HRS DOCUMENTATION RECORD
REVIEW COVER SHEET

Name of Site: Wilcox Oil Company

CONTACT PERSONS

Site Investigation:	Brenda Nixon Cook, EPA Region 6	(214) 665-7436
	(Name)	(Telephone)
Documentation Record:	Brenda Nixon Cook, EPA Region 6	(214) 665-7436
	(Name)	(Telephone)

Pathways, Components, or Threats Not Evaluated

1) **Ground Water Pathway:** The ground water migration pathway was evaluated but has not been scored. Private water wells have shown elevated levels of metals (Ref. 5, p. 10). Based on information available at this time, further evaluation of the ground water migration pathway would not significantly affect the listing decision (Ref. 1, Sec. 2.2.3).

2) **Surface Water Pathway: Ground Water to Surface Water Migration Component:** The Surface Water Pathway has been scored for the Human Food Chain Threat and Environmental Threat. The Ground Water to Surface Water Migration pathway has not been scored. Based on information available at this time, evaluation of this component would not significantly affect the listing decision (Ref. 1, Sec. 2.2.3).

3) **Air Migration Pathway:** The air migration pathway has not been scored because an observed release to the air migration pathway has not been documented and there are no analytical data to support a release. Based on information available at this time, evaluation of the air migration pathway would not significantly affect the listing decision (Ref. 1, Sec. 2.2.3).

4) **Soil Exposure Pathway:** The soil exposure pathway has not been scored. Observed contamination has been documented on or within 200 feet of soil pathway targets, but based on information available at this time, further evaluation of the soil exposure pathway would not significantly affect the listing decision (Ref. 1, Sec. 2.2.3).

   These pathways and components are of concern to the U.S. Environmental Protection Agency (EPA) and may be considered during a future evaluation.

HRS DOCUMENTATION RECORD

Name of Site:	Wilcox Oil Company
CERCLIS Number:	OK0001010917
Site Spill Identifier Number (SSID):	06GG
EPA Region:	6 Date Prepared: May 2013
Street Address of Site*:	West 221st Street South/Refinery Road, 0.35 mile east of U.S. Highway 66 (Ref. 5, p. 5, Fig.1 of this HRS documentation record)
County and State:	Creek County, OK, 74010
General Location in the State:	The site is located northeast of the City of Bristow in the central portion of the state (Fig. 1 of this HRS documentation record).
Topographic Map:	Bristow Quadrangle, OK (Ref. 3)

Latitude*: 35°50'26.8966" N Longitude*: 96°22'48.693" W (Ref. 5, p. 4)

Air Pathway	Not Scored
Ground Water Pathway	Not Scored
Soil Exposure Pathway	Not Scored
Surface Water Pathway	100.00
HRS SITE SCORE	**50.00**

*The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, placed, or otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

NOTES TO THE READER

Tracking numbers are assigned by the region to every page of every reference. The tracking number consists of the reference number followed by the page number within that reference. A tracking number will have a two-digit number followed by the sequential number (for example, 05 001; 05 002).

The following rules were used when citing references in the HRS (Hazard Ranking System) package.

1. The tracking numbers are cited for all references.

2. Hazardous substances are listed by how they appear in the Superfund Chemical Data Matrix (SCDM).

3. Significant figures: Calculations are reported to two significant figures to the right of the decimal place when the HRS does not specify rounding.

4. Abbreviations/Conventions used to identify references and citations:

Figure	Fig.
Number	No.
Reference	Ref.
Section	Sec.
Single Pages	p.
Multiple Pages	pp.
“.”	Next Reference
()	Selected acronyms

5. List of Figures

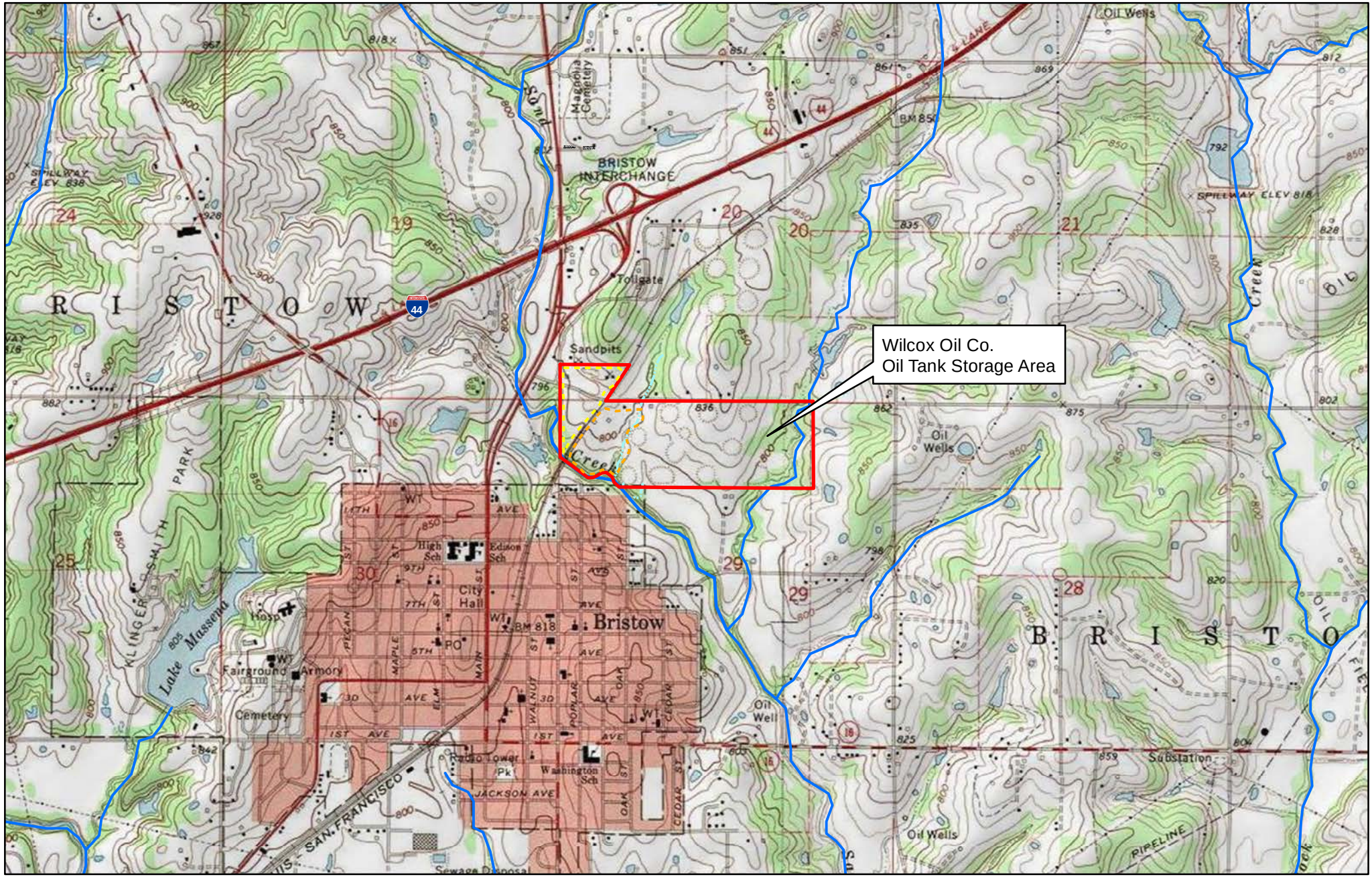
Figure 1	Facility Location Map
Figure 2	Facility Sketch
Figure 3	Sample Location Map
Figure 4	Background, Source, and Contaminated Sample Location Map
Figure 5	Probable Point of Entries (PPEs) for Surface Water Migration Pathway
Figure 6	Surface Water Pathway Map

6. Parent Site Wilcox Oil Company

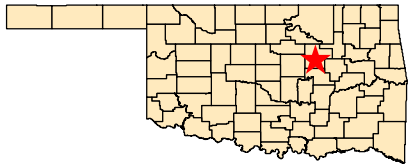
7. Child Sites Lorraine Refinery, CERCLIS No. OKN000606909

ACRONYMS

BGS	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFS	Cubic Feet Per Second
ESI	Expanded Site Inspection
HWD	Hazardous Waste Division
HRS	Hazard Ranking System
mg/kg	milligrams per kilogram
NPDES	National Pollutant Discharge Elimination System
NGV	National Geodetic Vertical Datum
NWI	National Wetlands Inventory
OFS	Overland Flow Segment
ODEQ	Oklahoma Department of Environmental Quality
PAH	Polynuclear Aromatic Hydrocarbon
PPE	Probable Point of Entry
RA	Removal Assessment
RL	Reporting Limit
RPB	Response and Prevention Branch
RCRA	Resource Conservation and Recovery Act of 1976
RSD	Remediation Services Division
START	Superfund Technical Assessment and Response Team
SA	Site Assessment
SI	Site Inspection
SCDM	Superfund Chemical Data Matrix
SSID	Site Spill Identifier Number
TAL	Target Analyte List
TAT	Technical Assistance Team
TCL	Target Compound List
TDL	Target Distance Limit
ug/kg	Micrograms per kilogram



Oklahoma



CERCLIS ID No. OK0001010917

Figure 1. Facility Location Map, Wilcox Oil Company
Bristow, Oklahoma

0 1,250 2,500 5,000 Feet

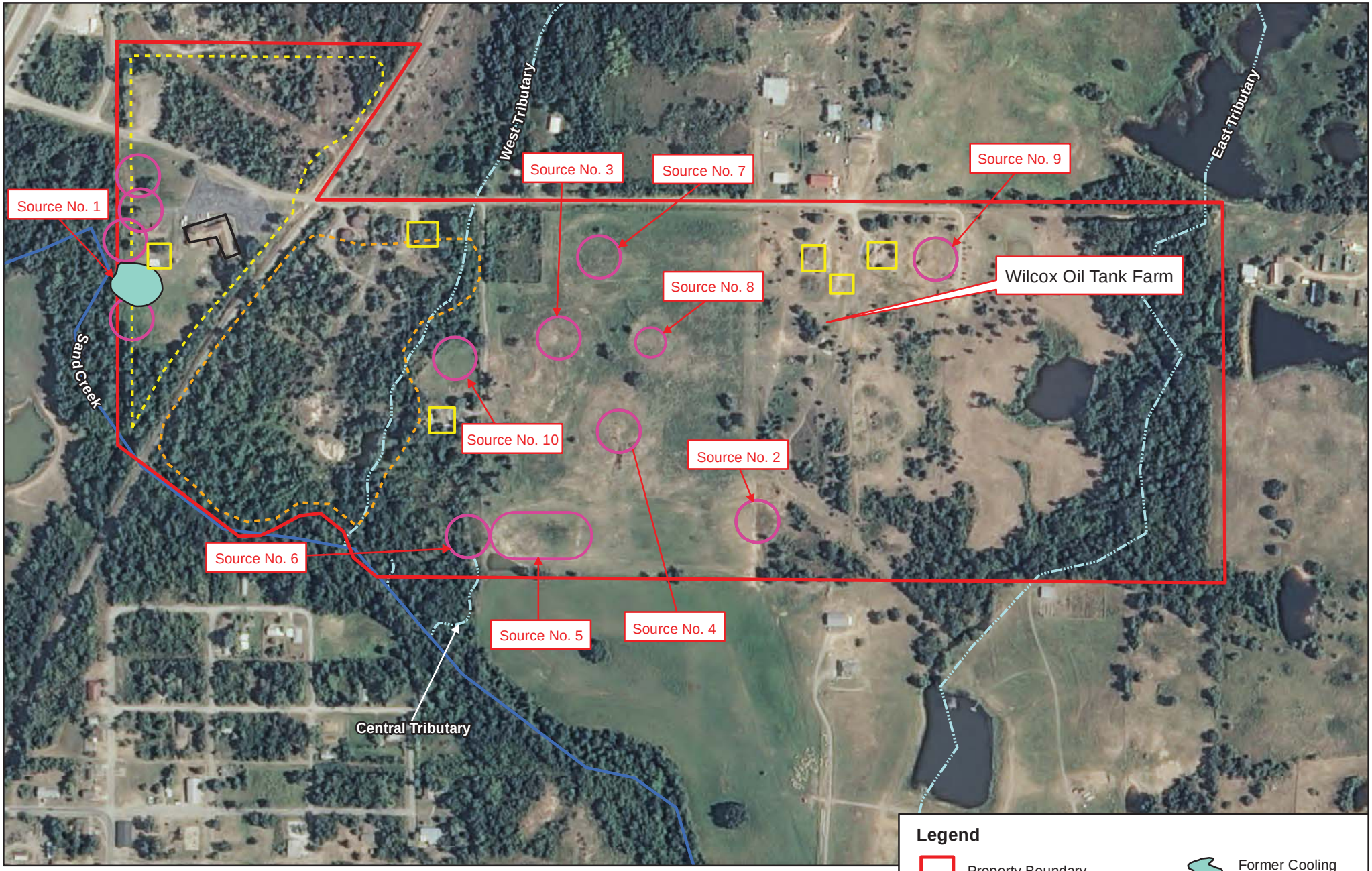
Source: 2009 National Geographic Society; (topographic quadrangle: Bristow, 1973 and Slick, 1973, Oklahoma)

Legend

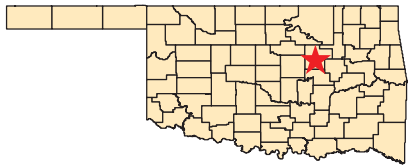
- Facility Boundary
- Lorraine Refinery Boundary
- Wilcox Oil Co. Refinery Process Area
- Streams

N

1:24,000



Oklahoma



CERCLIS ID No. OK0001010917

Figure 2. Facility Sketch, Wilcox Oil Company
Bristow, Oklahoma

N

0 250 500 1,000 Feet

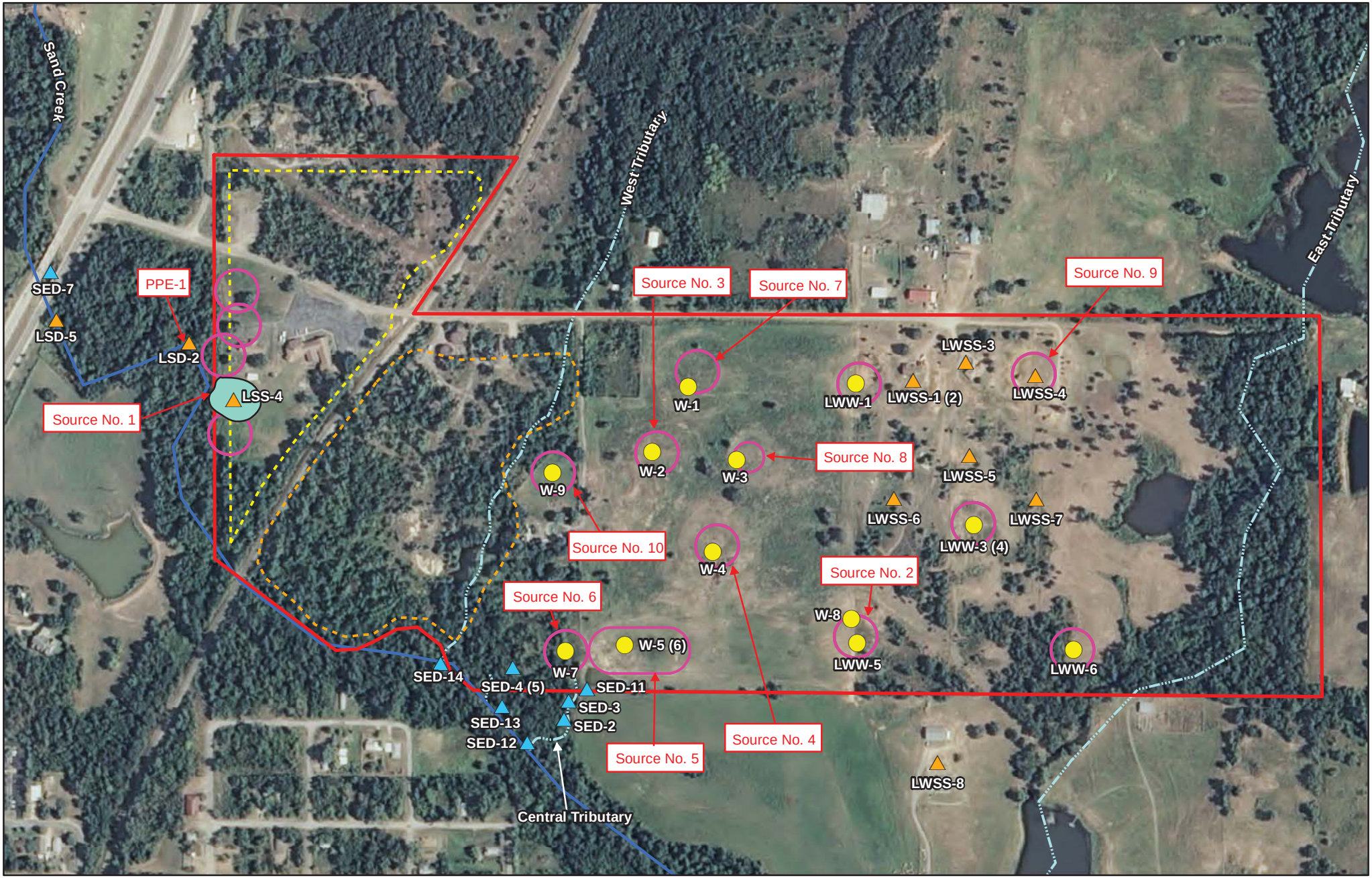
1:5,500

Bing Maps Aerial Imagery, National Agriculture Imagery Program, and 1923 Certified Sanborn Map

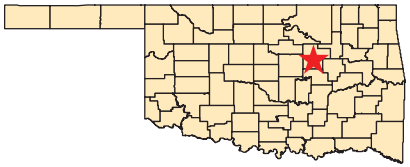
Annotated by START

Legend

- Property Boundary
- Lorraine Refinery Boundary
- Wilcox Oil Co. Refinery Process Area
- Intermittent Stream
- Perennial Stream
- Former Cooling Pond
- Former Tank Bottoms
- Church
- Residence



Oklahoma



CERCLIS ID No. OK0001010917

Figure 3. Sample Location Map
Wilcox Oil Company, Bristow, Oklahoma

0 250 500 1,000 Feet

N

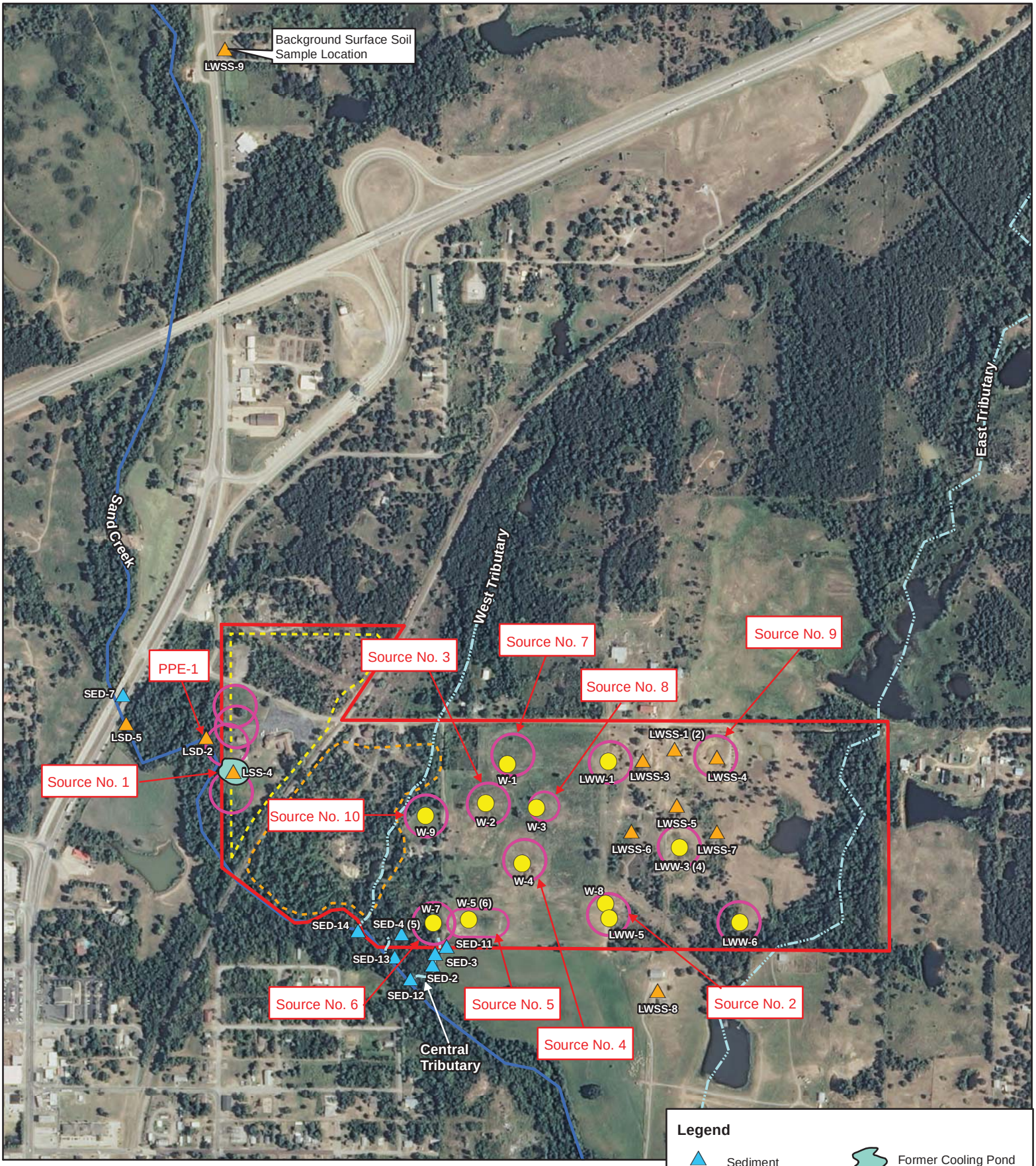
1:5,500

Source: Bing Maps Aerial Imagery, National Agriculture Imagery Program, and 1923 Certified Sanborn Map

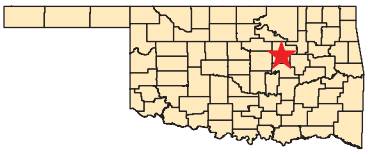
Legend

- Sediment
- Waste
- Surface Soil
- Former Cooling Pond
- Property Boundary
- Lorraine Refinery
- Wilcox Oil Co. Refinery Process Area
- Former Tank Bottoms
- Perennial Stream
- Intermittent Stream

Sample locations from Ref. 5, pp. 25-26; Ref. 7, p. 8; Ref. 9, pp.24-26; and Ref. 16, p.22.



Oklahoma



CERCLIS ID No. OK0001010917

Figure 4. Background, Source, and Contaminated Sample Location Map
Wilcox Oil Company, Bristow, Oklahoma

0 150 300 600 900 1,200 Feet

Source: Bing Maps Aerial Imagery, National Agriculture Imagery Program, and 1923 Certified Sanborn Map

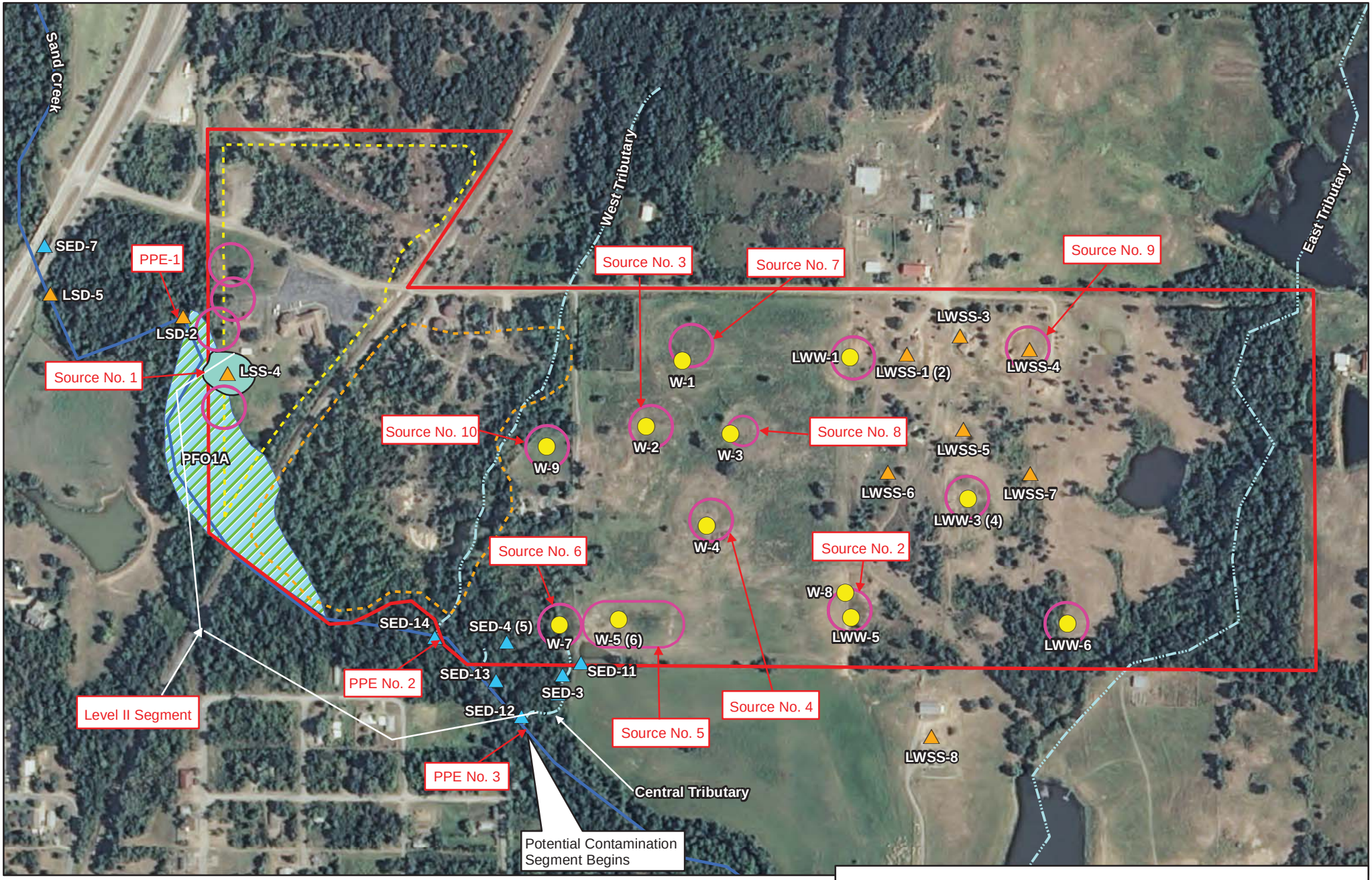
1:9,000

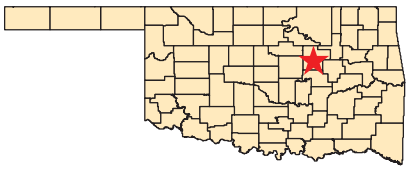
N

Legend

- Sediment
- Waste
- Surface Soil
- Property Boundary
- Lorraine Refinery
- Wilcox Oil Co. Refinery Process Area
- Former Cooling Pond
- Former Tank Bottoms
- Perennial Stream
- Intermittent Stream

Sample locations from Ref. 5, pp. 25-26; Ref. 7, p. 8; Ref. 9, pp.24-26; and Ref. 16, p.22.





CERCLIS ID No. OK0001010917

Figure 5. Probable Point of Entries (PPEs) for Surface Water Migration Pathway
Wilcox Oil Company, Bristow, Oklahoma

0 250 500 1,000 Feet

N

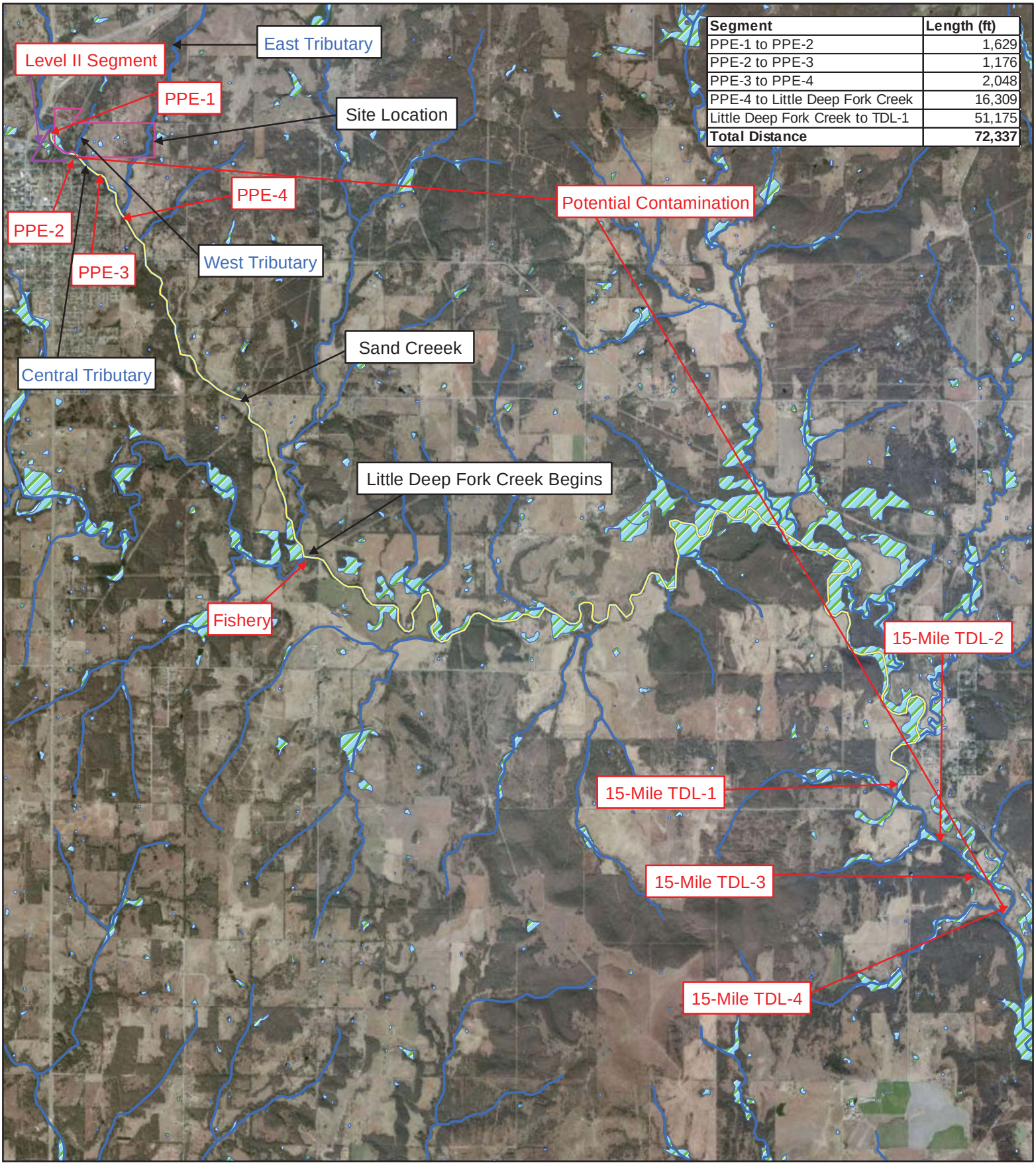
1:5,500

Source: Bing Maps Aerial Imagery, National Agriculture Imagery Program, 1923 Certified Sanborn Map, and U.S. Fish & Wildlife Service National Wetlands Inventory

Legend

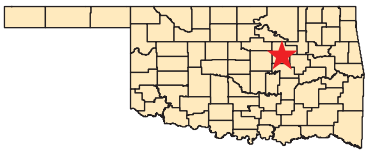
- Sediment
- Waste
- Surface Soil
- Property Boundary
- Lorraine Refinery
- Wilcox Oil Co. Refinery Process Area
- Former Cooling Pond
- Former Tank Bottoms
- Perennial Stream
- Intermittent Stream
- Forested wetlands as defined by 40 CFR 230.3

PFO1A-Palustrine Forested, Broad Leaf Deciduous, temporarily flooded (Ref. 30 and Ref. 38)



Segment	Length (ft)
PPE-1 to PPE-2	1,629
PPE-2 to PPE-3	1,176
PPE-3 to PPE-4	2,048
PPE-4 to Little Deep Fork Creek	16,309
Little Deep Fork Creek to TDL-1	51,175
Total Distance	**72,337**

Oklahoma



CERCLIS ID No. OK0001010917

Figure 6. Surface Water Pathway Map
Wilcox Oil Company
Bristow, Oklahoma

0 0.25 0.5 1 1.5 2 Miles

Source: Bing Maps Aerial Imagery, National Agriculture Imagery Program, 1923 Certified Sanborn Map, and U.S. Fish & Wildlife Service National Wetlands Inventory

Legend

Facility Boundary

15 Miles Downstream

Wetland

N

1:60,000

WORKSHEET FOR COMPUTING HRS SITE SCORE

	s	s2
1. Ground Water Migration Pathway Score (S w) (from Table 3-11, line 13)	NS	NS
2a. Surface Water Overland/Flood Migration Component (from Table 4-11, line 30)	100	10,000
2b. Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	NS	NS
2c. Surface Water Migration Pathway Score (ssw) Enter the larger of the line 2a and 2b as the pathway score	100	10,000
3. Soil Exposure Pathway Score (ss) (from Table 5-1, line 22)	NS	NS
4. Air Migration Pathway Score (sa)	NS	NS
5. Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		10,000
6. HRS Site Score: Divide the value on line 5 by 4 and take the square root.		50.00

NS = Not Scored

Table 4-1 Surface Water Overland/Flood Migration Component Score Sheet

Factor Categories and Factors		Maximum Value	Value Assigned
DRINKING WATER THREAT			
	Likelihood of Release		
1.	Observed Release	550	550
2.	Potential to Release by Overland Flow:		
	2a. Containment	10	
	2b. Runoff	25	
	2c. Distance to Surface Water	25	
	2d. Potential to Release by Overland Flow (Lines 2a[2b+2c])	500	NS
3	Potential to Release by Flood:		
	3a. Containment (Flood)	10	
	3b. Flood Frequency	50	
	3c. Potential to Release by Flood (Line 3a X 3b)	500	NS
4.	Potential to Release (Lines 2d + 3c, subject to a maximum of 500)	500	NS
5.	Likelihood of Release (Higher of Lines 1 and 4) NS	550	550
	Waste Characteristics		
6.	Toxicity/Persistence	*	
7.	Hazardous Waste Quantity	*	
8.	Waste Characteristics	100	NS
	Targets		
9.	Nearest Intake	50	NS
10.	Population:		
	10a. Level I Concentrations	**	NS
	10b. Level II Concentrations	**	NS
	10c. Potential Contamination	**	NS

Score Sheets

Factor Categories and Factors		Maximum Value	Value Assigned
	10d. Population (Lines 10a+10b+10c)	**	NS
11.	Resources	5	NS
12.	Targets (Lines 9+10d+11)	**	NS
	Drinking Water Threat Score		
13.	Drinking Water Threat Score ([Lines 5 x 8 x 12]/82,500, subject to a maximum of 100)	100	NS
HUMAN FOOD CHAIN THREAT			
	Likelihood of Release		
14.	Likelihood of Release (Same value as Line 5)	550	550
	Waste Characteristics		
15.	Toxicity/Persistence/Bioaccumulation	*	$1x10^{12}$
16.	Hazardous Waste Quantity	*	10,000
17.	Waste Characteristics	1,000	1,000
	Targets		
18.	Food Chain Individual	50	20
19.	Population:		
	19a. Level I Concentrations	**	0
	19b. Level II Concentrations	**	0
	19c. Potential Contamination	**	0.00003
	19d. Population (Lines 19a+19b+19c)	**	0.00003
20.	Targets (Value from Lines 18+19d)	**	20.00003
	Human Food Chain Threat Score		
21.	Human Food Chain Threat Score ([Lines 14 x 17 x 20]/82,500, subject to a maximum of 100)	100	100
ENVIRONMENTAL THREAT			
	Likelihood of Release		
22.	Likelihood of Release (Same value as Line 5)	550	550
	Waste Characteristics		
23.	Ecosystem Toxicity/Persistence/ Bioaccumulation	*	1×10^{12}
24.	Hazardous Waste Quantity	*	10,000

Score Sheets

Factor Categories and Factors		Maximum Value	Value Assigned
25.	Waste Characteristics	1,000	1,000
	Targets		
26.	Sensitive Environments:		
	26a. Level I Concentrations	**	0
	26b. Level II Concentrations	**	25
	26c. Potential Contamination	**	0
	26d. Sensitive Environments (Lines 26a+26b+26c)	**	25
27.	Targets (Value from Line 26d)	**	25
Environmental Threat Score			
28.	Environmental Threat Score ([Lines 22 x 25 x 27]/82,500subject to a maximum of 60)	60	60
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE FOR A WATERSHED			
29.	WATERSHED SCORE*** (Lines 13 + 21 + 28, subject to a maximum of 100)	100	100
30.	Component Score (S_{of})*** (Highest score from Line 29 for all watersheds evaluated, subject to a maximum of 100)	100	100

*Maximum value applies to waste characteristic category
**Maximum value applicable
***Do not round to the nearest integer

Reference Sheet

Reference
Number Description of the Reference

1. U.S. EPA Hazard Ranking System (HRS); Final Rule. Code of Federal Regulations, Title 40, Part 300, Appendix A. Washington, DC: U.S. Government Printing Office, 2000. A complete version of this document is available online at: http://www.epa.gov/superfund/sites/npl/hrsres/index.htm. Total Pages: 5

2. U.S. EPA. Superfund Chemical Data Matrix. Appendix B. December 2, 2011. A complete version of SCDM is available at: http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm . Excerpt Pages: 50

3. U.S. Geological Survey (USGS). 15-Minute Series Topographic Map. Bristow, Oklahoma. 1973. Total Pages:1

4. U.S. EPA, Office of Solid Waste. Associated Waste Report: Crude Oil Bottoms and Oily Debris. January 2000. Total Pages: 173

5. Oklahoma Department of Environmental Quality (ODEQ), Site Assessment Unit. Expanded Site Inspection Report for Wilcox Refinery. September 30, 2011. Total Pages: 55

6. ODEQ, State Environmental Laboratory. Report of Analysis by Metal Laboratory. Report of Analysis by Gas Chromatograph with Mass Spectrometer Detection (GCMS) Laboratory. Analysis Date: June 2011. Document Date: September 2011. Total Pages: 170

7. ODEQ, Land Protection Division. Supplemental Sampling Report Expanded Site Inspection for Wilcox Refinery. Total Pages: 15

8. ODEQ, State Environmental Laboratory. Data Package Wilcox. Report of Analysis by Metal Laboratory. Report of Analysis by Gas Chromatograph with Mass Spectrometer Detection (GCMS) Laboratory. Sample Date: December 2011. Document Date: March 2012. Total Pages: 69

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10. ODEQ, State Environmental Laboratory. Data Package Lorraine. Report of Analysis by Metal Laboratory. Report of Analysis by Gas Chromatograph with Mass Spectrometer Detection (GCMS) Laboratory. Date: June-July 2010. Total Pages: 240

11. Downham, T., ODEQ. Memorandum: Site Reconnaissance for the Former Wilcox Refinery in Bristow, Creek Co., Oklahoma. June 17, 2011. Total Pages: 2

Reference Sheet

12. ODEQ. Preliminary Assessment of the Wilcox Refinery, Creek County, Oklahoma. December 15, 1994. Total Pages: 25

13. Roy F. Weston, Inc. Prepared for U. S. Environmental Protection Agency. Expanded Site Inspection Report, Wilcox Oil Company, Bristow, Creek County, Oklahoma. March 1997. Total Pages: 68

14. Ecology and Environment, Inc. Prepared for U. S. Environmental Protection Agency. Site Assessment Report, Wilcox Refinery, Bristow, Creek County, Oklahoma. March 1999. Total Pages: 150

15. ODEQ. Preliminary Assessment Report, Lorraine Refinery, Bristow, Creek County, Oklahoma. September 28, 2008. Total Pages: 32

16. ODEQ. Site Inspection Report, Lorraine Refinery, Bristow, Creek County, Oklahoma. August 18, 2009. Total Pages: 278

17. Reference number reserved.

18. Environmental Data Resources. Certified Sanborn® Map Report for Wilcox/Lorraine Refinery. May 1, 2012. Total Pages: 6

19. ODEQ. State Environmental Laboratory. Quality Assurance Plan. State Fiscal Year 2010. February 15, 2010. Total Pages: 9

20. ODEQ. Wilcox Refinery ESI, Site ESI Field Logbook. June 28- 29, 2011. Total Pages: 14

21. ODEQ. Site Inspection and Analysis Plan, Wilcox Refinery ESI, Creek County, Oklahoma. June 8, 2011. Total Pages: 45

22. ODEQ. Site Inspection and Analysis Plan, Lorraine Refinery, Creek County, Oklahoma. May 31, 2010. Total Pages: 46

23. ODEQ. Lorraine Refinery ESI, Site SI Field Logbook. June 8- 9, 2010. Total Pages: 2

24. Downham, T., ODEQ. Memorandum: Changes from Wilcox ESI Sampling and Analysis Plan (SAP) during the Sampling Event. July 15, 2011. Total Pages: 1

25. Dynamac Corporation. Record of Communication. From: START-3, To: Fish and Game Warden, Creek County, Oklahoma. Subject: Fisheries within 15-mile TDL of Wilcox Refinery. May 11, 2012. Total Pages: 1

26. USDA. Average Annual Precipitation for Oklahoma for 1961-1990. Available online at: http://www.wrcc.dri.edu/pcpn/ok.gif . Downloaded: January 24, 2013. Total Pages: 1

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31. ODEQ. Sampling and Analysis Plan for Lorraine Sampling Inspection. March 24, 2009. Total pages: 39

32. U.S. EPA. Memorandum. To: J. Winston Porter, EPA Assistant Administrator. From: Francis S. Blake, General Council. Subject: Scope of the CERCLA Petroleum Exclusion under Sections 101(14) and 104(a)(2). July 31, 1987. Total Pages: 11

33. ODEQ. Memorandum. To: Lorraine PA File. From: Vanessa Peterson. Subject: Current Ownership of (Lorraine Refinery), Potentially Responsible Parties (PRPs) Search and Site Reconnaissance. September 12, 2008. Total Pages: 46

34. ODEQ. Memorandum. To: Wilcox/Lorraine File. From: Todd Downham. Subject: Locations and Physical Descriptions of Soil and Sediment Sampling. September 24, 2012. Total pages: 4

35. ODEQ. Memorandum. To: Wilcox/Lorraine File. From: Todd Downham. Subject: Clarification of Waste Sampling. October 4, 2012. Total pages: 1

36. U.S. District Court. U.S. vs. Western Processing Co., Inc. 761 F. Supp. 713 (1991). Available online at: http://www.leagle.com/xmlResult.aspx?xmldoc=19911486761FSupp725_11354.xml&docbase=CSLWAR2-1986-2006 . Downloaded: August 27, 2012. Total pages: 10

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http://www.fws.gov/wetlands/Documents/Wetlands-and-Deepwater-Habitats-Classification-chart.pdf . Total pages: 2

39. ODEQ, Land Protection Division. Quality Assurance Project Plan for Site Assessment Unit. Scope of Work FFY 2009 State of Oklahoma Department of Environmental Quality Land Protection Division Site Remediation Section Site Assessment Unit Quality Management Plan EPA QTRAK # 08-148. August 29, 2008. Total Pages: 125

40. ODEQ. Quality Management Plan for State FY 2010-2011. October 12, 2009. Total Pages: 155

Site Description and History:

Wilcox Oil Company is an inactive and abandoned oil refinery located in Creek County, Oklahoma. The site consists of contaminated areas and surface water bodies due to the release from the former Lorraine and former Wilcox Refineries. These refineries were located in the N ½ of the NW 1/4 of S29 T16N R9E and the SW 1/4 of the SW ¼ of S20 T16N R9E in Creek County, Oklahoma (Ref. 5, pp. 4, 5). The location of the releases from the two refineries are considered to be a single site composed of a commingled release from the combined refinery operations threatening the same targets. The release from the two refineries is comingled and /or the contamination is contiguous. The Wilcox Oil Company site is composed of a release from the combined facility operations.

The geographical coordinates for the site are 35°50'26.8966" north latitude and 96°22'48.693" west longitude (Ref. 5, p. 4). The property covers approximately 125 acres (Ref. 3; Ref. 5, pp. 4, 5, 23; Figure 1 of this HRS Documentation Record).

Two refinery process facilities and storage tank areas once operated at the two facilities. Recent investigations (2009-2011) indicate the site area contains elevated concentrations of metals and organic compounds in the former storage tank areas, surface soils, surface impoundment and sediments. Elevated levels of metals were also detected in three private residential wells on site, and from three wells adjacent to the property (Ref. 5, pp. 5 – 12, 17-22; Ref. 18).

Wilcox Oil Company (Wilcox) operated as a crude oil refinery from the 1920s until 1963. A skimming and cracking plant was constructed in 1929. The main components of the plant consisted of a skimming plant, cracking unit, and redistillation battery with a vapor recovery system and treatment equipment (Ref. 12, pp. 3, 5).

The Wilcox Oil Company expanded when it acquired the Lorraine Refinery in 1937, which was located west of the railroad (Figure 1 of this HRS documentation record; Ref. 33, pp. 2, 3). Oil refining began in 1915 at the Lorraine Refinery (Ref. 33, p.2). Wilcox sold the property to a private individual in 1963 (Ref. 13, p. 3). Most of the equipment and storage tanks were auctioned or salvaged for scrap metal by the new property owners. Wilcox Oil Company no longer operates in Oklahoma. Based on information from the Oklahoma Secretary of States' office, the company merged with Tenneco Oil Company in 1967 (Ref. 13, p. 15).

A church and six residents are presently on the facility (Ref. 5, p. 13).

A large volume of visible waste is present where refined product and crude oil storage tanks were once located (Ref. 15, pp. 3, 5, 6; Ref. 33, p. 5; Ref. 35). Approximately 4 inches of crude oil were discovered on a church property when a cap broke off an existing pipeline. Hydrocarbon sheen was visible when digging 2-3 feet below ground surface (Ref. 33, p. 4). Elevated levels of metals and semi-volatiles are present in waste samples collected (Tables 3 and 4 of this HRS documentation record).

The site includes remnants of former oil refining operations and tank farms. The facility can be divided into three major former operational areas: two processing areas with surrounding refined product storage and a crude oil storage area. An active railroad divides the two former processing areas and product storage areas (Ref. 18, pp. 1-4). Most of the refinery structures and tanks have been removed or are in ruins. The northwestern portion of the property, west of the railroad and north of West 221st Street South/Refinery Road, was used as a refined product storage area but is now rural land no longer used for refinery storage purposes. There are multiple areas of stressed vegetation, barren areas, and visible black tarry waste of a hydrocarbon nature (Ref. 11, pp. 1-2; Ref. 33, pp. 3, 4, 5).

The southwestern portion of the property, south of Refinery Road, west of the railroad had a processing area and refined product storage. The First Assembly of God Church, playground, and one residence are located where processing and storage occurred. There are multiple areas of stressed vegetation, barren areas, and visible black tarry waste (Ref. 11, pp. 1, 2; Ref. 15, pp. 2, 3).

East of the railroad was a processing area and refined product storage areas. Several refined product storage tanks, refinery-related debris, dilapidated buildings, and structures remain on the property. There is one residence in this portion of the property. An intermittent stream (West Tributary) marks the eastern extent of the processing and refined product storage area east of the railroad. This tributary runs north to south and flows into Sand Creek to the south. There are multiple areas of stressed vegetation, barren areas, and visible black tarry waste (Ref. 11, pp. 1, 2).

To the east of the West Tributary is a former large crude oil storage area/tank farm. There are four residences located on top of or directly next to former tank locations. There are multiple areas of stressed vegetation, barren areas, and visible black tarry waste of a hydrocarbon nature. Waste was also observed in several drainage channels that empty into Sand Creek (Ref. 11, pp. 1, 2).

There are a total of six residences on the property, all of which are located on former tank or refinery operations locations. Three of the residences located on the eastern portion of the property are known to use water from domestic/private wells located on site. The drainage pattern of the property is primarily towards Sand Creek that follows the western and southwestern boundaries of the property. Two intermittent streams and several drainage channels cross the portion of the property east of the railroad, both of which flow into Sand Creek (Ref. 11, pp. 1, 2).

A detailed title search in the Creek County Clerk office confirms that the property was used in oil refinery operations from 1915 until November 1963. Access to the property is not controlled (Ref. 15, pp. 3, 4). Portions of the property are fenced (Ref. 12, p. 4). There are no schools or day care centers located within 200 feet of the site (Ref. 15, p. 3) .

The Wilcox Oil site consists of a former cooling pond, former tank bottoms, and the associated releases of polynuclear aromatic hydrocarbons (PAHs) and metals to the nearby wetlands and

Sand Creek (Ref. 18, pp. 3, 4; Table 9 of this HRS documentation record).

Leaded tank bottoms are specifically listed as RCRA K052 waste and are CERCLA hazardous substances (Ref. 14, pp.1-8). In the definition of hazardous substances, Section101(14) of CERCLA provides that "[t]he term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as hazardous substance under subparagraph (A) through (F) of this paragraph…". This provision has been termed the "petroleum exclusion". In the EPA General Counsel's Opinion *Scope of the CERCLA Petroleum Exclusion under Sections 101(14) and 104(a) (2)* (July 31, 1987), the EPA interprets the petroleum exclusion to include hazardous substances such as benzene and toluene, which are "indigenous" to petroleum products. The petroleum exclusion also includes "refinery-added" hazardous substances that are normally mixed with or added to crude oil or crude oil fraction during the refining process. Conversely, "contaminants" found in petroleum or petroleum products do not fall within the petroleum exclusion. "Contaminants" include substances which are not indigenous to petroleum products or which are present at levels that exceed those normally found in petroleum products (Ref. 14, pp.1-8).

In its decision in *US v. Western Processing* (1991), the federal district court concluded that "tank bottom sludge is a contaminated waste product, and not a petroleum fraction, as that term is used in [CERCLA]." In so ruling, the court focused in part on the tank bottom's status as "waste" in contrast to a useful petroleum product, which would be considered a petroleum fraction under CERCLA (Ref. 36, pp. 1-10). In *Cose v. Getty Oil* (1993), the U.S. 9th Circuit of Appeals concluded "crude oil tank bottoms are never 'subjected to various refining processes'; as required by our 'petroleum' definition. Moreover, such tank bottoms are not used 'for producing useful products'…" and "crude oil tank bottoms do not fall within CERCLA's exclusion of 'petroleum', including crude oil or a fraction thereof" (Ref. 37, pp. 1-9). In addition, the circuit court of appeals also found it unnecessary to determine whether the level of lead in the refinery sludge exceeded levels indigenous to petroleum products such as leaded gasoline (Ref. 32, pp. 1-11).

A summary of sampling activities conducted at the facility is provided in Table 1:

Table 1- Summary of Investigations

Investigation	Agency/Company	Date	Findings/Summary	Ref. No.	
Preliminary Assessment- Wilcox Oil Company	ODEQ for EPA	Dec 1994	Oil waste and sludge observed on residential yards.	12, pp. 1, 4, 6, 7, 14, 22, 25	
Expanded Site Inspection – Wilcox Oil Company	Roy F. Weston, Inc. for EPA	Mar 1997	Oily, tarry, black-asphalt materials observed in the former bermed areas. Contaminated soil, and contaminated sediments detected in ponds. Copper and lead detected in Sand Creek sediments.	13, pp. 1, 28-32, 37, 40	
Site Assessment - Wilcox Refinery	Ecology & Environment, Inc. for EPA	Mar 1999	Approximately 73,000 cubic yards of oily waste and contaminated soil and 3,000 gallons of liquid waste identified.	14, pp. 1, 45	
Preliminary Assessment – Lorraine Refinery	ODEQ for EPA	Sept 2008	Church and residence located on former refinery operations. No sampling conducted.	15, pp. 1, 2, 3, 5, 14, 16, 24, 26	
Site Inspection – Lorraine Refinery	ODEQ for EPA	Aug 2009	LS series of soils (LSS) on Lorraine facility and sediments (LSD) from Sand Creek. Soil contamination and observed release in Sand Creek sediments documented.	16, pp. 1, 7, 12, 13	
				SAP/QAPP	Data
				31; 39; 40	16, pp. 70 - 258
Expanded Site Inspection – Lorraine Refinery	ODEQ for EPA	Sept 2010	LW series of soil (LWSS) and waste (LWW) samples collected at Wilcox facility from tank farm and residential yards. Metals and SVOCs detected in waste and soil samples.	9, pp. 1, 6, 7, 11-12; 23	
				SAP/QAPP	Data
				19; 22	10
Expanded Site Inspection – Wilcox Oil Company	ODEQ for EPA	Sept 2011	SS series of soil samples collected at Wilcox Refinery property and W series of waste samples collected from tank farm. SED series of sediment samples from tributaries and Sand Creek. Metals and SVOCs detected in waste and soil samples and metals detected in sediments.	5, pp. 1, 12, 15; 23	
				SAP/QAPP	Data
				19; 21; 24	6
Supplemental ESI – Wilcox Oil	ODEQ for EPA	Dec. 2011	SED series of samples collected from tributary and Sand Creek. Metals detected in sediments.	7, pp. 1, 3, 5, 6	
				SAP/QAPP	Data
				19; 21	8

Key: ESI: Expanded Site Inspection; ODEQ-Oklahoma Department of Environmental Quality; SAP-Sampling and Analysis Plan; QAPP-Quality Assurance Project Plan

SOURCE DESCRIPTION

2.2 SOURCE CHARACTERIZATION

Source characterization for the Wilcox Oil Company site includes identification of the sources, hazardous substances associated with the sources and pathways potentially threatened by the hazardous substances. There are 10 sources evaluated at the Wilcox Oil Company site, for HRS purposes:

Source No. 1- Cooling Pond
Source Nos. 2-10: Tank Bottoms

The first source evaluated is:

- Source No. 1: Cooling Pond

2.2.1 Source 1 Identification

Number of the source: Source No. 1

Name and description of the source: Cooling Pond (surface impoundment (buried/backfilled)

Source No. 1, a surface impoundment, is located on the east side of the former process and refinery areas at the Lorraine Refinery (Ref. 18, pp. 1-6; Figs. 2 and 3 of this HRS documentation record). The area in the vicinity of the surface impoundment contained a cooling tower, stills and storage tanks (Ref. 18, pp. 1-6). A church and parking lot near the surface impoundment are now located where the former refinery operations were conducted (Ref. 16, pp. 5, 6; Figure 2 of this HRS documentation record).

The contamination associated with Source No. 1 was based upon analytical results from the ODEQ Site Inspection (SI) (August 2009) (Ref. 16, pp. 6, 12, 13, and 25; Table 5 of this HRS documentation record). Sampling was conducted following the procedures set forth in the Quality Assurance Project Plan (QAPP) (Ref. 39) and the approved DEQ Quality Management Plan (QMP) for State fiscal year 2009-10, EPA QTRAK # 09-039 (Ref. 40).

•Location of the source, with reference to a map of the site:

Source No. 1 is located on the eastern side of the former process and refinery areas of the Lorraine Refinery (Ref. 18, pp. 1-6) (Figs. 2 and 3 of this HRS documentation record). The sample that was used to define Source No. 1 is LSS-4 (Table 2 of this HRS documentation record).

•Source Type for HRS evaluation purposes: Surface Impoundment (buried/backfilled)

•Containment

Gas release to air: The air migration pathway was not scored; therefore, gas release to air containment was not evaluated.

Particulate release to air: The air migration pathway was not scored; therefore, particulate containment was not evaluated.

Release to ground water: The ground water migration pathway was not scored; therefore, ground water containment was not evaluated.

Release via overland migration and/or flood: There is no documentation or evidence to indicate that Source No. 1 had a maintained run-on control system or runoff management system, or an engineered cover. There is also no evidence of any runoff treatment (Ref. 5, pp. 8, 31-54; Ref. 18, pp. 1-6). The containment factor value for Source No. 1 is 10 (Ref. 1, Table 4-2).

2.2.2 Hazardous Substances Associated with a Source

The substances listed in the following pages were present in the sample collected during the 2009 Lorraine Site Inspection from the waste in the former cooling pond (Ref. 16).

The sample contained arsenic, chromium, copper, lead, nickel, and zinc at concentrations equal to or greater than their corresponding reporting limits (RLs) and waste was evident during sample collection (Ref. 16, p. 17; Table 3 of this HRS documentation record). The sample was analyzed for semivolatiles and metals (Ref. 16, pp. 70, 125).

Table 2 - Source Evidence Sample				
Sample ID/SEL No.	**Depth**	**Soil Description**	**Date**	**Reference**
LSS-4/ 462168	0 to 24 inches	Light brown sandy	April 22, 2009	Ref. 16, pp. 17, 70, 125; Ref. 34; Figure 3 of this HRS documentation record

Table 3- Source No. 1 Evidence		
Hazardous Substance	Sample No. LSS-4 / SEL # 462168 Collection date: 4/22/2009	
	Conc. (mg/kg)	RL (mg/kg)
Arsenic	**1.50**	1
Chromium	**4.90**	1
Copper	**7.80**	1
Lead	**513**	1
Nickel	**6.70**	1
Zinc	**16.7**	1
Chain of Custody	Ref. 16, p. 70	
Laboratory Reports (including Form Is)	Ref. 16, p. 125	
Other Supporting References	Fig. 3 of this HRS documentation record	

Key:
Bold- Sample Concentration is greater than RL
Conc.- Concentration
SEL – State Environmental Laboratory
RL – Reporting Limit (The RL is commonly defined as the lowest contaminant concentration at which a laboratory can report the concentration with confidence; therefore, the RL is by definition at or above the detection limit.)

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

The hazardous constituent quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is the total mass of all Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) hazardous substances in the source is not known and cannot be estimated with reasonable confidence (Ref. 1, Sec. 2.4.2.1.1). There are insufficient historical and current data (manifests, PRP records, state records, permits, waste concentration data, etc.) available to adequately calculate the total mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source No. 1with reasonable confidence. Scoring proceeds to the evaluation of Hazardous Wastestream Quantity (Surface Water Pathway) according to the HRS (Ref. 1, Sec. 2.4.2.1.1 and 2.4.2.1.2).

Hazardous Constituent Quantity Value (S): Not Calculated
Are the data complete for hazardous constituent quantity for this area? No

2.4.2.1.2 Hazardous Wastestream Quantity

The hazardous wastestream quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is the mass of hazardous wastestreams plus the mass of any additional CERCLA pollutants is not known and cannot be estimated with reasonable confidence (Ref. 1, Sec. 2.4.2.1.2). There are insufficient historical and current data (manifests, PRP records, state records, and permits) available to adequately calculate the mass of the hazardous wastestream or the mass of any additional CERCLA hazardous substances in the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous wastestream quantity for Source No. 1with reasonable confidence. Scoring proceeds to an evaluation of volume according to the HRS (Ref. 1, Sec. 2.4.2.1.2 and 2.4.2.1.3).

Hazardous Wastestream Quantity Value (W): Not Calculated
Are the data complete for hazardous wastestream quantity for this area? No

2.4.2.1.3 Volume

The depth of the cooling pond is not known; therefore, volume of the area cannot be adequately determined. Volume is assigned a value of 0 and scoring will proceed to an evaluation of area according to the HRS (Ref. 1, Sec. 2.4.2.1.3 and 2.4.2.1.4).

2.4.2.1.4 Area

According to the 1923 Sanborn Map, the Cooling Pond measured approximately 25 feet (ft.) by 30 ft.; therefore, it occupied approximately 750 square feet (Ref. 18, p. 4).

The hazardous waste quantity evaluation equation for a buried/backfilled surface impoundment is A/13 (Ref. 1, Table 2-5). The area source will be assigned an area hazardous waste quantity value of 57.69.

750 sq. ft./13 = 57.69

Area of source (ft^2): 750
Area Assigned Value: 57.69
References: Fig. 2 of this HRS documentation record; Ref. 1, Sec. 2.4.2.1.4; Ref. 18, p. 4

2.4.2.1.5 Calculation of Source Hazardous Waste Quantity Value

Source No. 1, Cooling Pond

The highest value assigned to either Tier A, Tier B, Tier C, or Tier D is assigned as the Source No. 1 Hazardous Waste Quantity Value (Ref. 1, Section 2.4.2.1.5). The highest value assigned is Tier D.

Source No. 1 Hazardous Waste Quantity Value: 57.69

2.2 SOURCE CHARACTERIZATION

The sources evaluated at the Wilcox/Lorraine Refinery site, for HRS purposes include:

- Source Nos. 2 - 10: Tank Bottoms (Pile- other)

2.2.1 Sources 2- 10 Identification

The following information corresponds to sources 2 - 10 identified for this documentation record.

Number of the source: Source No. 2 - 10

Name and description of the source: Tank Bottom (Pile-other)

Source No. 2 through Source No. 10 are former tank bottoms located in the central portion of the former process and refinery areas of the Lorraine and Wilcox Refinery. Tank bottoms are generally defined as the liquids and residue, such as heavy hydrocarbons, solids, sands and emulsions, which collect in the bottom of or remain in the bottom of storage tanks after a period of service (Ref. 4, p. 9). Previous investigations identified approximately 6.5 acres of tank bottom material within the storage tank berms in the tank farm area (Ref. 12, p. 6). Tank bottom sediment and oily sludge was also observed in a former remnant of a tank bottom (Ref. 5, pp. 47-54).

The area of each tank bottom was measured based upon the Sanborn and historical aerial photographs (Ref. 18, Ref. 28). Tank waste bottoms were located in the bermed area for each oil storage tank.

Waste samples were collected during the ODEQ Site Inspection (SI) (August 2009) and Expanded Site Inspection (ESI) of the Lorraine Refinery (September 2010) and the ODEQ ESI of the Wilcox Refinery (September/December 2011) (Ref. 5, pp. 47-54; Ref. 21;Ref. 22; Ref. 24). During sampling activities, these areas contained oil, tarry and black asphalt-like materials (Ref. 5, p. 5; Ref. 34, pp. 2, 3).

•Location of the source, with reference to a map of the site:

Source No. 2 through Source No. 10 are located in the central portion of the facility. Waste samples were collected from each source. Analytical results are summarized in Table 4 of this HRS documentation record (Figs. 2, 3 and 4 of this HRS documentation record).

•Source Type for HRS evaluation purposes: Pile (other)

•Containment

Gas release to air: The air migration pathway was not scored; therefore, gas release to air containment was not evaluated.

Particulate release to air: The air migration pathway was not scored; therefore, particulate containment was not evaluated.

Release to ground water: The ground water migration pathway was not scored; therefore, ground water containment was not evaluated.

Release via overland migration and/or flood: There is no documentation or evidence to indicate that the tank bottoms had a maintained run-on control system or runoff management system (including treatment of diked liquids), liner, or an engineered cover (Ref. 5, pp. 8, 31-54). The containment factor value for Source Nos. 2-10 is 10 (Ref. 1, Table 4-2).

2.2.2 Hazardous Substances Associated with a Source

Table 4 shows the hazardous substances detected in the waste samples collected during the ESI sampling missions. The samples were analyzed for semivolatiles and metals (Ref. 6; Ref. 10; Table 4 of this HRS documentation record).

Table 4-EVIDENCE for Source Nos. 2-10				
WASTE SAMPLES				
Hazardous Substance	Source No. 2 Sample No. LWW-5 / SEL # 485658 Collection date: 6/9/2010		Source No. 2 Sample No. W-8 / SEL # 505872 Collection date: 6/28/2011	
	Conc.	RL	Conc.	RL
Metals (mg/kg)				
Arsenic	**11**	10	<10	10
Copper	**8.2**	5	<5	5
Lead	**164**	10	<10	10
Nickel	**13.8**	10	<10	10
Semivolatiles (ug/kg)				
Benzo(b)fluoranthene	<190,000	190,000	1,100	1,100
Benzo(a)pyrene	<190,000	190,000	**1,200**	1,100
Chrysene	<190,000	190,000	**2,500**	1,100
Fluoranthene	<190,000	190,000	<1,100	1,100
2-Methylnaphthalene	**380,000**	190,000	<1,100	1,100
Phenanthrene	**200,000**	190,000	**2,400**	1,100
Pyrene	**200,000**	190,000	**2,600**	1,100
REFERENCES				
Chain of Custody	Ref. 10, p. 239		Ref 6, p.6	
Laboratory Reports (including Form Is)	Ref. 10, pp. 116-119, 124		Ref 6, pp. 45-47, 50, 69-71	
Other Supporting References	Fig. 3 of this HRS documentation record		Ref. 5, p. 53; Ref 6, pp. 1, 9, 40, 42; Fig. 3 of this HRS documentation record	

Key:
Bold- conc. is greater than or equal to the RL
RL – Reporting Limit (The RL is commonly defined as the lowest contaminant concentration at which a laboratory can report the concentration with confidence; therefore, the RL is by definition at or above the detection limit.)
< - Conc. is less than the RL
mg/kg – milligrams per kilogram
ug/kg – micrograms per kilogram

Table 4 - EVIDENCE for Source Nos. 2-10										
WASTE SAMPLES										
Hazardous Substance	**Source No. 3 Sample No. W-2 / SEL # 505877 Collection date: 6/28/2011**		**Source No. 4 Sample No. W-4 / SEL # 505878 Collection date: 6/28/2011**		**Source No. 5 Sample No. W-5 / SEL # 505873 Collection date: 6/28/2011**		**Source No. 5 Sample No. W-6 (Duplicate of W-5) / SEL # 505890 Collection date: 6/28/2011**		**Source No. 6 Sample No. W-7 / SEL # 505992 Collection date: 6/29/2011**	
	Conc.	RL	Conc.	RL	Conc.	RL	Conc.	RL	Conc.	RL
Metals (mg/kg)										
Copper	**5.60**	5	**7.4**	5	**7.9**	5	**6.70**	5	**6.10**	5
Lead	**2,320**	10	**254**	10	**590**	10	**486**	10	**15.4**	10
Nickel	**153**	10	<10	10	<10	10	7.20	10	6.50	10
Semivolatiles (ug/kg)										
Benzo(a)anthracene	<350	350	**1,800 J**	1,700	<350	350	<350	350	<1,000	1,000
Benzo(b)fluoranthene	<350	350	<1,700	1,700	<350	350	<350	350	**1,200**	1,000
Benzo(a)pyrene	<350	350	<1,700	1,700	<350	350	<350	350	<1,000	1,000
Chrysene	<350	350	<1,700	1,700	<350	350	<350	350	<1,000	1,000
Fluoranthene	<350	350	<1,700	1,700	<350	350	<350	350	**1,500**	1,000
Phenanthrene	<350	350	<1,700	1,700	<350	350	<350	350	<1,000	1,000
Pyrene	<350	350	**3,300 J**	1,700	<350	350	<350	350	**1,200**	1,000
REFERENCES										
Chain of Custody	Ref 6, p. 6		Ref 6, p. 6		Ref 6, p. 6		Ref 6, p. 7		Ref 6, p. 8	
Laboratory Reports (including Form Is)	Ref 6, pp. 45-47, 55, 85-87		Ref 6, pp. 45-47, 56, 88-91		Ref 6, pp. 45-47, 51, 72-74		Ref 6, pp. 45-47, 68, 130-132		Ref 6, pp. 45-47, 139,153-155	
Other Supporting References	Ref. 5, p. 48; Ref. 6, p.14; Fig. 3 of this HRS documentation record		Ref. 5, p. 50; Ref. 6, p.15, 42; Fig. 3 of this HRS documentation record		Ref. 5, p. 51; Ref. 6, p.10; Fig. 3 of this HRS documentation record		Ref. 5, p. 51; Ref 6, pp. 1, 27; Fig. 3 of this HRS documentation record		Ref. 5, p. 52; Ref 6, pp.1, 32, 40, 42; Fig. 3 of this HRS documentation record	

Key:
Bold- conc. is greater than or equal to the RL
J – Concentration is an estimated quantity, but the identification of the hazardous substance is not in doubt.
RL – Reporting Limit (The RL is commonly defined as the lowest contaminant concentration at which a laboratory can report the concentration with confidence; therefore, the RL is by definition at or above the detection limit.)
< - Conc. is less than the RL
mg/kg – milligrams per kilogram
ug/kg – micrograms per kilogram

Table 4 - EVIDENCE for Source Nos. 2-10								
WASTE SAMPLES								
Hazardous Substance	**Source No. 7 Sample No. W-1 / SEL # 505876 Collection date: 6/28/2011**		**Source No. 8 Sample No. W-3 / SEL # 505875 Collection date: 6/28/2011**		**Source No. 9 Sample No. LWSS-4 / SEL # 485641 / 485656 Collection date: 6/9/2010**		**Source No. 10 Sample No. W-9 / SEL # 505886 Collection date: 6/28/2011**	
	Conc.	RL	Conc.	RL	Conc.	RL	Conc.	RL
Metals (mg/kg)								
Arsenic	<10	10	<10	10	**19.8**	10	<10	10
Copper	<5	5	<5.0	5	**52.1**	5	**78.2**	5
Lead	**122**	10	<10	10	**15.7**	10	**1,560**	10
Nickel	<10	10	<10	10	**23.6**	10	**22.6**	10
Semivolatiles (ug/kg)								
Benzo(a)anthracene	<1,000	1,000	<350	350	<360	360	<27,000	27,000
Benzo(b)fluoranthene	<1,000	1,000	<350	350	<360	360	<27,000	27,000
Benzo(a)pyrene	<1,000	1,000	<350	350	<360	360	<27,000	27,000
Chrysene	<1,000	1,000	<350	350	<360	360	<27,000	27,000
Fluoranthene	<1,000	1,000	<350	350	<360	360	<27,000	27,000
Phenanthrene	<1,000	1,000	<350	350	<360	360	<27,000	27,000
Pyrene	<1,000	1,000	**490**	350	<360	360	<27,000	27,000
REFERENCES								
Chain of Custody	Ref 6, p. 6		Ref 6, p. 6		Ref 10, p. 239		Ref 6, p. 7	
Laboratory Reports (including Form Is)	Ref 6, pp. 45-47, 54, 82-84		Ref 6, pp. 45-47, 53, 78-81		Ref 10, pp. 139-141, 167-169, 186		Ref 6, pp. 45-47, 64,117-119	
Other Supporting References	Ref. 5, p. 47; Ref. 6, p.13; Fig. 3 of this HRS documentation record		Ref. 5, p. 49; Ref. 6, p.12; Fig. 3 of this HRS documentation record		Ref. 9; Fig. 3 of this HRS documentation record		Ref. 5, p. 54; Ref 6, pp.1, 23; Fig. 3 of this HRS documentation record	

Key:
Bold- conc. is greater than or equal to the RL
RL – Reporting Limit (The RL is commonly defined as the lowest contaminant concentration at which a laboratory can report the concentration with confidence; therefore, the RL is by definition at or above the detection limit.)
< - Conc. is less than the RL
mg/kg – milligrams per kilogram
ug/kg – micrograms per kilogram

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

The hazardous constituent quantity for Source Nos. 2-10 could not be adequately determined according to the HRS requirements; that is the total mass of all Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) hazardous substances in the sources is not known and cannot be estimated with reasonable confidence (Ref. 1, Sec. 2.4.2.1.1). There are insufficient historical and current data (manifests, PRP records, state records, permits, waste concentration data, etc.) available to adequately calculate the total mass of all CERCLA hazardous substances in the sources and the associated releases from the sources. Therefore, there is insufficient information to evaluate the associated releases from the sources to calculate the hazardous constituent quantity for Source Nos. 2-10 with reasonable confidence. Scoring proceeds to the evaluation of Hazardous Wastestream Quantity (Surface Water Pathway) according to the HRS (Ref. 1, Sec. 2.4.2.1.1 and 2.4.2.1.2).

Hazardous Constituent Quantity Value (S): Not Calculated
Are the data complete for hazardous constituent quantity for this area? No

2.4.2.1.2 Hazardous Wastestream Quantity

The hazardous wastestream quantity for Source Nos. 2-10 could not be adequately determined according to the HRS requirements; that is the mass of hazardous wastestreams plus the mass of any additional CERCLA pollutants is not known and cannot be estimated with reasonable confidence (Ref. 1, Sec. 2.4.2.1.2). There are insufficient historical and current data (manifests, PRP records, state records, and permits) available to adequately calculate the mass of the hazardous wastestream or the mass of any additional CERCLA hazardous substances in the sources. Therefore, there is insufficient information to evaluate the associated releases from the sources to calculate the hazardous wastestream quantity for Source Nos. 2-10 with reasonable confidence. Scoring proceeds to an evaluation of volume according to the HRS (Ref. 1, Sec. 2.4.2.1.2 and 2.4.2.1.3).

Hazardous Wastestream Quantity Value (W): Not Calculated
Are the data complete for hazardous wastestream quantity for this area? No

2.4.2.1.3 Volume

The volume cannot be determined. Volume is assigned a value of 0 and scoring will proceed to an evaluation of area according to the HRS (Ref. 1, Sec. 2.4.2.1.3 and 2.4.2.1.4).

2.4.2.1.4 Area

Using the historical aerial photographs and the Sanborn maps, by sample collection of waste samples and visual inspection within each bermed area, the diameter of each waste source measured approximately 200 feet (Ref. 18; Ref. 28). The area source was determined by calculating the area of a circle. (Area of a circle = Πr^2).

$$100 \text{ ft.}^2 \times 3.14 = 31{,}400 \text{ ft.}^2$$
$$31{,}400 \text{ ft.}^2 / 13 = 2{,}415.38$$

Each area source for Source Nos. 2-10 will be assigned an area hazardous waste quantity value of 2,415.38.

Area of source (ft^2): 21,783.42
Area Assigned Value: 2,415.38
References: Figures 2 and 3 of this HRS documentation record; Ref. 1, Sec. 2.4.2.1.4; Ref. 18; Ref. 28

<u>Other Possible Sources Not Scored</u>

Other possible sources at Wilcox include:

- four tank bottom areas located north and south of Source No. 1 (Ref. 18, p. 4; Figure 5 of this HRS documentation record); two of the tank bottoms are located within the wetlands (Figure 5 of this HRS documentation record); and
- three tank bottom areas in the former tank farm area (Ref. 18, pp. 2-6).

The possible contaminants associated with the tank bottoms are most probably the same hazardous substances detected in the samples from Source Nos. 2 through 10.

2.4.2.2.5 Calculation of Hazardous Waste Quantity Factor Value

SITE SUMMARY OF SOURCE DESCRIPTIONS

			Containment			
Source No.	**Source Hazardous Waste Quantity Value**		**Ground Water**	**Surface Water**	**Air**	
	Surface Water Migration Pathway	**Soil Exposure Pathway**			**Gas**	**Air Particulate**
1	57.69	NS	NS	10	NS	NS
2	2,415.38	NS	NS	10	NS	NS
3	2,415.38	NS	NS	10	NS	NS
4	2,415.38	NS	NS	10	NS	NS
5	2,415.38	NS	NS	10	NS	NS
6	2,415.38	NS	NS	10	NS	NS
7	2,415.38	NS	NS	10	NS	NS
8	2,415.38	NS	NS	10	NS	NS
9	2,415.38	NS	NS	10	NS	NS
10	2,415.38	NS	NS	10	NS	NS
Total	**21,796.11**					

Key:
NS: Not Scored

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity Factor Value (Ref. 1, Sec. 2.4.2.2). The sum of the source hazardous waste quantity values for Surface Water Pathway is 21,796.11. For a Hazardous Waste Quantity range of greater than >10,000 to 1,000,000 a value of 10,000 is assigned for the migration pathway (Ref. 1, Sec. 2.4.2.2, Table 2-6).

Assigned Hazardous Waste Quantity Factor Value for Migration Pathways: 10,000

4.0 SURFACE WATER MIGRATION PATHWAY

4.1 OVERLAND/FLOOD MIGRATION COMPONENT

4.1.1.1 Definition of Hazardous Substance Migration Path for Overland/Flood Component

General Considerations:

Four PPEs have been identified. While contamination could have entered the wetlands anywhere along the boundary of the wetlands and the surface impoundment, PPE-1 is the most upstream probable point of entry into the wetlands from the surface impoundment. PPE-1 is located on the western part of the former Lorraine refinery (Figure 5 of this HRS documentation record). PPE-2 and PPE-3 are where on-site intermittent tributaries flow into Sand Creek (Figure 5 of this HRS documentation record). PPE-4 is located on the eastern side of the Wilcox facility where an eastern intermittent tributary also flows into Sand Creek (Figure 6 of this HRS documentation record). The 15 mile target distance limit is illustrated on Figure 6 of this HRS documentation record.

Table 5 describes the overland flow pathway and PPE information for each source.

Table 5 – Surface Water Pathway Description for Each Source

Source No	Pathway Description	PPE	Ref.
1	Source No. 1 transects the wetlands located on the west side of the facility	PPE-1: Palustrine forested wetlands contiguous with Sand Creek	9, p. 23; Figs. 5 and 6 of this HRS documentation record
2	Intermittent rills and sheet flow southeast to the East Tributary	PPE-4: Confluence of the eastern tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6 of this HRS documentation record
3	Intermittent rills and sheet flow south to an intermittent central tributary	PPE-3: Confluence of the central tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6 of this HRS documentation record
4	Intermittent rills and sheet flow south to an intermittent central tributary	PPE-3: Confluence of the central tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6 of this HRS documentation record
5	Intermittent rills and sheet flow south to an intermittent	PPE-3: Confluence of the central tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6

Table 5 – Surface Water Pathway Description for Each Source			
	central tributary		of this HRS documentation record
6	Intermittent rills and sheet flow south to an intermittent central tributary	PPE-3: Confluence of the central tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6 of this HRS documentation record
7	Intermittent rills and sheet flow south to an intermittent central tributary	PPE-3: Confluence of the central tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6 of this HRS documentation record
8	Intermittent rills and sheet flow southwest to an intermittent central tributary	PPE-3: Confluence of the central tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6 of this HRS documentation record
9	Intermittent rills and sheet flow south to the east tributary	PPE-4: Confluence of the eastern tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6 of this HRS documentation record
10	Intermittent rills and sheet flow south to the west tributary	PPE-2: Confluence of the western tributary into Sand Creek	13, pp. 24, 46; Figs. 5 and 6 of this HRS documentation record

Definition of In-Water Segments

The drainage pattern for the site is generally to the south (Ref. 3; Ref. 9, p. 23; Ref. 13, pp. 23, 46; Ref. 30. pp. 1-2). There are four locations where overland flow of surface waters across the site enters perennial waters (Sand Creek) (Ref. 9, p. 23; Ref. 13, pp. 3, 23, 46). Sand Creek meanders approximately 3.5 miles east until it merges with Little Deep Fork Creek. Little Deep Fork Creek begins approximately 3.1 miles southeast of PPE No. 4 (Figures 5 and 6 of this HRS documentation record).

Sand Creek

Sand Creek, a perennial stream, is located on the west side of the facility (Ref. 3; Figure 5 of this HRS documentation record). Sand Creek flows southward approximately 3.5 miles until it empties into the Little Deep Fork Creek (Ref. 3; Figure 6 of this HRS documentation record).

Little Deep Fork Creek

The Little Deep Fork Creek is joined by Sand Creek approximately 3.1 miles from the farthest downstream PPE (PPE 4). The remaining 8.9 miles of the 15-mile target distance limit (TDL) is contained within the Little Deep Fork Creek, which is a fishery (Ref. 5, pp. 1-4; Ref. 9, p. 1; Ref. 25, p.1).

4.1.2.1 Likelihood of Release

4.1.2.1.1 Observed Release

Chemical Analyses:

Field sampling procedures used for the samples collected followed the procedures set forth in the *EPA Guidance for Performing Site Inspections under CERCLA*, Interim Final, EPA 540-R-92-021(Ref. 5, pp. 4, 55; Ref. 16, pp. 4, 34; Ref. 31, pp. 6, 20). The sampling followed the procedures set forth in ODEQ's Site Assessment Quality Assurance Project Plan (QAPP) and the approved DEQ Quality Management Plan (QMP) (Ref. 39; Ref. 40). The samples were analyzed for total metals, including mercury, volatile and semivolatile organics using Oklahoma State Environmental Laboratory (SEL) methods and procedures (Ref. 16, pp. 59-68; Ref. 19).

Release sediment samples were compared to the background sediment samples to support an observed release to the surface water migration pathway. In addition to the chemical analyses, waste was also observed deposited into the stream bank during field activities by ODEQ personnel (Ref. 20, pp. 11, 12).

Soil types on the facility and surrounding area contain several soil series: the Stephenville and Darnell fins sandy loams, sloping and gently sloping, the Verdigris silt loam; and Oil-waste Land. Soils are described by the Creek County Soil Survey as follows (Ref. 16, pp. 7-9):

- The Stephenville and Darnell fine sandy loams cover most of the facility. These soils consist of shallow to moderately deep upland soils developed over reddish-yellow to red sandstone or interbedded sandstone and sandy shale (Ref. 16, p. 7).
- The Verdigris silt loam is located in the southwestern portion of the property, along Sand Creek. These soils occupy the flood plans of streams and are moderately well drained; however, they are flood occasionally to frequently. Parent material consists of slightly acid to weekly alkaline alluvial sediments washed from soils of the prairies (Ref. 16, p. 8).
- Oil-waste Land has been mapped in areas through the property, occurring in tanks farm and refinery areas. The areas mapped in this soil type have been practically ruined for agricultural use by oil and salt-water waste from oil wells. They are more or less gullied and eroded and are almost barren of vegetation (Ref. 16, p. 7).

• Background Concentration –

Table 6- Sediment Background Samples- Sand Creek				
Sample ID	**Depth**	**Sediment Description**	**Date**	**Reference**
LSD-5	0 to 24 inches	Dark brown sandy clay	April 22, 2009	Ref. 16, pp. 20, 277; Ref. 34, pp. 1, 2
SED-7	0 to 24 inches	Brown silty sediment	June 25, 2011	Ref. 20, p. 13; Ref. 34, pp. 1, 2

The background sediment samples, LSD-5 and SED-7 were collected upstream in Sand Creek (Figure 4 and Figure 5 of this HRS documentation record). The samples were grab samples collected from an area with similar flora and sediments (Figure 5 of this HRS documentation record; Ref. 5, p. 29; Ref. 16, p. 25, Ref. 30, p. 1; Ref. 34). The sediment samples were analyzed for semivolatiles by EPA Method 8270D and metals by EPA Methods 6010 or 6020 by the ODEQ SEL (Ref. 6, p. 2).

Table 7 – Background Sediment Concentrations for Sand Creek

	Sample No. SED-7 / SEL # 505996 Collection date: 6/25/2011		**Sample No. LSD-5 / SEL # 462188 Collection date: 4/22/2009**	
% moisture	19.2		27	
Hazardous Substance	Conc. (mg/kg)	RL (mg/kg)	Conc. (mg/kg)	RL (mg/kg)
Metals (mg/kg)				
Chromium	<5	5	4.90	1
Copper	<5	5	<1	1
Lead	<10	10	2.50	1
Nickel	<10	10	2.20	1
Zinc	8.60	5	6.40	1
Semivolatiles (ug/kg)				
Benzo(a)anthracene	<430	430	<400	400
Benzo(b)fluoranthene	<430	430	<400	400
Benzo(a)pyrene	<430	430	<400	400
Chrysene	<430	430	<400	400
Pyrene	<430	430	<400	400
Fluoranthene	<430	430	<400	400
Chain of Custody	Ref 6, p. 8		Ref. 16, p. 71	
Laboratory Reports (including Form Is)	Ref 6, pp. 45-47, 143, 165 to 167		Ref. 16, pp. 120, 250-253	
Other Supporting References	Fig. 4 of this HRS documentation record; Ref. 6, p.36		Fig. 4 of this HRS documentation record; Ref. 16	

Key:
RL – Reporting Limit (The RL is commonly defined as the lowest contaminant concentration at which a laboratory can report the concentration with confidence; therefore, the RL is by definition at or above the detection limit.)
< - concentration was detected below the RL

Table 8- Sediment Samples- Sand Creek					
Sample ID	**Depth**	**Sediment Description**	**% Moisture**	**Date**	**Reference**
LSD-2	0 to 24 inches	Brown sandy clay	18.4	April 22, 2009	Ref. 16, pp. 18, 117, 277; Ref. 34, pp. 1, 4
SED-12	0 to 24 inches	Sandy Dark Grey sediment	24.2	December 6, 2011	Ref. 7, p. 3; Ref. 8, p. 28; Ref. 34, pp. 1, 2
SED-13	0 to 24 inches	Reddish brown sediment	22.9	December 6, 2011	Ref. 7, p. 3; Ref. 8, p. 34; Ref. 34, pp. 1, 2
SED-14	0 to 24 inches	Brown sandy sediment, strong hydrocarbon and observance seep and sheen	6.9	December 6, 2011	Ref. 7, p. 3; Ref. 8, p. 40; Ref. 34, pp. 1, 3

Sediment sample LSD-2 was compared to background sample LSD-5 and sediment samples SED-12, SED-13, and SED-14 were compared to SED-7.

Table 9 – EVIDENCE										
SEDIMENT SAMPLES- Sand Creek										
Hazardous Substance	Established Background Level		Sample No. LSD-2 SEL No. 462185 Collection date: 4/22/2009		Sample No. SED-12 SEL No. 512702 Collection date: 12/6/2011		Sample No. SED-13 SEL No. 512703 Collection date: 12/6/2011		Sample No. SED-14 SEL No. 512704 Collection date: 12/6/2011	
	2009	2011								
			Conc.	RL	Conc.	RL	Conc.	RL	Conc.	RL
Metals (mg/kg)										
Lead	2.50	<10	**9.60**	1	17.0	10	<10	10	**145**	10
Semivolatiles (ug/kg)										
Benzo(a)anthracene	<400	<430	<390	390	<450	450	<410	410	**2,400**	580
Chrysene	<400	<430	<390	390	<450	450	<410	410	**4,100**	580
Pyrene	<400	<430	<390	390	<450	450	<410	410	**4,500**	580
Fluoranthene	<400	<430	<390	390	<450	450	<410	410	**1,600**	580
REFERENCES										
Chain of Custody	Table 7 of this HRS documentation record		Ref. 16, p. 71		Ref. 8, p. 6		Ref. 8, p. 6		Ref. 8, p. 6	
Laboratory Reports (including Form Is)			Ref 16, pp.117, 241-243		Ref 8, pp. 23-25, 27-32		Ref 8, pp. 23-25, 33-38		Ref 8, pp. 23-25, 39-45	
Other Supporting References			Fig. 4 of this HRS documentation record; Ref. 16, p. 277		Fig. 4 of this HRS documentation record; Ref 8, pp. 1, 8, 19		Fig. 4 of this HRS documentation record; Ref 8, pp. 1, 9, 19		Fig. 4 of this HRS documentation record; Ref 8, pp. 1, 10, 19	

Key:
Conc: Concentration
RL – Reporting Limit (The RL is commonly defined as the lowest contaminant concentration at which a laboratory can report the concentration with confidence; therefore, the RL is by definition at or above the detection limit.)
BOLD – Concentration meets observed release criteria (Ref. 1, Table 2-3).

Attribution:

The Wilcox facility is an inactive and abandoned oil refinery (Ref. 12, p. 3). The facility was active from 1915 until 1960s (Ref. 12, p. 3; Ref. 15, p. 4; Ref. 18, pp. 1-4).

The hazardous substances used to establish an observed release were associated with the site sources and the site contributed at least in part to the significant increase in the concentration of the hazardous substances in the observed release. Furthermore, the hazardous substances were detected at elevated levels in intermittent streams on the property that leads to Sand Creek (see Table 10 of this HRS documentation record).

Alternative sites that may be contributing releases of hazardous substances to those found at the Wilcox facility were identified. Former refineries were located north of the site. Little information is known about the dates of operation at these facilities. Sanborn maps from 1915 and 1920 indicate that the property west of the Wilcox Oil facility was occupied by Continental Refining Company (Ref. 18). Indiahoma Refining Company was located north of the facility (Ref. 18).

The background sediment samples (SED-7, LSD-5, and SED-9) were collected between any up gradient influences from former refinery activities and the site sources, which indicates that the significant increase in the concentration of the hazardous substances in the observed release is not due to other sites. The sources contained the same constituents in the observed release and in the drainage pathway to Sand Creek (see Tables 3, 4, 7 and 10 of this HRS documentation record).

Table 10- ATTRIBUTION												
SAMPLES- Overland flow into Sand Creek												
ODEQ Sampling, June 2011												
Hazardous Substance	Background Sample SED-9 / SEL No. 505888 Collection date: 6/28/2011		Sample No. SED-2 SEL No. 505990 Collection date: 6/29/2011		Sample No. SED-3 SEL No. 505991 Collection date: 6/29/2011		Sample No. SED-4 SEL No. 505993 Collection date: 6/29/2011		Sample No. SED- 5 SEL No. 505994 Collection date: 6/29/2011		Sample No. SED-11 SEL No. 505874 Collection date: 6/28/2011	
	Conc. (mg/kg)	RL (mg/kg)	Conc. (mg/kg)	RL (mg/kg)	Conc. (mg/kg)	RL (mg/kg)	Conc. (mg/kg)	RL (mg/kg)	Conc. (mg/kg)	RL (mg/kg)	Conc. (mg/kg)	RL (mg/kg)
Copper	<5	5	**9.90**	5	**12.3**	5	<5	5	**5.70**	5	**8.70**	5
Nickel	<10	10	**18.4**	10	**17.9**	10	<10	10	**12.8**	10	<10	10
REFERENCES												
Chain of Custody	Ref. 6, p. 7		Ref 6, p. 8		Ref 6, p. 8		Ref. 6, p. 8		Ref 6, p. 8		Ref 6, p. 6	
Laboratory Reports (including Form Is)	Ref. 6, pp. 43-48, 66		Ref 6, pp. 45-47, 137		Ref 6, pp. 45-47, 138		Ref. 6, pp. 45-47, 140		Ref 6, pp. 45-47, 141		Ref 6, pp. 47, 52	
Other Supporting References	Fig. 4 of this HRS documentation record; Ref. 6, p. 25		Fig. 4 of this HRS documentation record; Ref. 6, pp. 30, 39-41		Fig. 4 of this HRS documentation record; Ref. 6, pp. 31, 39-41		Fig. 4 of this HRS documentation record; Ref. 6, p. 33		Fig. 4 of this HRS documentation record; Ref. 6, p. 34		Fig. 4 of this HRS documentation record; Ref. 6, p.11	

Key:
BOLD: concentration is greater than the RL
Conc: Concentration
RL – Reporting Limit (The RL is commonly defined as the lowest contaminant concentration at which a laboratory can report the concentration with confidence; therefore, the RL is by definition at or above the detection limit.)
<: concentration was not detected above RL

The hazardous substances found on site may be directly related to crude oil or petroleum products. Waste petroleum products that contain higher concentrations of hazardous substances than the original product are CERCLA-eligible and are not subject to the petroleum exclusion provisions (Ref. 32, pp. 2-4).

Observed Release Factor Value: 550

4.1.3.2 HUMAN FOOD CHAIN THREAT - WASTE CHARACTERISTICS

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

The human food chain waste characteristics section provides the toxicity, persistence and bioaccumulation factor values for hazardous substances that are available to migrate from sources at the site to surface water in the watershed via the overland/flood hazardous substances migration path for the watershed (Ref. 1, Section 4.1.3.2.1), the hazardous waste quantity value for the watershed (Ref. 1, Section 4.1.3.2.2), and the calculation of the human food chain threat-waste characteristics factor category value (Ref. 1, Section 4.1.3.2.3). The highest combined toxicity, persistence and bioaccumulation factor is used to determine the waste characteristics factor value for the human food chain threat of the surface water migration pathway (Ref. 1, Section 4.1.3.2.1.4).

Hazardous substances that meet the criteria for an observed release to surface water and all hazardous substances associated with the sources that have a surface water containment factor value greater than 0 for the watershed are presented in Table 11 below. Each hazardous substance eligible to be evaluated is assigned a toxicity/persistence/bioaccumulation factor value. The hazardous substance with the highest toxicity/persistence/bioaccumulation factor value for the watershed is used to assign the value to this factor (Ref. 1, Section 4.1.3.2.1.4).

Table 11 – Human Food Chain Threat - Toxicity/Persistence/Bioaccumulation Summary

Hazardous Substance	Source No.	Toxicity Factor Value	Persistence Factor Value*	Toxicity/Persistence Factor Value (Table 4-12)	Bioaccumulation Factor Value **	Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-16)	Reference
Metals							
Arsenic	1, 2, 9	10,000	1.0	10,000	5.0	50,000	Ref. 1, Table 4-12, 4-16; Ref. 2, p .1
Chromium	1	10,000	1.0	10,000	500	5,000,000	Ref. 1, Table 4-12, 4-16; Ref. 2, p .3
Copper	1, 2, 3, 4, 5, 6, 9, 10	-	1.0	-	500	-	Ref. 1, Table 4-12, 4-16; Ref. 2, p. 3
Lead	1, 2, 3, 4, 5, 6, 7, 9, 10	10,000	1.0	10,000	5	50,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p.8
Nickel	1, 2, 3, 5, 9, 10	10,000	1.0	10,000	0.5	5,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p .9
Zinc	1	10	1.0	10	5.0	50	Ref. 1, Table 4-20, 4-21; Ref. 2, p .12

Table 11 – Human Food Chain Threat - Toxicity/Persistence/Bioaccumulation Summary							
Semivolatiles							
Benzo(a)anthracene	4	1,000	1.0	1,000	50,000	50,000,000	Ref. 1, Table 4-12, 4-16; Ref. 2, p. 2
Benzo(a)pyrene	2	10,000	1.0	10,000	50,000	500,000,000	Ref. 1, Table 4-12, 4-16; Ref. 2, p. 2
Benzo(b)fluoranthene	6	-	-	-	-	-	-
Chrysene	2	10	1.0	10	5	50	Ref. 1, Table 4-12, 4-16; Ref. 2, p. 3
Fluoranthene	6	100	1.0	100	500	50,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 2
2-methylnaphthalene	2	1,000	0.4	400	50,000	20,000,000	Ref. 1, Table 4-12, 4-16; Ref. 2, p. 9
Phenanthrene	2	-	0.4	-	5,000	-	Ref. 1, Table 4-12, 4-16; Ref. 2, p. 9
Pyrene	2, 3, 4, 6, 8	100	1.0	100	50,000	5,000,000	Ref. 1, Table 4-12, 4-16; Ref. 2, p. 10

Key:
* Persistence values assigned are based on Sand Creek, which is a perennially flowing water classified as a River.
**Bioaccumulation values are assigned based on the surface category of fresh water
- No value in SCDM

The hazardous substance with the highest Toxicity/Persistence/Bioaccumulation Factor Value is benzo(a)pyrene.

Toxicity/Persistence/Bioaccumulation Factor Value: 500,000,000

4.1.3.2.2 Hazardous Waste Quantity

Table 12- Hazardous Waste Quantity Summary		
Source Number	**Source Hazardous Waste Quantity Value (Section 2.4.2.1.5)**	**Is Source Hazardous Constituent Quantity Data Complete? (yes/no)**
1	57.69	No
2	2,415.38	No
3	2,415.38	No
4	2,415.38	No
5	2,415.38	No
6	2,415.38	No
7	2,415.38	No
8	2,415.38	No
9	2,415.38	No
10	2,415.38	No
TOTAL	21,796.11	

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity Factor Value (Ref.1, Sec. 2.4.2.2 and Table 2-6). The sum of the source hazardous waste quantity values for Surface Water Pathway, rounded to the nearest integer, is 21,796.

Sum of Values: 21,796
Hazardous Waste Quantity Assigned: 10,000 (Ref. 1 Table 2-6)

4.1.3.2.3 Waste Characteristics Factor Category Value

The waste characteristics factor category value is assigned based on the Waste Characteristics Product. The Waste Characteristics Product is the product of the Toxicity/Persistence Factor Value and the Hazardous Waste Quantity Factor Value subject to a maximum of 1×10^8. This product is multiplied by the Bioaccumulation Potential Factor Value subject to a maximum value of 1×10^{12}. The hazardous substance with the highest Toxicity/Persistence/Bioaccumulation factor value for the watershed is benzo(a)pyrene (Ref. 1, Section 4.1.3.2.3).

Toxicity/Persistence Factor Value: 10,000
x Hazardous Waste Quantity Factor Value: 10,000

(Toxicity/Persistence x Hazardous Waste Quantity):
$10{,}000 \times 10{,}000 = 1 \times 10^8$
(Subject to a maximum product of 1×10^8)

Bioaccumulation Potential Factor Value: 50,000
(Toxicity/Persistence x Hazardous Waste Quantity) x
Bioaccumulation Potential Factor Value:

$(1 \times 10^8) \times (50{,}000) = 5 \times 10^{12}$
(Subject to a maximum product of 1×10^{12})

A Waste Characteristics Product value of 1×10^{12} receives a waste characteristics factor value of 1,000 (Ref. 1, Table 2-7).

Hazardous Waste Quantity Assigned Value: 10,000
Waste Characteristics Factor Category Value: 1,000

4.1.3.3 HUMAN FOOD CHAIN THREAT-TARGETS

Little Deep Fork Creek, which is located in the 15-mile TDL is a fishery and fish collected are for human consumption (Ref. 25, p. 1). Little Deep Fork Creek is located approximately 3.7 miles downstream of PPE-2, where Sample No. SED-14 was collected (see Figures 5 and 6 and Table 9 of this HRS Documentation Record).

4.1.3.3.1 Food Chain Individual

A food chain individual factor value of 20 is assigned based on an observed release by chemical analyses of fluoranthene and pyrene with a Bioaccumulation Factor Value of 500 or greater to sediments within the surface water target distance limit, and due to the fishery present in Little Deep Fork Creek (Sec. 4.1.2.1.1 of this HRS documentation record; Ref.1, Sec. 4.1.3.3.1; Ref. 2, pp. 2, 3, and 10; Ref. 25, p.1; Figure 6 and Table 9 of this HRS Documentation Record).

Food Chain Individual Factor Value: 20 (Ref. 1, Section 4.1.3.3.1)

4.1.3.3.2 Population

The Population Factor for the watershed is based on three factors: Level I concentrations, Level II concentrations, and potential human food chain contamination.

4.1.3.3.2.1 Level I Concentrations

There are no Level I concentrations established because there were no tissue samples collected (Ref. 1, Sec. 4.1.3.3.2.1).

4.1.3.3.2.2 Level II Concentrations

No Level II concentrations have been established within a fishery.

4.1.3.3.2.3 Potential Human Food Chain Contamination

Fishing is documented in Little Deep Fork Creek. Fish are consumed from Little Deep Creek, but the exact pounds consumed are not known (Ref. 25, p. 1). Although the annual pounds of fish consumed are unknown, since some fish are consumed, the annual pounds consumed are greater than zero. A human food chain population value of 0.03 is assigned for production greater than zero (>0) and less than 100 (<100) pounds per year of annual human consumption (Ref. 1, Table 4-18).

According to gauging station #07243500 located in the NW ¼ of the SW ¼ of S20 T14N R12E in Okmulgee County, approximately 25 miles southeast from the site, the average annual flow rate of the Deep Fork River as measured for water year 1939 through 2011 is 932 cfs (Ref. 29, pp.1-2). No gauging stations are located on Sand Creek or the Little Deep Fork Creek. The flow rate at the target locations (wetlands, Sand Creek, and Little Deep Fork Creek) was extrapolated using the flow data from Deep Fork River, therefore these segments will be set to equal the flow at the downstream gauging station and will be considered to be a moderate to large stream and will be assigned a dilution value of 0.01 (Ref. 1, Table 4-13).

Table 13- Fishery Identification Summary

Identity of Fishery	Annual Production (pounds)	Type of Surface Water Body	Average Annual Flow	Population Value (P_i)	Dilution Weight (D_i)	$P_i x D_i$	Reference
Little Deep Creek	>0	moderate to large	>100 to 1,000 cfs	0.03	0.01	0.0003	Ref. 1, Tables 4-13, 4-18; Ref. 25, p. 1; Ref. 29, pp. 1-2

Sum: 0.0003

SWOF/
Food Chain-Hazardous Waste Quantity

(Sum of P_i x D_i)/10: 0.00003

Potential Human Food Chain Contamination
Factor Value: 3.0×10^{-5}

4.1.3.3.2.4 Calculation of Population Factor Value

The population factor value is equal to:

Level I Concentrations (0) + Level II Concentrations (0) + Potential Human Food Chain Contamination (0.00003) = 0.00003.

A value of 3.0×10^{-5} is assigned as the Population Factor Value.

Population Factor Value: 3.0×10^{-5}

4.1.3.3.3 Calculation of Human Food Chain Threat- Targets Factor Category Value

The Human Food Chain Threat - Targets Factor Category value is calculated by summing the food chain individual and population factor values for the watershed:

Food Chain Individual + Population Factor= 20 + 0.00003 = 20.00003

Target Factor Category Value: 20.00003

4.1.3.4 Calculation of Human Food Chain Threat Score for a Watershed

The Human Food Chain Threat score is calculated by multiplying the human food chain threat factor category values for likelihood of release, waste characteristics, and targets for the watershed (Ref. 1, Section 4.1.3.4).

Likelihood of Release (550) x Waste Characteristics (1000) x Targets (20.00003) = 11,000,016 (rounded to the nearest integer).

This product is then divided by 82,500:

$$11{,}000{,}016 \div 82{,}500 = 133.33$$

The resulting value, subject to a maximum of 100, is assigned as the Human Food Chain Threat Score.

Human Food Chain Threat Score= 100

4.1.4.2 ENVIRONMENTAL THREAT- WASTE CHARACTERISTICS

4.1.4.2.1 Ecosystem Toxicity/Persistence/Bioaccumulation

The environmental threat waste characteristics section provides the ecosystem toxicity, persistence and bioaccumulation factor values for hazardous substances that are available to migrate from sources at the site to surface water in the watershed via the overland/flood hazardous substances migration path for the watershed (Ref. 1, Section 4.1.4.2.1), the hazardous waste quantity value for the watershed (Ref. 1, Section 4.1.4.2.2), and the calculation of the environmental threat-waste characteristics factor category value. The highest combined ecosystem toxicity, persistence and bioaccumulation factor is used to determine the waste characteristics factor value for the environmental threat of the surface water migration pathway (Ref. 1, Section 4.1.4.2.3).

Hazardous substances that meet the criteria for an observed release to surface water and all hazardous substances associated with the sources that have a surface water containment factor value greater than 0 for the watershed are presented in Table 14 below. Each hazardous substance eligible to be evaluated is assigned an ecosystem toxicity/persistence/bioaccumulation factor value. The hazardous substance with the highest ecosystem toxicity/persistence/bioaccumulation factor value for the watershed is used to assign the value to this factor (Ref. 1, Section 4.1.4.2.1.4).

Table 14- Ecosystem Toxicity/Persistence/Bioaccumulation Factor Summary

Hazardous Substance	Source No.	Ecosystem Toxicity Factor Value**	Persistence Factor Value*	Ecosystem Bioaccumulation Value**	Ecosystem Toxicity/ Persistence Factor Value (Table 4-20)	Ecosystem Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-21)	Reference
Metals							
Arsenic	1, 2, 9	10	1.0	5,000	10	50,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 1
Chromium	1	10,000	1.0	500	10,000	5,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 3
Copper	1, 2, 3, 4, 5, 6, 9, 10	1,000	1.0	5,000	1,000	5,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 3
Lead	1, 2, 3, 4, 5, 6, 7, 9, 10	1,000	1.0	50,000	1,000	50,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 8

Table 14- Ecosystem Toxicity/Persistence/Bioaccumulation Factor Summary

Nickel	1, 2, 3, 5, 9, 10	100	1.0	500	100	50,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 9
Zinc	1	10	1.0	50,000	10	500,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p.12
Semivolatiles							
Benzo(a)anthracene	4	10,000	1.0	50,000	10,000	500,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 2
Benzo(a)pyrene	2	10,000	1.0	50,000	10,000	500,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 2
Benzo(b)fluoranthene	6	-	-	-	-	-	-
Chrysene	2	1,000	1.0	5,000	1,000	5,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 3
Fluoranthene	6	10,000	1.0	5,000	10,000	50,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 2
2-methylnaphthalene	2	100	0.4	50,000	40	2,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 9
Phenanthrene	2	10,000	0.4	50,000	4,000	200,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 9
Pyrene	2, 3, 4, 6, 8	10,000	1.0	50,000	10,000	500,000,000	Ref. 1, Table 4-20, 4-21; Ref. 2, p. 10

Key:
* Persistence values assigned are based on Sand Creek, which is a river.
**Ecosystem Toxicity and Ecosystem Bioaccumulation values are assigned based on the surface category of fresh water.
- No value in SCDM

The contaminants with the highest Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value are benzo(a)anthracene, benzo(a)pyrene and pyrene (Ref. 1, Table 4-21; Ref. 2, pp. 1-13).

Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value: 500,000,000

4.1.4.2.2 Hazardous Waste Quantity

Source Number	Source Hazardous Waste Quantity Value (Section 2.4.2.1.5)	Is Source Hazardous Constituent Quantity Data Complete? (yes/no)
1	57.69	No
2-10	21,738.42	No
TOTAL	21,796.11	No

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity Factor Value (Ref. 1, Sec. 2.4.2.2 and Table 2-6). The sum of the source hazardous waste quantity values for Surface Water Pathway, rounded to the nearest integer, is 21,796.

Sum of Values: 21,796
Hazardous Waste Quantity Factor Value: 10,000 (Ref. 1 Table 2-6)

4.1.4.2.3 Waste Characteristics Factor Category Value

A Waste Characteristics Factor Category Value is assigned based on the Waste Characteristic Product. The hazardous substances with the highest ecosystem toxicity/persistence/bioaccumulation factor value for the watershed are benzo(a)pyrene, benzo(a)anthracene, and pyrene (Ref. 1, Section 4.1.4.2.3). These values are used to determine the water characteristic product. The Waste Characteristic Product is the product of the Ecosystem Toxicity/Persistence/ Factor Value and the Hazardous Waste Quantity Factor Value subject to a maximum product of 1×10^8. This product is multiplied by the Ecosystem Bioaccumulation Potential Factor Value Subject to a maximum product of 1×10^{12}.

Using HRS Table 4-20 and Table 15 of this HRS documentation record, the Ecosystem Toxicity/Persistence value for benzo(a)pyrene, benzo(a)anthracene, and pyrene is 10,000.

A Hazardous Waste Quantity Factor Value of 10,000 is assigned from the sum of Source Hazardous Waste Quantity Values for all the sources (Ref. 1, Section 2.4.2.2, Table 2-6).

Ecosystem Toxicity/Persistence Factor Value = 10,000
Hazardous Waste Quantity Factor Value = 10,000
$10{,}000 \times 10{,}000 = 1 \times 10^8$
(Subject to a maximum product of 1×10^8

The Ecosystem Bioaccumulation Value for benzo(a)anthracene, benzo(a)pyrene and pyrene is 50,000 (Ref. 2, p. 8).

Ecosystem Bioaccumulation Value = 50,000

(Ecosystem Toxicity/Persistence x Hazardous Waste Quantity) x Bioaccumulation Factor Value:

$(1 \text{ X } 10^8) \times (50{,}000) = 5 \times 10^{12}$

(Subject to a maximum product of 1×10^{12})

A Waste Characteristics Product Value of 1×10^{12} receives a Waste Characteristic Factor Value of 1,000 (Ref. 1, Table 2-7).

(Ecosystem Toxicity/Persistence Factor Value
x Hazardous Waste Quantity Factor Value) x Bioaccumulation Factor Value: 1×10^{12}
Waste Characteristics Factor Value: 1,000

4.1.4.3 ENVIRONMENTAL THREAT- TARGETS

4.1.4.3.1 Sensitive Environments

4.1.4.3.1.1 Level I Concentrations

No water, benthic, or tissue samples have been collected within the Surface Water Pathway; therefore, Level l concentrations are not being scored (Ref. 1, Sec. 4.1.4.3.1.1).

Level I Concentrations Factor Value: 0

4.1.4.3.1.2 Level II Concentrations

Wetlands, as identified on National Wetland Inventory maps as a PFO1A designation, which meets the 40 CFR 230.3 definition of a wetland, are located on the southwest corner of the site and are contiguous with Sand Creek (Ref. 30, pp. 1-2; Ref. 38).

Level II concentrations have been established in the wetlands at PPE No. 1 to PPE No. 3 in Sand Creek (Figure 5 of this HRS documentation record). Chemical analyses of samples meet observed release criteria (Tables 7 and 9 of this HRS documentation record).

The wetted perimeter of the wetlands subject to Level II contamination (Ref. 1, p. 51625) measures 2,510 feet (Figures 5 and 6 of this HRS documentation record; Ref. 30, p. 1). A value of 25 is assigned from Table 4-24 of the HRS for length of wetlands from >0.1 to 1 mile (Ref. 1, Sec. 4.1.4.3.1.2).

Other listed sensitive environments will not be scored. The Level II concentration factor value is the sum of the wetlands value (25) and listed sensitive environments value (0):

$$25 + 0 = 25$$

Level II Concentrations Factor Value: 25

4.1.4.3.1.3 Potential Contamination

Wetlands

There is potential wetland frontage along Little Deep Fork River (Ref. 30, pp. 1 - 2). The potential contamination to the wetlands will not be scored at this time.

Sum of Sensitive Environments Value + Wetland Value: 0
Potential Contamination Factor Value: 0