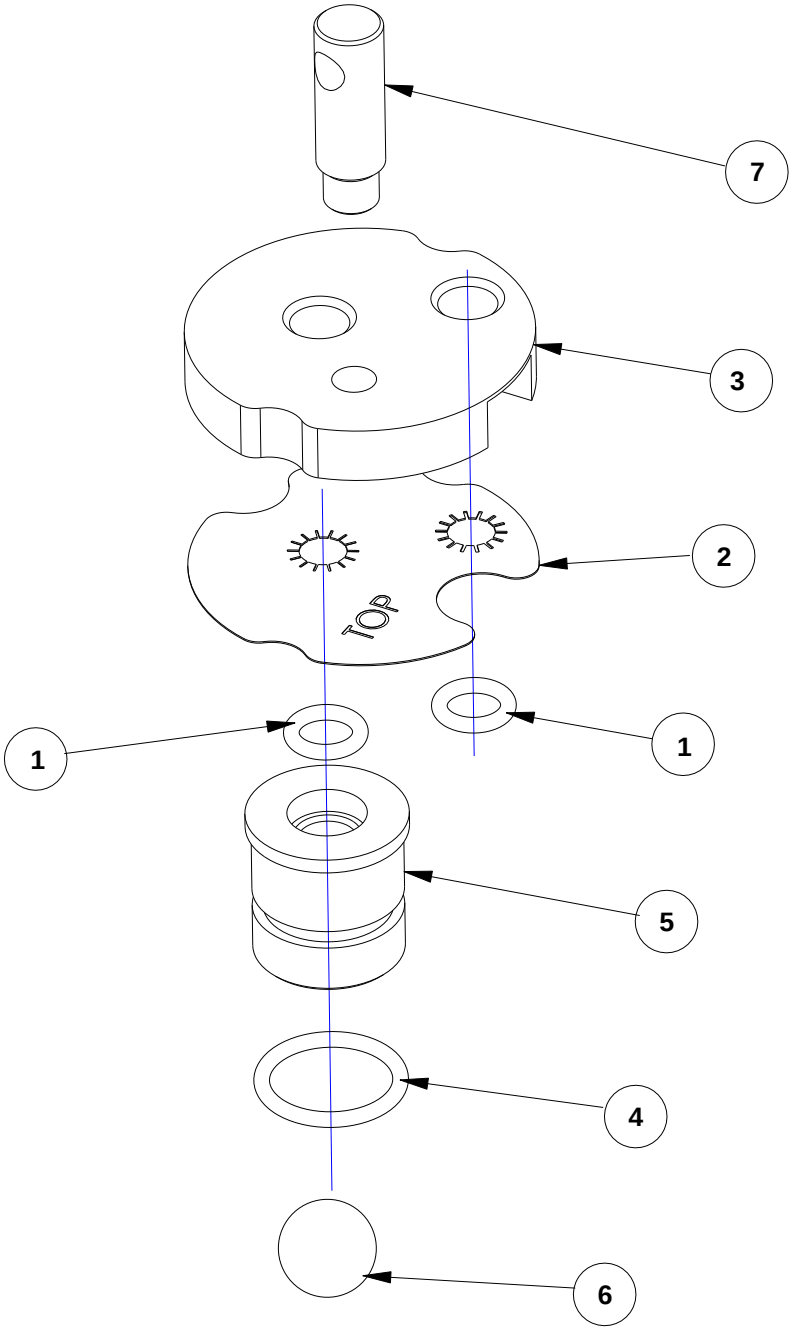
ITEM NO.	QTY.	PART NO.	DESCRIPTION
2	1	38224EP	BODY
3	2	34465	BALL TEFLON 7/16 DIA
4	1	38217EP	COVER
5	2	35172	O-RING VITON 2-015
6	1	38223EP	INLET
7	2	36465	O-RING VITON 2-220
8	1	38221EP	HEAD
11	1	35476	O-RING VITON 2-110
12	1	38220	GRABEPLATE 1/4" TUBE X 3/8" TUBE
13	1	38218EP	PLATE 1/4" TUBE X 3/8" TUBE
14	1	38222EP	DISCHARGE 3/8" TUBE
15	1	35474	O-RING VITON 2-010
16	1	38336	INLET SCREEN
17	1	38225	BLADDER PE
18	1	38340	COLLAR
19	2	38834	1 1/2 SAMPLE PRO EYE BOLT



38358 Tube Connector Assembly

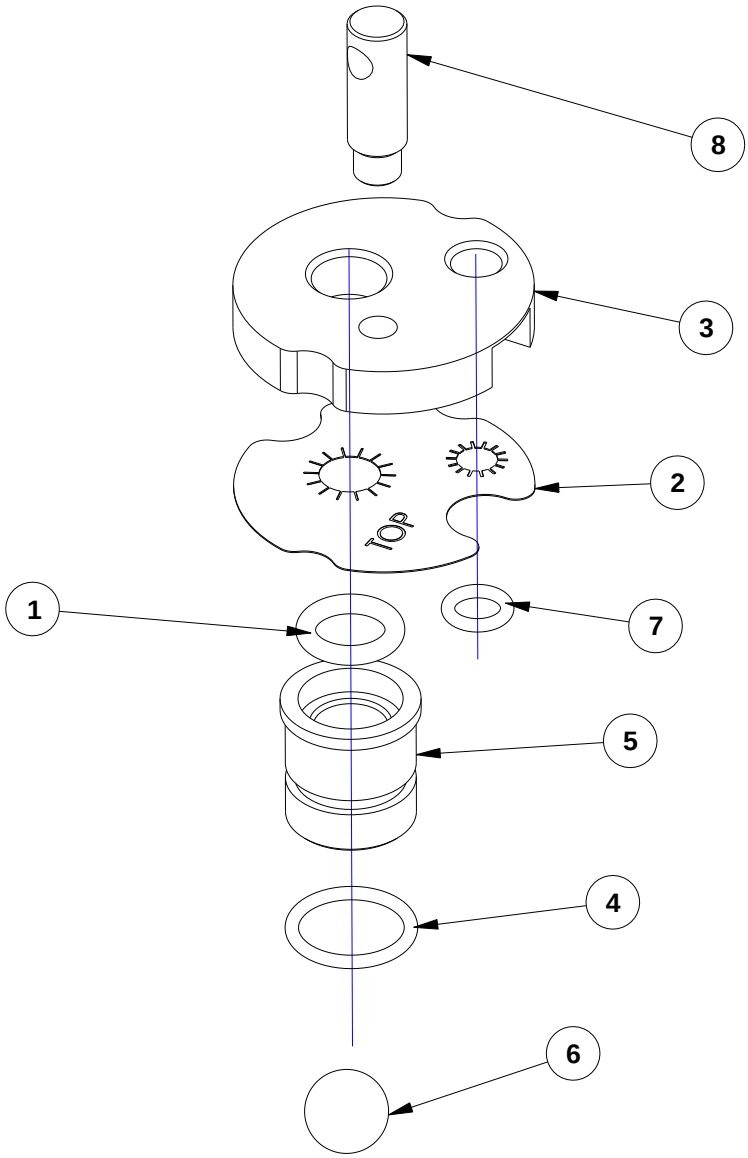
(For Use on MP-SP-4C)

No.	Qty	Part #	Description
1	1	35476	O-Ring Viton 2-110
2	1	35172	O-Ring Viton 2-015
3	1	38222EP	Discharge Tube 3/8"
4	1	34465	Ball Teflon 7/16 Dia.
5	1	38267EP	Compression Fitting Plate
6	1	35474	O-Ring Viton 2-010
7	1	38388EP	Eye Bolt with Nut
8	1	38374	Connector 1/4"T x 1/4" MPT SS
9	1	12022	Connector 1/4"T x 1/8" MPT SS



38356 TUBE CONNECTORPUSE ON MP-SP-4P

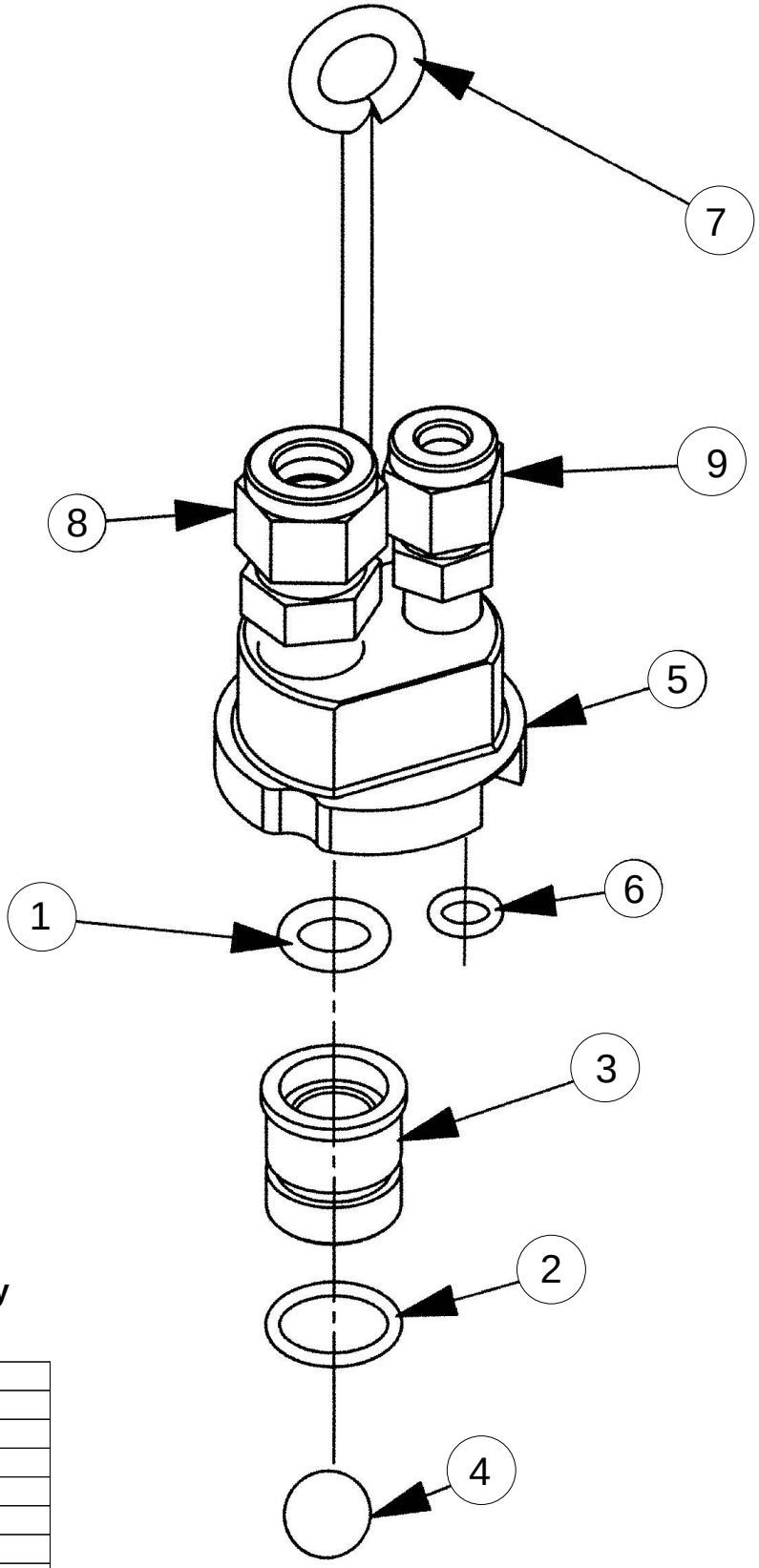
ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	2	35474	O-RING VITON 2-010
2	1	38219	GRABEPLATE 1/4" TUBE X 1/4" TUBE
3	1	38242EP	PLATE 1/4" TUBE X 1/4" TUBE
4	1	35172	O-RING VITON 2-015
5	1	38243EP	DISCHARGE 1/4" TUBE
6	1	34465	BALL TEFLON 7/16 DIA
7	1	38834	1 1/2 SAMPLE PRO EYE BOLT



38357 Tube Connector Assembly

(For Use on MP-SP-6P)

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	35476	O-RING VITON 2-110
2	1	38220	GRABEPLATE 1/4" TUBE X 3/8" TUBE
3	1	38218EP	PLATE 1/4" TUBE X 3/8" TUBE
4	1	35172	O-RING VITON 2-015
5	1	38222EP	DISCHARGE 3/8" TUBE
6	1	34465	BALL TEFLON 7/16 DIA
7	1	35474	O-RING VITON 2-010
8	1	38834	1 1/2 SAMPLE PRO EYE BOLT



38359 Tube Connector Assembly

(For Use on MP-SP-6C)

No.	Qty	Part #	Description
1	1	35476	O-Ring Viton 2-110
2	1	35172	O-Ring Viton 2-015
3	1	38222EP	Discharge Tube 3/8"
4	1	34465	Ball Teflon 7/16 Dia.
5	1	38267EP	Compression Fitting Plate
6	1	35474	O-Ring Viton 2-010
7	1	38388	Eye Bolt with Nut
8	1	36624	Connector 3/8"T x 1/4" MPT SS
9	1	12022	Connector 1/4"T x 1/8" MPT SS

SAMPLE PRO PUMP MODELS

MP-SP-4P Sample Pro Portable Pump push-in 1/4 x 1/4 tubing connector
MP-SP-6P Sample Pro Portable Pump push-in 1/4 x 3/8 tubing connector
MP-SP-4C Sample Pro Portable Pump compression 1/4 x 1/4 tubing connector
MP-SP-6C Sample Pro Portable Pump compression 1/4 x 3/8 tubing connector

SAMPLE PRO PUMP KITS

38355- Portable pump (Base pump without any tubing connectors.)
38356- Tubing connector 1/4" x 1/4" tubing push-in
38357- Tubing connector 1/4" x 3/8" tubing push-in
38358- Tubing connector 1/4" x 1/4" tubing compression
38359- Tubing connector 1/4" x 3/8" tubing compression
38360- Bladder PE (10/pieces)
38361- Screen (10)
38362- O-ring complete pump (10 sets)
38363- O-ring head only(10 sets)
38364- Grab-plate for push-in connector 1/4" x 1/4" (10)
38365- Grad-plate for push-in connector 1/4" x 3/8" (10)
38366- Ferrules for compression connectors 1/4" x 1/4" tube (5 sets)
38367- Ferrules for compression connectors 1/4 x 3/8 (5 sets)
38373- Bladder Teflon cartridge (parts for optional Teflon bladder)
38380- Teflon replacement bladders (10) with clamps and O-rings
38407- Pump controller air fitting, connects to 1/4" air supply tubing
38408- Ball, Teflon 7/16" dia. (5) for inlet and outlet check valves
38411- Brushes Sample Pro (3 sizes, 2 of ea.)

SPECIFICATIONS

Materials:

Body - 303 stainless steel
Inlet & Discharge Housing - 303 Stainless Steel
Bladder - Polyethylene or Teflon ®
O-rings - Viton

Dimensions:

Diameter - 1.75" (44.5 mm)
Length - 14.75" (37.5 cm)Push-in/16.5" (41.9 cm)Compression bottom of pump to centerline of inlet 12.12" (30.8 cm)
Weight - 4.25 Lbs.(1.93 kg)

Fittings:
Stainless Steel Compression or Push-in Type
Air - 1/4" (6.4 mm) O.D., 3/16" (4.7 mm)I.D.
Discharge - 1/4" (6.4 mm) O.D., 3/16" (4.7 mm)I.D.
Discharge - 3/8" (9.5 mm) O.D., 1/4" (6.4 mm) I.D.

Maximum Lift: 250 Feet (61 m)

Flow Rates (1/4" (6.4 mm) x1/4" (6.4 mm) O.D. Tubing)

1.2 liters per min @ 25 ft. (7.6 m) (10 ft. (3 m) submergence)
400 ml per min. @ 150 ft. (45.6 m) (10 ft. (3 m) Submergence)

Pump Volume:

Milliliters	Liters	Ounces	Gallons
100	.100	3.34	.026

For additional assistance contact QED Service at:

Phone: 1-800-624-2026 1-734-995-2547

Fax: 1-734-995-1170

E-mail: service@qedenv.com

24-Hour Service Hot Line: 1-800-272-9559

IMPORTANT WARRANTY NOTE

The push-in and compression fittings on the SamplePro pump are designed to provide at least 100 lbs. pullout strength when used with QED tubing. QED is not responsible for loss of the pump if non-QED tubing is used.

QED ENVIRONMENTAL SYSTEMS, INC. ("Q.E.D.") warrants to the original purchaser of its products that, subject to the limitations and conditions provided below, the products, materials and/or workmanship shall reasonably conform to descriptions of the products and shall be free of defects in materials and workmanship. Any failure of the products to conform to this warranty will be remedied by Q.E.D. in the manner provided herein.

This warranty shall be limited to the duration and the conditions set forth below. All warranty durations are calculated from the original date of purchase.

1. Dedicated-Use Systems Products- 10 year warranty on dedicated bladder pumps equipped with Q.E.D. inlet screens, and purge pumps used in periodic, non continuous groundwater sampling (up to 52 sampling events per year.) All other components, equipment and accessories are warranted for one year.

2. Portable-Use Systems- Pumps, Controllers and water level meters are warranted for one year. Hose reels and Caps are warranted for ninety (90) days. Tubing and Purge Mizers are covered by a ninety (90) day material and workmanship warranty. There will be no warranty for application on tubing and Purge Mizers when used as part of a Portable System.

3. Separately sold parts and Spare Parts Kits- Separately sold parts and spare parts kits are warranted for ninety (90) days. Repairs performed by Q.E.D. are warranted for ninety (90) days from date of repair or for the full term of the original warranty, whichever is longer.

Buyers' exclusive remedy for breach of said warranty shall be as follows:if, and only if, Q.E.D. is notified in writing within applicable warranty period of the existence of any such defect in the said products, and Q.E.D. upon examination of any such defects, shall find the same to be within the term of and covered by the warranty running from Q.E.D. to Buyer, Q.E.D. will, at its option, as soon as reasonably possible, replace or repair any such product, without charge to Buyer. If Q.E.D. for any reason, cannot repair a product covered hereby within four (4) weeks after receipt of the original Purchaser's/Buyer's notification of a warranty claim, then Q.E.D.'s sole responsibility shall be, at its option, either to replace the defective product with a comparable new unit at no charge to the Buyer, or to refund the full purchase price. In no event shall such allegedly defective products be returned to Q.E.D. without its consent, and Q.E.D.'s obligations of repair, replacement or refund are conditioned upon the Buyer's return of the defective product to Q.E.D.

IN NO EVENT SHALL Q.E.D. ENVIRONMENTAL SYSTEMS, INC. BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES FOR BREACH OF SAID WARRANTY.

The foregoing warranty does not apply to major sub-assemblies and other equipment, accessories and parts manufactured by others, and such other parts, accessories, and equipment are subject only to the warranties, if any, supplied by the respective manufacturers. Q.E.D. makes no warranty concerning products or accessories not manufactured by Q.E.D. In the event of failure of any such product accessory, Q.E.D. will give reasonable assistance to the Buyer in obtaining from the respective manufacturer whatever adjustment is reasonable in light of the manufacturer's own warranty.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY (INCLDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE), WHICH OTHER WARRANTIES ARE EXPRESSLY EXCLUDED HEREBY, and of any other obligations or liabilities on the part of Q.E.D.,neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with said products, materials and/or workmanship.

It is understood and agreed that Q.E.D. shall in no event be liable for incidental or consequential damages resulting from its breach of any of the terms of this agreement, nor for special damages, nor for improper selection of any product described or referred to for a particular application.

This warranty will be void in the event of unauthorized disassembly of component assemblies. Defects in any equipment that result from abuse, operation in any manner outside the recommended procedures, use and applications other than for intended use, or exposure to chemical or physical environment beyond the designated limits of materials and construction will also void this warranty. Q.E.D. shall be released from all obligations under all warranties if any product covered hereby is repaired or modified by persons other than Q.E.D.'s service personnel unless such repair by others is made with the written consent of Q.E.D.

If any product covered hereby is actually defective within the terms of this warranty, Purchaser must contact Q.E.D. for determination of warranty coverage. If the return of a component is determined to be necessary, Q.E.D. will authorize the return of the component, at owner's expense. If the product proves not to be defective within the terms of this warranty, then all costs and expenses in connection with the processing of the Purchaser's claim and all costs for repair, parts and labor as authorized by owner hereunder shall be borne by the purchaser.

RESPONSIBILITY OF THE PURCHASER

The original Purchaser's sole responsibility in the instance of a warranty claim shall be to notify Q.E.D. of the defect, malfunction, or other manner in which the terms of this warranty are believed to be violated. You may secure performance of obligations hereunder by contacting the Customer Service Department of Q.E.D. and:

1. Identifying the product invovled (by model or serial number or other sufficent description that will allow Q.E.D. to determine which product is defective).
2. Specifying where, when, and from whom the product was purchased.
3. Describing the nature of the defect or malfunction covered by this warranty.
4. Sending the malfunctioning component, after authorization by Q.E.D. to:

QED Environmental Systems, Inc.
6155 Jackson Rd.
Ann Arbor, Michigan 48103

Appendix B

Field Equipment Decontamination Procedure

GENERAL DECONTAMINATION PROCEDURES

Decontamination consists of physically removing contaminants and/or changing their chemical nature to innocuous substances. The extent of decontamination depends on a number of factors, the most important being the type of contaminants involved. The more harmful the contaminant, the more extensive and thorough decontamination must be. Less harmful contaminants may require less decontamination. Only general guidance can be given on methods and techniques for decontamination. The exact procedure to use must be determined after evaluating a number of factors specific to the incident.

Equipment

Decontamination equipment. materials, and supplies are generally selected based on availability. Other considerations include ease of equipment decontamination or disposability. Most equipment and supplies can be easily procured. For example, soft-bristle scrub brushes or long-handle brushes are used to remove contaminants. Water in buckets or garden sprayers is used for rinsing. Large galvanized wash tubs or stock tanks can hold wash and rinse solutions. Plastic wading pools can also be used. Large plastic garbage cans or other similar containers lined with plastic bags store contaminated clothing and equipment. Contaminated liquids can be stored temporarily in metal or plastic cans or drums. Other equipment includes paper or cloth towels for drying protective clothing and equipment.

Sampling tools and other equipment are usually decontaminated by scrubbing with detergent-water using a soft-bristle brush followed by rinsing with copious amounts of water. While this process may not be fully effective in removing some contaminants (in a few cases, contaminants may react with water), it is a relatively safe option compared to using a chemical contaminating solution, which requires that the contaminant be identified. A decon chemical that will change the contaminant into a less harmful substance is needed. Unknown substances or mixtures from a variety of known or unknown substances are especially troublesome. The appropriate decontamination solution must be selected in consultation with an experienced chemist.

Sampling Equipment Deontamination

Insofar as possible, measures should be taken to prevent contamination of sampling and monitoring equipment. Sampling devices become contaminated, but monitoring instruments, unless they are splashed, usually do not. Once contaminated, instruments are difficult to clean without damaging them. Any delicate instrument that cannot be easily decontaminated should be protected while it is being used. It should be bagged, and the bag should be taped and secured around the instrument. Openings are made in the bag for sample intake.

1. Sampling Devices

Sampling devices require special cleaning. Drill rigs, augers, drill rods, drill bits, mud tanks, and sand separators are steam-cleaned prior to use. Visible soil and grease are removed at this time. Soil sampling equipment (e.g., split-barrel or standard penetration samplers, and sampling tubes) is cleaned prior to use in each boring and between sampling. The sampler may be steam cleaned or washed in a detergent solution and triple-rinsed with contaminant-free water. Visible soil is removed at this time. Wash solutions and rinse water are replaced prior to each boring. Casing, screen, couplings, and caps used in monitoring-well installation are steam-cleaned prior to installation. Visible foreign matter is removed at this time.

The exterior surfaces and accessible interior portions of submersible, centrifugal, and positive-displacement pumps are steamed-cleaned prior to each use or prior to each sampling round. Tubing associated with pumps that will be used for sampling or purging of groundwater will be decontaminated by pumping five gallons each of a detergent solution and contaminant-free water through the tubing.

Bailers are steam-cleaned or washed in a detergent solution and triple-rinsed in contaminant-free water prior to each use. Rope or string (used with bailers or disposable sampling bottles) that has been in contact with the water in the well or boring is replaced after each sample collection.

Steel tapes, well sounders, transducers, and water-quality probes are triple-rinsed in distilled and/or deionized water or wiped clean with paper towels after each use (use of cloth rags, which become saturated, is not acceptable). Generally, only the wetted end of these devices requires cleaning.

2. Tools

Wooden tools are difficult to decontaminate because they absorb chemicals. They should be kept on-site and handled only by protected workers. At the end of the response, wooden tools should be discarded. Steel and plastic tools do not absorb chemicals as readily but accumulations may occur over time and decontamination measures should be thorough.

3. Respirators

Certain parts of contaminated respirators, such as the harness assembly and leather or cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. Regulators must be maintained according to manufacturer's recommendations. Persons responsible for decontaminating respirators should be thoroughly trained in respirator maintenance.

4. Heavy Equipment

Although contamination avoidance is the best posture to adopt at a hazardous material site, certain equipment used in remedial actions or sampling will unavoidably become contaminated. These items must either be properly decontaminated before being removed from the site or, in the case of drilling tools, thoroughly cleaned before the next use. Disposable plastic tarpaulins can be placed over certain items of equipment to minimize subsequent cleaning. Particular care must be given to items that have come into direct contact with contaminants such as tracks, tires, shovels, grapples, and scoops.

The type of decontamination employed is a function of the degree and nature of the hazard and the physical state and quantity of the contamination to be removed. In general, wet contamination should be kept wet, and dry contamination should be kept dry. The wetting of certain dry compounds which might contaminate equipment can form solid oxides which may be more difficult to remove or reaction products which may exacerbate decontamination procedures.

The decontamination of vehicles and large pieces of equipment, such as pumps, must be performed on a wash pad constructed such that cleaning solutions and wash water can be recycled or collected for later disposal.

Similarly, equipment being dry brushed or vacuumed should be placed on a nonporous pad to facilitate containment and collection of wastes. Decontamination operations should start with the easiest methods first. For example, a general spraying first to remove the bulk of contamination, followed by a scrubbing of difficult areas if necessary. Such a procedure will avoid unnecessary contact with equipment by decontamination personnel.

A thorough inspection of equipment, supplemented by a swipe test as appropriate, should be the governing factor for length and method of decontamination. It is important that all portions of the equipment including the undercarriage, chassis, and cab be thoroughly cleaned. Air filters on equipment utilized in or around the exclusionary zone should be considered highly contaminated and should be removed and replaced prior to leaving the site. Porous items such as wooden truck beds, cloth hoses, and wooden handles cannot be properly cleaned in many instances.

For wet decon procedures, steam cleaning or high pressure spraying utilizing water and a general purpose, low-sudsing soap or detergent (to improve wetting effects) is the decontamination method of choice. Physical scrubbing by disposable or easily decontaminated brushes may be necessary to loosen materials. In most instances, hot water is more effective than cold. Flushing should be done under high pressure, taking care not to damage items on the equipment such as dials and gauges and loosely hanging wires or hoses. In some cases, it may be more efficient to waterblast such items as shovels, loaders, and scoops.

Dry removal of contaminants can be done through brushing, vacuum cleaning, vacuum blasting, and sandblasting. Vacuum cleaning utilizing high efficiency units mounted over 55-gallon recovery drums provide for the greatest control of fugitive emissions.

As stated above, steam or hot water with detergent is the decontaminant of choice. However, in some cases, it may be necessary to utilize a special solution or combination of solutions to achieve a thorough decontamination. For any decontaminant utilized, it is important that the possible reactivity and suitability for the hazardous materials involved be evaluated. It is also important that decontamination personnel understand the potential hazards of the contaminants as well as any hazards associated with cleaning equipment or special decontamination solutions.

Additional specialized decontaminants or neutralizing agents that may be considered include ethanol; supertropical bleach (STB); 0S2, a mixture of diethylenetriamine (70%), ethylene glycol monmethyl ether (28%), and sodium hydroxide (2%); sodium hydroxide (caustic soda); chelating agents such as ETDA, citric acid, tartaric acid, and oxalic acid. Biological contaminants have been decontaminated utilizing betapropiolactone (BPL); fonnaldehyde solution; ethylene oxide-fluorinated hydrocarbon mixture; peracetic acid; and strong bleaches and caustics. These decontaminants all require special care in their handling and use. In addition, many can degrade rubber products on heavy equipment.

5. Persistent Contamination

In some instances, equipment will become contaminated with substances that cannot be removed by normal decontamination procedures. A solvent may be used to remove such contamination from equipment if it does not destroy or degrade the protective material.

Disposal of Contaminated Materials

All materials and equipment used for decontamination must be properly disposed. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be secured in labeled drums or other containers. Contaminated wash and rinse solutions should be contained by using step-in containers (for example, a plastic wading pool) to hold spent solutions. Another containment method is to dig a trench about 3 inches deep and line it with plastic. In both cases the spent solutions are transferred to drums, which are labeled and disposed with other substances on-site.

Operational Considerations

Weather is an important consideration during decontamination operations. Frozen contamination, particularly on tracked vehicles, may be impossible to remove. Wet procedures during cold weather can cause both operational and maintenance problems.

High pressure or steam operations can produce contaminated aerosols which could migrate away from the decontamination area. The utilization of tarpaulins, tents, prefabricated structures, or modification of existing on-site structures can help control both fugitive emissions and help mitigate adverse weather effects.

Numerous steam and low and high pressure spray units are available. In general, the lower pressure units (90 to 120 psi) flush off a general or special decontaminating or neutralizing solution at a rate generally from 5 to 30 gpm. With higher pressure units (up to 5000 psi), decon or neutralizing solutions are usually not needed. Likewise, hot water (120 to 180°F) is usually unnecessary when utilizing the higher pressure equipment.

Appendix C

Low Flow Sample Procedure

Appendix C

Groundwater Quality Monitoring

Low Flow Micro-purge Method

The Low Flow sampling procedure deployed at the Southeast Rockford Groundwater Contamination Site (Site) to collect groundwater quality samples from the groundwater monitoring network involves the deployment of dedicated low flow pumps in the groundwater monitoring wells to minimize the disturbance to the formation water normally resulting from application of procedures involving insertion of a pump or bailer into the well, and to minimize the volume of well purge water requiring off-site management.

The application of the Low Flow sample method for collection of groundwater quality samples at the Site is consistent with practices established in the EPA Region 5, Low Flow Standard Operating Procedure (EPA, 2021). A principle element in implementing the Low Flow sampling procedure is the attainment of sufficient purge of groundwater in the monitoring well, prior to sample collection, in order to remove stagnant water that may be present in the monitoring well water column and replace with representative groundwater in the sampled aquifer.

The monitoring well water purge process is complete when identified groundwater parameters in the purge water stabilize and a representative sample of groundwater conditions may be collected. The Low Flow stabilization parameters and measurement criteria established for the Site to determine sufficient purge of the monitoring well has been achieved are identified in the table below.

Groundwater Monitoring Well Stabilization Criteria

Parameter	**Criteria**
pH	± 0.1 unit
Conductivity	3%
DO	10%
ORP	± 10 mV
Temperature[1]	3%
Turbidity[2]	n/a

1 Water temperature will be monitored using the flow through analyzer and in the event measurements do not stabilize within the time during which the remaining field parameter measurements have stabilized, the last temperature reading obtained will be recorded in the field record. Ambient air temperature will be recorded in the field record as a contributing factor in purge water stabilization.

2. A turbidity reading will be recorded in the field notes just prior to sampling

Appendix C

This well purging technique minimizes stress on the ambient ground water conditions in achieving low water level draw-down using low pumping rates (< 1 liter/minute). The well purging process results in the removal of a much smaller volume of ground water from the well , limiting the physical disturbance of the ground water in the aquifer. The practices utilized to purge Site groundwater monitoring wells and achieve groundwater stabilization criteria are presented below:

- One tubing volume will be removed before measurement of the field parameters commences. The dedicated sampling pump tubing volume for each Site monitoring well is presented in Table 1.
- Field parameters pH, DO, conductivity, and ORP will be measured in a flow-through cell analyzer every 3 to 5 minutes at a desired flow rate of 250-500 ml/minute until the respective stabilization criteria identified in Table 1 have been met for three consecutive readings, or as provided below.
- Water temperature will be monitored using the flow through analyzer and in the event measurements do not stabilize within the time during which the remaining field parameter measurements have stabilized, the last temperature reading obtained will be recorded in the field notes. Ambient air temperature will be recorded in the field notes as a contributing factor in purge water stabilization.
- Turbidity measurements will be obtained using a portable nephelometer (e.g. flow-through cell analyzer with expanded turbidity capability or a Hach or equivalent unit). A single field turbidity measurement will be recorded for each well location just prior to sample collection rather than several measurements per the stabilization procedure. The relatively low levels of suspended solids that may be found in well purge water impart negligible influence on organics analyses and metals are not identified as chemicals of concern at the Site.

Appendix C

Table 1:
Monitoring Well Tubing Volumes

Well ID	Tubing Volume (l)
MW-16	1.0
MW-47	1.0
MW-101A	1.3
MW-101B	1.9
MW-101C	3.2
MW-101D	1.4
MW-102A	0.8
MW-102B	1.4
MW-102C	2.2
MW-113A	1.4
MW-113B	1.9
MW-114A	1.4
MW-114B	2.6
MW-117B	1.3
MW-117C	2.0
MW-117D	1.4
MW-119	2.0
MW-121	1.1
MW-124	1.4
MW-130	0.8
MW-133A	0.8
MW-133B	1.0
MW-133C	1.4
MW-136	0.9
MW-200	0.9
MW-201	1.3
MW-202	0.9
MW-203	0.9
MW 204	1.3
MW-205A	1.5
MW-205B	1.9
MW-206A	1.3
MW-206B	1.7
MW-206C	2.8
MW-207	1.3

Appendix D

Portable Sample Pump SOP

Southeast Rockford Groundwater Contamination Site
Portable Monitoring Well Sample Pump Operating Procedure Rev. 0
Effective Date: 09/15/2017
Source: Nationwide Environmental Services, Inc.
Review: B. LaFlamme, Sr Geologist
Approval: W. B. Dotterrer, Sr. Project Manager

Potable Monitoring Well Sample Pump
Standard Operating Procedure

The groundwater monitoring network installed at the Southeast Rockford Groundwater Contamination Site (Site) utilizes dedicated bladder pumps and downhole sample tubing to collect groundwater samples from each monitoring well location. This sample arrangement was installed at the Site to minimize the need for portable equipment to be deployed during sample events and decontamination procedures to be implemented at each sample location for downhole sample equipment.

In instances in which dedicated sample equipment at a particular monitoring well location is inoperative or otherwise unavailable during a scheduled sample event, a portable "sample pro model" stainless steel air diaphragm pump manufactured by QED is used in place of the dedicated pump. The portable pump is manufactured by the same supplier as the dedicated well pumps, and the pump controller and water quality meter used in collected samples from monitoring wells with dedicated sample pumps for sampling. In such instances, dedicated HDPE tubing is used along with a new, disposable HDPE bladder for collection of groundwater samples.

The procedure used in deploying the portable monitoring well sample pump and associated appurtenances is presented below.

<u>Portable Sample Pump Use:</u>

- The pump is placed at the same depth as the original installation, approximately 1 ft. from the bottom of the well,
- The well level is allowed to stabilize before purging.
- After sampling, the pump and tubing are removed and triple decontaminated with Alconox and distilled water.
- The components are allowed to dry and then stored for use at the next sampling event. The bladder is replaced for every event.

<u>Limitations:</u>

- The limitation associated with use of a portable sample pump for collection of groundwater samples at the Site are as follows:
- The sample pro pump has a smaller bladder and delivers less volume of water.
- The pumping rate is limited by the size of the bladder compared to the larger dedicated pumps.
- The portable pump is operated at a lower pumping rate and volume to prevent de-watering.
- The pumping rate and pumped volume are adequate for collection of groundwater samples using the Low Flow micropurge sample method with no variations in sample collection used for dedicated well pump installation.

Appendix E

Forms – Records (Samples)

Sample Report (Typ.)

Field Report Form

Chain of Custody Form

Sample Acknowledgment (Typ.)

SE ROCKFORD SAMPLING REPORT

Site Conditions

Period: **FALL 2021**
Type: Routine Semi-Annual; Monitoring Well Network
Sample dates: NOV 7 – NOV 11
Sample ship dates: NOV 8 & NOV 11 via FedEx priority overnight
Weather: Warm & Ptly Cloudy, highs in 50's degrees F, no precipitation.
Sampler: Pat Egan
Visitors: none
Method: Low Flow Micropurge

Observations
Field Duplicate: FD-1 = MW200
FD-2 = MW114B

One Trip Blank was submitted with each shipment (samples were submitted in two shipment(s)

Exceptions

- None

Maintenance Observations/issues

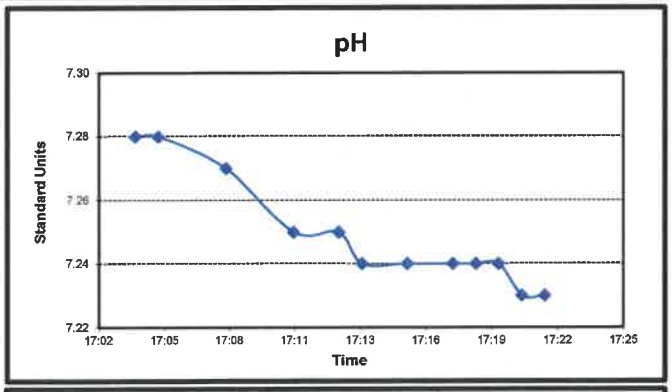
- Installed permanent pump in MW203 using same design data – sampled with new pump.

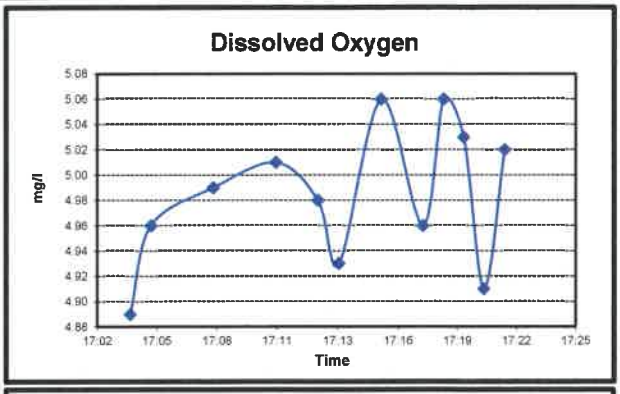
SE Rockford Superfund Site Ground Water Sampling - Field Report

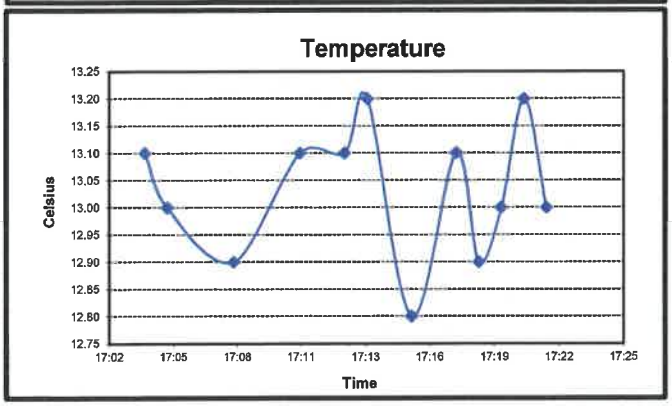
Casing Stickup (inch)	2	**Pump Inlet** (Ft.) TOC	60	**Lab Analysis**	VOCs (SW-846 8260)	Well ID:	**MW-16**
Casing Stickup (Ft.)	-0.028	**Purge Method**	Low Flow Micro Purge	**Container**	40 mL VOA Vial	Sample Date	16-Jun-21
Total Well Depth (Ft.) TOC	62.36	**Purge Equip**	QED Air Diaphragm	**Sample Type**	Grab (Groundwater)	Sampled by:	Patrick Egan
Static Water Level (Ft.) TOC	21.49	**Field Analysis Method**	Flow Thru Analysis - 250 mL	**Preservation**	HCl / Ice	Site Visitors:	None
Water Thickness (Ft.)	40.90	**Field Analysis Equip**	YSI 556 MSP	**Sampling Period**	SPRING 21		

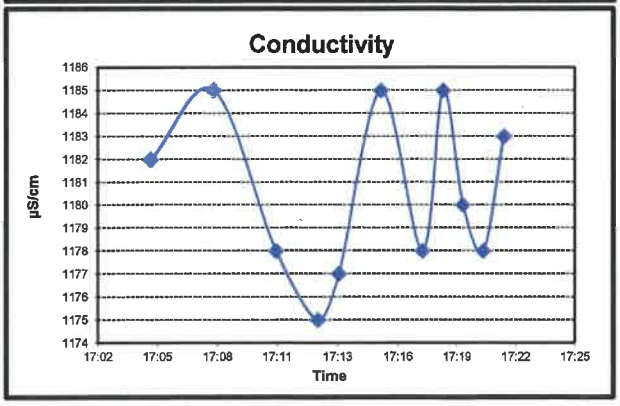
FIELD PURGE MONITORING

Time	pH	DO	Temp	ORP	SpCond	TURB	Flow Rate	Well Level	Annotation
HH:MM	Standard Units	mg/l	°C	mV	µS/cm	NTU	mL/min	(Ft.) TOC	
17:03									
17:04	7.28	4.89	13.10	-133.3	1186.00	43	380		
17:05	7.28	4.96	13.00	-131.8	1182.00		380	21.54	cloudy
17:08	7.27	4.99	12.90	-128.4	1185.00		380		
17:11	7.25	5.01	13.10	-125.6	1178.00		380		
17:13	7.25	4.98	13.10	-124.0	1175.00		380	21.62	clear
17:14	7.24	4.93	13.20	-123.6	1177.00		380		
17:16	7.24	5.06	12.80	-122.7	1185.00		380		
17:18	7.24	4.96	13.10	-121.9	1178.00		380		
17:19	7.24	5.06	12.90	-121.4	1185.00		380	21.68	clear
17:20	7.24	5.03	13.00	-120.6	1180.00		380		
17:21	7.23	4.91	13.20	-120.5	1178.00		380		
17:22	7.23	5.02	13.00	-120.3	1183.00		380		
MINUTES							TOTAL LITERS		
19.0	-0.01	-0.20%	0.00%	0.30	0.25%		**7.22**		









Remarks: (well condition, maintenance, etc...)

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed acc

WO# : 50302364

50302364

Section A Required Client Information		Section B Required Project Information		Section C Invoice Information	
Company	Nationwide Environmental Services	Report To	Bill Dotterrer	Attention	Bill Dotterrer
Address	14818 W. 6th Ave STE 5A	Copy To		Company Name	Nationwide Environmental Svc.
	Golden CO 80401			Address	14818 W. 6th Ave STE 5A, Golden
Email To	Bill Dotterrer	Purchase Order No		Pace Quote Reference	
Phone	303-232-2134 Fax	Project Name	SE Rock	Pace Project Manager	Booms, Melanie
Requested Due Date/TAT:	Normal	Project Number		Pace Profile #	7941

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☑ OTHER CERCLA

Site Location STATE: IL

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED Composite Start Date	Composite Start Time	Composite Endgrab Date	Composite Endgrab Time	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test (Y/N): IN VOC by 624	IN 1,4 dioxane by 8260 SI	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	MW203	WT	G			11/7/21	12:39		6				6					X	X	N	
2	MW202	T	G			11/7/21	13:20		6				6					X	X	N	
3	MW121	WT	G			11/7/21	14:41		6				6					X	X	N	
4	MW124	WT	G			11/7/21	15:24		6				6					X	X	N	
5	MW204	WT	G			11/7/21	16:17		6				6					X	X	N	
6	MW101A	WT	G			11/08/21	12:11		6				6					X	X	N	
7	MW101B	WT	G			11/08/21	12:49		6				6					X	X	N	
8	MW101C	WT	G			11/08/21	13:42		6				6					X	X	N	
9	MW136	WT	G			11/08/21	16:00		6				6					X	X	N	
10	MW200	WT	G			11/08/21	16:44		6				6					X	X	N	
11	FD-1	WT	G			11/08/21	16:48		6				6					X	X	N	
12	TRIP BLANK	WT	O						3				3					X			

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
All Samples kept in secure location at 4 degree C	Patrick Egan AEE	11/8/21	1900	Lynn Regal	11/9/21	15:10	
FEDEX: 7751 5265 1645							

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: PATRICK EGAN

SIGNATURE of SAMPLER: Patrick Egan DATE Signed (MM/DD/YY): 11/08/21

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

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Sample Conditions Upon Receipt Form (SCUR)

Date/Time: 11-09-21	**Evaluated by:** MSB	Affix Workorder/Login Label Here or **WO#: 50302364** PM: MSB Due Date: 11/23/21 CLIENT: GR-NES
Client: Nationwide Env Services		
Project Manager: MSB	**Profile ID:** 7941	
Rush TAT Requested: YES (NO) **Due Date:**		
Lab Notified of Rush or Short Holds: YES (NO)		**Non Conformance Form Required:** YES NO

Samples Received Via: (FedEx) UPS Client Pace Courier Other: _____ **Comments:**

Custody Seals Present and Intact:	(YES)	NO	NA	
Received Sample Information Form(s): Drinking Waters Only	YES	NO	(NA)	
USDA Regulated Soils: (AL, AR, CA, FL, GA, ID, LA, MS, NM, NY, NC, OK, OR, SC, TN, TX, WA or Puerto Rico)	YES	NO	(N/A)	
Short Holds Present (< 72 Hours):	YES	(NO)		
Samples Received in Hold:	(YES)	NO		
Custody Signatures Present:	(YES)	NO		
Collector Signature Present:	(YES)	NO		
Packing Material Used:	(YES)	NO		
Samples Collected Today and On Ice:	YES	(NO)	N/A	
IR Gun #: (280) 281	**Digital Thermometer #:** 282 283			
Ice Type: (WET Bagged / WET Loose) BLUE NONE	**1.** Cooler Temp Upon Receipt: 1.9 °C			
Ice Location: TOP BOTTOM MIDDLE (DISPERSED)	Temp should be 0-6°C (Initial/Corrected)			
Temp Blank Received:	(YES)	NO		
Containers Intact:	YES	NO		
Correct Containers:	(YES)	NO		
Sufficient Volume:	(YES)	NO		
Sample pH Acceptable: All containers needing preservation are found to be in complaince with EPA recommendation **pH Strip Lot #:** _____ *Exceptions are VOA, coliform, LLHg, O&G, or any container with a septum cap or preserved with HCl*	YES	NO	(N/A)	
Residual Chlorine Absent: **Cl_2 Strip Lot #:** _____ (SVOC/Pest 625, PCB 608, Total/Amenable Cyanide)	YES	NO	(N/A)	
VOA Headspace Acceptable (<6mm):	(YES)	NO	N/A	
Trip Blank Received: (HCl) MeOH TSP OTHER	(YES)	NO		
Comments:	**2.** Cooler Temp Upon Receipt: _____ °C			
	3. Cooler Temp Upon Receipt: _____ °C			
	4. Cooler Temp Upon Receipt: _____ °C			

7726 Moller Road
Indianapolis, IN 46268
(317)228-3100

SAMPLE ACKNOWLEDGMENT

Samples Submitted By: Nationwide Environmental Services
Client Project ID: SE Rockford, IL Site
Client PO#:

Pace Project Manager: Melanie Booms
Phone (616)975-4500
melanie.booms@pacelabs.com

Pace Analytical Project ID: 50302364
Samples Received: November 9, 2021 03:10 PM
Estimated Completion: November 23, 2021

CC: Bill Dotterrer

Comments: [1] Some analyses will be performed by different laboratories within the Pace Network.

Customer Sample ID	Pace Analytical Lab ID	Matrix	Date/Time Collected	Method
MW203	50302364001	Water	11/07/21 12:39	1,4-Dioxane by 8260 SIM 8260 MS Volatiles Data Package MSSV Environmental Impact Fee
MW202	50302364002	Water	11/07/21 13:20	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
MW121	50302364003	Water	11/07/21 14:41	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
MW124	50302364004	Water	11/07/21 15:24	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
MW204	50302364005	Water	11/07/21 16:17	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
MW101A	50302364006	Water	11/08/21 12:11	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
MW101B	50302364007	Water	11/08/21 12:49	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
MW101C	50302364008	Water	11/08/21 13:42	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
MW136	50302364009	Water	11/08/21 16:00	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
MW200	50302364010	Water	11/08/21 16:44	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
FD-1	50302364011	Water	11/08/21 16:48	1,4-Dioxane by 8260 SIM 8260 MS Volatiles
Trip Blank	50302364012	Water	11/08/21 00:00	8260 MS Volatiles

Please contact your project manager if you recognize any discrepancy in this form or have any questions about your project.

Confidentiality Statement: The Parties agree that they will take all reasonable precautions to prevent the unauthorized disclosure of any proprietary or confidential information of each other and that they will not disclose such information except to those employees, subcontractors, or agents who have expressly agreed to maintain confidentiality.

Thank you for choosing Pace Analytical Services, LLC.

Appendix B

Laboratory SOP

ENV-SOP-IND1-0034-rev.02

GCMS Volatiles 8260C

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ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-IND1-0034 **Revision:** 02

Document Title: Volatiles by GC/MS (8260C)

Department(s): VOA

Date Information

Effective Date: 21 Oct 2021

Notes

Document Notes:

All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-IND1-0034 **Revision:** 02
Title: Volatiles by GC/MS (8260C)

All dates and times are in Central Time Zone.

ENV-SOP-IND1-0034 Volatiles by GC/MS (8260C)

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Anne Troyer (008754)	Manager - Quality	20 Oct 2021, 01:31:43 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Elizabeth Schrage (008534)	Manager	20 Oct 2021, 12:13:32 PM	Approved
Steven Sayer (004775)	General Manager 2	20 Oct 2021, 12:17:26 PM	Approved

Pace Analytical®

STANDARD OPERATING PROCEDURE
TITLE: VOLATILE ORGANIC COMPOUNDS BY GC/MS
METHOD: SW-846 8260C
ISSUER: Pace ENV – Indianapolis – IND1

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1.0 SCOPE AND APPLICATION

1.1 The purpose of this SOP is to provide a laboratory specific procedure for determining Volatile Organic Compounds (VOCs) in environmental samples. The laboratory utilizes purge-and-trap GC/MS and bases these documented procedures on those listed in SW-846 Method 8260C, 5030A, 5030B, and 5035A.

1.2 This method is applicable to most organic compounds that have boiling points below 200 °C and are insoluble or slightly soluble in water. Volatile water-soluble compounds may also be determined although quantitation limits are typically higher due to their hydrophilic properties (e.g. ketones, oxygenates).

1.3 This method is applicable to most water and solid samples, regardless of moisture content. Matrices are groundwater, surface water, soil, sediment, and waste. Procedures may need to be adapted to address limitations in the method or equipment that might hinder or interfere with sample analysis.

1.4 The list of target compounds and reporting limits is found in Table 1. Refer to the LIMS for method detection limits.

1.5 Reporting limits, control limits, volumes/weights used, standard concentrations, vendors, instrumentation, equipment, and supplies are subject to change.

2.0 SUMMARY OF METHOD

2.1 Volatile organic compounds are introduced into the gas chromatograph by a purge-and trap method. The analytes are purged from a sample aliquot or extract using an inert gas. The purged analytes are collected on an absorbent trap. At the completion of the purge time, the trap is rapidly heated and back flushed to drive out the trapped analytes. The analytes are transferred into the inlet of a capillary gas chromatography column. The carrier gas flow through the column is controlled and the temperature is increased according to a set program to achieve optimum separation of purged analytes. The mass spectrometer is operated in a repetitive scan mode. Analytes are identified by the GC/MS retention times and by a comparison of their mass spectra with spectra of authentic standards. Analytes are quantified by comparing the response of a selected primary ion relative to an internal standard against a calibration curve.

3.0 INTERFERENCES

3.1 Major contaminant sources are volatile materials in the laboratory and impurities in the inert purging gas and in the absorbent trap. Many common solvents, most notably acetone and methylene chloride, are frequently found in laboratory air at low levels. The use of polytetrafluoroethylene (PTFE, Teflon) as thread sealants, tubing, or in flow controllers is highly recommended since other materials can be sources of contamination which may concentrate in the trap during the purging.

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3.2 A common source of interfering contamination is carryover. This may occur when a sample containing low concentrations of volatile organic compounds is analyzed immediately after a sample containing high concentrations of volatile organic compounds. The preventive action to this condition is rinsing the purging apparatus and sample syringes with organic free water between samples. Analyze one or more blanks to check for contamination prior to sample analysis. If the sample immediately following the high concentration sample does not contain the compounds present in the high-level sample, freedom from carryover contamination has been established.

3.3 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal of the sample container into the sample during shipment and storage. A trip blank prepared from organic-free reagent water and carried through the sampling, handling, and storage protocols can serve as a check on such contamination.

3.4 Since methylene chloride and acetone are common laboratory solvents, special precautions must be taken. The volatiles analysis and sample storage area must be located as far as possible from areas where these solvents are used or stored. Where possible, the volatiles analysis and sample storage area should be served by a separate HVAC system and maintained under positive pressure to prevent intrusion of contaminants. Laboratory clothing previously exposed to methylene chloride fumes during extraction procedures can contribute to sample contamination.

4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 HEALTH AND SAFETY

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handling these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit

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large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME, AND STORAGE

Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory and data quality objectives for the project.

Sample type	Collection per sample	Preservation	Storage	Holding time
5030B Aqueous	Minimum (3) VOA vials Additional sample is required if MS/MSD is requested	Acidified w/ 1:1 HCl to pH<2, no headspace	Cool to ≤6°C	pH>2: Analysis must be completed within 7 days of collection date. pH<2: Analysis must be completed within 14 days of collection date. (pH determined post-analysis)
5035A Solid Terra Core Kits (Preferred)	One (1) container for % moisture **AND** Two (2) 5-g portions in vials with magnetic stir bar and 5.0mL reagent water plus one (1) 5 g portion in a vial with 5.0mL methanol, OR Two (2) 10-g portions in vials with 10mL methanol. Additional sample is required if MS/MSD is requested.	Either no preservative or methanol as a preservative.	Cool to ≤6°C for no more than 48 hours from collection then freeze at -7°C to -20°C. Methanol vials may be stored at ≤6°C.	Analysis must be completed within 48 hours if samples are not frozen or preserved with methanol prior to the expiration of the 48-hour period. The holding time may be extended to 14 days if the sample is frozen or preserved with methanol prior to the expiration of the 48-hour period.
5035A Solid Coring Devices (Alternate)	One (1) container for % moisture **AND** Two (2) EnCore, TerraCore or similar sampling tubes. Additional sample is required if MS/MSD is requested.	No preservative Sample is extruded into a vial with a magnetic stir bar and 5.0mL reagent water.	Freeze at -7°C to -20°C within 48 hours of collection.	Analysis must be completed within 14 days of collection date.
5030A Solid Bulk Jars	One (1) container for % moisture **AND** One bulk sample jar, usually 4 oz. or 8oz.	No preservative Sample is weighed into a vial with a magnetic stir bar and 5.0mL reagent water.	Cool to ≤6°C	Analysis must be completed within 14 days of collection date

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7.0 EQUIPMENT AND SUPPLIES

7.1 Equipment

Equipment	Description / Comments
Gas Chromatograph	Agilent 6850, 6890, 8890, or equivalent
Mass Spectrometer	Agilent 5973, 5975, 5977, or equivalent
P&T Concentrators	EST Analytical Encon or Evolution, Tekmar 3000 series, or equivalent
Analytical Columns	J&W Scientific DB-624, 20m x 0.18mm x 1um, or equivalent
Trap	Supelco Trap K, or equivalent
Autosampler	EST Analytical Centurion, 8100, Centurion W/S, or equivalent
Data System	Agilent Chemstation, or equivalent

7.2 Supplies

Supplies	Description
Gas tight syringes	Hamilton or equivalent, various sizes
Syringe valves	Supelco or equivalent, 2-way with Luer ends
Volumetric flasks	Class A, various sizes
Standard vials	Supelco or equivalent vials with stop/go (mininert) caps
Sample vials	C&G #V54-A000-A01A-P01, or equivalent 40mL vials; pre-cleaned
pH paper	School Masters Science #46809, or equivalent
Analytical Balance	Mettler, Ohaus, or equivalent, capable of measuring to the nearest 0.001g/0.01g

8.0 REAGENTS AND STANDARDS

8.1 Reagents

Reagent	Concentration / Description
Reagent water	Volatile-free water
Methanol	Purge-and trap grade or equivalent
Sand	Or equivalent material to be used as a simulated soil matrix.

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8.2 Standards

Standard Type	Description	Expiration	Storage
Stock VOA calibration standards	Phenova cat# ALO-180007, 180024, 180025, 180003, 180006 and Restek cat# 30287; or equivalent standards	Manufacturer's expiration date	Manufacturer's storage conditions
Stock Gas calibration standards	Phenova cat# ALO-180002, 180010, 180018; or equivalent standards	Manufacturer's expiration date	Manufacturer's storage conditions
Intermediate VOA calibration standard	Refer to Section 8.3.1	Solution good for 1 month from preparation	Same as stock standard
Intermediate Gas calibration standard	Refer to Section 8.3.2	Solution good for 1 week from preparation	Same as stock standard
Working VOA calibration standards	Refer to Section 8.3.3	One-time use	Not applicable
Stock VOA ICV/Spiking standards	Agilent cat# CUS-00002038, 00002379, 00002584, 00002032, 00002084, 00002344, 00002036, 00002037; or equivalent standards	Manufacturer's expiration date	Manufacturer's storage conditions
Intermediate VOA ICV/Spiking standard	Refer to Section 8.3.4	Solution good for 1 month from preparation	Same as stock standard
Working ICV/Spiking standard	Refer to Section 8.3.5	One-time use	Not applicable
Stock VOA Tune/ Surrogate standard	Restek; cat# 30240, 2500ug/mL or equivalent	Manufacturer's expiration date	Manufacturer's storage conditions
Stock VOA Internal standards	Restek; cat# 30241, 2500ug/mL or equivalent	Manufacturer's expiration date	Manufacturer's storage conditions
Working Tune/Surrogate/Internal standard mix	Refer to Section 8.3.6	Solution good for 1 month from preparation	Stored on autosampler under pressure in a 5mL vial

8.3 Standard Preparation Procedures

Note: for all standard preparations, opened stock vials must be used within one week or be discarded.

8.3.1 Intermediate VOA Calibration Standard Preparation

Using gas-tight syringes, add the following standard volumes to a 5mL stop/go vial and dilute to 5.0mL by adding 2.125mL methanol for a final concentration of 25-1000mg/L (larger or smaller final volume of standard may be prepared if components are proportional):

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Standard	Catalog #	Volume (uL)	Volume (mL)
8260REACT-STK	ALO-180007	125	0.125
8260CAL-STK	ALO-180024	125	0.125
8260ADD1-STK	ALO-180025	125	0.125
8260ELEV-STK	ALO-180003	125	0.125
8260ADD2-STK	ALO-180006	500	0.500
8260Dioxane	30287	1875	1.875

8.3.2 Intermediate Gas Calibration Standard Preparation

Using gas-tight syringes, add the following standard volumes to a 5mL stop/go vial and dilute to 5.0mL by adding 3.875mL methanol for a final concentration of 50-1000mg/L (larger or smaller final volume of standard may be prepared if components are proportional):

Standard	Catalog #	Volume (uL)	Volume (mL)
8260GAS-STK	ALO-180002	125	0.125
8260ACRO-STK	ALO-180010	500	0.500
8260VACE-STK	ALO-180018	500	0.500

8.3.3 Working VOA Calibration Standards Preparation

The following are examples of one-time use calibration standards and could vary based on requirements, calibration range may vary.

8.3.3.1 Working Calibration Standards – Regular Level (examples only):

Standard	Int. Calibration Std Volume	Int. Gas Std. Volume	Final Total Volume	Nominal Final Concentration
CAL1*	3uL	3uL	200mL	0.75 ug/L
CAL2	2uL	2uL	50mL	2 ug/L
CAL3	5uL	5uL	50mL	5 ug/L
CAL4	10uL	10uL	50mL	10 ug/L
CAL5	2uL	2uL	5mL	20 ug/L
CAL6 (CCV)	5uL	5uL	5mL	50 ug/L
CAL7	15uL	15uL	5mL	150 ug/L
CAL8	30uL	30uL	5mL	300 ug/L

*CAL1 as described is primarily used to calibrate Benzene, 1,2-Dibromoethane (EDB), and Naphthalene for programs with regulatory limits below the CAL2 concentration.

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8.3.3.2 Working Calibration Standards – Low Level (examples only):

Standard	Int. Calibration Std Volume	Int. Gas Std. Volume	Final Total Volume	Nominal Final Concentration
CAL2**	2uL	2uL	200mL	0.5ug/L
CAL3	2uL	2uL	100mL	1ug/L
CAL4	4uL	4uL	100mL	2ug/L
CAL5	10uL	10uL	100mL	5ug/L
CAL6	20uL	20uL	100mL	10ug/L
CAL7 (CCV)	100uL	100uL	100mL	50ug/L
CAL8	300uL	300uL	100mL	150ug/L
CAL9	600uL	600uL	100mL	300ug/L

**CAL2 as described is primarily used to calibrate Acetonitrile, Acrylonitrile, Vinyl acetate, and Xylenes for programs with regulatory limits below the CAL3 concentration.

8.3.4 Intermediate VOA ICV/Spiking Standard Preparation (Example)

Using gas-tight syringes, add the following standard volumes to a 5mL stop/go vial and dilute to 5.0mL by adding 3.25mL methanol for a final concentration of 50-1000mg/L (larger or smaller final volume of standard may be prepared if components are proportional):

Standard	Catalog #	Volume (uL)	Volume (mL)
8260REAC-STK	CUS-00002038	125	0.125
8260VACE-STK	CUS-00002379	500	0.500
8260ADD2-STK	CUS-00002584	500	0.500
8260ADD1-STK	CUS-00002032	125	0.125
8260MEGA-STK	CUS-00002034	125	0.125
8260CHLO-STK	CUS-00002344	125	0.125
8260ELEV-STK	CUS-00002036	125	0.125
8260GAS-STK	CUS-00002037	125	0.125

8.3.5 Working ICV/Spiking Standard Preparation (Example)

Water/Soil Systems: Add 5uL of the Intermediate ICV/Spiking standard to 5mL reagent water for a final nominal ICV concentration of 50ug/L.

Water Systems: Dilute 50uL of the Intermediate ICV/Spiking standard to 50mL reagent water and transfer to a 40mL vial for a final nominal ICV concentration of 50ug/L.

8.3.6 Working Tune/Surrogate/Internal Standard Preparation (Example only, may vary)

Add together 100uL of Restek #30240 plus 100uL of Restek #30241 plus 4.8mL of methanol for a final concentration of 50mg/L.

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9.0 PROCEDURE

9.1 Equipment Preparation

9.1.1 Configure the purge & trap system and GC/MS system per manufacturer's instructions.

9.1.2 Tune Verification: At the beginning of each analytical sequence, prior to the analysis of any standards or samples, the mass spectrometer must be hardware tuned by injecting ≤50ng of 4-Bromofluorobenzene (BFB). This is done by analyzing a standard containing BFB. The BFB and calibration verification standard may be combined provided both tuning and calibration verification acceptance criteria are met without interferences. Use the BFB mass intensity criteria in the table below as tuning acceptance criteria. Alternate tuning criteria may be used provided method performance is not adversely affected.

Mass (m/z)	Ion Abundance criteria
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	<2% of m/z 174
174	>50% of m/z 95
175	5 to 9% of m/z 174
176	95 to 101% of m/z 174
177	5 to 9% of m/z 176

9.1.3 The mass spectrum of BFB may be obtained by averaging three scans, the peak apex scan and the scans immediately preceding and following the apex. Background subtraction is required using this approach and must be accomplished using a single scan no more than 20 scans prior to the elution of BFB. Do not background subtract part of the BFB peak. Alternatively, the analyst may use other approaches suggested:

9.1.3.1 A single scan within the BFB peak with background subtraction of a single scan no more than 20 scans prior to the elution of BFB

9.1.3.2 An average of multiple scans within the BFB peak with background subtraction of a single scan no more than 20 scans prior to the elution of BFB.

9.1.4 Refer to Section 11 for corrective actions.

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9.2 Initial Calibration (ICAL)

9.2.1 Initial Calibration standards are introduced into the GC/MS from the lowest to highest concentration of each working calibration standard. The lowest calibration standard must be at or below the required reporting limit. Five calibration points, at a minimum, are analyzed to evaluate linearity.

9.2.2 Initial Calibration Evaluation

9.2.2.1 The response factor (RF) is calculated for each compound for each calibration standard as follows:

$$RF = \frac{(A_x)(C_{IS})}{(A_{IS})(C_x)}$$

where: A_x = Area of the quantitation ion for the compound being measured
A_{IS} = Area of the quantitation ion for the internal standard
C_{IS} = Concentration of the internal standard
C_x = Concentration of the compound being measured

9.2.2.2 For each calibration standard, all reported compounds that appear in Table 3 must meet the minimum response factor criteria shown.

9.2.2.3 The average response factor (RF_{avg}) is determined by averaging the response factors at the different concentrations for each target analyte.

9.2.2.4 The percent relative standard deviation (%RSD) of the response factors is calculated as follows:

$$\%RSD = \frac{(SD)}{RF_{avg}} \times 100$$

where: SD = Standard deviation of average RF for a compound
RF_{avg} = Mean of RFs for a compound

9.2.2.5 If the percent relative standard deviation (%RSD) of the RFs for a compound is ≤20% over the calibration range, then linearity through the origin is assumed and the RF_{avg} may be used to determine sample concentrations.

9.2.2.6 If the %RSD for any compound is >20%, the analyst may employ a linear regression equation, non-weighted or weighted 1/x or $1/x^2$, that does not pass through the origin. The regression calculation will generate a correlation coefficient (r) that is the measure of the "goodness of fit" of the regression line to the data. To be used for quantitative purposes, the correlation coefficient must be >0.99.

9.2.2.7 Individual analyte calibration levels may be removed from the lowest and/or highest levels of the calibration curve provided the number of remaining calibration points meet the minimum requirements and the quantitation range is adjusted, as necessary.

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9.2.2.8 Removal of interior calibration levels is not permitted unless a standard introduction error or preparation error can be documented.

9.2.2.9 A calibration level may be replaced provided that the replacement calibration standard is analyzed within 24 hours of the original analysis and all analytes are replaced.

9.2.2.10 For compounds evaluated using correlation coefficient (r), the laboratory must evaluate Relative Error:

Relative Error (%RE)

$$\%\ Relative\ Error = \frac{x_i' - x_i}{x_i}\ x\ 100$$

Where: x_i = True value of the calibration standard
x'_i = Measured concentration of the calibration standard

Determine %RE by back-calculating two (2) initial calibration levels, the standard at the midpoint and the standard at the lowest point. %RE must be ≤30% (70-130% Recovery) for the midpoint standard and ≤50% (50-150% Recovery) for the lowest point.

9.2.2.11 If compounds fail to meet the criteria in Sections 9.2.2.1 – 9.2.2.10, the calibration fit must be set to average response factor. Sample concentrations may be determined for failing compounds but they must be reported as estimated. To report non-detects for a failing compound, the compound must have been detected with a response greater than zero in the initial calibration standard that corresponds to the reporting limit.

9.2.2.12 Each day that analysis is performed, the calibration standard(s) should be evaluated to determine if the chromatographic system is operating properly. Questions that should be asked are: Do the peaks look normal? Is the response obtained comparable to the response from previous calibrations? Are the retention times consistent over the range of calibration for each compound? Careful examination of the standard chromatogram can indicate whether the column is still performing acceptably. Additionally, examination of signal-to-noise ratio of analytes in low-level standards may be a useful diagnostic tool to monitor instrument performance. Signal-to-noise ratio is defined as the ratio of the analyte signal to the noise measured on a blank. It is recommended but not required that the signal-to-noise ratio be at least three to confirm detection.

9.2.2.13 Refer to Section 11 for corrective actions.

9.2.3 Initial Calibration Verification (ICV)

9.2.3.1 In addition to meeting the response and linearity criteria, any new calibration curve must be assessed for accuracy of the values generated.

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To assess the accuracy of the calibration, a single standard from a secondary source must be analyzed and the results obtained must be compared to the known true value. This step is referred to as the Initial Calibration Verification. The ICV must be from an alternative vendor or, in the event an alternative vendor is not available, from a different lot from the same vendor. The ICV is analyzed immediately following the initial calibration curve.

9.2.3.2 Calculate the percent recovery for each analyte using the equation:

$$\% \text{ Recovery} = \frac{\text{Observed Concentration}}{\text{Theoretical Concentration}} \times 100$$

The acceptance limits for the ICV are 70-130% recovery for all reported compounds, except the following compounds with acceptance limits of 50-150% recovery:

Acetone	Vinyl acetate
Acrolein	tert-Butyl alcohol
Bromomethane	Isobutyl alcohol
Iodomethane	1,4-Dioxane
Methyl acetate	

9.2.3.3 Refer to Section 11 for corrective actions.

9.3 Continuing Calibration Verification (CCV)

9.3.1 The initial calibration is verified every 12 hours by analyzing a BFB tune that must meet the criteria in Section 9.1.2, followed by a Continuing Calibration Verification (CCV) standard.

9.3.2 All target compounds in the CCV must be evaluated using a +/-20% variability criterion. Use percent difference when the average RF model calibration has been used. Use percent drift when a regression fit model has been used.

$$\% \text{ Difference (\%D)} = \frac{\text{Calculated conc.} - \text{Expected conc.}}{\text{Expected conc.}} \times 100$$

$$\% \text{ Drift} = \frac{\text{Calculated conc.} - \text{Theoretical conc.}}{\text{Theoretical conc.}} \times 100$$

9.3.3 If the percent difference or percent drift for a compound is $\leq$20%, then the initial calibration for that compound is considered valid and sample analysis can continue. If the criterion is not met for more than 20% of the compounds included in the calibration, then corrective action must be taken prior to sample analysis.

In cases where compounds are >20% difference or drift, they may still be reported as non-detects if the compound was detected with a response greater than zero in the initial calibration standard that corresponds to the reporting limit. When a failed compound is present in samples at or above the reporting limit, reported

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concentration must be qualified as estimated. Alternatively, the sample may be reanalyzed.

9.3.4 All reported compounds that appear in Table 3 must meet the minimum response factor criteria shown. If the minimum response factors are not met, the system should be evaluated, and corrective action should be taken before sample analysis begins.

9.3.5 The internal standard areas in the CCV must be between 50%-200% of the internal standard areas of the corresponding standard in the initial calibration. In addition, the retention time of the internal standards in the CCV cannot shift by more than 10 seconds from the corresponding standard in the initial calibration. Failure in either of these two areas requires the analyst to evaluate their system and perform maintenance if necessary.

9.3.6 Refer to Section 11 for corrective actions.

9.4 Sample Preparation and Handling

9.4.1 Refer to Section 6 for additional information regarding sample handling.

9.4.2 **Aqueous Samples**

9.4.2.1 Water samples analyzed using the Centurion autosampler require no sample preparation and are loaded as full 40mL vials, unless they require a dilution.

9.4.2.2 Water samples to be purged on the Archon/8100 autosampler are prepared by quickly measuring a 5mL aliquot of the sample using a 5mL gastight syringe and transferring it to a clean 40mL vial. This is done as quickly as possible to minimize analyte loss. The syringe is thoroughly rinsed inside and out with reagent water before measuring each sample.

9.4.2.3 Dilutions on aqueous samples must be prepared in a volumetric fashion. Sample aliquots are measured in either a volumetric pipet or gas-tight syringe and brought to volume in either a volumetric flask or gas-tight syringe.

9.4.2.4 After analysis is complete, check the residue in the vial using pH paper. The pH should be <2 if HCl-preserved vials were used. Holding time for water samples with pH >2 is 7 days. Appropriately qualify on the sequence log and in LIMS any sample not meeting the pH requirement and/or holding time requirement.

9.4.2.5 Aqueous Method Blank Preparation:

9.4.2.5.1 Water/Soil Systems: The Method Blank consists of a 40mL vial containing 5mL reagent water.

9.4.2.5.2 Water Systems: The Method Blank consists of an HCl-preserved 40mL vial filled completely with reagent water.

9.4.2.6 Aqueous LCS Preparation:

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9.4.2.6.1 Water/Soil Systems: Add 5uL of the Intermediate ICV/Spiking standard to 5mL reagent water for a nominal LCS concentration of 50ug/L.

9.4.2.6.2 Water Systems: Dilute 50uL of the Intermediate ICV/Spiking standard to 50mL reagent water and transfer to a 40mL vial for a nominal LCS concentration of 50ug/L.

9.4.2.7 Aqueous MS Preparation:

9.4.2.7.1 Water/Soil Systems: Add 5uL of the Intermediate ICV/Spiking standard to 5mL sample for a nominal MS concentration of 50ug/L.

9.4.2.7.2 Water Systems: Inject 40uL of the Intermediate ICV/Spiking standard directly into the 40mL vial containing the sample.

9.4.3 **Low-Level Soil Samples**

9.4.3.1 Preferably, samples received for low level analysis should be contained in pre-weighed Terra Core vials with reagent water. Prior to analysis the sample weight must be determined and recorded by weighing the vial and recording the weight. Subtract the tare weight indicated on the vial and correct for the label weight to determine the sample weight. The sample is ready for analysis.

9.4.3.2 Alternatively, samples received in coring devices, such as Encore, must be extruded into a pre-weighed vial either with or without 5mL reagent water and a stir bar. Record the weight of the vial after the sample has been placed into it. Subtract the tare weight determined initially to determine the sample weight. The sample is ready for analysis.

9.4.3.3 Samples received in bulk soil jars are sub-sampled into a vial. Place an empty vial on the balance pan and tare the balance. Quickly add 5.0–5.5g of sample to the vial. Record the sample weight. Add 5mL of reagent water and a stir bar and cap the vial. The sample is ready for analysis.

9.4.3.4 Low-Level Soil Method Blank Preparation: The Method Blank consists of a 40mL vial containing 5.0–5.5g simulated soil matrix and 5mL reagent water and a stir bar.

9.4.3.5 Low-Level Soil LCS Preparation: Place 5.0–5.5g of simulated soil matrix, 5mL reagent water and a stir bar into a vial. Add 5uL of the Intermediate ICV/Spiking standard for a nominal LCS concentration of 50ug/kg.

9.4.3.6 Low-Level Soil MS Preparation: Place 5.0–5.5g of sample, 5mL reagent water and a stir bar into a vial. Add 5uL of the Intermediate ICV/Spiking standard for a nominal MS concentration of 50ug/kg.

9.4.4 **Medium-Level Soil Samples**

9.4.4.1 Preferably, samples received for medium-level analysis should be received in pre-weighed Terra Core vials with methanol as a preservative. Prior to

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analysis the sample weight must be determined and recorded by weighing the vial and recording the weight. Subtract the tare weight indicated on the vial and correct for the label weight to determine the sample weight. The sample is mixed well on a vortex mixer and allowed to settle. A maximum of 200uL of the methanol extract per 5mL reagent water is used for analysis.

9.4.4.2 Alternatively, samples received in coring devices, such as Encore, must be extruded into a pre-weighed vial with 5mL methanol. Record the weight of the vial after the sample has been placed into it. Subtract the tare weight determined initially to determine the sample weight. The sample is mixed well on a vortex mixer and allowed to settle. A maximum of 200uL of the methanol extract per 5mL reagent water is used for analysis.

9.4.4.3 Samples received in bulk soil jars are sub-sampled into a 40mL vial. Place an empty vial on the balance pan and tare the balance. Quickly add 5.0–5.5g of sample to the vial. Record the sample weight. Add 5mL methanol and cap the vial. The sample is mixed well on a vortex mixer and allowed to settle. A maximum of 200uL of the methanol extract per 5mL reagent water or 1000uL of the methanol extract per 50mL reagent water is used for analysis.

9.4.4.4 Medium-Level Soil Method Blank Preparation: Medium-Level soils may be analyzed/batched with aqueous samples. Refer to Section 9.4.2.5 for Method Blank preparation.

9.4.4.5 Medium-Level Soil LCS Preparation: Medium-Level soils may be analyzed/batched with aqueous samples. Refer to Section 9.4.2.6 for LCS preparation.

9.4.4.6 Medium-Level Soil MS Preparation:

9.4.4.6.1 Water/Soil Systems: place a maximum of 200uL methanol sample extract into a vial and add enough reagent water to bring the final volume to 5mL. Add 5uL of the Intermediate ICV/Spiking standard.

9.4.4.6.2 Water Systems: Inject 80uL of the Intermediate ICV/Spiking standard directly into the 40mL vial containing the sample dilution.

9.5 Sample Analysis

9.5.1 All samples must be analyzed at room temperature and the system must be calibrated and free of contamination before samples are analyzed.

9.5.2 The purge & trap system and GC/MS system configuration settings used for sample analysis must be the same as from initial calibration.

9.5.3 Load vials into the autosampler in the desired order and start the sequence.

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10.0 DATA ANALYSIS AND CALCULATIONS

10.1 Qualitative Analysis

Analytes of interest are identified as present when the following criteria are met:

10.1.1 The relative retention time (RRT) for the analyte must compare within +/- 0.06 RRT units of the RRT for that analyte in the CCV.

10.1.2 The intensities of the characteristic ions of a compound must maximize in the same scan or within one scan of each other. Refer to Table 2 for the characteristic ions.

10.1.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.

10.1.4 If the acquired mass spectrum is contaminated or if identification is ambiguous, an experienced mass spectrometrist must determine the presence or absence of the compound.

10.2 Quantitative Analysis: When an analyte has been identified, quantitation of that analyte is based on the integrated response of the primary characteristic ion (quant ion). Calculate the concentration using the response factor (RF) or regression equation established with initial calibration.

10.3 Samples with target compound concentrations that exceed the calibration range must be reanalyzed at a dilution or qualified as estimated.

10.4 Refer to the Manual Integrations SOP for guidance on performing and documenting manual integrations.

10.5 Calculations

10.5.1 Calculate the final concentration in the sample as follows:

Aqueous Sample (ug/L) = $(X_s)(D)$

Solid Sample (ug/kg) = $\frac{(X_s)(V_f)(D)}{(W_s)}$

Where: X_s = Concentration of the analyte from the instrument, ug/L
V_f = Final volume, L
D = Dilution factor (Final Volume/Initial Volume)
W_s = Weight of solid sample, kg

Moisture corrected concentration = $\frac{\text{(Final concentration as received)}}{\text{(100 - \%Moisture)}} \times 100$

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10.5.2 LCS calculation:

$$R = (C / S) \times 100$$

Where: R = Percent Recovery
C = Observed LCS concentration
S = True LCS concentration

10.5.3 MS calculation:

$$R = \frac{(C_s - C)}{S} \times 100$$

Where: R = Percent Recovery
C_s = Observed MS concentration
C = Sample concentration
S = True spike concentration

10.5.4 RPD calculation:

$$RPD = \frac{|D_1 - D_2|}{[(D_1 + D_2)/2]} \times 100$$

Where: RPD = Relative Percent Difference
D_1 = First Sample Result
D_2 = Second Sample Result

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TITLE: VOLATILE ORGANIC COMPOUNDS BY GC/MS
METHOD: SW-846 8260C
ISSUER: Pace ENV – Indianapolis – IND1

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11.0 QUALITY CONTROL AND METHOD PERFORMANCE

11.1 Instrument Quality Control

QA Sample	Component	Frequency	Acceptance Criteria	Corrective Action
Tune	BFB	Every 12 hours of instrument operation	Refer to Sections 9.1.2 and 9.1.3	Reanalyze the BFB tune. If the tune still fails the criteria, instrument maintenance, and/or preparation of new standards must be considered.
Initial Calibration	Applicable target analytes	As needed	Refer to Section 9.2	Analyze a new initial calibration curve. Instrument maintenance and/or preparation of new calibration standards should also be considered. Samples associated with a failed initial calibration must be reanalyzed or affected data must be qualified.
Initial Calibration Verification (ICV)	Second Source Standard	Immediately following initial calibration of the instrument	70-130% Recovery 50-150% Recovery for compounds noted in Section 9.2.3.2.	Reanalyze an ICV. If the second ICV also exceeds the acceptance range, a new initial calibration should be prepared. Samples associated with a failed ICV must be reanalyzed or affected data must be qualified. *Exception:* If the ICV is outside of the upper control limit, indicating high bias, associated samples determined to be <RL may be reported.
Continuing Calibration Verification (CCV)	Primary Source Standard	Every 12 hours of continuous instrument operation	Refer to Section 9.3	Reanalyze a CCV. If the second CCV also fails, a new initial calibration should be prepared. Samples associated with a failed CCV must be reanalyzed or affected must be qualified. *Exception:* If the CCV is outside of the upper control limit, indicating high bias, associated samples determined to be <RL may be reported.

11.2 Batch Quality Control

QA Sample	Component	Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	Reagent water	One per preparation batch of up to 20 samples, per matrix.	Target analytes must be less than reporting limits.	Reanalyze method blank. If target compound is still >RL in method blank and associated samples, reanalyze samples. *Exceptions:* 1) If no additional sample remains for reanalysis or if reanalysis cannot take place within holding time, the reported method blank and samples must be qualified. 2) If a contaminant is present only in the method blank and not the samples, no action is required. 3) If contaminant is present in the sample at a concentration >10x the method blank, sample may be reported with qualification.

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QA Sample	Component	Frequency	Acceptance Criteria	Corrective Action
Laboratory Control Standard (LCS)	Applicable target analytes	One per preparation batch of up to 20 samples, per matrix.	Lab-generated %Recovery limits Refer to the LIMS for acceptance limits. Refer to Section 11.3 for allowable marginal exceedances.	Reanalyze the LCS. If LCS is still outside acceptance limits, reanalyze all associated samples. Refer to Section 11.3 for allowable marginal exceedances. *Exceptions:* 1) If no additional sample remains for reanalysis or if reanalysis cannot take place within holding time, reported data must be qualified. 2) If LCS recovery is >QC limits and sample results are non-detect, the sample data may be reported. The LCS data must be qualified. 3) If allowed by program or client, an associated matrix spike that meets LCS acceptance limits may be used in place of the LCS. LCS must be reported and qualified.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	Applicable target analytes	One MS/MSD set per preparation batch of up to 20 samples, per matrix.	Lab-generated %Recovery limits RPD ≤20% Refer to the LIMS for acceptance limits.	No corrective actions necessary for spiked compounds or surrogates. If LCS recovery is in range, the system is considered in-control and the out-of-control MS/MSD must be qualified appropriately.
Sample Duplicate (DUP)	Sample	One sample duplicate per batch of up to 20 samples if no MS/MSD.	RPD ≤20%	Qualify duplicate appropriately if RPD is out-of-control.
Surrogates	Applicable surrogate compounds	Added to each standard, sample, and method blank.	Lab-generated %Recovery limits Refer to the LIMS for acceptance limits.	Samples with surrogate failures must be reanalyzed. *Exceptions:* 1) If no additional sample remains for reanalysis or if reanalysis cannot take place within holding time, reported surrogate data must be qualified. 2) If surrogate result is >QC limits, and sample results are non-detect, the sample results may be reported without qualifiers. The surrogate must be qualified. 3) If there is obvious visible chromatographic interference with a surrogate, results may be reported but must be qualified.
Internal Standards Evaluation for Samples **(If required by client or program only)**	Applicable Internal Standard compounds	Added to each standard, sample, and method blank.	Sample ISTD areas must be +/-50% from CCV. Sample ISTD RTs must be +/-10 seconds from CCV.	If required by client or program, samples with ISTD failures must be re-analyzed at the same dilution or more concentrated. *Exception:* If no additional sample remains for reanalysis or if reanalysis cannot take place within holding time, reported data must be qualified.

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11.3 **Allowable Marginal Exceedances**: If a large number of analytes are in the LCS, it becomes statistically likely that a few will be outside control limits. A marginal exceedance (ME) is defined as being beyond the LCS control limit of +/-3 standard deviations, but within the ME limits of +/-4 standard deviations around the mean. The number of allowable MEs is based on the number of analytes in the LCS. If more analytes exceed the LCS control limits than is allowed, or if any one analyte exceeds the ME limits, the LCS fails, and correction action is necessary. If analytes exceed the upper marginal exceedance limit, indicating high bias, associated samples determined to be <RL may be reported. If the same analyte exceeds the LCS control limit consecutively, it is an indication of a systemic problem. The source of the error shall be located, and corrective action taken.

The number of allowable marginal exceedances is as follows:

Number of Analytes in LCS	Number Allowed as Marginal Exceedances
> 90	5
71 – 90	4
51 – 70	3
31 – 50	2
11 – 30	1
< 11	0

NOTE: As allowed by client or program, the LCS may be outside the control limits but ≥10% recovery for up to four additional volatile compounds except benzene, toluene, ethylbenzene, m&p-xylene, o-xylene, total xylenes and any requested oxygenate, without corrective action.

11.4 Method Performance

11.4.1 Method Validation

Refer to the SOP for Method Validation and Instrument Verification for the procedures used for initial method validation. Method Detection Limits (MDL) must be determined per the procedure in 40CFR Part 136, Appendix B.

11.5 Analyst Qualifications and Training

Employees that perform this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must document acceptable accuracy and precision by completing an initial demonstration of capability (DOC). Analysts must document on-going DOCs on an annual basis.

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12.0 DATA REVIEW AND CORRECTIVE ACTION

12.1 Data Review

The analyst must perform primary review of data and calculated results for accuracy. Secondary review of the data and calculated results must be performed by another qualified analyst, the department supervisor, or the Quality Manager prior to release for reporting. Refer to the SOP for Data Review Process for more information.

12.2 Corrective Action

Corrective action is expected any time QC is not within acceptance criteria, when sample results exceed the calibration range, and when carryover is suspected. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

Refer to Section 11 for a complete summary of QC, acceptance criteria, and recommended corrective actions.

13.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

Procedures for handling waste generated during this analysis are addressed in Waste Handling and Management, or other applicable SOP. All wastes are accumulated, managed, and disposed of in accordance with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace's Chemical Hygiene Plan / Safety Manual.

14.0 MODIFICATIONS

14.1 GC columns and chromatographic conditions may differ from those recommended.

14.2 Calibration solutions are purchased as certified standards.

15.0 RESPONSIBILITIES

Pace employees that perform any part of this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP. If an employee is unable to follow the procedures in this SOP, they must consult with their supervisor for guidance.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

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16.0 ATTACHMENTS

16.1 Table 1: Method 8260C Target Compounds and Reporting Limits

16.2 Table 2: Characteristic Ions and Internal Standard Association of Target Compounds

16.3 Table 3: Minimum Average Response Factor Criteria

17.0 REFERENCES

17.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Methods 8000D, 8260C, 5030A, 5030B, and 5035A.

17.2 Pace Analytical Quality Manual; latest revision.

17.3 NELAC/TNI Standards; Quality Systems section; 2003, 2009, and 2016.

18.0 REVISION HISTORY

This Version:

Section	Description of Change
All	Converted to new SOP format.
6.0	Added 10g/10mL methanol option.
7.1	Updated equipment.
7.2	Updated supplies.
8.1	Changed ASTM Type II water to volatile free-water.
8.2	Updated standards to match current practice.
8.3	Updated standard preparation to match current practice.
9.2.2	Added point-dropping rules and requirement to measure relative error.
9.2.3	Updated ICV acceptance criteria.
9.4.2	Updated details for both systems.
9.4.3	Updated weight range.
9.4.4	Updated to indicate medium-level soils batched/analyzed with aqueous samples.
11.1	Updated corrective actions to include qualification of data.
11.2	Updated ISTD RT requirements, when applicable for samples.
11.3	Added language to allow reporting of ND samples if bias is high.
Table 1	Added compounds from TNI cert and updated RLs where needed
Table 2	Added compounds from TNI cert
Table 3	Updated minimum average RF for Bromomethane.

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-IND1-0034	Volatiles by GC/MS (8260C)	01

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Table 1
Method 8260C Target Compounds and Reporting Limits[1]

Analyte	Water (ug/L)	Low-Level Water (ug/L)	Low-Level Soil (ug/kg)	Medium-Level Soil (ug/kg)
1,1,1,2-Tetrachloroethane	5	1	5	50
1,1,1-Trichloroethane	5	1	5	50
1,1,2,2-Tetrachloroethane	5	1	5	50
1,1,2-Trichlorotrifluoroethane	5	1	5	50
1,1,2-Trichloroethane	5	1	5	50
1,1-Dichloroethane	5	1	5	50
1,1-Dichloroethene	5	1	5	50
1,1-Dichloropropene	5	1	5	50
1,1,2-Trichlorotrifluoroethane	5	1	5	50
1,1-Dichloroethene	5	1	5	50
1,2,3-Trichlorobenzene	5	1	5	50
1,2,3-Trichloropropane	5	1	5	50
1,2,4-Trichlorobenzene	5	1	5	50
1,2,4-Trimethylbenzene	5	5	5	50
1,2-Dibromo-3-chloropropane (DBCP)	10	10	10	100
1,2-Dibromoethane (EDB)	5	1	5	50
1,2-Dichlorobenzene	5	1	5	50
1,2-Dichloroethane	5	1	5	50
1,2-Dichloropropane	5	1	5	50
1,3,5-Trimethylbenzene	5	5	5	50
1,3-Dichlorobenzene	5	1	5	50
1,3-Dichloropropane	5	1	5	50
1,4-Dichlorobenzene	5	1	5	50
1,4-Dioxane (p-Dioxane)	100	100	500	5000
1-Methylnaphthalene	10	20	10	100
2,2-Dichloropropane	5	1	5	50
2-Butanone (MEK)	25	20	25	250
2-Chloroethyl vinyl ether	50	50	50	500
2-Chlorotoluene	5	1	5	50
2-Hexanone	25	20	100	1000
2-Methylnaphthalene	10	20	10	100
4-Chlorotoluene	5	1	5	50
4-Isopropyltoluene (p-Isopropyltoluene)	5	1	5	50
4-Methyl-2-pentanone (MIBK)	25	20	25	250
Acetone	100	20	100	1000
Acetonitrile	100	100	100	1000
Acrolein	50	20	100	1000

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METHOD: SW-846 8260C
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Analyte	Water (ug/L)	Low-Level Water (ug/L)	Low-Level Soil (ug/kg)	Medium-Level Soil (ug/kg)
Acrylonitrile	100	100	100	1000
Allyl chloride	5	20	10	100
Benzene	5	1	5	50
Bromobenzene	5	1	5	50
Bromochloromethane	5	1	5	50
Bromodichloromethane	5	1	5	50
Bromoform	5	1	5	50
Bromomethane (Methyl bromide)	5	5	5	50
Carbon Disulfide	10	5	10	100
Carbon Tetrachloride	5	1	5	50
Chlorobenzene	5	1	5	50
Chlorodibromomethane (Dibromochloromethane)	5	1	5	50
Chloroethane	5	2	5	50
Chloroform	5	1	5	50
Chloromethane (Methyl chloride)	5	2	5	50
Chloroprene	100	100	100	1000
cis-1,2-Dichloroethene	5	1	5	50
cis-1,3-Dichloropropene	5	1	5	50
Cyclohexane	100	20	100	1000
Dibromomethane	5	1	5	50
Dichlorodifluoromethane	5	2	5	50
Diethyl ether (Ethyl ether)	5	20	5	50
Ethyl acetate	100	20	1000	10000
Ethyl Methacrylate	100	20	100	1000
Ethylbenzene	5	1	5	50
Hexachlorobutadiene	5	1	5	50
Iodomethane	10	5	100	1000
Isobutanol (Isobutyl alcohol)	100	100	100	1000
Isopropylbenzene (Cumene)	5	1	5	50
Methacrylonitrile	100	100	100	1000
Methyl acetate	50	20	5	50
Methyl methacrylate	100	20	10	100
Methyl tert-butyl ether (MTBE)	4	4	5	50
Methylcyclohexane	50	20	5	50
Methylene Chloride (Dichloromethane)	5	5	20	200
m&p-Xylene	5	2	5	50
Naphthalene	5	1	5	50
n-Butylbenzene	5	1	5	50
n-Hexane	5	5	5	50
n-Propylbenzene	5	1	5	50

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Analyte	Water (ug/L)	Low-Level Water (ug/L)	Low-Level Soil (ug/kg)	Medium-Level Soil (ug/kg)
o-Xylene	5	1	5	50
Propionitrile	100	100	100	1000
sec-Butylbenzene	5	1	5	50
Styrene	5	1	5	50
tert-Butyl alcohol	50	10	50	500
tert-Butylbenzene	5	1	5	50
Tetrachloroethene	5	1	5	50
Tetrahydrofuran	100	20	100	1000
Toluene	5	1	5	50
trans-1,2-Dichloroethene	5	1	5	50
trans-1,3-Dichloropropene	5	1	5	50
trans-1,4-Dichloro-2-butene	100	100	100	1000
Trichloroethene	5	1	5	50
Trichlorofluoromethane	5	2	5	50
Vinyl acetate	50	20	100	1000
Vinyl chloride	5	1	5	50
Xylene (Total)	10	3	10	100

[1]*Target Compounds and Reporting Limits are subject to change. List may not represent all calibrated compounds.*

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Table 2: Characteristic Ions and Internal Standard Association of Target Compounds[2]

Analyte	Primary Ion	Secondary Ion
Group 1 – Fluorobenzene (IS)	**96**	-
Dichlorodifluoromethane	85	87
Chloromethane (Methyl chloride)	50	52
Vinyl Chloride	62	64
Bromomethane (Methyl bromide)	94	96
Chloroethane	64	66
Trichlorofluoromethane	101	103
Diethyl ether (Ethyl ether)	74	45
Acrolein	56	55
1,1,2-Trichlorotrifluoroethane	101	151
1,1-Dichloroethene	96	61
Acetone	43	58
Iodomethane	142	127
Carbon Disulfide	76	78
Acetonitrile	39	40
Allyl chloride	41	76
Methyl acetate	43	74
Methylene Chloride	84	49
tert-Butyl alcohol	59	41
Acrylonitrile	53	52
Methyl tert-butyl ether	73	57
trans-1,2-Dichloroethene	96	61
n-Hexane	57	55
1,1-Dichloroethane	63	65
Vinyl Acetate	43	86
Chloroprene	53	88
2-Butanone (MEK)	43	72
2,2-Dichloropropane	77	97

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Group 1 – Fluorobenzene (IS) continued	**96**	**-**
cis-1,2-Dichloroethene	96	61
Propionitrile	54	52
Ethyl acetate	88	61
Methacrylonitrile	41	67
Bromochloromethane	49	128
Tetrahydrofuran	42	71
Chloroform	83	85
Dibromofluoromethane (Surr)	113	111
1,1,1-Trichloroethane	97	99
Cyclohexane	56	84
Carbon Tetrachloride	117	119
1,1-Dichloropropene	75	77
Isobutanol (Isobutyl alcohol)	43	41
Benzene	78	52
1,2-Dichloroethane	62	64
Trichloroethene	95	130
Methylcyclohexane	55	69
1,2-Dichloropropane	63	62
Dibromomethane	93	95
1,4-Dioxane (p-Dioxane)	88	58
Methyl methacrylate	69	41
Bromodichloromethane	83	85
Group 2 – Chlorobenzene-d5 (IS)	**117**	**82**
2-Chloroethylvinyl ether	63	65
cis-1,3-Dichloropropene	75	77
4-Methyl-2-pentanone (MIBK)	43	58
Toluene-d8	98	100
Toluene	91	92
trans-1,3-Dichloropropene	75	77
Ethyl Methacrylate	69	99

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Group 2 – Chlorobenzene-d5 (IS) continued	**117**	**82**
1,1,2-Trichloroethane	83	85
Tetrachloroethene	166	168
1,3-Dichloropropane	76	78
2-Hexanone	43	58
Dibromochloromethane (Chlorodibromomethane)	129	127
1,2-Dibromoethane (EDB)	107	109
Chlorobenzene	112	114
1,1,1,2-Tetrachloroethane	131	133
Ethylbenzene	106	91
m&p-Xylene	106	91
o-Xylene	106	91
Styrene	104	78
Isopropylbenzene (Cumene)	105	120
4-Bromofluorobenzene (Surr)	95	174
Bromobenzene	77	156
trans-1,4-Dichloro-2-butene	53	88
Group 3 – 1,4-Dichlorobenzene-d4 (IS)	**152**	**150**
Bromoform	173	175
1,1,2,2-Tetrachloroethane	83	85
1,2,3-Trichloropropane	110	75
n-Propylbenzene	91	120
2-Chlorotoluene	91	126
1,3,5-Trimethylbenzene	105	120
4-Chlorotoluene	126	91
tert-Butylbenzene	119	91
1,2,4-Trimethylbenzene	105	120
sec-Butylbenzene	105	134
1,3-Dichlorobenzene	146	148
p-Isopropyltoluene	119	134
1,4-Dichlorobenzene	146	148

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Group 3 – 1,4-Dichlorobenzene-d4 (IS)	**152**	**150**
n-Butylbenzene	91	92
1,2-Dichlorobenzene	146	148
1,2-Dibromo-3-chloropropane	155	75
1,2,4-Trichlorobenzene	180	182
Hexachlorobutadiene	225	223
Naphthalene	128	127
1,2,3-Trichlorobenzene	180	182
2-Methylnaphthalene	142	141
1-Methylnaphthalene	142	141

[2]*Internal standard association and/or characteristic ions are subject to change.*

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Table 3: Minimum Average Response Factor Criteria

Analyte	Minimum Response Factor (RF)
Dichlorodifluoromethane	0.100
Chloromethane	0.100
Vinyl Chloride	0.100
*Bromomethane	0.05
Chloroethane	0.100
Trichlorofluoromethane	0.100
Methylene Chloride	0.100
1,1-Dichloroethene	0.100
trans-1,2-Dichloroethene	0.100
1,1-Dichloroethane	0.200
cis-1,2-Dichloroethene	0.100
Chloroform	0.200
1,1,1-Trichloroethane	0.100
Cyclohexane	0.100
Carbon Tetrachloride	0.100
Benzene	0.500
1,2-Dichloroethane	0.100
*Trichloroethene	0.100
1,2-Dichloropropane	0.100
Bromodichloromethane	0.200
Toluene	0.400
1,1,2-Trichloroethane	0.100
*Tetrachloroethene	0.100
Dibromochloromethane (Chlorodibromomethane)	0.100
1,2-Dibromoethane (EDB)	0.100
Chlorobenzene	0.500
Ethylbenzene	0.100
m&p-Xylene	0.100

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Analyte	Minimum Response Factor (RF)
o-Xylene	0.300
Styrene	0.300
Bromoform	0.100
Isopropylbenzene (Cumene)	0.100
1,1,2,2-Tetrachloroethane	0.300
1,3-Dichlorobenzene	0.600
1,4-Dichlorobenzene	0.500
1,2-Dichlorobenzene	0.400
1,2,4-Trichlorobenzene	0.200
trans-1,3-Dichloropropene	0.100
cis-1,3-Dichloropropene	0.200
*Acetone	0.010
*2-Butanone (MEK)	0.010
*4-Methyl-2-pentanone (MIBK)	0.050
*2-Hexanone	0.050
Methyl tert-butyl ether	0.100
Carbon Disulfide	0.100
1,2-Dibromo-3-chloropropane	0.050
Methylcyclohexane	0.100
1,1,2-Trichlorotrifluoroethane	0.100
Methyl acetate	0.100

**Alternate minimum average RF criteria based on compound performance.*

Appendix C

Laboratory SOP

ENV-SOP-MAD1-0060 v02

1,4-dioxane by SPME SW-846 8260 SIM-45530-1

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Document Information

Document Number: ENV-SOP-MAD1-0060 **Revision:** 02

Document Title: 1,4-Dioxane by Solid Phase Micro-Extraction (SPME) and GCMS SIM

Department(s): VOA

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All Dates and Times are listed in: Central Time Zone

Signature Manifest

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Title: 1,4-Dioxane by Solid Phase Micro-Extraction (SPME) and GCMS SIM

All dates and times are in Central Time Zone.

ENV-SOP-MAD1-0060

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Patrick Letterer (005125)	Manager - Quality	11 Nov 2021, 03:57:41 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Benjamin Claas (005049)	Manager - Operations	12 Nov 2021, 06:35:56 AM	Approved
Karl Olm (005057)	General Manager 2	16 Nov 2021, 04:48:38 PM	Approved

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TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: 1,4-Dioxane by SPME and GC\MS with Selective Ion Monitoring (SIM)
TEST METHOD See References
ISSUER: Pace ENV – Madison Quality – MAD1

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1 SCOPE AND APPLICATION

1.1 This standard operating procedure (SOP) is based on SW-846 Method 8260 and is used to determine the concentration of 1,4-dioxane in water samples. The target analyte and associated CAS number is provided below with the reporting limit and method detection limit (MDL).

Controlled Compounds	CAS Number	Reporting Limit	MDL
1,4-dioxane	123-91-1	0.20 µg/L	0.057 µg/L

1.2 1,4-Dioxane is a flammable, colorless liquid mainly used as a stabilizer for the solvent 1,1,1-Trichloroethane. In addition, 1,4-dioxane is used in a variety of applications as a solvent and is also found in numerous household products.

1.3 Identification of 1,4-dioxane is accomplished by comparing retention times and the relative abundance of characteristic ions obtained from authentic standards using the MSD in selective ion monitoring (SIM) mode and the isotope dilution internal standard technique.

1.4 The analyst should be a chromatography expert capable of operating and maintaining a GC/MS system, with specific experience with VOC analysis.

2 SUMMARY OF METHOD

2.1 1,4-Dioxane is partitioned to the headspace of a heated water sample contained in a 20 mL headspace vial. The 1,4-dioxane is extracted from the headspace using a coated micro-fiber. The fiber is then inserted into the heated injection port of the GC. Compounds are then desorbed from the fiber onto the narrow-bore capillary column using a splitless injection. The column is temperature programmed to separate organic compounds, which are then detected with a MSD directly interfaced to the GC. The MSD is operated in the SIM mode.

2.2 1,4-Dioxane is analyzed by the isotope dilution technique. 1,4-Dioxane-d8 is the internal standard.

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2.3 1,4-Dioxane identification is facilitated by comparison of retention time and the relative abundance of characteristic ions obtained from authentic standards. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using a calibration curve generated from six levels of calibration standard.

2.4 Solid phase microextraction (SPME) is a fast, solvent-free alternative to conventional sample extraction techniques. In SPME, analytes establish equilibria among the sample matrix, the headspace above the sample, and a polymer-coated fused fiber, then are desorbed from the fiber to a chromatography column. Because analytes are concentrated on the fiber, and are rapidly delivered to the column, minimum detection limits are improved, and resolution is maintained.

2.5 Sodium Chloride (NaCl) is added to each injection to aid in the 'salting out effect'. Salt will enhance the tendency of 1,4-dioxane to escape the water matrix and assist in partitioning to the SPME fiber. While not in excess, the ½ teaspoon added to each 10 mL of sample is enough to achieve this effect, even without being fully dissolved prior to SPME extraction.

3 DEFINITIONS AND ACRONYMS

3.1 There are many terms and acronyms used throughout this document. Check the definitions and acronyms sections of the Pace Quality Systems Manual for complete explanations.

4 INTERFERENCES

4.1 The adsorption efficiency of 1,4-dioxane onto the SPME fiber is affected by the total mass of other non-discrete VOCs in the sample. For example, high levels of petroleum hydrocarbons in the sample can impact the adsorption efficiency of the 1,4-dioxane onto the fiber. A sample's internal standard response less than 50% of the initial calibration response may indicate the presence of competing non-target VOCs onto the fiber. Diluting the sample until achieving an acceptable internal standard recovery is an appropriate method of confirming the original results and thus reporting the original number without qualification.

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4.2 The SPME fiber must not be allowed to remain in contact with ambient air for extended periods between analyzing samples. VOCs in the ambient air could potentially contribute to false positives. Therefore, when the fiber is removed from the heated injection port, the fiber should be immediately inserted into the headspace within the vial containing the water sample.

4.3 Known laboratory contaminant sources are volatile materials and solvents that might be present in ambient laboratory air from nearby point or non-point sources. These ambient contaminants could diffuse into the methanol solvent being used for the method. Special care must be used with often-used laboratory extraction solvents such as dichloromethane, isooctane, and acetone to avoid contamination. Analysis of calibration and reagent blanks provides information about the presence of contaminants.

4.4 When potential interfering peaks or non-target VOCs are noted in method blanks, the analyst should analyze additional blanks to identify the source of contamination and eliminate the problem. Subtracting blank values from sample results is not permitted.

4.5 Carry over may occur when a sample containing high concentrations of 1,4-dioxane is analyzed. Caution should be exercised when interpreting data collected after analysis of a sample containing high concentrations of 1,4-dioxane. This carry over is minimized by leaving the SPME fiber in the heated injection port for a bake out period over ten minutes. It may be necessary to analyze additional blanks after samples containing high levels of 1,4-dioxane.

5 SAFETY

5.1 Employees must abide by the policies and procedures in the Pace Chemical Hygiene / Safety Manual, and this document. Refer to the Chemical Hygiene / Safety Manual for more detailed safety information or for information not listed in this document.

5.2 Eye protection that protects against splash and appropriate gloves must be worn when handling samples, standards, solvents, and reagents. Lab coats are recommended.

5.3 Employees must handle glassware and equipment carefully in order to prevent injury and accidents. Any damaged or broken glassware is to be discarded or moved to the glass repair box.

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5.4 Pace utilizes MSDSonline to provide SDS to employees in an online database that can be easily accessed at any time using Pace Connect. The corporate Safety Manual is available through Master Control®. Any questions or concerns should be taken to the laboratory Safety Officer.

6 APPARATUS AND MATERIALS

Brand names and catalog/part numbers represent materials in use at the time of this revision. Other materials which meet the QC requirements may be substituted.

6.1 GC: HP 5890A equipped with a split/splitless injector and a 30 m x 0.32 mm ID, 1.8 µm film, RTX-624 capillary column

6.2 MSD: HP5972 capable of scanning from 35 to 300 amu every 2 seconds or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The MSD must be capable of successfully completing an autotune and providing mass spectra of 4-bromofluorobenzene (BFB) meeting the criteria in Table 5.

6.3 Autosampler: CTC Combipal equipped with agitator, heating block, and SPME holder assembly.

6.4 SPME Fiber Assembly: 75 µm CAR/PDMS Fused Silica, 24 GA, Supelco #53719.

6.5 SPME Injection Sleeve 0.75 mm ID Supelco #2-6375,05 or Topaz 0.75 mm ID straight/ SPME inlet liner, Restek #23434.

6.6 Computer Hardware: HP Compaq DC7600

6.7 Computer Software

6.7.1 Microsoft Windows 2000 operating system

6.7.2 Microsoft Office 2007

6.8 Promium Element Data System

6.9 Data System: Agilent MSD Productivity ChemStation utilizing Enviroquant data analysis software that allows the continuous acquisition and storage of mass spectra obtained throughout the duration of the gas chromatographic program. Reference mass spectra of all analytes are generated from the analysis of calibration standards.

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6.10 Micro-syringes, gas-tight – 1.0, 10, 25, 100, 250, 500 and 1,000 µL.

6.11 Vials

6.11.1 2 mL GC vials, Part No. 40811A-120 and PTFE/silicone aluminum seals, #5150-11

6.11.2 20 mL headspace vials and caps, Restek #23083 and #23091

6.12 Volumetric flasks, Class A, various volumes

6.13 Helium - grade 5

6.14 Refrigerator capable of maintaining 4 °C

6.15 Freezer capable of maintaining temperatures below -10 °C

6.16 NIST traceable thermometer, capable of measuring liquid at 60 °C

7 REAGENTS AND STANDARDS

7.1 Solvents

7.1.1 Methanol: purge and trap grade; stored apart from other solvents.

7.2 Solid Reagents

7.2.1 Sodium chloride: reagent grade and heated in a muffle furnace at 400 °C overnight prior to use.

7.3 Acids and Bases – none

7.4 Stock Standards

7.4.1 The 1,4-dioxane calibration stock is purchased at a concentration of 1000 µg/mL from Absolute Standards #70373.

7.4.2 The second source is purchased at concentration of 2000 µg/mL from Restek #30287.

7.4.3 The 1,3-dioxane surrogate stock is purchased at a concentration of 1000 µg/mL

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from Absolute Standards #73790.

7.4.4 The 1,4-dioxane-d8 internal standard is purchased at a concentration of 1000 µg/mL from Absolute Standards #71882.

7.4.5 Stock standards may be used up to the expiration date from the provider until the ampoule is broken.

7.4.5.1 Once an ampoule is opened, a stock standard is transferred to a 2 mL GC vial, sealed, and stored in a freezer. The stock standard may then be used for 3 months.

7.5 Intermediate Calibration Standards: There are three levels of intermediate standard prepared at 2.0, 100, and 500 µg/mL.

7.5.1 The 500 µg/mL intermediate standard is prepared in a 2 mL volumetric flask. Add 1000 µL of the 1,4-dioxane stock standard at 1000 µg/mL (7.4.1). Add 1000 µL of the 1,3-dioxane stock surrogate standard at 1000 µg/mL (7.4.3). Transfer to labeled 2 mL GC vials. Assign a three-month expiration on the standard and store in the freezer.

7.5.2 The 100 µg/mL intermediate standard is prepared in a 5 mL volumetric flask. Add 500 µL of the 1,4-dioxane stock standard at 1000 µg/mL (7.4.1). Add 500 µL of the 1,3-dioxane stock standard at 1000 µg/mL (7.4.3). Fill to volume with methanol. Transfer to labeled 2 mL GC vials. Assign a three-month expiration on the standard and store in the freezer.

7.5.3 The 2.0 µg/mL intermediate standard is prepared by transferring 100 µL of the 100 µg/mL intermediate standard (7.5.2) to a 5 mL volumetric flask. Fill to volume with methanol. Transfer to labeled 2 mL GC vials. Assign a three-month expiration on the standard and store in the freezer.

7.6 Working Calibration Standards

7.6.1 Working Calibration Standards are prepared in water by injecting microliter amounts of the intermediate standard solutions (7.5.1, 7.5.2, and 7.5.3) into 10 mL of distilled water contained in a 20 mL headspace vial. Six levels of calibration standard are prepared: 0.2, 0.5, 1.0, 25, 250, and 500 µg/L.

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Table 4 lists the µg/L concentrations of 1,4-dioxane and the 1,3-dioxane surrogate in the six levels of calibration standards.

7.7 Working Surrogate Standard: Prepare the 50 µg/mL working surrogate standard in a 25 mL volumetric flask by adding 1.25 mL of the 1,3-dioxane surrogate stock (7.4.3) and filling to volume with methanol. Transfer to labeled 2 mL GC vials. Assign a three-month expiration on the standard and store in the freezer

7.8 Laboratory Control Sample (LCS) Spike Mix

7.8.1 The LCS spike mix is the 100 µg/mL intermediate standard as prepared in Section 7.5.2.

7.9 MS/MSD Spike Mix

7.9.1 The MS/MSD spike mix is the 100 µg/mL intermediate standard as prepared in Section 7.5.2.

7.10 Limit of Detection (LOD) Spike Mix: The LOD spike mix is the 2.0 µg/mL intermediate standard as prepared in Section 7.5.3.

7.11 Second Source Standard Intermediate: Prepare a second source intermediate standard at a concentration of 100 µg/mL by adding 250 µL of the Restek standard (Section 7.4.2) to a 5 mL volumetric flask and fill to volume with methanol. Transfer to labeled 2 mL GC vials. Assign a three-month expiration on the standard and store in the freezer

7.12 Internal Standard: The internal standard is 1,4-dioxane-d8. The stock solution is purchased from Absolute Standards at 1,000 µg/mL and is Part No. 71882. The stock solution is used directly by adding 2 µL to every injection.

7.13 Tuning Standard

7.13.1 The tuning standard 4-bromoflurobenzene is prepared at 12.5 µg/mL. Add 0.5 mL of the 8260 Surrogate Mix (which contains 4-BFB) from Restek #30073 at 2,500 µg/mL to a 100 mL volumetric containing approximately 70 mL of methanol. Add the stock aliquot below the level of methanol in the flask. Fill to volume with methanol. Transfer to a 40 mL VOA vial and assign a three-month expiration date. Store frozen. This standard is not extracted via the SPME extraction method. Typically, 2 µL of standard are injected directly into the GC

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inlet. Alternatively, prepare a 20 mL headspace vial with ½ teaspoon of NaCl, 10 mL water, and 4 µL of BFB standard. Cap, shake briefly, and place on autosampler for analysis.

8 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

8.1 Water Samples

Glass 40 mL VOA vials with Teflon® lined septa are provided by Pace for water samples. Once samples are received at Pace laboratories, they are stored in a refrigerator at 4 °C. Unpreserved water samples have a hold time of 7 days. VOA vials preserved with HCL are also used. Preserved samples have a hold time of 14 days. If preserved samples are utilized and analyzed between 7 and 14 days since sampling, the pH must be verified to be ≤ 2. If the pH is >2, the sample will be qualified as having insufficient pH preservation.

9 PROCEDURE

9.1 Preparation Method: The Combipal autosampler is programmed to preheat the prepared sample to 60 °C for two minutes, expose the SPME fiber to the sample headspace for 12 minutes, and desorb the contents of the fiber into the GC inlet for 4 minutes. Samples and quality control injections are prepared in an identical manner.

9.1.1 The SPME fiber is conditioned at the beginning of each run by running an empty headspace vial through the above procedure. Any ambient contamination should be driven off during this step.

9.1.2 Calibration Standard Preparation: To a 20 mL headspace vial weigh 10 g of distilled water on a top loading balance. Add 2 µL of the 1,4-dioxane-d8 internal standard (7.12) to the water in the vial. Add 1 µL of the 2.0 µg/mL intermediate standard (7.5.3). Add ½ teaspoon (2-3 g) of sodium chloride and cap the vial. Shake briefly to mix, noting that all of the sodium chloride may not dissolve. This is an example of how to prepare the 0.20 µg/L calibration standard. See Table 3 intermediate standard amounts used for the remaining calibration standards.

9.1.3 Blank Preparation: To a 20 mL headspace vial weigh 10 g of distilled water using a top loading balance. Add 2 µL of the working internal standard solution (7.12) and 2 µL of the working surrogate standard solution (7.7) to the water in the vial. Add ½ teaspoon (2-3 g) of sodium chloride and cap the vial. Shake

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briefly to mix, noting that all of the sodium chloride may not dissolve.

9.1.4 Sample Preparation: To a 20 mL headspace vial weigh 10 g of water sample using a top loading balance. Add 2 µL of the working internal standard solution (7.12) and 2 µL of the working surrogate standard solution (7.7) to the sample in the vial. Add ½ teaspoon (2-3 g) of sodium chloride and cap the vial. Shake briefly to mix, noting that all of the sodium chloride may not dissolve.

9.1.4.1 Sample Dilutions: Weigh an appropriate aliquot of the water sample to a 20 mL headspace vial using a top loading balance. Dilute the sample aliquot in the headspace vial with distilled water so the total weight of water is 10 g. Add 2 µL of the working internal standard solution (7.12) and 2 µL of the working surrogate standard solution (7.7) to the water in the vial. Add ½ teaspoon (2-3 g) of sodium chloride and cap the vial. Shake briefly to mix, noting that all of the sodium chloride may not dissolve.

9.1.5 Laboratory Control Sample Preparation: To a 20 mL headspace vial weigh 10 g of distilled water using a top loading balance. Add 2 µL of the working internal standard solution (7.12) and 2.5 µL of the 100 µg/mL intermediate standard solution (7.5.2) to the water in the vial. Add ½ teaspoon (2-3 g) of sodium chloride and cap the vial. Shake briefly to mix, noting that all of the sodium chloride may not dissolve.

9.1.6 Matrix Spike and Matrix Spike Duplicate Sample Preparation: To a 20 mL headspace vial weigh 10 g of water sample, or an appropriate aliquot of a diluted sample using a top loading balance. If a diluted sample is used, dilute the sample aliquot in the headspace vial with distilled water so the total weight of water in the vial is 10 g. Add 2 µL of the working internal standard solution (7.12) and 2.5 µL of the 100 µg/mL intermediate standard solution (7.5.2) to the sample in the vial. Add ½ teaspoon (2-3 g) of sodium chloride and cap the vial. Shake briefly to mix, noting that all of the sodium chloride may not dissolve.

9.2 Clean-up Methods: Not applicable.

9.3 Instrument Conditions

9.3.1 GC/MS Pump Down: Allow the GC/MS system to stabilize under high vacuum when starting from a vented state. Before analysis, allow at least 4 hours for the MSD to stabilize after pumping down. Initially analyze several solvent blanks to allow the GC column and MSD to stabilize.

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9.3.2 GC Conditions:

Column:	RTX-624, 30 m x 0.32 mm, 1.8 µm film
Injector Temp:	300 °C
Transfer Line Temp:	260 °C
Column Head Pressure:	2 PSI
Column Flow:	1.5 mL/min
Split Flow:	30 mL/min
Split Mode:	Splitless 0.1 min

Oven Temperature Program

Initial Temperature:	45 °C
Initial Hold:	2 minutes
Initial Ramp:	10 °C/ minute
Final 1st Ramp Temperature:	100 °C
2nd Ramp:	22 °C/ minute
Final Temperature:	240 °C
Final Hold:	1.5 minutes

9.3.3 MSD Conditions

Tune:	Maximum sensitivity autotune
EM Voltage:	Set by Autotune
Scan Mode:	Selective ion monitoring (SIM)

9.3.3.1 SIM Scan Parameters

Group	Start Time	Ion	Dwell Time (msec)
1	0.0 min	64	40
		87	40
		88	40
		92	40
		56	40
		61	40

9.4 Preventive Maintenance/Troubleshooting

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9.4.1 The autotune report for the MSD serves as a useful diagnostic tool. It can be used to indicate when maintenance on the MSD is required.

9.4.1.1 Detection of leaks in the GC/MS system: The presence of a base peak at m/z 28 (N_2) that is higher than m/z 69 (base peak of PFTBA) in the tune report indicates the presence of a gross leak in the GC/MS vacuum system. A common source of the leak is a loose transfer line nut sealing the GC capillary column to the MSD transfer line. Tightening this nut often eliminates a leak.

9.4.1.2 Water in the GC/MS system: The presence of a base peak at m/z 18 (H_2O) that is higher than m/z 69 in the tune report indicates excessive water remains in the MSD manifold. The MSD vacuum system does not efficiently remove water and this condition indicates that a longer equilibration time is needed prior to initial calibration.

9.4.1.3 Electron multiplier voltage: An electron multiplier voltage higher than 2,700 in the tune report indicates that the multiplier needs replacement and/or the MSD source needs cleaning.

9.4.1.4 Peak shape/resolution of perfluorotributylamine (PFTBA) calibration peaks: The appearance of the PFTBA peaks (m/z 69, 219, 502) used to calibrate the MSD should be symmetric without any shoulders. Isotope masses of these same peaks (m/z 70, 220, 503) should be present and indicated in the autotune report. Non-symmetric peak shape or the non-detection of isotope masses usually indicates that the MSD source needs to be cleaned.

9.5 Retention Time Windows: The retention time window for extracted ion chromatograms for peak identification is 0.6 minutes wide. The GC/MS software identifies the peak in this window with the relative retention time closest to the actual relative retention time determined from the authentic standard. The window must be 0.6 minutes wide in order for the software's integration algorithm to have sufficient time to accurately calculate baselines as part of peak integration. The relative retention time of target compounds should not vary by more than ± 0.06 minutes when compared to the authentic standard. However, retention times are used, only in part, to qualitatively identify compounds as in conventional GC analysis. Rather, this GC/MS method also utilizes the ratio of the qualifier ions for qualitative identification of target compounds.

9.6 Calibration

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9.6.1 Maximum sensitivity autotune: The GC/MS system is software-tuned by successfully completing a maximum sensitivity autotune. PFTBA is used as the tuning compound. A hardcopy report is generated from the tune (see Figure 1). See Section 9.4.1 for interpretation of the tune report.

9.6.2 The tuning of the MSD is verified by injecting a maximum of 25 ng of 4-bromofluorobenzene (BFB) in full scan mode at the beginning of each sequence and once every 12 hours thereafter. BFB must pass acceptance criteria (see Table 5) prior to continuing with initial calibration or continuing calibration. If BFB fails, common corrections include alternative MSD tuning and/or inlet maintenance.

9.6.3 Calibration Standards

9.6.3.1 Initial calibration (ICAL) curve preparation: Six levels of calibration standards are used in the initial calibration. A low-level standard is prepared at the report limit of 0.20 µg/L. The remaining five standards are prepared at 0.5, 1.0, 25, 250, and 500 µg/L.

9.6.3.2 Section 9.1.2 describes preparation of the low-level calibration standard. See Table 3 for intermediate standard amounts used for the remaining calibration standards. Sections 9.1 and 9.1.1 describe details of the extraction and desorption steps.

9.6.4 Collect the data from each of the calibration standards and tabulate the area response of the quantitation ions against the concentration for each target compound using the internal standard method. Characteristic ions are listed in Table 1. Calculate amount ratios and response ratios for each target compound and at each calibration level relative to the appropriate internal standard.

The amount ratio and response ratios are calculated as follows:

$$Amount\ Ratio = \frac{C(s)}{C(is)} \qquad Response\ Ratio = \frac{A(s)}{A(is)}$$

Where:

A(s) = Peak area of the target compound or surrogate
A(is) = Peak area of the internal standard
C(s) = Concentration of the target compound or surrogate in ng/L

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C(is) = Concentration of the internal standard in ng/L

9.6.4.1 Linear curves are used for target compounds.

9.6.4.2 Plot the response ratio against the amount ratio for each of these target compounds. The curve fit is linear regression with the weight of the inverse of the concentration (1/x). See Section 10.7 for acceptance criteria.

9.6.5 Updating qualifier ion abundances

9.6.5.1 The relative responses of qualifier ions for target compounds are updated through the data system with each initial calibration. The high-level initial calibration standard is used for this purpose. Qualifier ion responses of peaks found in samples are compared to these reference qualifier ion responses for identification. These same qualifier ion ratios are included as a unique window in the Q-edit data analysis menu and can further assist the analyst during data review.

9.6.6 Prepare and analyze the second source standard in the same manner as a calibration standard (see 9.1.2). See Section 10.9 for acceptance criteria.

9.6.7 Continuing calibration verification (CCV): A CCV standard must be injected at the beginning of each sequence, after every ten samples, and at the conclusion of each sequence. The concentration of the CCV is 25 µg/L. Activate the fiber as described in Section 9.1.1. To a 20 mL headspace vial containing 10 g of distilled water, prepare the 25 µg/L CCV by adding 2 µL of the working internal standard (7.12) to the water in the vial. Add 2.5 µL of the 100 µg/mL intermediate standard (7.5.2). Add ½ teaspoon of sodium chloride and cap the vial. Shake briefly to mix, noting that all of the sodium chloride may not dissolve. Follow the procedure outlined in section 9.1 thru 9.1.1. The response for each compound to be quantitated should not exceed a 20 % difference when compared to the theoretical value of the calibration standard. When this criterion is exceeded, inspect the GC/MS system to determine the cause and perform whatever maintenance is necessary before re-calibrating and proceeding with sample analysis. All samples that were injected after the last acceptable CCV should be re-injected, or the data should be qualified in accordance with ENV-SOP-MAD1-0017, Qualification of Data.

$$Percent\ Difference = \frac{R2 - R1}{R1} \times 100$$

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Where: R1 = Theoretical Concentration.
R2 = Calculated Concentration from succeeding analyses.

9.6.8 Qualitative analysis - The qualitative identification of each compound determined by this method is based on retention time, and on comparison of the sample qualifier ion ratios with reference qualifier ion ratios. The reference qualifier ion ratios must be generated using the conditions of the method. Compounds are identified as present when the following criteria are met:

9.6.8.1 The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by the data system is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

9.6.8.2 The relative retention time of the sample component is within ± 0.06 minutes of the relative retention time of the standard component.

9.6.8.3 The relative intensities of the qualifier ions agree within 30 % of the relative intensities of reference qualifier ions. Example: For an ion with an abundance of 50 % in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20 % and 80 %.

9.6.8.4 Once a compound has been identified, the quantitation of that compound will be based on the integrated abundance from the extracted ion current profile of the primary characteristic ion. The concentration in the sample analysis is determined using the linear regression as described in Section 9.6.4. The concentration of the compound is determined on a µg/L basis.

10 QUALITY CONTROL

10.1 Quality control criteria are based upon information found in Method 8260 from EPA publication SW-846. Additional criteria may be found in Method 8000B.

10.2 The mass spectrometer should successfully complete a maximum sensitivity autotune (see Section 9.6.1 and Figure 1) and must complete a passing mass spectrum of 50 ng (or less) of 4-BFB every 12 hours (see Table 5) prior to calibration and sample analysis.

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10.3 An analytical batch consists of 20 or fewer samples. Batch quality control samples should be analyzed with each set with the following frequency:

Blank	-	One per 20 or fewer samples, minimum one per day
LCS	-	One per 20 or fewer samples, minimum one per day
MS/MSD	-	One MS/MSD per 20 or fewer samples, minimum one set per day

10.4 Method blanks consist of a sample of distilled water also used to prepare calibration standards. If target analytes or interferences are present at concentrations that impact the analytical results for samples, the samples (including quality control samples) should be re-analyzed or appropriately qualified in accordance with ENV-SOP-MAD1-0017, Qualification of Data.

10.5 Laboratory Control Samples (LCSs) consist of a sample of distilled water spiked with 1,4-dioxane, prepared and processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. LCS control limits for precision and accuracy are established on a yearly basis through the use of at least 20 data points. If the recovery of 1,4-dioxane is outside control limits, the samples (including quality control samples) should be re-extracted or appropriately qualified in accordance with ENV-SOP-MAD1-0017, Qualification of Data.

10.6 MS/MSD samples consist of actual sample spiked with 1,4-dioxane, prepared and processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. MS/MSD control limits for precision and accuracy are established on at least a yearly basis through the use of at least 20 data points. If the recovery or RPD of 1,4-dioxane is outside control limits, data should be appropriately evaluated for possible re-analysis. If necessary, the data can then be qualified in accordance with ENV-SOP-MAD1-0017, Qualification of Data.

10.7 Initial calibration (ICAL) is performed using the isotope dilution technique by analyzing six levels of calibration standard. The low calibration point is at or below the reporting limit. The high-level standard is the upper end of the calibration curve. A linear model across the calibration range is used to develop the calibration curve. These compounds must meet a linear calibration criterion of correlation coefficient (r^2) of > 0.990. % Relative Error (% RE) must be determined for the lowest and middle concentration calibration points. The lowest calibration point must have a % RE ≤50% from the expected value for each analyte. The middle point must have a % RE ≤30% from the expected value for each analyte. Check all other calibration points for their % RE, gross outliers could indicate a problem with the calibration.

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$$\%RE = \frac{X'_i - X_i}{X_i} \times 100$$

Where X_i = true value for calibration standard
X'_i = measured concentration of calibration standard

10.8 The working calibration curve must be verified on each working day by the injection of one or more CCV standards and every 10 injections thereafter. If the response for 1,4-dioxane varies from the theoretical concentration by more than 20 %, a new calibration curve must be prepared or data appropriately qualified in accordance with ENV-SOP-MAD1-0017, Qualification of Data.

10.9 A second source calibration verification (ICV) standard must be analyzed with every initial calibration. To a 20 mL headspace vial containing 10 g of distilled water, prepare the 25 µg/L ICV by adding 2 µL of the working internal standard (7.12) to the water in the vial. Add 2.5 µL of the 100 µg/mL second source intermediate standard (7.11). Add ½ teaspoon of sodium chloride and cap the vial. Shake briefly to mix, noting that all of the sodium chloride may not dissolve. The response for each compound to be quantitated should not exceed a 20 % difference when compared to the theoretical value of the standard. If an ICV fails, immediate corrective action is required before proceeding with sample analysis. Affected data should be qualified according to ENV-SOP-MAD1-0017, Qualification of Data.

10.10 Internal standard recovery for each injection should be within 50-200 % of the midpoint of the calibration. It is not unusual for samples with high levels of interferences to overwhelm the capacity of the SPME fiber, thereby reducing the fiber's selectivity for the target compound. Built in recovery correction is one of the principal advantages of isotope dilution because the physical and chemical properties of the labeled compound are identical to the native analog. Every effort is made to reach the 50-200 % criteria, but data outside this range cannot be discarded without careful consideration.

11 METHOD PERFORMANCE

11.1 Method Detection Limit (MDL) Study: An MDL study must be conducted per SOP, ENV-SOP-MAD1-0021, Determination of Detection and Quantitation Limits (most current revision) for each matrix per instrument.

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11.2 Demonstration of Capability (DOC): Every analyst who performs this method must first document acceptable accuracy and precision by passing a demonstration of capability study (DOC) per ENV-SOP-MAD1-0023, Demonstration of Capability (DOC) Determinations.

12 CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

12.1 QC exceedances and the related follow-up actions must be documented on the applicable data review checklist contained in ENV-SOP-MAD1-0018, Data Review Procedures. Non-conformances that have a higher level of risk, or are due to a detected trend, a PT sample failure, an audit finding (internal or external), etc., should be documented on a Corrective Action Form (CAF) according to ENV-FRM-MAD1-0085, Corrective and Preventive Actions.

13 WASTE MANAGEMENT / POLLUTION PREVENTION

13.1 All waste will be disposed of in accordance with federal, state, and local regulations. This method has been prepared to minimize the waste produced and the potential for pollution of the environment. All Pace employees shall follow this method and the guidance provided in the Pace Chemical Hygiene / Safety manual.

14 REFERENCES

14.1 Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8260C, SW-846, Test Methods for Evaluating Solid Wastes, Update III Revision 3, December 2006.

14.2 Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8260B, SW-846, Test Methods for Evaluating Solid Wastes, Update III Revision 2, December 1996.

14.3 ASTM D650, Standard Practice for the Solid Phase Micro Extraction (SPME) of Water and its Headspace for the Analysis of Volatile and Semi-Volatile Organic Compounds.

14.4 Air Sampling of VOCs by SPME for Analysis by Capillary GC. Application Note 141. Sigma Aldrich Co. 1998.

14.5 Developing a Quantitative SPME Method, Reporter EU Volume 22, Robert Shirley.

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14.6 Determination of Volatile Organic Compounds (VOCs) Using Tedlar Bag/Solid Phase Micro-extraction/Gas Chromatography/Mass Spectrometry (SPME/GC/MS) in Ambient and Workplace Air. Jae-Hwan Lee et al. Bull. Korean Chem. Soc. 2002, Vol. 23, No. 3.

14.7 Determinative Chromatographic Separations, Method 8000D, SW-846, Test Methods for Evaluating Solid Wastes, Revision 4, July 2014.

15 REVISION HISTORY

Version	Date	Description of Change
00	04/04/2017	Upload of LAM-042 Rev. 1.1 to Master Control
01	04/15/2020	SOP Review
02	10/29/2021	Annual Review

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TABLE 1

ABSOLUTE RETENTION TIME ORDER AND CHARACTERISTIC MASSES (M/Z)

Compound	Absolute RT (min)	Quantitation Ion	Secondary Ion
1,4-dioxane-d8	5.81	64	96
1,4-dioxane	5.86	88	58
1,3-dioxane	5.92	87	59, 57

NOTE: RTX-624, 30 m x 0.32 mm, 1.8 µm

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TABLE 2

STOCK STANDARDS

Description	Solution	Concentration (µg/mL)
Stock Standards		
1,4-dioxane	Absolute #70373	1,000
Internal Standard		
1,4-dioxane-d8	Absolute #71882	1,000
Surrogate Standards		
1,3-dioxane	Absolute #73790	1,000
Second Source Standards		
1,4-dioxane	Restek #30287	2,000

Solvent: Methanol

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TABLE 3

INTERMEDIATE CALIBRATION STANDARDS

Intermediate Description	Stock	Conc. (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc. (µg/mL)
500 µg/mL Standard	Absolute #70373	1,000	1,000	2.0	500
	Absolute #73790	1,000	1,000		500
100 µg/mL Standard	Absolute #70373	1,000	500	5.0	100
	Absolute #73790	1,000	500		
2.0 µg/mL Standard	100 µg/mL Int.	100	100	5.0	2.0

Solvent: Methanol

SECOND SOURCE INTERMEDIATE STANDARD

Description	Stock	Stock Conc. (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc. (µg/mL)
100 µg/mL Second	Restek #30287	2,000	250	5.0	100

Solvent: Methanol

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TABLE 4

INITIAL CALIBRATION

	L-1	L-2	L-3	L-4	L-5	L-6	ICV
Intermediate Standard Conc. (µg/mL)	**2.0**	**2.0**	**2.0**	**100**	**500**	**500**	**100 ICV**
Volume Used (µL)	**1.0**	**2.5**	**5.0**	**2.5**	**5**	**10**	**2.5**
Final Volume (mL)	**10**	**10**	**10**	**10**	**10**	**10**	**10**
Final Concentration Target Analyte (µg/L)							
1,4-dioxane	0.20	0.50	1.0	25	250	500	25
1,3-dioxane	0.20	0.50	1.0	25	250	500	25

All standards made to volume with distilled water, all injections are also fortified with 2 µL of internal standard and ½ teaspoon of NaCl.

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TABLE 5

BFB TUNE CRITERIA

m/z	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	Less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

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TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: 1,4-Dioxane by SPME and GC\MS with Selective Ion Monitoring (SIM)
TEST METHOD See References
ISSUER: Pace ENV – Madison Quality – MAD1

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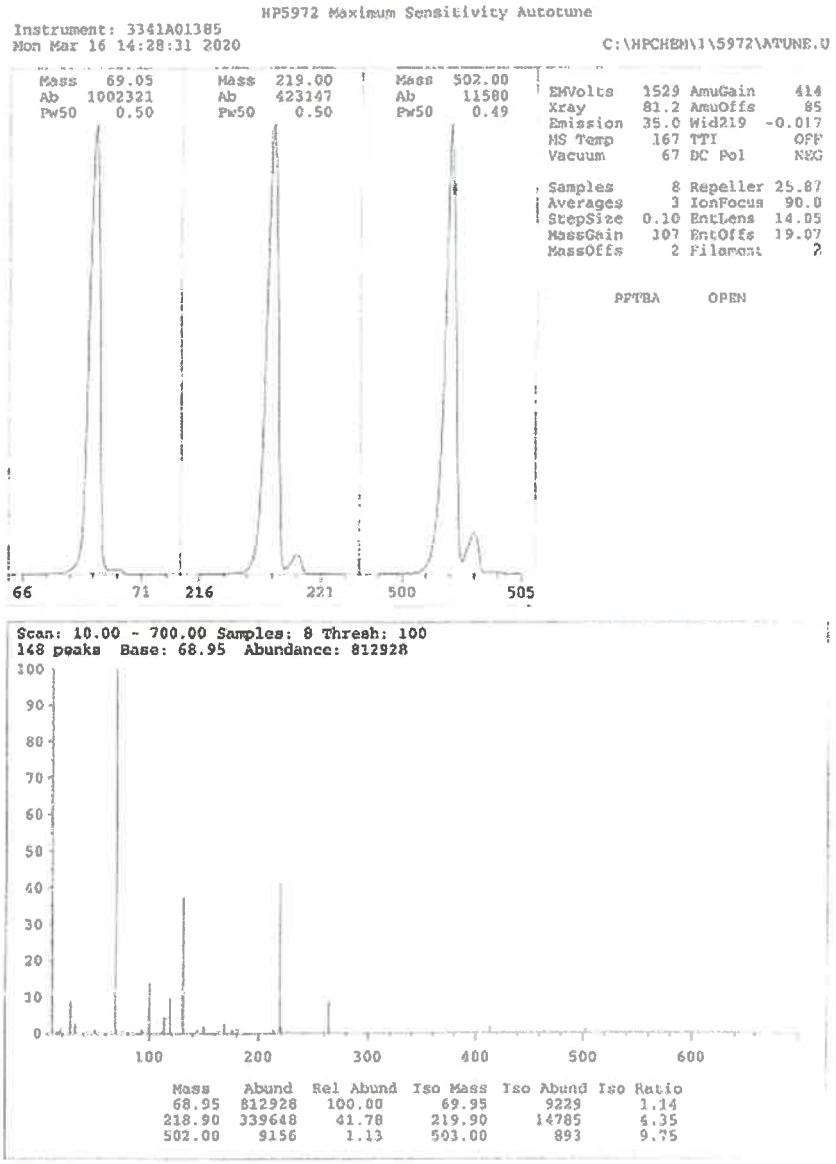
FIGURE 1
MAXIMUM SENSITIVITY AUTOTUNE REPORT



TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: 1,4-Dioxane by SPME and GC\MS with Selective Ion Monitoring (SIM)
TEST METHOD See References
ISSUER: Pace ENV – Madison Quality – MAD1

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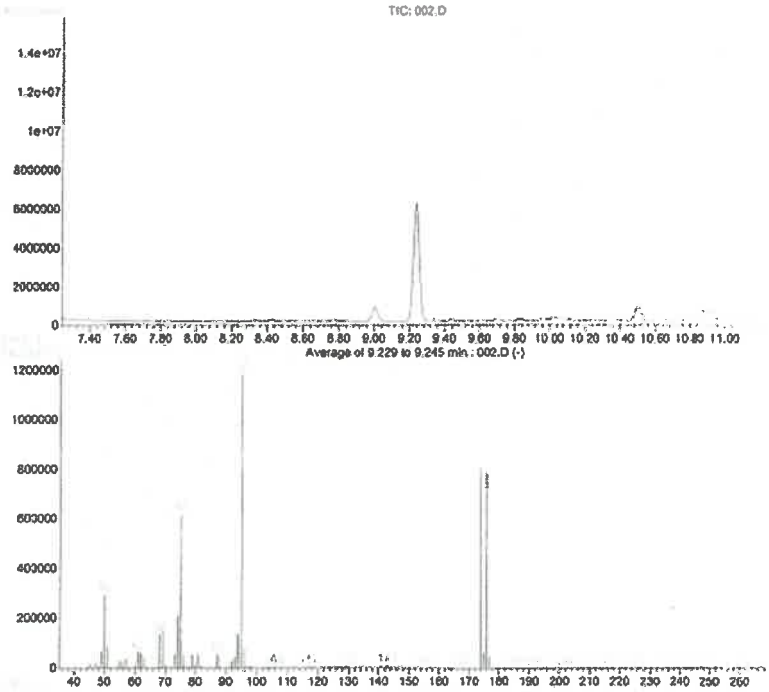
FIGURE 2
BFB TUNE REPORT AND PASSING CRITERIA

BFB

```
Data File : C:\HPCHEM\1\DATA\A0B1801\002.D              Vial: 2
Acq On    : 18 Feb 2020   1:40 pm                    Operator: MH
Sample    : A0B1801-TUN1                             Inst    : 3341A0138
Misc      :                                          Multiplr: 1.00
MS Integration Params: RTEINT.P
Method    : C:\HPCHEM\1\METHODS\QA0C1104.M (RTE Integrator)
Title     : PACE DI SIM
```



AutoFind: Scans 642, 643, 644; Background Corrected with Scan 633

Target Mass	Rel. to Mass	Lower Limit%	Upper Limit%	Rel. Abn%	Raw Abn	Result Pass/Fail
50	95	15	40	25.2	298071	PASS
75	95	30	60	52.1	617007	PASS
95	95	100	100	100.0	1184021	PASS
96	95	5	9	6.5	77395	PASS
173	174	0.00	2	0.0	0	PASS
174	95	50	100	68.4	810005	PASS
175	174	5	9	7.8	63573	PASS
176	174	95	101	96.8	784412	PASS
177	176	5	9	6.5	51028	PASS

002.D QA0C1104.M Mon Mar 16 14:41:04 2020

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: 1,4-Dioxane by SPME and GC\MS with Selective Ion Monitoring (SIM)
TEST METHOD See References
ISSUER: Pace ENV – Madison Quality – MAD1

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FIGURE 3
REPORT AND TOTAL ION CHROMATOGRAM OF A CCV

```
                    Quantitation Report     (Not Reviewed)

Data File : C:\HPCHEM\1\DATA\A0B0401\003.D              Vial: 3
Acq On    :  4 Feb 2020   9:38 am                    Operator: JSF
Sample    : A0B0401-CCV1                             Inst    : 3341A0138
Misc      :                                          Multiplr: 1.00
MS Integration Params: RTEINT.P
 Quant Time: Feb  5  9:12 2020              Quant Results File: QA0A2705.RES

Quant Method : C:\HPCHEM\1...\QA0A2705.M (RTE Integrator)
Title        : 8260 SPME
Last Update  : Tue Jan 28 08:52:32 2020
Response via : Initial Calibration
DataAcq Meth : 14DIOXAN

 Internal Standards                R.T. QIon  Response  Conc Units Dev(Min)
 ------------------------------------------------------------------------
   1) 1,4-Dioxane-d8               6.39   64  1298737   200.00 ug/L    0.00

 System Monitoring Compounds
   3) 1,3-Dioxane                  6.72   87   813169    24.10 ug/L    0.00

 Target Compounds                                                   Qvalue
   2) 1,4-Dioxane                  6.45   88   260592    25.69 ug/L      99


 ------------------------------------------------------------------------
 (#) = qualifier out of range (m) = manual integration
 003.D  QA0C1104.M      Mon Mar 16 14:30:38 2020                      Page 1
```

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: 1,4-Dioxane by SPME and GC\MS with Selective Ion Monitoring (SIM)
TEST METHOD See References
ISSUER: Pace ENV – Madison Quality – MAD1

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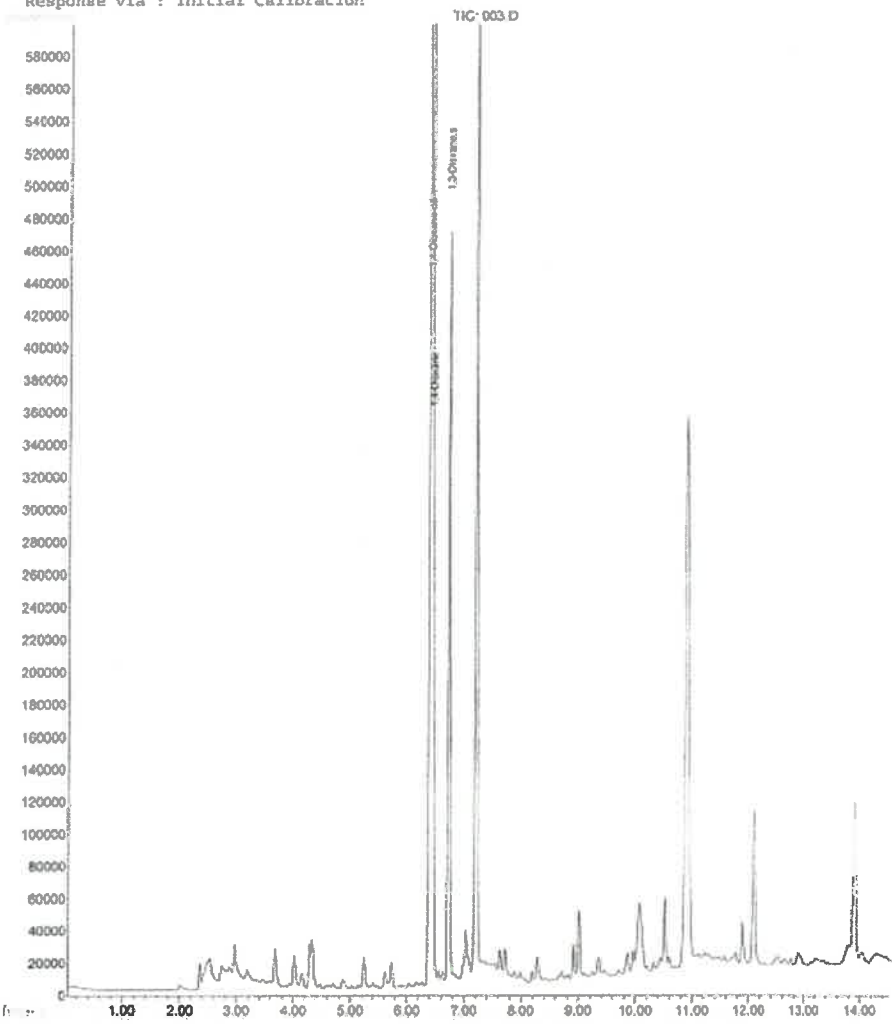
FIGURE 3 (CONT.)
REPORT AND TOTAL ION CHROMATOGRAM OF A CCV

Quantitation Report

```
Data File : C:\HPCHEM\1\DATA\A0B0401\003.D                Vial: 3
Acq On    :  4 Feb 2020   9:38 am                      Operator: JSF
Sample    : A0B0401-CCV1                               Inst    : 3341A0138
Misc      :                                            Multiplr: 1.00
MS Integration Params: RTEINT.P
Quant Time: Feb  5  9:12 2020              Quant Results File: QA0A2705.RES

Method       : C:\HPCHEM\1\METHODS\QA0C1104.M (RTE Integrator)
Title        : PACE DI SIM
Last Update  : Thu Mar 12 08:59:53 2020
Response via : Initial Calibration
```




```
003.D  QA0C1104.M      Mon Mar 16 14:30:39 2020                    Page 2
```

Appendix D

Laboratory SOP

ENV-SOP-IND1-0051-rev.02

Internal Chain of Custody

Pace Analytical®
ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-IND1-0051 **Revision:** 02

Document Title: Internal Chain-of-Custody

Department(s): Client Services

Date Information

Effective Date: 10 Aug 2021

Notes

Document Notes:

All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-IND1-0051 **Revision:** 02
Title: Internal Chain-of-Custody

All dates and times are in Central Time Zone.

ENV-SOP-IND1-0051 Internal Chain-of-Custody

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Elizabeth Schrage (008534)	Manager - Quality	05 Aug 2021, 07:48:42 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Kelly Jones (005070)	Manager	10 Aug 2021, 05:33:52 AM	Approved
Steven Sayer (004775)	General Manager 2	10 Aug 2021, 07:30:08 AM	Approved

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STANDARD OPERATING PROCEDURE
TITLE: INTERNAL CHAIN OF CUSTODY
ISSUER: Pace ENV – Indianapolis – IND1

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures used by the lab to document an internal chain-of-custody. This SOP is only applicable to project samples that require an internal chain-of-custody (ICOC) as outlined in a specific program or contract.

2.0 SUMMARY

For projects **requiring** an official internal chain-of-custody, samples are received as outlined in the Sample Management SOP and are tracked through the lab using the container transfer section of the LIMS system and using the preparation and sequence logbooks used in the various departments. The samples are tracked from receipt until disposal.

3.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

4.0 EQUIPMENT AND SUPPLIES

Item	Description / Comments
LIMS	Horizon EPIC Pro Laboratory Information Management System, or equivalent
Laboratory sequence or preparation logbooks or database	Or equivalent system for documentation of sample preparation and analysis

5.0 PROCEDURE

5.1 Samples are received, logged into the LIMS system and stored according to applicable Sample Management SOP. Project Managers must determine, prior to log-in, which projects require internal chain-of-custody based on project requirements, historical data or as stated on sample receipt documentation. Project Management must clearly communicate using sample comments to the laboratory when a project requires internal chain of custody procedures.

5.2 EPIC Pro's container tracking system allows users to document the location and transfer custody status of each sample container that is logged into the system. The complete sample history can be tracked and documented from receipt to log-in to disposal.

5.3 **Tracking Transfer of Containers**

5.3.1 From the menu bar of EPIC Pro, select 'Samples', then 'Custody', and then 'Transfer'. For all fields, the analyst can use the dropdown menus by selecting F9 or the arrow-down button on the menu bar.

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5.3.2 The 'Transfer Containers' window will open up. This window captures all the information about the transfer. Enter the destination in the 'Destination' field. Enter the name of the person (user) who will receive the sample in the 'Released To' field.

5.3.3 Enter the reason for the transfer in the 'Reason' field.

5.3.4 EPIC Pro will automatically create and enter a chain number in the 'Chain' field when the analyst saves each transfer by clicking on the 'Save' button.

5.3.5 Enter each container that needs to be transferred into the container fields provided in the 'Transfer Containers' window. This can be done by either manually inputting the container ID from the container labels or by scanning the bar code if a bar code reader is available. The analyst must have the cursor in the 'Container ID' field when using the bar scanner.

5.3.6 Once the containers have all been entered in the table, the sub-location can be assigned, if applicable. This would be to further distinguish the samples destination if there are multiple sample storage units at the destination. For example, if there were 5 coolers in the volatile department, the analyst could assign a sub-location as 'Cooler 1'. Multiple sub-locations can be added in a single 'Transfer Containers' window.

5.3.7 Press the 'save' button to complete the transfer of containers.

5.3.8 Perform steps 5.3.1 through 5.3.7 each time the container is transferred from one location to another. For example, from the walk-in cooler to the wet chemistry lab and from the wet chemistry lab back to the walk-in cooler.

5.4 **Tracking Disposal of Containers**

5.4.1 After all preparation and analysis procedures are completed, the analyst can now dispose of each sample container by transferring the sample container to the disposal area.

5.4.1.1 From the menu bar of EPIC Pro, select 'Samples', then 'Custody' and then 'Disposal'.

5.4.1.2 Fill in the information in the 'Container Disposal' window. Enter the disposal type by using the dropdown menu provided by selecting F9 or the arrow-down button on the menu bar. In the 'Reason' field, enter in the reason for disposing of the container.

5.4.1.3 Enter the person transferring the sample to disposal into the 'Disposed by' field. Select 'Sample Disposal Area' in the 'To Location' field.

5.4.1.4 Type or scan in the container ID numbers as in the prior paragraphs. When all fields have been completed, press tab and a window will pop-up asking if you do want to proceed with the disposal of these sample containers. If everything is correct, click on 'Yes'. If information is incorrect for any reason, click on 'Cancel' and proceed accordingly. Clicking on the 'save' button will complete the transfer.

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5.4.2 Personnel from the following departments will be involved in tracking of the original sample containers: sample receiving/disposal, volatiles (GC and GC/MS), inorganic wet chemistry, metals, and organic extractions.

5.4.3 Original samples which are depleted, consumed, or otherwise rendered useless by preparation or analysis should be marked as depleted in Epic Pro.

5.4.4 When organic extractions personnel take sample extracts to the appropriate analysts, the analysts must sign and date the preparation logbook accepting custody of the sample extracts. The sample extracts are then stored in the two applicable analytical areas, the GC semi-volatiles lab and the GC/MS semi-volatiles lab, until disposal.

5.4.5 Sample digestates or leachates from the inorganic wet chemistry lab are also tracked via the sample preparation logbooks. The applicable analyst, metals analyst for metals and mercury digestates; organic extractions personnel for semi-volatile TCLP leachates; volatile personnel for volatile TCLP leachates, must sign and date the applicable preparation logbook thus taking custody of the sample by-products. These sample by-products are stored in the appropriate analytical areas until time of disposal.

6.0 RESPONSIBILITIES

Pace employees that perform any part of this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP. If an employee is unable to follow the procedures in this SOP, they must consult with their supervisor for guidance.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

7.0 ATTACHMENTS

Not applicable to this SOP.

8.0 REFERENCES

8.1 Pace Analytical Quality Manual; latest revision.

8.2 NELAC/TNI Standards; Quality Systems section; 2003, 2009, and 2016.

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STANDARD OPERATING PROCEDURE
TITLE: INTERNAL CHAIN OF CUSTODY
ISSUER: Pace ENV – Indianapolis – IND1

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9.0 REVISION HISTORY

This Version:

Section	Description of Change
All	Converted to new SOP format.
8.2	Added reference to 2016 TNI.

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-IND1-0051	Internal Chain of Custody	01

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Appendix E

Laboratory SOP

ENV-SOP-IND1-0001-rev.02

Sample Management

Pace Analytical®

ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-IND1-0001 **Revision:** 02

Document Title: Sample Management

Department(s): Client Services

Date Information

Effective Date: 21 Aug 2020

Notes

Document Notes:

All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-IND1-0001 **Revision:** 02
Title: Sample Management

All dates and times are in Central Time Zone.

ENV-SOP-IND1-0001 Sample Management

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Elizabeth Schrage (008534)	Manager - Quality	21 Aug 2020, 07:52:35 AM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Steven Sayer (004775)	General Manager 2	21 Aug 2020, 08:20:55 AM	Approved
Kelly Jones (005070)	Manager	21 Aug 2020, 03:45:13 PM	Approved

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STANDARD OPERATING PROCEDURE
TITLE: SAMPLE MANAGEMENT
ISSUER: Pace ENV – Indianapolis – IND1

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to outline the procedures involved with the receipt, login, storage, and disposal of samples received by Pace Analytical Services, LLC Indianapolis.

2.0 SUMMARY

2.1 Samples are delivered to the laboratory via several delivery mechanisms. Samples received are checked for adherence to the Sample Acceptance Policy with any discrepancies noted. Discrepancies are communicated to the client if necessary for their acknowledgement and decision making.

2.2 The Laboratory Information Management System (LIMS) assigns all samples with a unique sample number and manages the analyses assigned to each sample.

2.3 Samples are labeled with the appropriate information and staged in refrigerated sample storage coolers if temperature preservation is required, or possibly stored on open shelves for samples not requiring sub-ambient temperature preservation. Samples will remain under these conditions until prepared and/or analyzed. Samples received under United States Department of Agriculture (USDA) protocols need to be stored separately (please refer to the lab's Regulated Soils SOP, if applicable).

2.4 Samples and associated sub-samples (digestates, extracts, etc.), are maintained for a minimum of 21 days from the date of the final report unless otherwise requested by the client or other regulatory agency.

2.5 Samples are disposed of in accordance with local laboratory regulatory requirements, waste handling procedures, and any USDA regulated soil requirements.

2.6 The policies and procedures contained in this SOP apply to all personnel involved in the receipt, login, storage, shipping, and disposal of samples.

3.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

3.1 **Chain-of-Custody (COC):** a form used to record the field identification of samples collected, analyses requested, date and time of collection, sample preservation used, and traceability of samples from time of collection until delivery to the laboratory. This is a legal document. See example Attachment II.

3.2 **Laboratory Information Management System (LIMS):** a computer system used to manage the flow and traceability of environmental samples and associated data within the laboratory.

3.3 **Matrix:** the bulk characteristics of a sample (e.g water, soil, oil, etc…).

3.4 **Safety Data Sheet (SDS):** contains information on chemicals used in the laboratory.

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3.5 **Sample Acceptance Policy:** a list of requirements, in accordance with regulatory guidelines, describing the conditions that must be met before the lab will accept a sample without qualification. Any deviation from the required conditions must be documented and may require client contact. See Attachment I.

3.6 **Sample Custody:** a sample is considered to be in someone's custody if:

- It is in one's physical possession;
- It is in someone's view, after being in someone's physical possession;
- It is kept in a secured area, restricted to authorized personnel only.

3.7 **Sample Condition Upon Receipt (SCUR) form:** a form used to record the condition of samples received in the laboratory. See example Attachment III.

3.8 **Sample Container Count form:** a form used to record the number, type, and preservative of containers received for each sample received in the laboratory. See example Attachment IV.

3.9 **Sample Receipt Form (SRF):** form generated by LIMS system after a project is logged in. Contains sample and project information.

3.10 **UN Number** - identification numbers preceded by the letters UN are associated with proper shipping names considered appropriate for international and domestic transportation. These shipping names along with the identification numbers are located in the Federal Register (49CFR172.101).

4.0 HEALTH AND SAFETY

The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace Chemical Hygiene / Safety Manual.

Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handling these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol.

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5.0 SAMPLE COLLECTION, PRESERVATION, HOLDING TIME, AND STORAGE

5.1 Acceptable sample preservation, containers, and hold times can be referenced in the Bottle and Preservation Table, available within the Pace Quality Assurance Manual, or as a separate document.

5.2 Sample Storage – See Section 7.7 for general storage guidelines.

5.3 Samples may be prone to cross contamination from others within the same delivery group or from other client projects. The sample receiving personnel must make every effort to minimize cross- contamination.

5.4 Equipment used in the process of performing preservation and chlorine checks must be specific to each sample and may not be used for multiple samples or multiple containers of the same sample in order to prevent cross-contamination.

5.5 Samples are stored under specific conditions and in specific locations, typically per the requirements of the analytical method. However, consideration must be given to samples that are uniquely different from others. Samples that are anticipated to be severely contaminated must be segregated from others in anticipation that the high levels of contaminants may cross-contaminate others in close proximity.

5.6 To avoid contamination, no food or drink products can be located near the areas where samples are unpacked, labeled, or staged.

6.0 EQUIPMENT AND SUPPLIES

Item	Description / Comments
Sample Labels	To label sample containers with laboratory ID
Thermometers	Digital or Infrared, NIST traceable
Sample storage cooling units	Capable of holding required storage temperatures
COC forms	Chain of Custody form
SCUR forms	To document sample condition upon receipt
Sample Container Count forms	To document number/type/preservative of containers received for each sample
pH paper	Wide range, 0-14
Label Printer	For printing sample labels
LIMS computer system	EPIC Pro
FedEx Ship Manager / labels	For shipping coolers and containers
Storage bags / Cooler liners	For organization during subout shipments
Disposable pipets	For checking pH and chlorine of preserved samples, as appropriate

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Item	Description / Comments
Sample containers	For fulfilling bottle kit orders
Residual chlorine strips	Capable of measuring 0.5mg/L of chlorine
Temperature blank	For determining cooler temperature upon receipt

7.0 PROCEDURE

7.1 Sample Delivery and Chain of Custody (COC) Documentation

The laboratory receives client samples via three major methods: commercial delivery service, Pace Analytical courier/field services, and client drop-off.

7.1.1 **Commercial Delivery COC Procedures:** For samples received via commercial carrier or mail delivery, the COC is signed by lab personnel when the cooler or package is opened and processed for login. The delivery date and time is considered the date/time received.

7.1.2 **Courier COC Procedures**: Pace labs use courier services that pick up client samples on either a routine schedule or an as-needed basis as communicated by Project Managers (PMs) or by the client.

7.1.2.1 When the client is present during courier pick-up, the client signs the COC relinquishing custody to the courier. The courier signs the COC as accepting the samples and provides the client with a copy of the COC. When the courier returns to the lab with the client samples, the courier signs the COC as relinquishing the samples to the lab.

7.1.2.2 If the client is not present during courier pick-up, the courier signs the COC as accepting the samples and leaves a copy of the COC for the client. If a client also has a sample log, the courier must sign and date the log when the samples are picked up. When the courier returns to the lab with the client samples, the courier signs the COC as relinquishing the samples to the lab.

7.1.2.3 The date/time the courier relinquishes the cooler to the lab is the official date/time received by the lab.

7.1.2.4 To ensure the sample security, the Pace courier vehicle remains locked when it is unattended.

7.1.2.5 IMPORTANT: Pace Analytical courier/field services personnel must open the sample coolers and verify there is adequate ice in the coolers before transporting or shipping to the laboratory. An exception to this policy would be for coolers already custody-sealed by the client. These coolers are not to be opened except by the laboratory receiving personnel.

7.1.3 **Client Drop-off COC Procedures**: If the client drops off the samples at the laboratory, the client signs the COC relinquishing custody to the lab personnel. The lab personnel signs the COC as accepting the samples. The drop-off date and time is considered the date/time received.

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7.1.4 **Triage:** Sample receiving personnel must review the COC for any evidence of rush turnaround requests, analyses with short hold times (see Attachment V), and/or samples with very little hold time remaining. Projects that fall into these categories must be given immediate attention. The PM responsible for that client must be alerted in the event that they have not already alerted the laboratory to the project, as it is possible that the client did not pre-schedule the project. Once the samples are received and logged into the LIMS, the sample technician and PM will coordinate the notification and delivery of samples to the laboratory.

7.1.5 **Internal Chain-of-Custody:** If a client or program requires internal chain-of-custody (ICOC) procedures, the PM must determine, prior to log-in, which projects require ICOC processing and must clearly communicate the requirement to the laboratory. Refer to ENV-SOP-IND1-0051 *Internal Chain-of-Custody* for detailed information.

7.1.6 **Sample Acceptance Policy** - Copies of the Sample Acceptance Policy must be provided, in the form of a letter, fax, or e-mail to each client or sampler, as necessary. Samples are considered acceptable if they meet the criteria listed in the Sample Acceptance Policy.

7.1.6.1 Some labs may have agreements with clients regarding exceptions to the client contact requirements for sample acceptance policy deviations. If a lab has such agreements, two conditions must be met:

1) the agreement must be a formal document showing client approval;

2) the lab must qualify the final report as appropriate based on applicable regulatory requirements.

7.1.6.2 For Wisconsin Drinking Water samples: Samples that do not meet the criteria in the Sample Acceptance Policy will be rejected by sample receiving. Sample receiving will notify the PM and the client will be notified before proceeding with login. If the client wishes to proceed with analysis, the project manager will retain documentation of the request to proceed.

7.2 Measuring temperature

7.2.1 Thermometers, IR guns, and other equipment used for measuring temperatures must be calibrated according to ENV-SOP-IND1-0086 *Support Equipment*, or its equivalent revision or replacement.

7.2.2 Record the uncorrected (observed) and corrected cooler temperatures on the COC and/or SCUR form. In addition, record the type of "ice" used for packing the cooler (e.g., wet ice, "blue ice", gel packs, etc.).

7.2.3 **Temperature blank:** The preferred method for measuring sample temperature is the use of a temperature blank. Open the cooler and verify the temperature of the samples by taking the temperature of the temperature blank. The temperature of the temperature blank must be determined using a NIST-traceable stick thermometer. Remove the temperature blank bottle from the cooler and place it on the benchtop. Remove the lid of the temperature blank and place the stick thermometer into the bottle. If there is no temperature blank in the cooler, or if the observed temperature of

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the temperature blank is outside of the acceptable range of 0°C to 6°C, proceed to Section 7.2.4.

7.2.4 **Contingency - measuring the temperature of cooler melt water:** If there is no temperature blank in the cooler or if the observed temperature of the temperature blank is outside of the acceptable range of 0°C to 6°C, measure the temperature of visible cooler melt water. The temperature must be determined using a NIST-traceable stick thermometer. Place the stick thermometer into the cooler melt water. If the observed temperature of the visible cooler melt water is outside of the acceptable range of 0°C to 6°C, proceed to Section 7.2.5.

7.2.5 **Contingency - measuring temperature of a centrally located sample container:** If there is no temperature blank in the cooler, if there is no visible cooler melt water, or if the observed temperature of the temperature blank and/or cooler melt water is outside of the acceptable range of 0°C to 6°C, measure the temperature of a representative sample container. A representative sample container will be centrally located within the cooler and be of average size. The temperature must be determined using a NIST-traceable IR gun. Remove the representative sample container from the cooler. While holding the container by the lid, take the container temperature using an IR gun pointed at an opaque surface such as the bottle label. If the observed temperature of the representative sample container is outside of the acceptable range of 0°C to 6°C, proceed to Section 7.2.6.

7.2.6 **Contingency – all measured temperatures are outside of the acceptable range:** If the observed temperature of the temperature blank, cooler melt water, and representative sample container are all outside of the acceptable range of 0°C to 6°C, immediately consult with the Sample Receiving Manager, the Project Manager, or the Customer Service Manager to initiate client notification and the need for additional documentation that may include photos of the cooler condition upon receipt.

7.2.7 **Measuring the temperature of West Virginia samples:** measure the temperature of each sample container using an IR gun as described in Section 7.2.5 and specifically document any container that is outside of the acceptable range of 0°C to 6°C.

7.2.8 If samples within a project are spread over multiple coolers and one or more of the coolers are outside of the temperature criteria, then the contents of the cooler must be itemized and the samples and sample containers affected by the out-of-control temperature condition must be documented on the SCUR form for communication to the client. This itemization must be retained in the project file for future reference.

7.3 Unpacking Coolers

7.3.1 Carefully unpack the cooler and organize the samples, grouped by client sample ID, according to the order on the COC. Review COC against samples to make sure the bottles received match the analysis requested. All anomalies must be recorded on the SCUR form and/or the Sample Container Count form.

7.3.2 Note any discrepancies pertaining to samples as defined by the Sample Acceptance Policy detailed above on the COC, SCUR, or Sample Container Count form, as applicable. Any discrepancies involving temperature, preservation, hold time, collection dates and times, sample volume, sample containers, unclear analysis,

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and/or missing signatures must be reported to project management as soon as possible.

7.3.3 Make a copy of the COC. Give the original COC to login personnel to begin the login process.

7.3.4 The laboratory must be notified when samples are received for short hold analyses listed in Attachment V. Containers for short hold tests are delivered to the appropriate lab as soon as possible.

7.3.5 If a cooler is received at the end of the day and will not be checked in until the next day, the temperature of the cooler must be determined and documented the same day of arrival to the lab. The COC must be evaluated for any short hold analyses or rush requests before the cooler is placed into the walk-in cooler overnight. If there are short hold analyses or rush requests, the lab personnel and/or project manager must be notified.

7.3.6 For USDA regulated soil samples, the cooler and all contents must be decontaminated with a 10% bleach solution and cooler contents requires special handling. Refer to ENV-SOP-IND1-0012 *Regulated Soil Handling* SOP for detailed instructions.

7.3.7 For non-USDA samples, discard any ice or water that remains in the cooler and the packing material used to secure the samples. Water or ice should be discarded down a drain that connects to the local sewer. Packing materials should be placed in the garbage. If a sample container was broken, any broken glass must be safely disposed of and the cooler must be cleaned to remove any sample residue.

7.4 pH Verification

7.4.1 The pH of the sample must be verified on all preserved sample bottles requiring pH preservation, with the following exceptions:

EXCEPTIONS: Samples for these analyses will be checked by the analyst at the bench and *must not be opened by sample management personnel:*

- Coliform
- Volatiles
- Oil and Grease or Hexane Extractable Materials (HEM)
- Any bottle with a septum lid

7.4.2 Open each preserved bottle (except as noted above). Use a new disposable pipet, a stirring rod, or another inert utensil to withdraw a small portion of the sample. Dispense the aliquot onto an unused pH strip and check the pH.

Sample Preservatives	Sample pH Requirement
Hydrochloric Acid (HCl)	pH <2
Nitric Acid (HNO_3)	pH <2
Sulfuric Acid (H_2SO_4)	pH <2
Sodium Hydroxide (NaOH)	pH >10
Zinc Acetate and Sodium Hydroxide (NaOH)	pH >9

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7.4.3 If the pH for a sample container that is supposed to be preserved is not within the required range, indicate the anomaly on the SCUR form, Sample Container Count form, and/or on the COC. Use a red sharpie to mark the container lid with a solid red dot (approximately 6 mm diameter). If all preservation is acceptable, check "Yes" in the appropriate section on the SCUR form. If a sample does not require preservation, write N/A in the applicable section of the SCUR form.

7.4.4 Any pH adjustments will be made by the analytical departments.

7.5 Total Residual Chlorine Verification

7.5.1 Total residual chlorine must be verified at the time of receipt for the analyses in the following table. *Do not check* the sample bottles for those analyses listed in Section 7.4.1.

Analysis
Cyanides SM4500 CN, EPA 335.4, 9012, 9014, OIA 1677
Pesticides/PCBs by EPA 608.3
Semivolatiles by EPA 625.1

7.5.2 Open the appropriate sample container. Use a new disposable pipet, a stirring rod, or other inert utensil to withdraw a small portion of the sample. Dispense the aliquot on an unused residual chlorine test strip.

7.5.3 If any chlorine is detected, regardless of amount, note the information on the COC or SCUR.

7.5.4 Samples submitted for cyanide analysis that test positive for chlorine are taken to the analytical department for treatment. If a sample submitted for 608.3 and/or 625.1 tests positive for chlorine, the lab will be instructed by the PM to qualify the results.

7.6 Sample Login

7.6.1 All samples received by the laboratory must be logged into the LIMS. Rush projects and/or projects with short holds are prioritized into four categories during the triage process:

- Critical A: HT or TAT ≤ 24 hrs
- Critical B: HT or TAT ≤48 hrs
- Critical C: HT or TAT ≤3 days
- Non-Critical: HT or TAT ≥4 days

Critical A projects should be processed first, followed by Critical B, Critical C, then Non-Critical.

7.6.2 Samples must be logged into the LIMS so the samples can be uniquely identified using lab sample identification numbers. These lab sample ID numbers are used to track the prep and analysis activities of the samples, as well as identify the sub-samples, digestates, extracts, and other sample byproducts. This laboratory code maintains an unequivocal link with the unique client field sample ID code assigned to each sample.

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7.6.3 Using the COC and LIMS profile, login the container types, number of containers, matrix, and requested tests. Once saved, LIMS will give the project a workorder number and each sample will be given a sequential sample number. Any special instructions to the lab should be communicated as a comment at the time of login, such as USDA Regulated Soils, OH VAP, or LabTrack ticket number. Once logged in, a Sample Receipt Form (SRF) will be generated by LIMS.

7.6.4 For USDA Regulated soils, the project must be commented in LIMS at the time of login and a LabTrack must be created in the Hazardous Disposal queue to alert the lab to the special handling and disposal requirements of regulated soils.

7.6.5 Cross-check the SRF with the COC and then generate labels for each sample container.

7.6.6 Cross-check the information on the sample container and the sample label and attach the sample label to the appropriate sample container. If there are any discrepancies between the sample containers and the sample labels, make corrections in LIMS, then reprint the SRF and sample labels.

7.6.7 If any samples require analyses performed outside of the laboratory, prepare the samples for subcontracting according to the procedures listed in ENV-SOP-IND1-0005 *Subcontracting Samples*, or equivalent revision or replacement.

7.6.8 SRF Review: The Project Manager, Project Coordinator, or designated Client Services personnel must review and verify the following information by comparing the COC to the SRF. Some of this information may not be provided by the client and those fields should be left blank. Review the following:

- Report Recipient(s);
- Invoice Recipient;
- PO#;
- Project Name;
- Project Number;
- Requested Due Date;
- Sample ID;
- Matrix;
- Collection Date & Time;
- Received Date & Time;
- Analysis: Double check compound lists;
- Comments for special instructions to the lab;
- Check SCUR and Sample Container Count forms for any noted issues;
- Price;
- Region Codes;
- Work Region % Split (for Pace internal subcontracted work).

7.7 Sample Storage

7.7.1 Once unpacked, samples will be logged into the LIMS in a timely manner and returned to appropriate storage conditions as soon as possible. Labs must make every effort to keep samples under the required thermal conditions during the login process. For the

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exceptional case where samples are not logged in the day they were received, they must be stored under appropriate temperature-controlled conditions until login takes place. In all cases, the sample temperatures must be taken as soon after receipt as possible and the samples stored to maintain the required storage conditions while awaiting login or labeling.

7.7.2 Once logged into the LIMS and labeled, samples are placed in the appropriate storage areas. Specific temperature requirements are outlined in the analytical methods, but general guidelines are outlined below:

7.7.2.1 Short hold samples are delivered directly to the laboratory. Once analysis is completed, samples will be stored in the walk-in cooler in sequential order.

7.7.2.2 In order to prevent cross-contamination, samples such as oils, solvents, or other products that could be heavily impacted or have a strong odor should be double-bagged in Ziploc bags and placed in the main walk-in cooler, even if volatiles are requested.

7.7.2.3 Samples to be analyzed in another lab are stored in the temp cooler until they are packed and shipped according to ENV-SOP-IND1-0005 *Subcontracting Samples.*

7.7.2.4 Volatiles

- Aqueous samples are stored by receiving date or by project number in segregated volatiles walk-in cooler. Associated trip blanks are stored with the samples.
- Soil and other solid samples received preserved in methanol are stored by date received or by project number in a segregated volatile walk-in cooler or freezer. Associated trip blanks are stored with the samples when compatible with storage conditions.
- Soil and other solid samples received preserved with a stir bar, or deionized water and a stir bar, are stored by date received or by project number in a segregated volatiles freezer. Associated trip blanks are stored with samples when compatible with storage conditions.
- Soil and other solid samples received in 4oz jars, EnCore sleeves, or similar bulk containers are stored by date received or by project number in a segregated volatile walk-in cooler. If required by client or program, these samples may be sub-sampled and preserved upon receipt.

7.7.2.5 General Chemistry/Semivolatiles—Waters, other liquid samples, soils, and other solid samples are stored by date received or by project number on the shelves in the appropriate sample storage walk-in cooler.

7.7.2.6 Metals Solids and Liquids: These samples are stored by date received or by project number on designated shelving in the laboratory or appropriate designated area. These samples may be stored at ambient temperature unless Mercury or Hexavalent Chromium analysis is needed. If Mercury or Hexavalent Chromium analysis will be performed, the samples are stored by date received or by project number in the appropriate sample storage cooler.

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Samples requiring low level mercury analysis by Method 1631 are taken to the clean room for ambient storage and preservation, as needed.

7.7.2.7 Summa canisters and Tedlar bags are stored on designated shelving at ambient temperature.

7.8 Sample Retention and Disposal

7.8.1 If samples must be returned to customers, the lab must take special care to ensure that the samples are not damaged during any handling, testing, storing, or transporting processes.

7.8.2 Samples may need to be retained longer than the routine sample retention time of 21 days from date of final report. Reasons for this extended sample retention include: customer, program, or contract requirements so that samples can be retained in a secure location that is designated as a long-term storage area. In these cases, the samples are noted in LabTrack, labeled, and segregated by extended hold.

7.8.3 Disposal of unconsumed samples: Refer to the laboratory SOPs regarding waste handling and disposal: ENV-SOP-IND1-0004 *Waste Handling and Management*, ENV-SOP-IND1-0012 *Regulated Soil Handling*, or their revisions or replacements.

7.9 Documentation and Resolution of Discrepancies

7.9.1 All supporting documentation related to sample custody must be retained by the laboratory. This includes: memorandums, fax transmissions, the original COC, all paperwork received with the COC, the completed SCUR and Sample Container Count forms, and copies of email transmissions.

7.9.2 For any sample received at the laboratory that does not meet the sample acceptance, hold time or preservation criteria, the client must be contacted by project management and advised of the situation.

7.9.2.1 If the client instructs the laboratory to proceed with the analysis, all appropriate personnel/departments must be informed and the client approval must be maintained and/or documented on the SCUR or COC. Data will be appropriately qualified.

7.9.2.2 The client may also give instructions to preserve the samples at the laboratory prior to proceeding with analysis. Documentation of these instructions must made on the COC or SCUR and must be noted in the final laboratory report.

7.9.3 The following are examples of client discrepancies that must be documented on the appropriate paperwork (e.g., SCUR and/or Sample Container Count form):

- Lost samples/insufficient sample volume;
- Broken or missing bottles;
- Missing COC;
- Mislabeled bottles;
- Preservation errors/issues;
- VOA vials with headspace >6 mm in diameter
- Missing sample related details (date, time, sample type);

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7.9.4 Discrepancies attributable to errors and omissions on the part of the laboratory will be documented on the SCUR form, COC, or within the project files, and will be addressed and resolved through the formal corrective action process.

8.0 RESPONSIBILITIES

Pace employees that perform any part of this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP. If an employee is unable to follow the procedures in this SOP, they must consult with their supervisor for guidance.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

9.0 ATTACHMENTS

9.1 Attachment I: Sample Acceptance Policy

9.2 Attachment II: Example Chain of Custody

9.3 Attachment III: Example Sample Condition Upon Receipt form

9.4 Attachment IV: Example Sample Container Count form

9.5 Attachment V: Analyses with Short Holding Times

10.0 REFERENCES

10.1 SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, USEPA, current revision.

10.2 Standard Methods for the Examination of Water and Wastewaters, APHA, AWWA, WPCF, current approved edition.

10.3 U.S. Environmental Protection Agency, 1983, Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

10.4 U.S. Environmental Protection Agency, 1988, Methods for Determination of Organic Compounds in Drinking Water, EPA/600/4-88/039, Environmental Monitoring Systems Laboratory, Cincinnati, Ohio.

10.5 Code of Federal Regulations- most recent version.

10.6 Pace Analytical Quality Manual; latest revision.

10.7 NELAC/TNI Standards; Quality Systems section; 2003, 2009, and 2016.

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STANDARD OPERATING PROCEDURE
TITLE: SAMPLE MANAGEMENT
ISSUER: Pace ENV – Indianapolis – IND1

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11.0 REVISION HISTORY

This Version:

Section	Description of Change
All	Converted to new SOP format.
2.4	Updated sample retention period to 21 days from date of final report.
3.0	Added definitions for Sample Acceptance Policy and Sample Container Count form.
6.0	Added Sample Container Count forms, FedEx Manager/Labels, and Storage bags/cooler liners.
7.1	Clarified what date/time is considered the date/time received by the lab. Added reference to ICOC SOP.
7.2	Added reference to Support Equipment SOP, clarified temperature determination procedures.
7.3	Reordered unpacking procedures to match practice and added reference to Regulated Soil Handling SOP.
7.4.2	Updated NaOH pH requirement from >12 to >10 per MUR.
7.5.1	Added OIA 1677 to table.
7.5.4	Updated procedure for checking chlorine upon receipt.
7.6	Added reference to Subcontracting Samples SOP and updated procedures to match practice.
7.7	Updated soil sub-sampling procedures to match practice and added reference to Subcontracting Samples SOP. Added storage requirements for heavily impacted samples.
7.8	Updated sample retention period to 21 days from date of final report and added reference to Waste Handling and Management SOP and Regulated Soil Handling SOP.
7.9	Added references to Sample Container Count form.
9.5	Added Attachment V: Analyses with Short Holding Times
10.7	Added reference to 2016 TNI.
Att. V	Removed unpreserved Sulfide. There is no accommodation for this.

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-IND1-0001	Sample Management	01

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Attachment I: Sample Acceptance Policy

In accordance with regulatory guidelines, Pace Analytical facilities comply with the following sample acceptance policy for all samples received.

If the samples do not meet the sample receipt acceptance criteria outlined below, the Pace facility is required to document all non-compliances, contact the client, and either reject the samples or fully document any decisions to proceed with analyses of samples that do not meet these criteria. Any results reported from samples not meeting these criteria are appropriately communicated to the client.

Sample Acceptance Policy requirements:

1. Sample containers must have unique client identification designations, and dates and times of collection, that are clearly marked with indelible ink on durable, water-resistant labels. The client identifications must match those on the chain-of-custody (COC);
2. There must be clear documentation on the COC, or related documents such as the Sample Condition Upon Receipt (SCUR) form, that lists the unique sample identification, sampling site location (including state; some regulations may require city, county, etc.), date and time of sample collection, and name and signature of the sample collector;
3. There must be clear documentation on the COC, or related documents, that lists the requested analyses, the preservatives used, sample matrix, and any special remarks concerning the samples (i.e., data deliverables, samples are for evidentiary purposes, field filtration, etc.);
4. Samples must be in appropriate sample containers. If the sample containers show signs of damage (i.e., broken or leaking) or if the samples show signs of contamination, the samples will not be processed without prior client approval;
5. Samples must be correctly preserved upon receipt, unless the method requested allows for laboratory preservation. If the samples are received with inadequate preservation, and the samples cannot be preserved by the lab appropriately, the samples will not be processed without prior client approval;
6. Samples must be received within required holding time. Any samples with hold times that are exceeded will not be processed without prior client approval;
7. Samples must be received with sufficient sample volume or weight to proceed with the analytical testing. If insufficient sample volume or weight is received, analysis will not proceed without client approval;
8. All samples that require thermal preservation are considered acceptable if they are received at a temperature within 2°C of the required temperature, or within the method-specified range. For samples with a required temperature of 4°C, samples with a temperature ranging from just above freezing to 6°C are acceptable. Samples that are delivered to the lab on the same day they are collected are considered acceptable if the samples are received on ice. Any samples that are not received at the required temperature will not be processed without prior client approval.
9. For all compliance **drinking water** samples, analyses will be rejected at the time of receipt if they are not received in a secure manner, are received in inappropriate containers, are received outside the required temperature range, are received outside the recognized holding time, are received with inadequate identification on sample containers or COC, or are improperly preserved (with the exception of VOA samples- tested for pH at time of analysis).
10. Some specific clients may require custody seals. **For these clients**, samples or coolers that are not received with the proper custody seals will not be processed without prior client approval.

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STANDARD OPERATING PROCEDURE
TITLE: SAMPLE MANAGEMENT
ISSUER: Pace ENV – Indianapolis – IND1

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Attachment II: Example Chain of Custody Form

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CHAIN-OF-CUSTODY Analytical Request Document

Chain-of-Custody is a LEGAL DOCUMENT - Complete all relevent fields

LAB USE ONLY- Affix Workorder/Login Label Here or List Pace Workorder Number or MTJL Log-in Number Here

ALL SHADED AREAS are for LAB USE ONLY

Company:	Billing Information:
Address:	
Report To:	Email To:
Copy To:	Site Collection Info/Address:
Customer Project Name/Number:	State: County/City: Time Zone Collected: / [ ]PT [ ]MT [ ]CT [ ]ET

Phone: Email:	Site/Facility ID #:	Compliance Monitoring? [ ] Yes [ ] No
Collected By (print):	Purchase Order # : Quote #:	DW PWS ID #: DW Location Code:
Collected By (signature):	Turnaround Date Required:	Immediately Packed on Ice: [ ] Yes [ ] No
Sample Disposal: [ ] Dispose as appropriate [ ] Return [ ] Archive: _____ [ ] Hold	Rush: [ ] Same Day [ ] Next Day [ ] 2 Day [ ] 3 Day [ ] 4 Day [ ] 5 Day (Expedite Charges Apply)	Field Filtered (if applicable): [ ] Yes [ ] No Analysis: _____

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SL), Oil (OL), Wipe (WP), Air (AR), Tissue (TS), Bioassay (B), Vapor (V), Other (OT)

Customer Sample ID	Matrix *	Comp / Grab	Collected (or Composite Start) Date	Collected (or Composite Start) Time	Composite End Date	Composite End Time	Res Cl	# of Ctns

Container Preservative Type **

Lab Project Manager:

** Preservative Types: (1) nitric acid, (2) sulfuric acid, (3) hydrochloric acid, (4) sodium hydroxide, (5) zinc acetate, (6) methanol, (7) sodium bisulfate, (8) sodium thiosulfate, (9) hexane, (A) ascorbic acid, (B) ammonium sulfate, (C) ammonium hydroxide, (D) TSP, (U) Unpreserved, (O) Other _____

Analyses

Lab Profile/Line:

Lab Sample Receipt Checklist:
Custody Seals Present/Intact Y N NA
Custody Signatures Present Y N NA
Collector Signature Present Y N NA
Bottles Intact Y N NA
Correct Bottles Y N NA
Sufficient Volume Y N NA
Samples Received on Ice Y N NA
VOA -Headspace Acceptable Y N NA
USDA Regulated Soils Y N NA
Samples in Holding Time Y N NA
Residual Chlorine Present Y N NA
Cl Strips: _____
Sample pH Acceptable Y N NA
pH Strips: _____
Sulfide Present Y N NA
Lead Acetate Strips: _____

LAB USE ONLY:
Lab Sample # /Comments:

Customer Remarks / Special Conditions / Possible Hazards:	Type of Ice Used: Wet Blue Dry None	SHORT HOLDS PRESENT (<72 hours): Y N N/A	LAB Sample Temperature Info: Temp Blank Received: Y N NA Therm ID #: _____ Cooler Temp Upon Receipt: ___oC Cooler Therm Corr. Factor: ___oC Cooler Corrected Temp: ___oC Comments:
	Packing Material Used:	Lab Tracking #:	
	Radchem sample(s) screened (<500 cpm): Y N NA	Samples received via: FEDEX UPS Client Courier Pace Courier	

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:	MTJL LAB USE ONLY Table #:
Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:	Acctnum: Template: Prelogin:
Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:	PM: PB:

Trip Blank Received: Y N NA
HCL MeOH TSP Other

Non Conformance(s): YES / NO

Page: ____ of: ____

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STANDARD OPERATING PROCEDURE
TITLE: SAMPLE MANAGEMENT
ISSUER: Pace ENV – Indianapolis – IND1

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Attachment III: Example Sample Condition Upon Receipt Form

F-IN-Q-290-rev.19,23Jul2020

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SAMPLE CONDITION UPON RECEIPT FORM

Date/Time and Initials of person examining contents: _____

Courier: ☐ Fed Ex ☐ UPS ☐ Client ☐ Pace ☐ USPS ☐ Other _____

Custody Seal on Cooler/Box Present: ☐ Yes ☐ No (If yes)Seals Intact: ☐ Yes ☐ No (leave blank if no seals were present)

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☐ None ☐ Other _____

Thermometer: 1 2 3 4 5 6 A B C D E F

Ice Type: ☐ Wet ☐ Blue ☐ None

Cooler Temperature: _____
Temp should be above freezing to 6°C (Initial/Corrected)

If temp. is over 6°C or under 0°C, was the PM notified? ☐ Yes ☐ No

All discrepancies will be written out in the comments section below.

	Yes	No		Yes	No	N/A
Are samples from West Virginia? Document any containers out of temp.			All containers needing acid/base pres. Have been CHECKED?: exceptions: VOA, coliform, LLHg, O&G, and any container with a septum cap or preserved with HCl. Circle: HNO3 (<2) H2SO4 (<2) NaOH (>10) NaOH/ZnAc (>9) Any non-conformance to pH recommendations will be noted on the container count form			
USDA Regulated Soils? (HI, ID, NY, WA, OR, CA, NM, TX, OK, AR, LA, TN, AL, MS, NC, SC, GA, FL, or Puerto Rico)						
Short Hold Time Analysis (48 hours or less)? Analysis:			Residual Chlorine Check (SVOC 625 Pest/PCB 608)	Present	Absent	N/A
Time 5035A TC placed in Freezer or Short Holds To Lab	Time:		Residual Chlorine Check (Total/Amenable/Free Cyanide)			
Rush TAT Requested (4 days or less):			Headspace Wisconsin Sulfide?			
Custody Signatures Present?			Headspace in VOA Vials (>6mm):			
Containers Intact?:			Trip Blank Present?			
Sample Label (Ds/Dates/Times) Match COC?: Except TCs, which only require sample ID			Trip Blank Custody Seals?:			
Extra labels on Terracore Vials? (soils only)						

COMMENTS: _____

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Attachment IV: Example Container Count Form

COC PAGE ____ of ____

Sample Container Count

Sample Line Item	WGFU	SBS DI BK Kit R	DG9H VG9H	VOA VIAL (Pre-Pres)	VG9U	DG9U	DG9T	AG0U	AG1H	AG1U	AG3S	AG3C	BP1U	BP1N	BP2U	BP3U	BP3N	BP3F	BP3S	BP3B	BP3Z	CG3H				Matrix	pH <2	pH >9	pH>10
1																													
2																													
3																													
4																													
5																													
6																													
7																													
8																													
9																													
10																													
11																													
12																													

Container Codes

Glass				Plastic / Misc.	
DG9B	40mL Na Bisulfate amber vial	AG0U	100mL unpres amber glass	BG3U	250mL Unpres Clear Glass
DG9H	40mL HCl amber voa vial	AG1H	1L HCl amber glass	BP1A	1L NaOH, Asc Acid plastic
DG9M	40mL MeOH clear vial	AG1S	1L H2SO4 amber glass	BP1N	1L HNO3 plastic
DG9P	40mL TSP amber vial	AG1T	1L Na Thiosulfate amber glass	BP1S	1L H2SO4 plastic
DG9S	40mL H2SO4 amber vial	AG1U	1liter unpres amber glass	BP1U	1L unpreserved plastic
DG9T	40mL Na Thio amber vial	AG2N	500mL HNO3 amber glass	BP1Z	1L NaOH, Zn, Ac
DG9U	40mL unpreserved **amber** vial	AG2S	500mL H2SO4 amber glass	BP2A	500mL NaOH, Asc Acid plastic
VG9H	40mL HCl clear vial	AG2U	500mL unpres amber glass	BP2N	500mL HNO3 plastic
VG9T	40mL Na Thio. clear vial	AG3S	250mL H2SO4 amber glass	BP2O	500mL NaOH plastic
VG9U	40mL unpreserved **clear** vial	AG3U	250mL unpres amber glass	BP2S	500mL H2SO4 plastic
VGFX	40mL w/hexane wipe vial	AG3C	250mL NaOH amber glass	BP2U	500mL unpreserved plastic
VSG	Headspace septa vial & HCl	BG1H	1L HCl clear glass	BP2Z	500mL NaOH, Zn Ac
WGKU	8oz unpreserved clear jar	BG1S	1L H2SO4 clear glass	BP3B	250mL NaOH plastic
WGFU	4oz clear soil jar	BG1T	1L Na Thiosulfate clear glass	BP3N	250mL HNO3 plastic
JGFU	4oz unpreserved amber wide	BG1U	1L unpreserved glass	BP3F	250mL HNO3 plastic (field filtered)
CG3H	250mL clear glass HCl	BG3H	250mL HCl Clear Glass		

BP3U	250mL unpreserved plastic
BP3S	250mL H2SO4 plastic
BP3Z	250mL NaOH, Zn Ac plastic

AF	Air Filter
C	Air Cassettes
R	Terra core kit
SP5T	120mL Coliform Na Thiosulfate
U	Summa Can
ZPLC	Ziploc Bag

WT	Water
SL	Solid
NAL	Non-aqueous liquid
WP	Wipe

F-IN-Q-270-rev.12,11Aug2020

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Attachment V: Analyses with Short Holding Times

Waters

Analyte (Method)	ACODE(S) / Department	Holding Time
Biochemical Oxygen Demand (BOD, CBOD, SM5210B)	5210BW, 5210BWC / Wet Chem	48 Hours
Color (SM2120B)	2120B W / Wet Chem	48 Hours
Hexavalent Chromium (Cr+6, CrVI, Cr6+,7196, SM3500-Cr B)	7196A W, 3500CrDW / Wet Chem **Unpreserved**	24 Hours
Nitrate / Nitrite (NO3, NO2, 353.2, 300.0, 9056)	3532 W / Wet Chem; 3000 S, 3000 W, 9056 S, 9056 W / SVOA	48 Hours
Ortho-Phosphate (O-Phos, PO4, SM4500-P E)	4500PE WO / Wet Chem	48 Hours
Settleable Matter / Solids (SM2540F)	2540F W / Wet Chem	48 Hours
Surfactants (MBAS, SM5540C)	5540C W / Wet Chem	48 Hours
Turbidity (Turb, 180.1)	1801 W / Wet Chem	48 Hours

Solids

Analyte (Method)	ACODE(S) & Department	Holding Time
BP Volatile Soils	8260 S	Subsample within 48 hours
Volatile (8260 Terracore 5035A)	8260E5035A, 8260TCUST	Frozen within 48 Hours of sampling

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Appendix F

Laboratory SOP

ENV-SOP-IND1-0004-rev.01

Waste Handling and Management.

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ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-IND1-0004 **Revision:** 01

Document Title: Waste Handling and Management

Department(s): Waste

Date Information

Effective Date: 13 Apr 2020

Notes

Document Notes:

All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-IND1-0004 **Revision:** 01
Title: Waste Handling and Management

All dates and times are in Central Time Zone.

ENV-SOP-IND1-0004 Waste Handling and Management

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Elizabeth Schrage (008534)	Manager - Quality	03 Apr 2020, 02:43:42 PM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Scott Bryan (003661)	Quality Analyst 3	06 Apr 2020, 12:38:02 PM	Approved
Steven Sayer (004775)	General Manager 2	09 Apr 2020, 07:34:12 AM	Approved
Joshua Kelly (003669)	Client Services Tech 2	13 Apr 2020, 07:12:17 AM	Approved

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1.0 PURPOSE

This standard operating procedure (SOP) describes the documents the systems, processes and procedures that this location uses to manage generated wastes.

2.0 SCOPE AND APPLICATION

The policies and procedures contained in this SOP are applicable to all personnel responsible for all aspects of waste handling and management.

This SOP is applicable to all processes that involve generated waste, and is designed to assist its operations in adhering to regulations set forth in the following federal statutes: Resource Conservation and Recovery Act (RCRA), Clean Water Act (CWA), Toxic Substances Control Act (TSCA), and DOT Title 49, and Transportation (parts 100-199). Particular attention is given to local pretreatment standards covering discharges to publicly owned treatment works (POTW) when performing elementary neutralization on acidic and basic waste. The local standards are based in part upon provisions in the National Pretreatment Standards and Prohibited Discharge Standards.

The degree to which RCRA regulations apply to Pace facilities is dependent upon the generator status of the operation. Under the federal rules there are three different classes of hazardous waste generators based upon the amount of waste generated in a month to month time frame. Refer to Attachment I. State requirements may be more stringent or give the classes a slightly different name.

3.0 SUMMARY

Pace Analytical Services (Pace) acknowledges its obligation to the responsible management of the environment and its resources. Pace senior management is committed to operating in such a way that meets or exceeds the state and federal laws governing waste management and encourages the use of best practices to reduce, reuse and recycle waste material where possible.

It is Pace's policy to minimize the amount of hazardous waste it produces and to reduce the hazardous properties of those wastes whenever practical within regulatory compliance. This can be achieved by periodic auditing of all processes producing hazardous waste; reduction of sample volume delivered by the client; return of excess sample material to clients whenever practical and economical; investigation of new technologies that might require smaller volumes of sample, or produce fewer or less hazardous by-products; implementation of lab cleaning procedures that reduce the volume of cleaning residue; recycling of hazardous materials; and investigation of new treatment technologies that are comprehensively destructive or are effective in reducing the volume or hazardous qualities of the wastes produced.

Pace facilities that generate waste must initially contact the EPA to obtain an ID number. Each unique type of generated waste is classified and characterized into waste streams according to procedures in 40 CFR 261. The amount of waste the facility generates determines the Generator Status of a lab, which in turn determines how long and how much waste can accumulate. Pace is ultimately responsible for the waste it generates, and is required to obey any and all regulations during the process of creating, accumulating, disposing, and releasing waste to a TSDF for final disposal. Documentation is kept to prove all regulations have been obeyed.

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4.0 DEFINITIONS

Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

Acutely Hazardous Waste - A waste which is hazardous as identified with an (H) Hazard Code in the lists of Hazardous Waste in 40 CFR Part 261, Subpart D, Sections 261.30, 261.31 and 261.33.

Animal and Plant Health Inspection Service (APHIS) - an agency of the USDA responsible for protecting animal health, animal welfare, and plant health. APHIS is the lead agency for collaboration with other agencies to protect U.S. agriculture from invasive pests and diseases.

Clean Air Act - The Federal Clean Air Act, 42 U.S.C. 7401, and amendments thereto amending 42 U.S.C. 1857 et.seq.

Confined Space – A space that is large enough and so configured that an employee can bodily enter and perform assigned work; and has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and is not designed for continuous employee occupancy.

Container - Any device material is stored, transported, treated, disposed of, or otherwise handled.

Contingency Plan - A document setting out an organized, planned, and coordinated course of action to be followed in case of fire, explosion, or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment.

Designated Hazardous Waste Storage Area - Area used to hold hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere. This is the storage area into which hazardous waste from the laboratory (e.g., satellite waste) is moved.

DOT - The United States Department of Transportation.

DTSC – Department of Toxic Substances Control.

Elementary Neutralization Unit – A device which: (1) is used for neutralizing wastes which are hazardous only because they exhibit the corrosivity characteristic defined in 40 CFR 261.22 or are listed in Subpart D of Part 261; and (2) meets the definition of tank, container, transport vehicle, or vessel in 40 CFR 260.10.

EPA - The United States Environmental Protection Agency.

EPA Hazardous Waste Number - The EPA number assigned to each EPA hazardous waste identified in 40 CFR Part 260, Subpart D - Lists of Hazardous Wastes.

EPA Identification Number - The site-specific number assigned to each generator, transporter, and TSDF upon approval of a notification form.

Federal Clean Water Act - 33 U.S.C. 1251, et. Seq.

Foreseeable Emergency - Any fire, explosion, or sudden or non-sudden release of hazardous waste or hazardous waste constituents to the air, soil, or surface water, which could threaten human health or the environment.

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Generator - Any person, by site who owns or operates a facility where hazardous waste is generated, i.e. Pace.

Hazardous Waste Coordinator - The Pace employee responsible for creating, guiding, and implementing all hazardous waste management operations.

Hazardous Waste - As defined in 40 CFR Part 261, Subparts B and C, a solid, semi-solid, liquid or contained gaseous waste, or any combination of these wastes.

Which, because of either quantity, concentration, physical, chemical, or infectious characteristics may:

- Cause or contribute to an increase in mortality or an increase in irreversible or incapacitating reversible illness; or
- Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise mismanaged.
- Or which has been identified as having a characteristic of hazardous waste by the EPA using the criteria established under 40 CFR Part 261, Subpart C, or as listed under Sections 261.31, 261.32, 261.33, and 261.34. Such wastes include, but are not limited to, those which are reactive, toxic, corrosive, ignitable, irritants, strong sensitizers or which generate pressure through decomposition, heat or other means. Such wastes do not include radioactive substances that are regulated by the Atomic Energy Act of 1954, as amended. A waste is considered hazardous if it is listed or it fits into one of four categories. These categories are as follows:
    - Ignitable – (40 CFR 261.21, Waste Code D001) A flash point of less than 60°C/140°F.
    - Corrosive – (40 CFR 261.22, D002) A pH of less than 2.0 or greater than 12.5.
    - Reactive – (40 CFR 261.23, Waste Code D003) Reactive wastes exhibit one or more of the following characteristics:
        - It is unstable and can undergo a violent change without detonating.
        - It can react violently with water.
        - When mixed with water it can generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.
        - It is cyanide or sulfide bearing waste that, when exposed to pH conditions between 2.0 and 12.5, can generate gases, vapors, or fumes that can present a danger to human health or the environment.
        - It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.
        - It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

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- It is a forbidden explosive as defined in 49 CFR 173.51, or a Class A explosive as defined in 49 CFR 173.53, or a Class B explosive as defined in 49 CFR 173.88.

- Toxic – (40 CFR 261.24, Waste Codes D004-D043) A solid waste that contains a toxic concentration of a contaminant listed in 40 CFR 261.24, Table 1. A toxic waste is given any and all D-codes that apply to the particular material.

Hazardous Waste Constituent - A substance, compound, or element listed as hazardous waste in EPA 40 CFR 261.

Lab Pack Material - A hazardous waste that does not match a listed Pace waste stream category.

Large Quantity Generator (LQG) - Any generator who generates at a rate greater than 1000 kilograms of hazardous waste per month.

Manifest - As defined in 40 CFR Part 262, Subpart B, namely "the form used for identifying the origin, quantity composition, routing and destination of hazardous waste".

Plant Protection and Quarantine (PPQ) – A program within APHIS which attempts to safeguard agriculture and natural resources in the U.S. against the entry, establishment, and spread of animal and plant pests and noxious weeds.

Regulated Soil – Soil from foreign countries, U.S. territories and areas within states that are under Federal quarantine that can be moved into or through continental U.S. only if conditions and safeguards prescribed by the USDA and APHIS are met.

Sample - Any solid material/waste, water, soil, or air that is collected for the sole purpose of being tested to determine its characteristics or composition.

Samples are not subject to any requirements of 40 CFR Part 261.5 or Parts 262 through 267 or Part 270 or Part 124 or to the notification requirements of Section 3010 of RCRA, when:

- The sample is being transported to a laboratory for the purpose of testing; or
- The sample is being transported back to the sample collector after testing; or
- The sample is being stored by the sample collector before transport to a laboratory for testing; or
- The sample is being stored in a laboratory before testing; or
- The sample is being stored in a laboratory after testing but before it is returned to the sample collector; or
- The sample is being stored temporarily in the laboratory after testing for a specific purpose (for example, until conclusion of a court case or enforcement action where further testing of the sample may be necessary).

In order to qualify for the exemption above, a sample collector shipping samples to a laboratory and a laboratory returning samples to a sample collector must:

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- Comply with U.S. Department of Transportation (DOT), U.S. Postal Service (USPS), or any other applicable shipping requirements; or
- Comply with the following requirements if the sample collector determines that DOT, USPS, or other shipping requirements do not apply to the shipment of the sample:
    - Assure that the following information accompanies the sample:
        - The sample collector's name, mailing address, and phone number;
        - The laboratory's name, mailing address, and phone number;
        - The quantity of the sample;
        - The date of shipment; and
        - A description of the sample.
    - Package the sample so that it does not leak, spill, or vaporize from its packaging.
    - This exemption does not apply if the laboratory determines that the waste is hazardous but the laboratory is no longer meeting any of the conditions stated

Satellite Waste or Laboratory Satellite Waste - Hazardous waste generated by Pace that is at or near any point of generation and under the control of the operator. Satellite accumulation provisions allow generators to accumulate up to 55 gallons of hazardous waste (or 1 quart of acute hazardous waste) in containers without starting the storage clock as described in Section 3.4.

Satellite Waste Container - Any portable device used to accumulate laboratory generated waste prior to transfer to the hazardous waste storage area.

Small Quantity Generator (SQG) - A generator who produces no more than 1000 kilograms of hazardous waste (or a total of 1000 kilograms of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or any acute hazardous waste) in a calendar month. The total amount of hazardous waste which may be accumulated on-site is 6000 kilograms.

TSDF - A Treatment/Storage/Disposal Facility.

Universal Waste – any hazardous wastes that are subject to universal waste requirements. The federal universal wastes include Batteries as described in §273.2; Pesticides as described in §273.3; Mercury-containing equipment as described in §273.4; Lamps as described in §273.5; and Aerosol cans as described in §273.6. State or local regulations may allow for additional universal waste designations.

Very Small Quantity Generator - A generator who produces no more than 100 kilograms of hazardous waste or one kilogram of acutely hazardous waste (or a total of 100 kilograms of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or any acute hazardous waste) in a calendar month. The total amount of hazardous waste which may be accumulated on-site is 1000 kilograms.

Waste Stream - The generic profile of chemical and physical properties that satellite wastes exhibit.

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5.0 PROCEDURE

5.1 Generator's US EPA Identification Number

All Pace facilities that generate hazardous waste must have a Generator's US EPA Identification Number. The ID number is obtained through the applicable state or EPA region's office by completing EPA form 8700-12, and must be completed before generating any hazardous waste. A new ID number is necessary when changing locations as the number is tied to the facility address. Pace only utilizes transporters and treatment, storage, or disposal facilities (TSDFs) that have EPA identification numbers for hazardous waste handling and meet the TSDF transfer requirements.

The Pace Analytical - Indianapolis US EPA Identification Number is IND984874206.

5.2 Generator Status

Hazardous Waste Generator Class	Quantity of Hazardous Waste Generated per Month	Generated Monthly Acute Hazardous Waste	Maximum Allowable Hazardous Waste Quantity on-site	Maximum Permitted Waste Accumulation Time
Very Small Quantity	<100kg	<1 kg	<1000kg	Unlimited
Small Quantity	100-1000kg	<1 kg	<6000kg	180 days (270 days if the waste must be sent >200 miles to TSDF)
Large Quantity	>1000kg	>1kg	Unlimited	90 days

Table 5.1 - Waste Generator Class Limits (federal categories, some operations may have different Hazardous Waste Generator Class names):

Based on Table 5.1, Pace Analytical – Indianapolis is classified as a Small Quantity Generator.

5.3 Hazardous Waste Characterization and Classification

Hazardous waste classification is the most critical step in establishing an effective, compliant waste-handling program. Laboratory wastes are classified using the criteria set forth under RCRA for ascertaining non-hazardous versus hazardous status, and this criterion is listed in the definition of hazardous waste in Section 4.0.

The laboratory generates wastes originating from several source types: materials and chemicals used to prepare and analyze samples (e.g., solvents, acids), unconsumed liquid and solid samples, certain types of batteries, automobile waste, and mercury from lamps and broken thermometers. Unconsumed samples may include laboratory-contaminated sample residue (both liquid and solid) generated as part of digestion, extraction, etc., procedures used to prepare samples for analysis.

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The following sections describe the waste streams resulting from materials and chemicals used in the laboratory operation. Applicable information for each is given pertaining to packing, labeling, or listing on a manifest. A description of how the wastes are created, and the preferred method of final disposal for each, is included. The overriding principle in hazardous waste classification is application of a conservative formula based on all known or suspected hazards related to a waste material.

5.3.1 Corrosive Waste

Corrosive waste is generated in the majority of the departments in the laboratory. This waste stream consists primarily of spent or excess aqueous reagent solutions generated from preservatives, acid digestions of metals, impinger solutions or other corrosive solutions generated in the course of analysis. The predominant corrosives include hydrochloric acid, nitric acid, and sulfuric acid, but corrosives also include bases. Varying concentrations of metals may be present dependent upon the composition of the reagents added. This waste stream only has the hazardous quality of being corrosive; therefore, if a waste has any additional hazardous waste quality (e.g., Toxic or Ignitable) it cannot be mixed with this stream. This stream is most commonly treated onsite by neutralization.

Corrosive Waste	
DOT Shipping Name	N/A
EPA Waste Code(s)	D002
Average pH	<2.0, >12.5
Disposal Method	Treatment onsite by neutralization
Label	Corrosive

5.3.2 Methylene Chloride / Chlorinated Solvent Waste

The Methylene Chloride Waste Stream consists primarily of methylene chloride with a very small amount of other organic solvents derived from extraction procedures performed on samples and from rinsing glassware. As a best practice, effort is made to have this waste stream as pure as possible in order to offer for recycling.

Chlorinated Solvents	
DOT Shipping Name	UN1593, Waste Dichloromethane
EPA Waste Code(s)	D001, F002, F003
Average pH	7.0
Disposal Method	Fuel blending by licensed waste handler
Label	Toxic, Chlorinated

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5.3.3 Lab Solvent / Methylene Chloride Vials

Lab solvent / methylene chloride vials is specific waste that results from semivolatile organics analysis. This waste comes from used and expired vials of sample extract and vials of analytical standards. This stream includes small volumes of methylene chloride, hexane, and other lab solvents in glass vials with plastic or aluminum lids/closures.

Chlorinated Solvents	
DOT Shipping Name	UN1593, Waste Dichloromethane
EPA Waste Code(s)	D001, F002, F003
Average pH	N/A
Disposal Method	Incineration by licensed waste handler
Label	Toxic, Chlorinated

5.3.4 COD Waste

COD Waste is specific waste that results from COD analysis. This waste comes from used and expired COD vials of samples and reagent. This stream has sulfuric acid, mercuric sulfate, potassium dichromate, and silver sulfate.

COD Waste	
DOT Shipping Name	UN2922, Waste Corrosive Liquids, Toxic
EPA Waste Code(s)	D002, D007, D009, D011
Average pH	<2
Disposal Method	Metals recovery by licensed waste handler
Label	Corrosive, Toxic

5.3.5 PCB Waste

PCB Waste is specific waste that results from PCB analysis. This waste is generated from the preparation of standard solutions used for PCB analysis and may include pipets, vials and other disposable glassware that is contaminated with PCBs. Environmental samples containing 50ppm or more of PCBs are included in this waste stream for transport by a licensed waste hauler and disposal by incineration at a specially-licensed incineration facility.

PCB Waste	
DOT Shipping Name	UN3432, Polychlorinated Biphenyls
EPA Waste Code(s)	N/A
Average pH	N/A
Disposal Method	Incineration by licensed waste handler
Label	PCB Waste

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5.3.6 Methanol Waste

Methanol Waste is specific waste that results from the analysis of soils for VOCs. This waste comes from soil samples that are preserved in the vial with methanol and the waste stream will include glass vials with plastic lids along with the soil and methanol.

Methanol Waste	
DOT Shipping Name	UN1230, Waste Methanol
EPA Waste Code(s)	F003
Average pH	N/A
Disposal Method	Incineration by licensed waste handler
Label	Methanol Waste

5.3.7 Miscellaneous Lab Waste

Miscellaneous Lab Waste is generated as a result of expired reagents and chemicals, and hazardous samples that cannot be included in another waste stream. This would include waste such as heavy metals waste, solid and aqueous flammable waste, toxic waste and oils. This waste is lab-packed for disposal by a licensed waste handler.

5.4 Declared Hazardous Wastes

Some waste can become complicated when attempting to classify as non-hazardous or hazardous due to the list of hazardous constituents contained in sections 40 CFR 261.30-261.35 including a majority of analytes of interest routinely analyzed in Pace laboratories. Definitions have been established for each of the F, K, P, and U lists covering hazardous waste originating from non-specific sources, specific sources and discarded commercial chemical products, off-specification species, container residues, and spill residues. The application of listed hazardous wastes and substances is intended for manufacturing processes involving pure products, by-products, wastes generated as part of the production process and cleanup of materials contaminated from a spill of the listed commercial chemical product or manufacturing chemical intermediate. See Attachment II for common F-listed wastes.

Hazardous waste classification of unconsumed samples by listed hazardous waste criteria is not commonly applied in laboratory operations. Examples of sample types which would be identified as hazardous wastes include the following:

- Samples containing 5% or more (by volume) of halogenated and non-halogenated "spent solvents:" (e.g., drum sample with > 10% TCE);
- Pure product and two phase solution samples containing a listed chemical product or manufacturing intermediate (e.g., drum sample) or an unknown sample that appears to be oil or oily material;
- Samples representing any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water of any commercial chemical product or manufacturing chemical intermediate having a generic name listed in section 261.33, or any residue or contaminated soil, water or other debris resulting from the cleanup of a spill, into or on any land or water, of any off-specification chemical product and manufacturing chemical

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intermediate which, if it met specifications, would have the generic name listed in section 261.33.

5.5 Sample Disposal

For the samples listed in 5.4, disposal can be achieved by individually lab packing them or combining with other compatible hazardous wastes. However, it is important to note that in order for the laboratory to ascertain that the samples were derived from a specific listed source or from a spill of a listed chemical, they must be so informed by the industrial concern or lead agency (e.g., EPA, state regulators) submitting the sample for analysis. If a water or soil sample contains a listed hazardous waste substance whose origin is unknown or uncertain to the lead agency, then that sample is not classified as a listed hazardous waste. In this case, determination of a hazardous waste classification can only be obtained by the waste exhibiting a characteristic of hazardous waste (e.g., ignitability, corrosivity, reactivity).

Due to the fact that the majority of samples analyzed by Pace do not meet the well-defined criteria for identifying "listed" hazardous waste, disposal classification of unconsumed samples and sample by-products (digestates, extracts, etc.) will be based upon characteristics of hazardous waste:

- Non-Hazardous - Analysis results indicate an absence of contaminants; unless contaminants listed under the hazardous disposal categories are required to perform the requested sample analysis and are contained in sample by-products.
- Hazardous – Analysis results indicate presence of contaminants (Attachment III). Samples in this category are segregated from others and disposed of as hazardous according to laboratory procedures.
- PCB Waste - Generated exclusively by samples contaminated with greater than trace levels of polychlorinated biphenyls ($\geq$ 50ppm). Samples containing 50ppm (total) or higher of PCBs must be segregated and disposed of as PCB waste.
- Waste Oil/Paint - Samples which are predominantly an oil matrix (e.g., highly viscous organic liquid) or paint (solvent and pigment blend) are segregated and disposed in a separate container. Though these samples are defined as nonhazardous, oil samples are a special case and are never disposed as non-hazardous. Note: Bottle caps and liners do not typically contain sample residuals and can be disposed of directly through the non-hazardous building refuse.

USDA-APHIS-PPQ Regulated Soils (Regulated Soils) are a special case of sample strictly controlled under quarantine regulations 7 CFR 330, 331, and 318-330 because they can readily provide a pathway for a variety of dangerous organisms throughout the United States. The movement of soil into the United States from foreign sources and from certain regulated areas within the continental U.S. is restricted unless permitted by APHIS under specific conditions and safeguards.

Any laboratory that handles Regulated Soils must have an approved Compliance Agreement from USDA-APHIS-PPQ, and labs that handle foreign soils must have an approved Permit to Receive Soil. Refer to SOP ENV-SOP-IND1-0012 Regulated Soil Handling or its replacement.

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5.6 Consolidation of Wastes

Consolidation of wastes from the laboratory proceeds via two distinct routes covering either laboratory-generated hazardous wastes or excess unconsumed samples.

5.6.1 Laboratory Accumulation and Satellite Accumulation Areas/Containers

Waste materials from routine lab procedures are collected in containers of appropriate construction, placed in convenient locations near the point of waste generation. Under RCRA guidelines, these are defined as satellite containers.

The amount of hazardous waste stored in the laboratory within the individual satellite areas cannot exceed 55 gallons (liquid) or 550 lbs. (solid) per waste stream, for non-acute hazardous waste.

Satellite waste containers must be labeled in accordance with all regulations, including:

- Designation of the contents as hazardous waste with the words "Hazardous Waste" clearly legible.
- The waste stream description (e.g., acid waste).
- A hazard communication label (e.g., corrosive).

The satellite containers must be maintained such that evolution of chemical vapors is minimized or eliminated. This requires that the container be closed at all times, except when adding or emptying hazardous waste to and from the container.

The most critical point in the waste handling system is when a person (e.g., analyst, technician) places a waste material into a satellite container. Here, the characteristics or listing of the waste and the waste stream must both be known to match. For this reason, only material from approved procedures should be placed in the compatible satellite containers. All materials from experimental procedures, unknown or out of the ordinary sources, or from spill cleanups must be characterized and described to the Hazardous Waste Coordinator, who determines the proper method of disposal.

Full satellite containers must be transferred to the proper accumulation drum within 3 calendar days. Lab collection containers must not be filled to the top of the opening. Space must be left to prevent splashing of hazardous material when containers are emptied and to allow for expansion and contraction within the drum during transport.

Satellite containers for liquid hazardous waste must have secondary containment made of material that could successfully contain the entire satellite container's contents.

5.6.2 Storage of Unconsumed Samples

Client samples are stored on-site for a defined period of time after the final analytical report is generated and prior to sample disposal. The purpose of sample storage is to provide the client time to review the analytical report and determine if the samples require additional testing or need to be returned to the client. Samples are not considered a waste during this time according to 40 CFR 261.4(d)(1)(vi).

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The default sample storage time is 21 days from the date of the final report. Other sample storage hold times may be assigned based on specific contractual requirements.

During sample storage, the sample status must be obvious to employees, customers and auditors through signage posted on storage racks – Refer to Attachment VII for examples of signage. This transparency is imperative to ensure samples are considered active test specimens to be retained until they are categorized as a waste for disposal.

5.6.3 Disposal of Unconsumed Hazardous Samples

Hazardous samples which cannot be returned to the client for disposal are characterized according to section 5.5. Samples are handled as follows:

- Analytical results are evaluated against characterization criteria established for the sample waste stream. The samples which exhibit hazardous waste characteristics as previously outlined are segregated and denoted per laboratory/facility policies. A LabTrack ticket is created and then forwarded to the Hazardous Waste Coordinator, who in turn uses the information to coordinate removal of unconsumed samples from active sample storage by the receiving staff.
- The Hazardous Waste Coordinator prints the LabTrack ticket and assigns a client services technician in receiving the task of labeling the sample containers. The number, type and storage locations for the containers are determined from Epic Pro or the COC. An orange dot sticker indicating the hazard (e.g. Mercury) is affixed to the top of each container. Non-aqueous liquid samples that are not determined to be hazardous are labeled as Oil/Liquid Non-Hazardous.
- When sample storage areas and/or walk-in coolers are cleared of samples ready for disposal, any samples with orange dot stickers or Oil/Liquid Non-Hazardous labels are placed on a shelf in the disposal area intended for lab-packing. Lab-pack is performed periodically throughout each year by a licensed waste handler.
- Samples containing PCBs ≥50 ppm and USDA regulated soils/by-products are disposed of in the PCB waste drum located in the organic prep lab after they have been retained for greater than 21 days after the final report has been issued or other applicable sample retention period.
- Dilute corrosive solutions (e.g., preserved metals samples) which do not exhibit any hazardous characteristics other than being corrosive, may be neutralized using the

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procedure in Section 5.8. Elementary neutralization is exempt from RCRA permitting requirements for on-site hazardous waste treatment. While exempt under RCRA guidelines, before utilizing this practice to reduce off-site treatment or disposal of wastes, local pretreatment and discharge standards must be met for publicly owned treatment works (POTW).

5.7 Disposal of Unconsumed Non-Hazardous Samples

- Non-hazardous soil/solid samples are placed into the trash compactor in their original container, destined for incineration.
- Non-hazardous, neutral pH, aqueous samples are disposed by pouring down the drain while flushing with clean water. Dispose of the empty container in the trash compactor for incineration.

5.8 Elementary Neutralization

Dilute corrosive solutions (e.g., preserved samples for metals or cyanide analysis) which do not exhibit any hazardous characteristics other than being corrosive, may be neutralized. Elementary neutralization is exempt from RCRA permitting requirements for on-site hazardous waste treatment. While exempt under RCRA guidelines, before utilizing this practice to reduce off-site treatment or disposal of wastes, local pretreatment and discharge standards must be met for publicly owned treatment works (POTW).

The discharges listed below are prohibited under the National Pretreatment Standards and Prohibited Discharge Standards:

- Pollutants causing fire or explosion (waste with a flashpoint < 60 °C);
- Solid or viscous pollutants that could potentially block the system;
- Oxygen-demanding pollutants;
- Wastes which generate toxic gases.

5.8.1 Dilute corrosive/acidic samples are neutralized as follows:

- Aqueous samples in glass containers are passed through the glass crusher. The water is pumped from the drum to a neutralization tank. Refer to Section 6.0 for instructions in the operation of waste disposal equipment.
- Aqueous samples in plastic containers are poured from the container into a neutralization tank.
- As needed, Sodium Hydroxide solution is added while stirring to adjust pH to between 6 and 8. Check pH using a pH strip.
- Once the pH is within the pH 6-8 range, open the discharge valve from the neutralization tank and allow neutralized liquid to flow down the drain while flushing with clean water.

5.8.2 Dilute caustic/basic samples are neutralized as follows:

- Aqueous samples in plastic containers are poured from the container into a neutralization tank.

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- As needed, Hydrochloric Acid solution is added while stirring to adjust pH to between 6 and 8. Check pH using a pH strip.
- Once the pH is within the pH 6-8 range, open the discharge valve from the neutralization tank and allow neutralized liquid to flow down the drain while flushing with clean water.

5.9 Transferring Satellite Waste to the Waste Storage/Accumulation Area

All transfers of satellite waste to waste drums must be made by the Hazardous Waste Coordinator or designated, trained personnel. When a satellite waste container is full, the Hazardous Waste Coordinator, or designee must be notified. Regular disposal events may be scheduled to dispose satellite waste on a continuous basis. When transferring hazardous waste:

- Find the correct accumulation container by referring to the Hazardous Waste placard, hazard label, and internal symbol/color combination. If an employee is not certain the waste profile from the satellite and accumulation container are the same, they must stop and ask the Hazardous Waste Coordinator for more information. Mixing solvents that are not compatible may result in a reaction or a more hazardous waste mixture.
- Ensure there is enough capacity in the drum to hold the content to be added.
- Check to make sure there is a ground connection before opening a solvent waste drum.
- Open and slowly pour the contents of the satellite container into the proper waste drum using an appropriate solvent resistant funnel.
- Close the container, by securing the lid on the funnel or drum, or replace the cap on the bunghole and carefully screw the cap on but do not tighten the cap.

5.10 Waste Storage Container Requirements

Drums in the hazardous waste storage area are labeled consistent with both DOT and EPA regulations concerning hazardous materials and wastes (see Attachment IV for example of label).

Closure instructions must be available for all containers used to transport hazardous materials. If a container in the accumulation area is the same one the waste will be shipped away in, the Waste Coordinator must obtain the closure instructions from the provider of the containers.

Labels must be easily visible and legible (e.g., a drum must not be labeled and then placed in such a way that the label cannot be seen).

The Accumulation Start Date must be recorded on the drum. The date should reflect the first time waste was added to the drum and not the date when the waste was generated in the laboratory.

- Once a waste is removed from the point of generation to a hazardous waste staging area, the clock is started for storage time prior to disposal.
- Drums must be picked up by TSDF for disposal before accumulation time exceeds RCRA requirement for lab's generator status (see Table 5.1).

The hazardous waste staging room must be arranged in such a fashion to assure direct access pathways in the event of foreseeable emergency and for safe waste transfer. A minimum aisle space of three feet must be maintained at all times to access hazardous waste containers.

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All hazardous waste drums and containers must be securely closed when not in use. All volatile and flammable hazardous waste liquid containers must be securely grounded at all times. Drums containing these liquids should also be manipulated with non-sparking tools and fitted with a drum venting bung, to assure that excess pressure build-ups are safely released.

All liquid waste stream containers must be provided with secondary containment devices. Such containment devices must be made of materials compatible with each waste, and they must be free of leaks.

- The waste storage room may act as secondary containment as long as the room has been constructed to safely and effectively contain a hazardous waste spill.
- Secondary containers must exceed the total volume of the largest container stored in each containment device for indoor storage.

Compatibility of wastes must be considered in arranging storage areas. For example, acid waste should never be stored adjacent to basic waste, particularly cyanide wastes. Further examples are outlined in 40 CFR 264, Appendix V.

The hazardous waste staging area is controlled with signage and a latched gate restricting access to unauthorized personnel.

The maximum volume of acutely hazardous waste (e.g., P-listed wastes) that can be accumulated in the laboratory is one quart. The volumetric measurement of one quart is based upon container size in which the waste is stored and not the actual amount (volume) of waste present. An example of how this one-quart limit can inadvertently be exceeded involves the disposal of a neat standard of 2,4-dinitrophenol into a one-gallon bottle. While the neat standard itself may only constitute 1-2mL, the volume as defined under RCRA would be one gallon, thus the laboratory would be out of compliance.

5.11 Waste Inspections

The central accumulation staging room must have a documented inspection weekly. Satellite Accumulation Areas must have documented monthly. Refer to Attachments V and VI for example inspection forms. The inspections should ensure all regulations are obeyed; see sections 5.6.1 and 5.10 for accumulation storage and satellite rules.

A record of the inspections must be kept for at least 3 years in an inspection log or summary

Records must be maintained for at least three years from the date of inspection. At a minimum, the records must indicate:

- The date of the inspection;
- The name and signature of the inspector
- A notation of the observations made (can be in a check-off format, e.g., fire extinguisher: charged X_ requires recharging __);
- The date and nature of any repairs or other remedial actions.

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5.12 Waste Documentation and Reporting

5.12.1 The following hazardous waste records must be maintained a minimum of five years and should be retained indefinitely:

- Sample Reports;
- Sample disposal information and waste records;
- Analytical records relating to sample waste stream profiling and characterization;
- Labpack inventory logs;
- Annual Reports, Biennial Reports, Exception Reports, or other reports filed for compliance reasons;
- Records related to unresolved enforcement action must be retained indefinitely until such a time that the matter is resolved;
- Facility Certificates of Destruction or Recycling.

A Waste Manifest is the documentation form that must accompany all shipments of hazardous waste while in transit.

Hazardous Waste manifests are to be signed and dated by a DOT trained Pace employee responsible for the shipment and the transporter. The transporter will leave at least one copy of these "two-signature page" manifests.

Within 35 days the waste generator will receive a three-signature page (generator, transporter, facility) showing the waste reached its intended destination. The Waste Coordinator is responsible for collecting, organizing, and filing all waste manifests. If you do not receive the three signature page within 35 days of shipment, call the waste handler to find out why you have not received it.

All manifests must be kept for a minimum of three years.

5.12.2 Annual Hazardous Waste Generator Reports

Hazardous Waste Generators in Indiana must file an annual report with the Indiana Department of Environmental Management (IDEM). The report must be submitted by March 1st each year and is submitted via the Biennial Report Module within the Industry Application of RCRAinfo. The report summarizes hazardous wastestreams generated for the previous year and includes the following information for each wastestream:

1. Description of the hazardous waste
2. Applicable EPA Hazardous Waste Code(s)
3. Quantity generated
4. Facility to which the waste was shipped
5. Management method code (incineration, fuel blending, etc.)

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5.13 Equipment and Supplies

The following equipment is mandatory under RCRA guidelines unless otherwise denoted. Periodic review (not to exceed monthly) of availability of equipment and supplies below should be conducted to maintain an adequate and viable supply.

Chemical Spill Control Neutralizers: The waste room stores three types of bulk dry spill neutralizers: solvent, acid and base. They may be utilized by placing the dry neutralizer onto a liquid chemical spill. Neutralization is indicated by a prevalent color change.

Communication Device: Required for emergency notification of spill, fire, etc.

Drums: Common types of waste drums used for storing and shipping hazardous wastes are polyethylene, steel-polyethylene lined, and steel. Sizes are typically 5 gal, 15 gal, 30 gal, and 55 gal. Drums used for liquids typically are closed top with an opening to pour the solvent through a funnel, while drums used for solids or lab packs are open-top. The UN rating for all containers must be suitable if the waste is to be transported under DOT regulations.

Emergency Drench Shower: Shower should deliver water approximately twenty gallons per minute with a non-interruptible flow. It may be turned on by pulling the shower handle down. It may be turned off by pushing the handle back to the 'off' position.

Emergency Lighting (as needed): The waste room is outfitted with emergency lighting that goes on if power fails.

Exit Signs (as needed): Exit signs are provided on all waste room doors. These signs are self-illuminating.

Fire Alarm Pull Station/Evacuation Alarm: A fire alarm pull station must be in close proximity to the hazardous waste room. The alarm may be activated by pulling the switch. Other alarm systems may be utilized as long as all personnel are trained on the procedures and the process can effectively notify facility employees of an emergency.

Fire Extinguisher: An extinguisher with a rating appropriate to the waste being stored in the area must be in close proximity to the hazardous waste room.

Labels: A multitude of labels are provided to ensure compliant labeling. They may be purchased, prepared manually, or may be provided by the licensed waste handler.

Liquid Chemical Neutralizers: Liquid chemical neutralizers (base and acid) may be used to neutralize a contained hazardous liquid. This may be done by slowly adding the neutralizer to the liquid starting at the outside of the spill and circling inward.

Spill Control Pads: Spill pads are used to soak up hazardous liquids. They do not neutralize spills. They are especially effective for cleaning up oily materials. Various pads are available for aqueous and petroleum based liquids.

Spill Control Pillows: Spill pillows may be used to soak up large amounts of liquid chemical spills. No neutralization occurs.

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Spill Dikes: vary depending on the size and type of room: Their purpose is to encircle a spill, barring the spread of a hazardous chemical. They will also absorb liquids, but do not neutralize spills.

6.0 Operation of Waste Disposal Equipment

6.1 Specific Safety Warnings

6.1.1 Failure to connect the proper voltages to the equipment may result in personal injury or equipment damage.

6.1.2 Failure to follow installation instructions may result in personal injury or equipment damage.

6.1.3 Do not place solid foreign articles such as wood or metal into the glass crusher as they could cause it to malfunction.

6.1.4 Eye protection and hearing protection must be worn at all times when operating waste disposal equipment.

6.1.5 Never wear loose fitting clothing, such as neckties, necklaces or scarves when operating waste disposal equipment. Gloves should be worn at all times when operating waste disposal equipment.

6.1.6 Always keep work area clean. Spills and/or debris on the floor may cause someone to fall against equipment causing personal injury or equipment damage.

6.2 Glass Crusher Operation

6.2.1 When placing the glass crusher onto the 55-gallon drum, make sure the drum is stable and level. The drum should be free of defects or holes to insure proper fitting of the crusher. The area chosen for the location of the crusher must allow for airflow around the equipment as well as clearance for the feeding of containers into the machine.

6.2.2 The crusher is located in the waste disposal area under a ventilation hood. The unit requires a 115 volt AC receptacle. No lubrication of the equipment is required.

6.2.3 The chamber of the glass crusher can be cleaned with water and soap but care must be taken not to put water directly on the electrical controls and the machine should be unplugged before cleaning.

6.2.4 To operate, attach the crusher to the drum and plug in the cord. Turn on the motor's power switch and feed waste material into the feeder. If rubber flaps become worn or torn, they should be replaced.

6.3 Trash Compactor Operation

6.3.1 NOTE: Always stay clear of all moving parts of the compactor.

6.3.2 Carefully raise the overhead door.

6.3.3 Open the safety gate and carefully place waste into the receiving compartment of the compactor. Lighter waste items can be added over the top of the safety gate without opening it.

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6.3.4 Do not overfill the receiving compartment.

6.3.5 Ensure that the safety gate is closed and securely latched prior to activating the compactor ram.

6.3.6 Press the green Start button to activate the compactor. The unit will make one complete cycle and then stop. Repeat the cycle if necessary.

6.3.7 Press the red Stop button to stop the compactor ram in mid-cycle. Press the black Reverse button to reverse the ram.

6.3.8 Close and lock the overhead door when compactor is not in use.

6.3.9 Container is removed for incineration of the contents once per month by Republic Services. Do not allow compactor pressure gauge to exceed 1400 psi because this means that the container is too full. Contact Republic Services for container removal/disposal or service of the compactor mechanism.

7.0 RESPONSIBILITIES

Pace employees that perform any part of this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP. If an employee is unable to follow the procedures in this SOP, they must consult with their supervisor for guidance.

Pace supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

8.0 ATTACHMENTS

Attachment I: RCRA Requirements for Labs as a Function of Generator Status

Attachment II: Hazard Codes for Common F-List Wastes (solvents)

Attachment III: TCLP Contaminant List with Concentration Limits

Attachment IV: Hazardous Waste Label for Accumulation Drum (example)

Attachment V: Satellite Container Inspection Form (example)

Attachment VI: Waste Accumulation Room Inspection Form (example)

Attachment VII: Sample Storage Signs (example)

9.0 REFERENCES

Pace Chemical Hygiene/Safety Manual-most current version.

Pace Quality Assurance Manual- most current version.

National Environmental Laboratory Accreditation Conference (NELAC) Standard- most current version.

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The NELAC Institute (TNI) Standard- most current version applicable to each lab.

Department of Defense (DoD) Quality Systems Manual- most current version.

10.0 REVISION HISTORY

This Version:

Section	Description of Change
All	Update to new SOP Template
All	Pace Indianapolis adoption of COR-HSE-0003 00 Waste Handling and Management Template
5.0	Added Pace Indianapolis EPA ID number and generator status.
5.3	Added Pace Indianapolis details and waste streams.
5.5	Added sample by-products and reference to Regulated Soil SOP.
5.6/5.7/5.8	Updated for Pace Indianapolis procedures.
5.12.2	Updated for Pace Indianapolis procedures.
6.0	Added section for Operation of Waste Disposal Equipment

This document supersedes the following document(s):

Document Number	Title	Version
ENV-SOP-IND1-0004	Waste Handling and Management	00

Pace Analytical®

PROCESS STANDARD OPERATING PROCEDURE
TITLE: WASTE HANDLING AND MANAGEMENT
ISSUER: Pace ENV – Indianapolis – IND1

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Attachment I: RCRA Requirements for Labs as a Function of Generator Status

Requirement (40CFR)	CESQG	SQG	LQG
Waste Determination (262.11)	Applicable	Applicable	Applicable
Generation Rate Limits (261.5 and 262.34)	<100 kg/mo	100-1,000 kg/mo	1,000 kg/mo or greater
Accumulation Quantity Limit w/o Permit (261.5 and 262.34)	Not to exceed 1,000 kg at any time. Not to exceed 1 kg acute at any time	not to exceed 6,000 kg at any time	No limit
Accumulation Time (261.5 and 262.34)	No limit	180 days or 270 if waste is to be transported over 200 miles.	90 days
EPA ID Number (262.12)	Not required***; possible state requirement	Required	Required
Mark Containers with Start Date (262.34)	Not applicable	Applicable	Applicable
Mark Containers "Hazardous Waste" (262.34(a))	Not applicable	Applicable	Applicable
Air Emission Standards 40 CFR 265 Subpart CC	Not applicable	Not applicable	Applicable
Satellite Accumulation (262.34(c))	Not applicable	Applicable	Applicable
Use Manifests (262, Subpart B)	Not required; possible state requirement	Required	Required
Exception Reporting (262.42)	Not required	Required after 60 days. No TSDF notification requirement.	Required after 45 days. Notification of TSDF within 35 days.
Biennial Report (262.41)	Not required	Not required; possible state requirement	Required
Contingency Plan (265, Subpart D)	Not required, but OSHA (29 CFR 1910.38) requires emergency planning	Basic planning required in accordance with the standards in 262.34(d)(4) and (5) and 265, Subpart C as well as OSHA regulations	Full written plan in accordance with 265 Subpart D, is required by 262.34(a)(4) and OSHA regulations
RCRA Personnel Training (262.34 and 265.16)	Not required, but recommended	Basic training required by 262.34(d)(5)(iii)	Full compliance with the training requirements in 265.16 is required by 262.34(a)(4)
Storage Requirements (without permit) (262.34 and 265)	None, but OSHA regulations under 29 CFR 1910, Subparts H and N, apply, particularly 29 CFR 1910.106	Compliance with technical standards in Part 265, Subparts I and J; for containers and tanks is required by 262.34(d)(2) and (3) and OSHA regulations	Compliance with technical standards in Part 265, Subparts I, J, W, and DD, is required by 262.34(a)(1) and OSHA regulations

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Requirement (40CFR)	CESQG	SQG	LQG
Recordkeeping Requirements (262.40)	Waste determinations and generation log required (notification of regulated waste activity, training records, manifests, and land disposal restriction notifications recommended)	Notification of regulated waste activity, waste determinations, generation log, manifests, land disposal restriction notifications, exception reports, and correspondence with local emergency responders (written contingency plan, weekly container inspection & periodic equipment maintenance logs, and RCRA training records recommended)	Notification of regulated waste activity, waste determinations, generation log, manifests, land disposal restriction notifications, exception reports, biennial reports, correspondence with local emergency responders, RCRA training records, and written contingency plan required (weekly container inspection is required & periodic equipment maintenance logs is recommended)
Waste "Designated Facility"	State-approved or RCRA permitted facility or legitimate recycler	RCRA-permitted facility or legitimate recycler	RCRA-permitted facility or legitimate recycler
Land Disposal Restrictions (268.7)	Possible state requirement	Applicable	Applicable

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Attachment II: Common F-Listed Solvents

Waste Name	Hazardous Waste Code(s)	Waste Name	Hazardous Waste Code(s)
Acetone	F003	Methylene Chloride	F002
Benzene	F005	Methyl ethyl ketone (MEK)	F005
iso-Butanol	F005	Methyl isobutyl ketone	F003
n-Butyl alcohol	F003	Nitrobenzene	F004
Carbon Disulfide	F005	2-Nitropropane	F005
Carbon Tetrachloride	F001	Orthodichlorobenzene	F002
Chlorobenzene	F002	Pyridine	F005
Chlorinated fluorocarbons (CFC)s	F001	Tetrachloroethylene	F002
Cresols	F004	Toluene	F005
Cresylic acid	F004	1,1,1-Trichloroethane	F002
Cyclohexanone	F003	1,1,2-Trichloeoethane	F002
2-Ethoxyethanol	F005	1,1,2-Trichloro-1,2,2-trifluoroethane	F002
Ethyl acetate	F003	Trichloroethylene	F002
Ethyl benzene	F003	Trichloroflourormethane	F002
Ethyl ether	F003	Xylene	F003
Methanol	F003		

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Attachment III: TCLP Contaminant List

Waste Code	Contaminant	Regulated Level (mg/L)
D004	Arsenic	5.0
D005	Barium	100.0
D006	Cadmium	1.0
D007	Chromium	5.0
D008	Lead	5.0
D009	Mercury	0.2
D010	Selenium	1.0
D011	Silver	5.0
D012	Endrin	0.02
D013	Lindane	0.4
D014	Methoxychlor	10.0
D015	Toxaphene	0.5
D016	2,4-D	10.0
D017	2,4,5-TP Silvex	1.0
D018	Benzene	0.5
D019	Carbon Tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D023	o-Cresol	200.0
D024	m-Cresol	200.0
D025	p-Cresol	200.0
D026	Cresol	200.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D031	Heptachlor	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D039	Tetrachloroethylene	0.7
D040	Trichlorethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D043	Vinyl Chloride	0.2

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Attachment IV: Hazardous Waste Label for Accumulation Drum (Example)

Pace Analytical®

PROCESS STANDARD OPERATING PROCEDURE
TITLE: WASTE HANDLING AND MANAGEMENT
ISSUER: Pace ENV – Indianapolis – IND1

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Attachment V: Satellite Container Inspection Form (Example)

Pace Analytical®

Form: Satellite Waste Inspection (COR-FOR-0016-rev.01, 27Jan2020)

Approved & Issued by: Corporate – EHS
Pace Analytical Services, LLC (PAS)

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Waste Container ID	Clearly Labeled as "Hazardous Waste" with Waste Stream	Liquid Waste has Secondary Containment	Closed when not in use
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No
	Yes / No	Yes / No	Yes / No

Example

If any of the above fields are a "NO", please document how the container was brought back into compliance.

Comments:

_____

_____

_____

Inspector Signature: _____ **Inspection Date:** _____

Reviewer Signature: _____ **Review Date:** _____

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Pace Analytical®

PROCESS STANDARD OPERATING PROCEDURE
TITLE: WASTE HANDLING AND MANAGEMENT
ISSUER: Pace ENV – Indianapolis – IND1

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Attachment VI: Waste Accumulation Room Inspection Form (Example)

Pace Analytical®

Form: Weekly Waste Room Inspection (COR-FOR-0035-rev.00, 27Jan2020)

Approved & Issued by: Corporate – EHS
Pace Analytical Services, LLC (PAS)

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Containers closed when not in use	Labels Easily Seen and Legible	Drums have Accumulation Start Date	Storage Amounts and Limits Obeyed[1]	Secondary Containment for Liquid Waste	Adequate Aisle Space	Available Emergency Equip. and Materials	Signature and Date of Inspection	Corrective Action for NO Answers
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		
Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No		

[1] Accumulation limits are 90 days for LQG, and 180 days for SQG. SQG may have no more than 6000kg waste at any time.

Example

Reviewed by: _____ Date: _____

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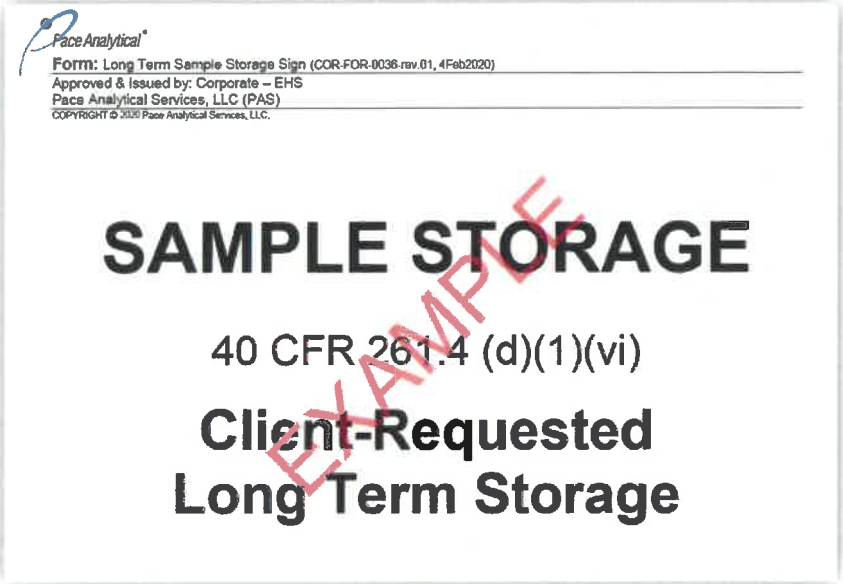
Attachment VII: Sample Storage Signs (Example)



Appendix G

Data Review and Validation SOP rev. 01

Southeast Rockford Groundwater Contamination Site
Data Review and Validation Operating Procedure Rev. 0
Effective Date: 04/06/2022
Source: Nationwide Environmental Services, Inc.
Review: M. Mandell, Project QA Manager
Approval: W. B. Dotterrer, Sr. Project Manager

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Data Review and Validation
Standard Operating Procedure

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1. Purpose and Scope

The purpose of this document is to assure that analytical results meet the requirements presented in the Quality Assurance Project Plan (QAPP). Data that do not meet these requirements will be qualified so that the data user is aware a problem was observed with the data.

2. Requirements

Analytical results obtained for the project will be subject to the review procedures described in this standard operating procedure (SOP), as required per the General QAPP (see worksheets #20, #34, #35, and #36).

3. Responsibilities

The Project Quality Assurance Manager will be responsible for reviewing the analytical results, adding the data qualifiers to the data report and for documenting the discrepancies in the Data Validation Summary Report.

4. Procedure

The data-quality evaluation has both an electronic and a manual review component. Quality control data will be compared to the criteria provided in the electronic data deliverables (EDDs) and specified in the laboratory reports. A summary quality control data package will be reviewed; however, if systematic or severe quality control issues are identified, a Level 4 data package may be requested and reviewed. The following quality control (QC) checks will be performed during the data validation, as applicable to the specific analysis:

- Data Package Completeness (Section 4.1)
- Sample Integrity (Section 4.2)
- Laboratory Method (Section 4.3)
- Holding Times (Section 4.4)
- Method Blanks and Field Quality Control Blanks (Section 4.5)
- Surrogate Recoveries (Section 4.6)
- Laboratory Control Samples (Section 4.7)
- Matrix Spikes/Matrix Spike Duplicates (Section 4.8)
- Analyte Reporting Limits (Section 4.9)
- Field Duplicates (Section 4.10)
- Re-analyses and Professional Judgement (Section 4.11)

EDDs are initially reviewed to capture quality control exceedances as described in the following sections of this SOP, a Data Validation Summary Report is prepared, and qualifiers entered into the EDD. The laboratory report is then reviewed to confirm any non-compliances identified; and to review the chains of custody (CoCs), case narratives, and laboratory qualifiers for any additional issues.

Validation qualifiers and definitions are included in QAPP WS #36. All non-detects are considered to be associated with a "U" qualifier and the "U" qualifier is only assigned when a detected analyte is not considered to be present in the sample (e.g., due to blank contamination). In addition, for analytes analyzed at dilutions, the laboratory will report detections below the reporting limit (RL) as estimated (J); these qualifications are generally accepted by the validator.

4.1. Data Package Completeness

Are the analytical results present for each sample?

a. Samples and/or fractions as appropriate
b. MS/MSDs
c. LCS
d. Blanks
e. Duplicates

ACTION: If not, check the CoC to verify that the sample was sent (i.e., MS/MSD). If necessary, contact the laboratory project manager (PM) for submittal of the missing data (i.e., laboratory QC).

4.2. Sample Integrity

4.2.1. Chain of Custody

Are the Chain-of-Custody (CoC) records present for all samples?

ACTION: If not, contact the laboratory PM for the location and/or replacement of missing or illegible copies. Review the CoC to verify sample identifications, collection date/times, and requested analyses match the laboratory report; note discrepancies in the Data Validation Summary Report, along with any missing items (such as collection dates/times and signatures). Do the CoC records or Case Narrative indicate any problems with sample receipt, condition of samples, analytical problems, or special circumstances affecting the quality of the data?

ACTION: If problems with sample receipt were documented, note problem in the Data Validation Summary Report. If issues are evident that warrant qualification (i.e., VOC headspace exceeding 6 mm, or receipt temperature and preservation (see Section 4.2.2) discuss the issue and qualifications in the Data Validation Summary Report.

4.2.2. Containers & Preservatives

Were the correct bottles and preservatives used? Refer to the QAPP for the project methods.

ACTION: Document justification for change in container/volume (if applicable), qualify detects as estimated biased low (J-) and nondetects UJ, for data associated with cooler temperature exceeding 10°C (if cooling required per QAPP or method). Rejection (R) of data requires professional judgment.

4.3. Laboratory Method

Were the correct laboratory methods used? (Refer to the General QAPP for the required methods).

ACTION: If not provide justification for method change and determination of comparability to the requested method.

4.4. Holding Times

Have any technical holding times, determined from date of collection to date of extraction (if applicable) and analysis, been exceeded? Refer to the QAPP for method-specific and matrix-specific holding times.

ACTION: If holding times are exceeded, qualify detections as estimated biased low (J-) and nondetect as UJ. For parameters where the direction of bias is unknow (i.e., pH, qualify the data as estimated).

ACTION: If holding time is exceeded by > 2×, all non-detected analytes are unusable (R).

ACTION: List samples that exceeded holding time with number of days exceedance in the Data Validation Summary Report.

4.5. Method Blanks and Field QC Blanks

Is the Method Blank Summary present?

ACTION: If not, contact the laboratory PM for submittal of missing data.

Has a method blank been analyzed for each QC batch (1 per every 20 samples of similar matrix)?

ACTION: If not, contact the laboratory for method blanks results and document discrepancy in Data Validation Summary Report. Use professional judgment to qualify the data.

Do any method blanks have detected analytes?

When applied as described below, the contaminant concentration in these method blanks are multiplied by the sample dilution factor and corrected for percent moisture when necessary.

ACTION: List all contaminant detections for each method blank (including the concentration detected and batch) in the Data Validation Summary Report. Qualifications for detections are summarized below.

Blank Detection	Sample Detection	Action
<RL	<RL	Report at RL and qualify U
	>RL but <2x blank	J+
>RL	≥ RL but < Blank Result	Report at sample result and qualify U
	≥ RL and ≥ Blank Result or 2x Blank Result for common laboratory contaminants	J+

ACTION: Common laboratory contaminants: methylene chloride, acetone, 2-butanone, and/or phthalate esters. Professional judgement will be used for qualification due to systematic contamination (usually the maximum blank values is used to qualify all data using scenario above). Systematic contamination can be laboratory and/or field related.

Do rinsate blanks contain detected analytes > RL?

ACTION: Contact field sampler for associated samples if rinsate blank was submitted blind.

ACTION: Evaluate rinsate results against method blank results to determine if contaminant may be laboratory derived. If results are not laboratory related, qualify according to the table in 4.4.3.

Does the trip blank (if applicable) contain detected analytes?

ACTION: Evaluate trip blank results against method blank results to determine if they may be laboratory related. If results are not associated with laboratory contamination, qualify according to the table in 4.4.3.

4.6. Surrogate Recoveries

Was one or more surrogate recoveries outside of acceptance limits for any samples, or field QC samples (if applicable)?

NOTE: $$\%R = \frac{QD}{QA} \times 100$$

Where:

QD = Quantity determined by analysis
QA = Quantity added

If yes, were samples reanalyzed?

NOTE: If surrogate recovery fails due to the surrogate being diluted out, results are not qualified, but should be documented in the Data Validation Narrative.

ACTION: If recoveries are >10 percent, but less than the laboratory control limit for one or more surrogates, qualify detections as estimated biased low (J-) and nondetects as UJ. If surrogate recoveries are greater than the control limits, qualify detected results as estimated biased high (J+).

If any surrogate compound recovery is <10 percent:

1. Qualify detected analytes as estimated biased low (J-).

2. Qualify non-detected analytes as unusable (R).

4.7. Laboratory Control Sample

NOTE: Data qualification for LCS failures apply to all samples in the QC batch.

Was a LCS pair analyzed with each QC batch of a similar matrix or every 20 samples, whichever is more frequent? The standard method analytes must be in the LCS.

ACTION: If data are not available, contact the laboratory PM for submittal of the missing data.

Is an LCS Summary Form present?

ACTION: If not, contact the laboratory PM for submittal of missing data.

Are 80 percent of LCS recoveries within acceptance limits?

ACTION: If 80 percent of LCS recoveries are not within limits, reject (R) data from that QC batch.

Is the recovery of any analyte outside of acceptance limits?

ACTION: If recovery is below the lower control limits (as provided in the laboratory reports), qualify all detects as estimated biased low (J-) and non-detects as UJ. If LCS/LCSD recovery is <10 percent, the non-detect analytes are rejected (R). If the recovery is above the upper control limit, qualify all detected analytes within the batch as estimated biased high (J+).

4.8. Matrix Spikes/Matrix Spike Duplicate

NOTE: The MS/MSD qualifiers when appropriate, are applicable only to the sample that was spiked. Qualification of associated sample results based on MS/MSD data will be left to professional judgment of the validator. MS/MSDs are preferred to be project-specific. Project-specific MS/MSDs will be used to qualify data for VOCs and 1,4-dioxane in groundwater. Laboratories may report non-project MS/MSDs.

Is the MS/MSDs Recovery Form present?

ACTION: If not, contact the laboratory for submittal of missing data.

Were MS/MSDs analyzed at the required frequency of one per QC batch (1 per 20 samples per matrix)?

ACTION: If MS/MSD data are missing, call the laboratory for submittal of missing data.

Were MS/MSD recoveries outside acceptance limits?

NOTE: Acceptance limits apply only when spiked samples results fall within the normal calibration range. If dilutions are required due to high sample concentrations, the data are evaluated, but no qualifiers are applied, as the spiked analytes were diluted out.

ACTION: If recovery is below the lower control limits, qualify detects for the parent sample as estimated biased low (J-), and nondetects as UJ. If MS/MSD recovery is <10 percent, nondetect analytes are rejected (R). If the recovery is above the upper control limit, qualify all detected analytes for the parent sample as estimated biased high (J+).

ACTION: Evaluate MS/MSD results against LCS results to determine if batch requires qualification and/or rejection. Use professional judgment on batch qualifying because of MS/MSD results.

Were any RPDs for matrix spike and matrix spike duplicate recoveries outside acceptance?

ACTION: If the RPD between the site-specific MS and MSD exceeds acceptance limits, qualify the parent sample results estimated (J).

4.9. Analyte Reporting Limits

Are the RLs at or below those identified in the QAPP?

NOTE: Results will be reported to the RL except where reporting to the MDL is specifically requested (e.g., when sample dilutions are > 5x). Results reported to the MDL (for dilution analyses) will be qualified as estimated (J) by the laboratory, and this J qualifier will be retained during the validation and reported with the results.

ACTION: If not, evaluate change with respect to sample matrix, preparation, clean-up, dilution, moisture, etc. If sample is not the reason for change, determine if the RLs achieved meet the action levels for the project.

4.10. Field Duplicates

Were field duplicates submitted for analysis?

ACTION: Calculate the RPDs

NOTE: $$\text{RPD} = \frac{|S - D|}{(S + D)} \times 200$$

Where:

S = Sample result
D = Duplicate sample result

ACTION: Compare the reported results for field duplicates and calculate the RPD for all results >5× RL and provide in the Data Validation Narrative. RPD should be below the limits shown in the QAPP. For results ≤5× the RL, the absolute value between the sample and its duplicate is evaluated. The acceptance limit is ±2× RL.

ACTION: Qualify data as estimated (J) for sample and field duplicate for the analyte if the RPD exceeds acceptance limits (or exceeds limits for results ≤5× the RL).

4.11. Re-analyses and Professional Judgement

Were samples reanalyzed? Are both sets of data provided?

Laboratory issues do not always fall into the distinct categories as previously described and may require professional judgement.

ACTION: If yes, list samples, QC problems, and indicate which analysis/concentration is to be reported.

4.12. Data Validation Qualifier Hierarchy

When more than one data qualifier is applied to the same data point, the following hierarchy should be used to make the appropriate selection of the final data qualifier to assign: R > J

4.13. Application of Validation Qualifiers and Validation Memorandum

A Data Validation Summary Report will be prepared that discusses the quality control exceedances and results qualified. If qualifications are required, a summary table of the data qualifiers will be included in the Data Validation Summary Report. In addition, the data validator will apply the qualifiers in the EDD. The data validation qualifiers will be included on report tables.

5. Terms and Definitions

ºC degrees Centigrade
CoC(s) chain(s) of custody
EDD(s) electronic data deliverable(s)
LCS laboratory control sample (quality control sample)
LCSD laboratory control sample duplicate (quality control sample)
MS matrix spike (quality control sample)
MSD matrix spike duplicate (quality control sample)
QAPP Quality Assurance Project Plan
QC quality control
RL reporting limit
RPD relative percent difference
SOP(s) standard operating procedure(s)
VOC(s) volatile organic compound(s)

6. References

USEPA (2009). Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. Office of Solid Waste and Emergency Response (OSWER) No. 9200.1-85. EPA 540-R-08-005. Available at https://nepis.epa.gov/Exe/ZyPDF.cgi/P1002WWF.PDF?Dockey=P1002WWF.PDF. January 13, 2009.

USEPA (2020). National Functional Guidelines for Organic Superfund Methods Data Review, Office of Superfund Remediation and Technology Innovation. OLEM 9240.0-51. EPA 540- R-20-005. Available at https://www.epa.gov/clp/superfund-clp-national-functional-guidelines-data-review.