



Fact Sheet

Phillips 66 Company Billings Refinery

1. Introduction

1.1 Facility Description

Phillips 66 Company Billings Refinery (Phillips 66) is a petroleum refinery that began operation in 1949. The refinery is located on the southeast side of Billings, Montana and covers approximately 200 acres. See Figure 1. Site Location.

1.2 Site Geology and Hydrology

The refinery is situated on an alluvial terrace deposit associated with the Yellowstone River. The river is approximately 1,000 feet east of the refinery. The geology underlying the site is clay-silts from ground surface to about 6 feet below ground surface, sandy-gravels from 6 to 22 feet below ground surface, and gray shale bedrock (Colorado Shale) at approximately 22 feet below ground surface. The bedrock contact at the refinery varies between 17 to 25 feet below ground surface. The Colorado Shale acts as an aquitard. An aquitard limits the downward flow of water. Groundwater flows northeast towards the Yellowstone River.

1.3 Regulatory Authority

Phillips 66 was issued a Montana Hazardous Waste Permit #MTHWP-18-01 on September 21, 2018. The 2018 permit was a renewal of a hazardous waste permit originally issued in 2002. The permit requires Phillips 66 conduct corrective actions to cleanup releases of hazardous waste and hazardous constituents in soil and groundwater that are a result of past refinery activities.

Table 1 list all the Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) at the refinery and their corrective action status. Figure 2 shows their location at the refinery.

2. Corrective Action History

2.1 Facility-Wide

Cleanup activities at the site have been occurring since 1990 when Phillips 66 and EPA agreed to an Administrative Order on Consent. The Administrative Order required Phillips 66 to perform facility-wide corrective action. Corrective action is a cleanup process for investigating releases of contamination to the environment and designing remedies to address those releases. The Administrative Order also required Phillips 66 to install interim corrective measures to address contamination that presented an immediate or potential threat to human health or the environment.

In 1993, a groundwater interceptor system (GWIS) was installed as an interim measure (IM) to control the off-site migration of contamination in groundwater. The GWIS functioned as a pump and treat system for the recovery of free-phase petroleum products, including light nonaqueous-phase liquid [LNAPL]) and hydrocarbon-impacted groundwater.

In 1997, EPA approved the RCRA Facility Investigation Report (RFI) and risk assessment. The report presented the results of an investigation to determine the nature and extent of groundwater, surface water, and soil contamination on and off-site. The objective of the risk assessment was to identify potential human health and ecological risks.

As a result of the RFI findings, EPA required Phillips 66 to conduct a Corrective Measures Study (CMS). The CMS evaluated potential remediation technologies for contaminated soil and groundwater at the refinery. A remedy was selected for these areas in 2002. See Table 1 for the areas included in the 2002 approved remedy.

With the completion of the CMS, the requirements of EPA's Administrative Order were fulfilled. The Administrative Order was terminated and a Montana Hazardous Waste Permit was issued in 2002. The permit incorporated the selected remedy and included requirements to implement the remedy.

In 2005, DEQ approved Phillips 66's Corrective Measures Implementation Plan (CMI) to implement the remedy. An updated CMI was approved by DEQ in 2016 and 2018.

The permit also required investigation and remedy selection for SWMUs/AOCs that were not included in the 2002 remedy. These SWMUs/AOCs include the South Oily Sludge Pits (SOSP), South 40 DNAPL, Butane Release Area, Glacier Manifold Pipeline Release, and Jupiter Sulfur Expansion.

In 2005, Phillips 66 submitted a CMS for the South Oily Sludge Pit (SOSP). A permit modification incorporating the remedy for the SOSP was finalized in 2006. On October 2, 2009, DEQ

approved the Corrective Measures Implementation Certification Report and Certification of Completion for the SOS. No further corrective action is required for soils at the SOS.

2.2 GWIS Shutdown Testing and Sparging Technologies

Since 2015, DEQ has approved a series of sparging systems as an interim measure. Sparging is a technology where air, oxygen, and/or other constituents are introduced into the water table to stimulate the breakdown of contamination by microorganisms. The sparge systems function as a source and boundary control measure to prevent off-site migration of BTEX (benzene, toluene, ethylbenzene, and xylene) and vinyl chloride as well as to promote downgradient biodegradation of constituents of interest (COIs).

2.3 Future Corrective Action and Permit Modification

The 2002 remedy selection did not include the South 40 DNAPL Area, Butane Release Area, Glacier Manifold Pipeline Release Area, and Jupiter Sulfur Expansion Area. In 2020 DEQ required Phillips 66 to submit a CMS Report to address these areas. DEQ also required Phillips 66 to provide information to justify permanently changing the remedy from the GWIS to sparging technologies.

Phillips 66 proposed the change in the *2021 Outstanding SWMU/AOC Corrective Measures Study Report* dated November 8, 2021. A modification to the site's hazardous waste permit will be required for DEQ to select a remedy. A modification is anticipated to be finalized in 2022. Table 1 reflects the anticipated 2022 remedy selection.

3. Current Site Conditions and Risks

3.1 Active Remedies

The following corrective actions, including interim measures, are being implemented at the refinery:

- Non-aqueous phase liquid (NAPL) recovery
- Operation of four interim measures sparge systems, including:
 - 2nd Street Biosparge System
 - East Fence Line Biosparge System
 - EFL Ozone-Peroxide Sparge System
 - North Fence Line Sparge System
- Continuation of the site-wide groundwater interceptor system (GWIS) shutdown test

3.2 Groundwater Monitoring

The site-wide groundwater monitoring network is depicted in Figure 3. The groundwater monitoring strategy includes:

- Fluid level gauging
- Compliance point monitoring
- Groundwater plume monitoring
- Corrective action performance monitoring

Wells are gauged and sampled as dictated by the approved CMI Work Plan or IM Work Plan. In the third quarter of 2021, fluid level gauging was completed at 242 wells. Groundwater samples were collected from 140 monitoring locations.

3.3 Groundwater Contamination

Eleven monitoring wells had measurable or observed LNAPL or DNAPL during the third quarter of 2021. Figure 4. shows the observed LNAPL at the refinery. Since 2001, approximately 36,772 gallons of LNAPL have been recovered. This value does not include LNAPL recovered by the GWIS.

COIs are tracked and evaluated after each sampling event. In general, the COIs at the refinery that drive groundwater monitoring and corrective action are BTEX and vinyl chloride. Figures 5 and 6 show the extent and magnitude of these constituents in 2021. Remedial activities have reduced the extent and magnitude of groundwater contamination. Figures 7 and 8 show changes in BTEX and vinyl chloride concentrations from 2010 to 2021.

Vinyl chloride in groundwater at the Phillips 66 refinery is generally caused by the breakdown of trichloroethene (TCE). Known sources for the vinyl chloride plume, at the southern portion of the refinery, include historical releases from the SOSP, South 40 DNAPL Area, and Area 3 Landfarm.

Vinyl chloride does not degrade easily under anaerobic conditions. The sparge technologies described above create more aerobic conditions in the subsurface that increases degradation of the vinyl chloride plume.

Boundary monitoring wells are used to evaluate whether COIs meet the Montana groundwater quality standards. In the third quarter of 2021, vinyl chloride exceeded groundwater standards in monitoring locations OR-3 and PZ-19. Arsenic was detected in monitoring locations PZ-19 and PZ-23 above groundwater standards.

Arsenic is the primary inorganic COI at the refinery. Arsenic is found at the refinery from refinery contamination, naturally occurring amounts in soil, and potentially historical insecticide

use. Dissolved arsenic mobilization, due to shifting redox conditions resulting from microbial degradation of petroleum hydrocarbons, is normal and expected. Widespread use of arsenic-based insecticides (the site's prior use was agricultural) may also be a component of elevated arsenic levels. Arsenic levels have been reduced by corrective action at the site, including sparging technologies. See Figure 9 showing the change in arsenic concentrations over time.

3.4 Soil Contamination

Soil at the refinery has been impacted by hydrocarbon contamination. Leaching of COIs from subsurface soil to groundwater is being monitored. Phillips 66 requires HAZWOPER-trained personnel perform sub-surface work at or within known SWMUs/AOCs and areas where contamination is suspected through an on-site administrative permitting process. This activity is intended to mitigate on-site human health risks.

3.5 Vapor Intrusion

Vapor intrusion is a potential human exposure pathway to hazardous constituents from contact with hazardous vapors. A complete vapor intrusion pathway is required for the exposure in a structure.

Phillips 66 conducted a vapor intrusion study, following DEQ's *Montana Vapor Intrusion Guide* for potential impacts from NAPL and dissolved phase groundwater sources. On March 5, 2021, DEQ approved the *Phase 3 Vapor Intrusion Evaluation Report* provided by Phillips 66. DEQ agreed with their recommendation that no further investigation or corrective action related to vapor intrusion is necessary, because there are no unacceptable vapor intrusion exposures.

4. Corrective Action Objectives

The corrective action objectives for the site were established in the 2001 CMS Report. The objectives are the following:

- 1 Prevent leaching of contaminants in soil to groundwater above regulatory or risk-based action levels;
- 2 Prevent residential use of property in areas that pose unacceptable lifetime human health risk from exposure;
- 3 Reduce the amount of free product in the aquifer beneath the refinery to the extent possible utilizing available technologies;
- 4 Prevent unacceptable exposure to human health and the environment from both free product and contaminated groundwater; and

- 5 Comply with state and federal applicable water quality standards or risk-based concentrations on and off the site.

5. Additional Information

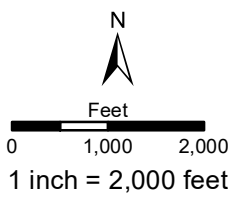
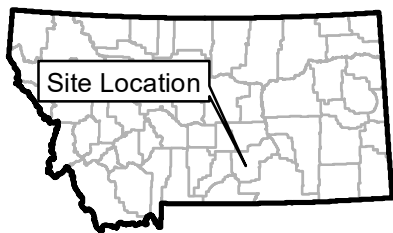
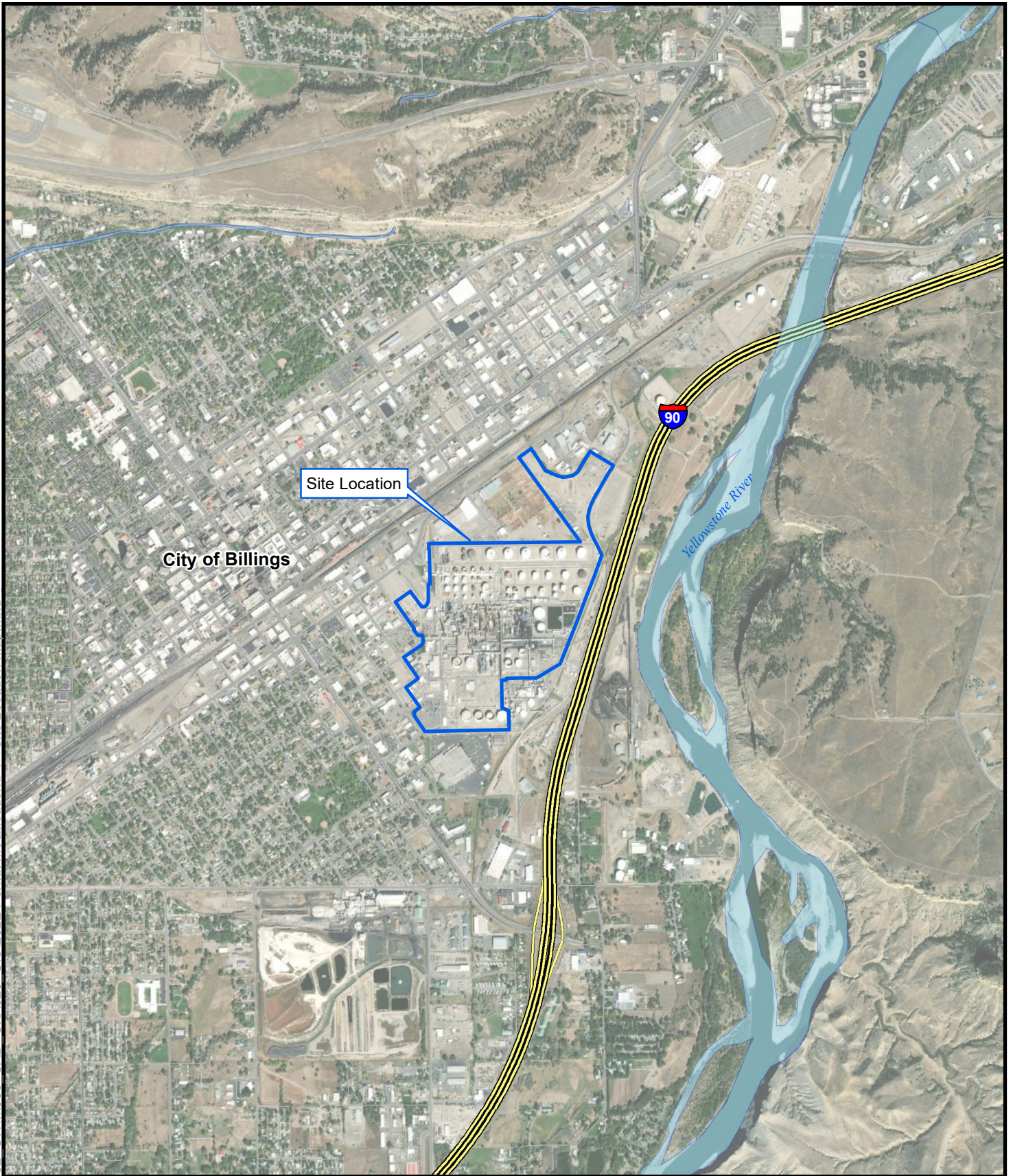
For additional information about Phillips 66 Company Billings Refinery's hazardous waste permit or corrective action activities, please contact:

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Waste and Underground Tank Management Bureau
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Table 1. Corrective Action Status of Solid Waste Management Units (SWMU) and Areas of Concern (AOC)

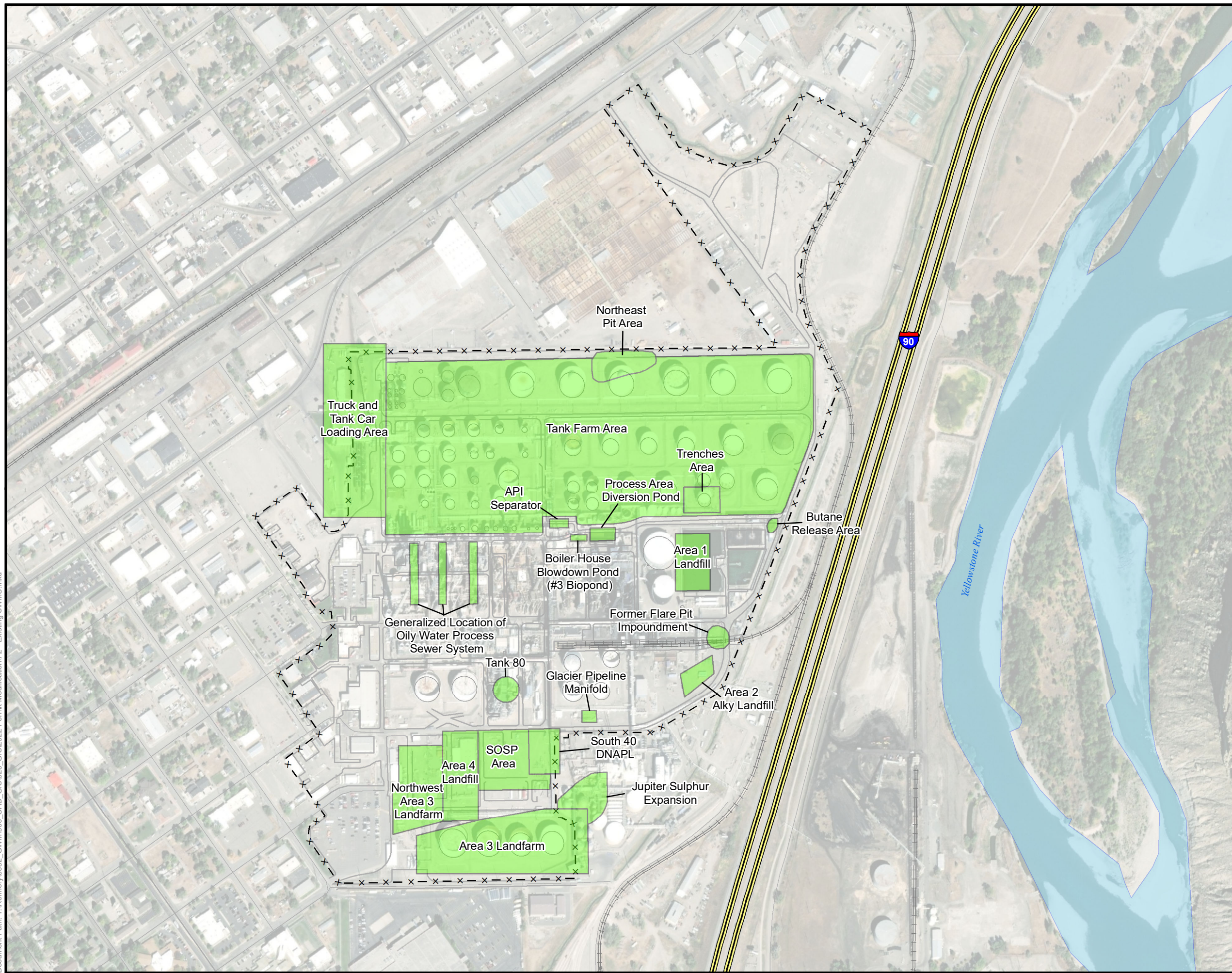
SWMU/AOC Name	Included in EPA Consent Order	RFI Status	CMS Status	Statement of Basis Date	CMI Status
API Separator	Yes	C	NR	NR	NR
Area 1 Landfill	Yes	C	C	2002	IP
Area 2 Alky Landfill	Yes	C	NR	NR	NR
Area 3 Landfarm	Yes	C	C	2002	C
Area 4 Landfarm	Yes	C	NR	NR	NR
Boiler House Blowdown Pond	Yes	C	C	2002	IP
Butane Release Area	No	C	C	2022	R
COI in Ground Water	No	C	C	2002 & 2022	IP
COI in Soil	No	C	C	2002 & 2022	IP
Former Flare Pit Impoundment	Yes	C	C	2002	IP
Glacier Manifold Pipeline Release	No	C	C	2022	R
Jupiter Sulfur Expansion	No	C	C	2022	R
Northeast Pit Area	Yes	C	C	2002	IP
Northwest Area 3 Landfarm	No	C	NR	NR	NR
Oily Water Process Sewer System	Yes	C	C	2002	IP
Process Area Diversion Pond	Yes	C	C	2002	IP
Product on Ground Water	No	C	C	2002 & 2022	IP
South 40 DNAPL	No	C	C	2022	R
South Oily Sludge Pits	Yes	C	C	2006	C
Tank 80	No	NR	NR	NR	NR
Tank Farm Area	No	C	C	2002	IP
Trenches Area of Concern	No	C	C	2002	IP
Truck and Tank Car Loading Area	Yes	C	C	2002	IP

C Complete
 R Required
 RFI RCRA Facility Investigation
 CMI Corrective Measures Implement
 NR Not Required
 IP In Progress
 CMS Corrective Measures Study




AECOM		
Title: Site Location Map		
Project: DRAFT Statement of Basis		
Location: Phillips 66 Company Billings Refinery Billings, Montana (RM Site No. 6052 and 6058)		
Date: 2/3/2022	Project No: 60675209	Figure: 1

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Legend

 Known SMWUs and AOCs

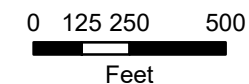
 Refinery Fence Line

Notes:

- 1. CMI - Corrective Measures Implementation
- 2. SWMU - Solid Waste Management Unit
- 3. AOC - Area of Concern
- 4. SOSP - South Oily Sludge Pit
- 5. API - American Petroleum Institute



1 inch = 500 feet



AECOM

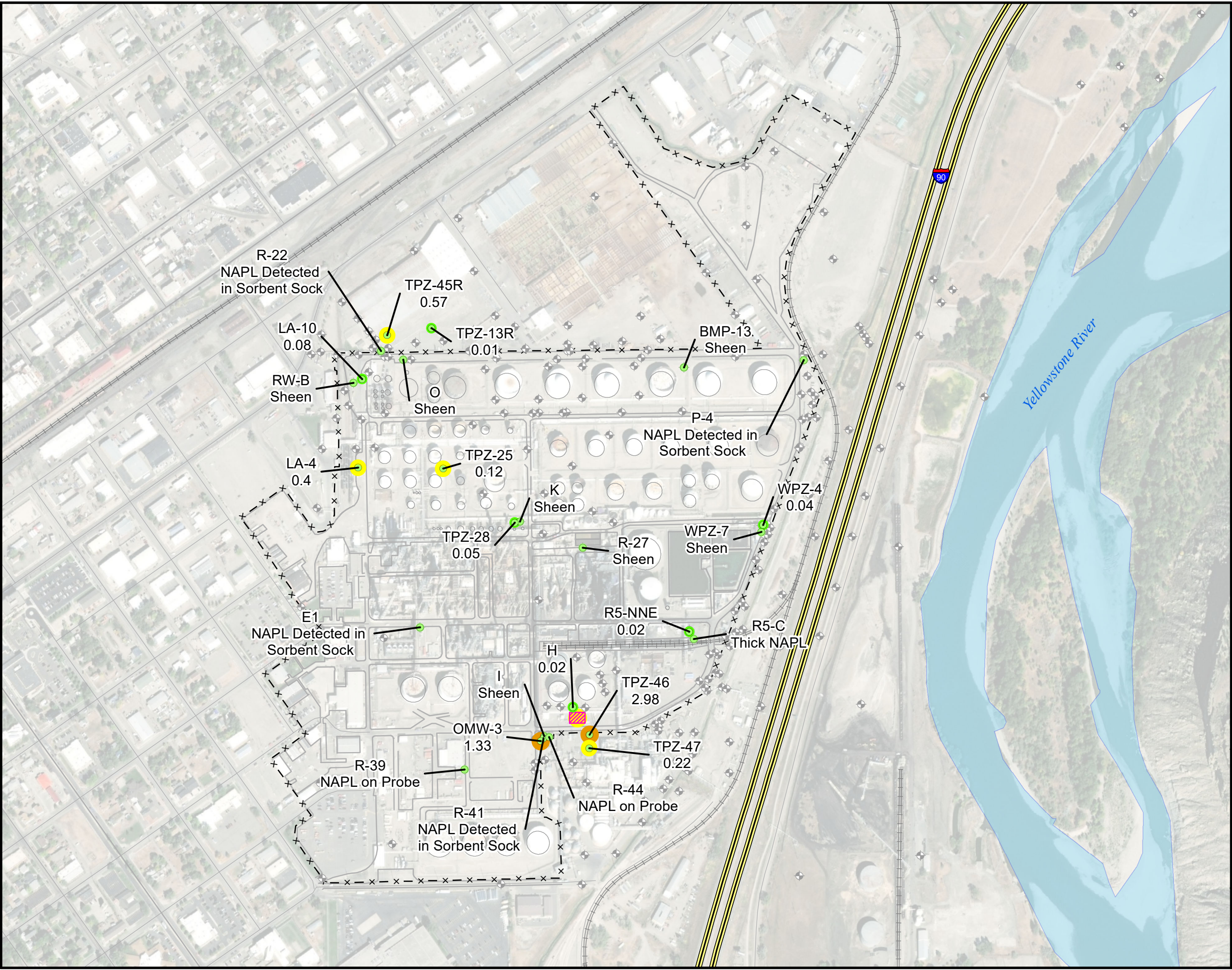
Title: Existing Solid Waste Management Unit and Area of Concern Map

Project: DRAFT Statement of Basis

Location: Phillips 66 Company Billings Refinery Billings, Montana (RM Site No. 6052 and 6058)

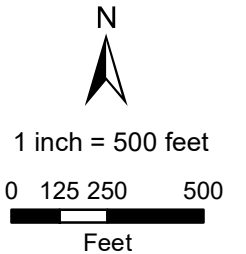
Project No.: 60675209	Date: 3/11/2022	Figure: 2
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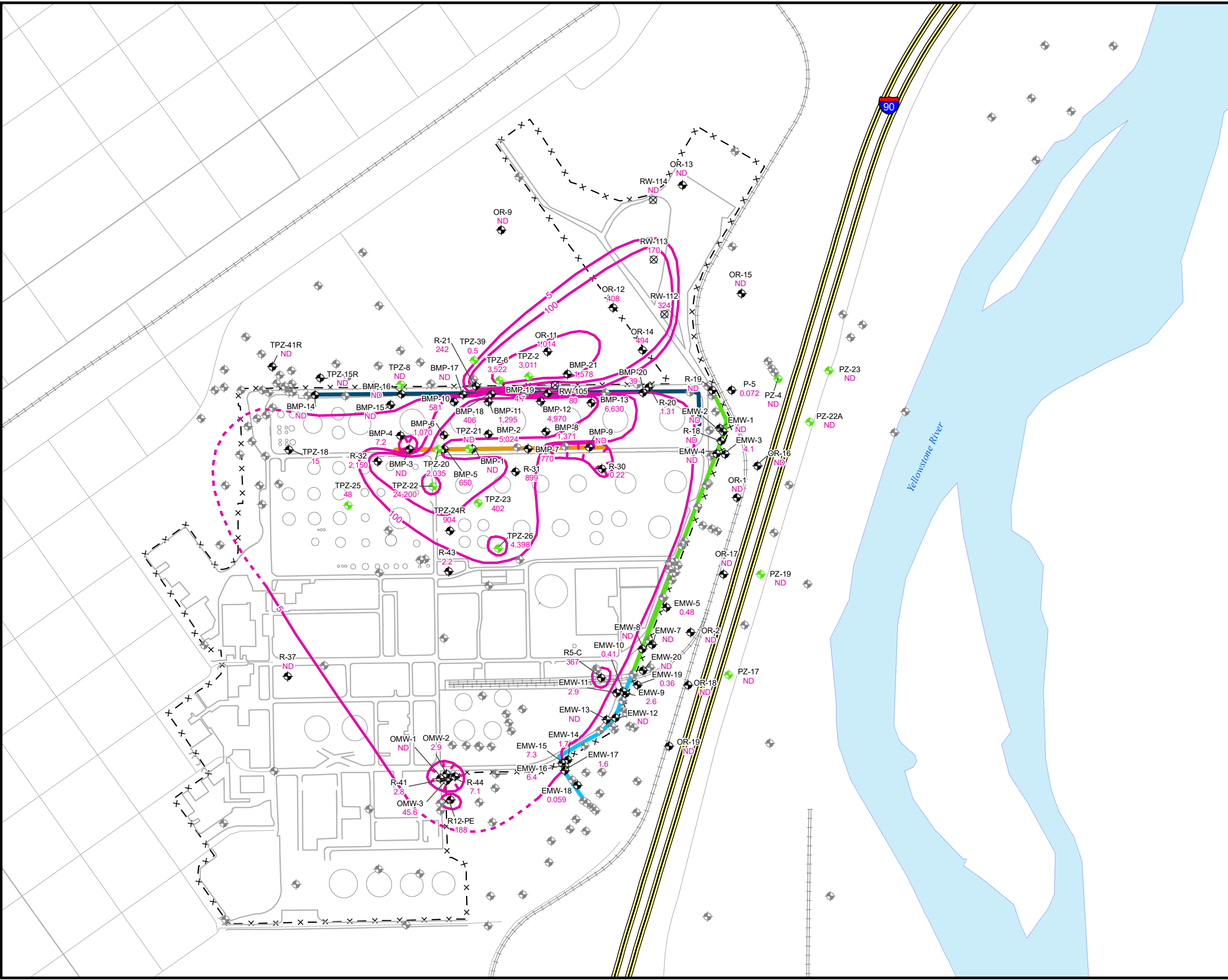
- Legend**
- Well Containing LNAPL
 - LNAPL Trace or Sheen
 - LNAPL Thickness 0.01 to 0.1 ft
 - LNAPL Thickness >0.1 to 1.0 ft
 - LNAPL Thickness >1.0 ft
 - ◆ Well Location
 - Glacier Manifold
 - Refinery Fence Line

- Notes:**
1. LNAPL - light non-aqueous phase liquid
 2. Wells in Glacier Manifold typically contained LNAPL at a thickness between 0.1 and 1.0 ft.



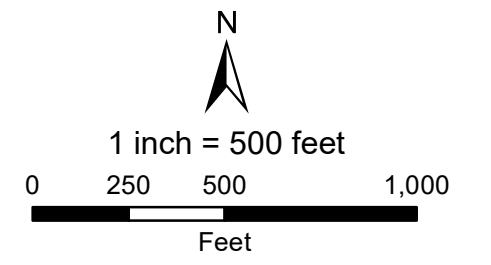
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Title: LNAPL Distribution Map October 2021		
Project: DRAFT Statement of Basis		
Location: Phillips 66 Company Billings Refinery Billings, Montana (RM Site No. 6052 and 6058)		
Project No.: 60675209	Date: 2/3/2022	Figure: 4

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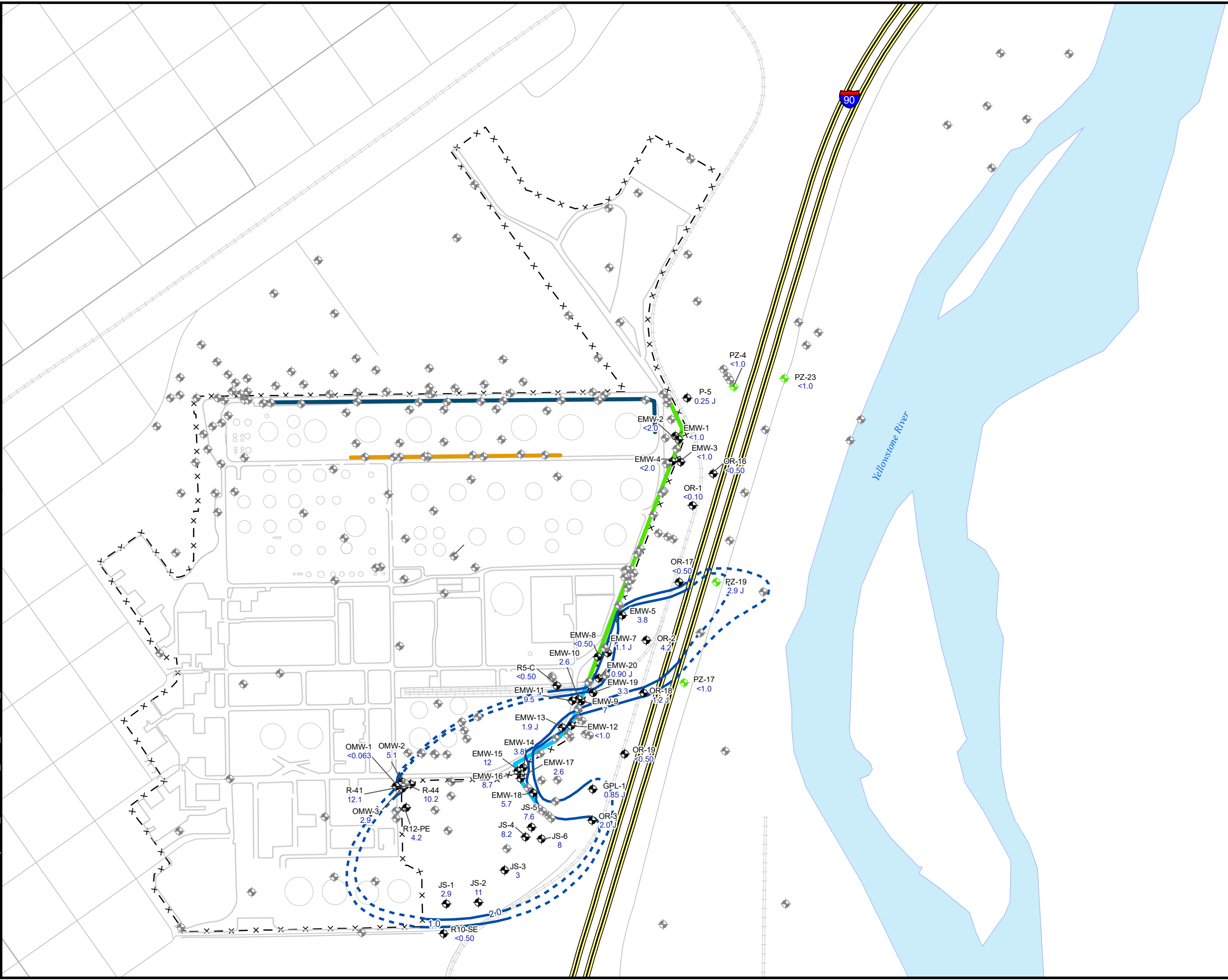
- ### Legend
- Monitoring Well
 - Piezometer
 - Inactive GWIS Recovery Well
 - Wells not sampled for BTEX in October 2021
 - BTEX Isoconcentration Contour
 - Cone of Depression
 - Inferred Contour
 - NFL Sparge System
 - 2nd Street Biosparge System
 - East Fence Line Biosparge System
 - East Fence Line Ozone-Peroxide System
 - Refinery Fence Line

- ### Notes:
1. 4.1 = Total BTEX concentration
 2. Concentrations shown in micrograms per liter (µg/L).
 3. BTEX = benzene, toluene, ethylbenzene, and total xylenes
 4. ND = Non detect; no BTEX results were greater than the respective Method Detection Limit.
 5. GWIS = Groundwater Interceptor System



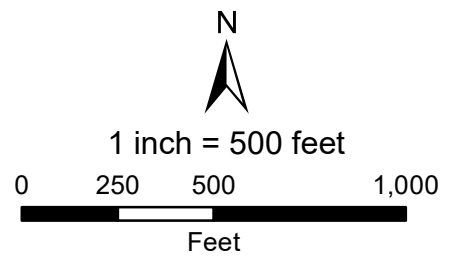
AECOM		
Title: Total BTEX Isoconcentration Map - October 2021		
Project: DRAFT Statement of Basis		
Location: Phillips 66 Company Billings Refinery Billings, Montana (RM Site No. 6052 and 6058)		
Project No.: 60675209	Date: 2/3/2022	Figure: 5

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- ### Legend
- Monitoring Well
 - Piezometer
 - Wells not sampled for VC in October 2021
 - VC Isoconcentration Contour
 - Inferred Contour
 - NFL Sparge System
 - 2nd Street Biosparge System
 - East Fence Line Biosparge System
 - East Fence Line Ozone-Peroxide System
 - Refinery Fence Line

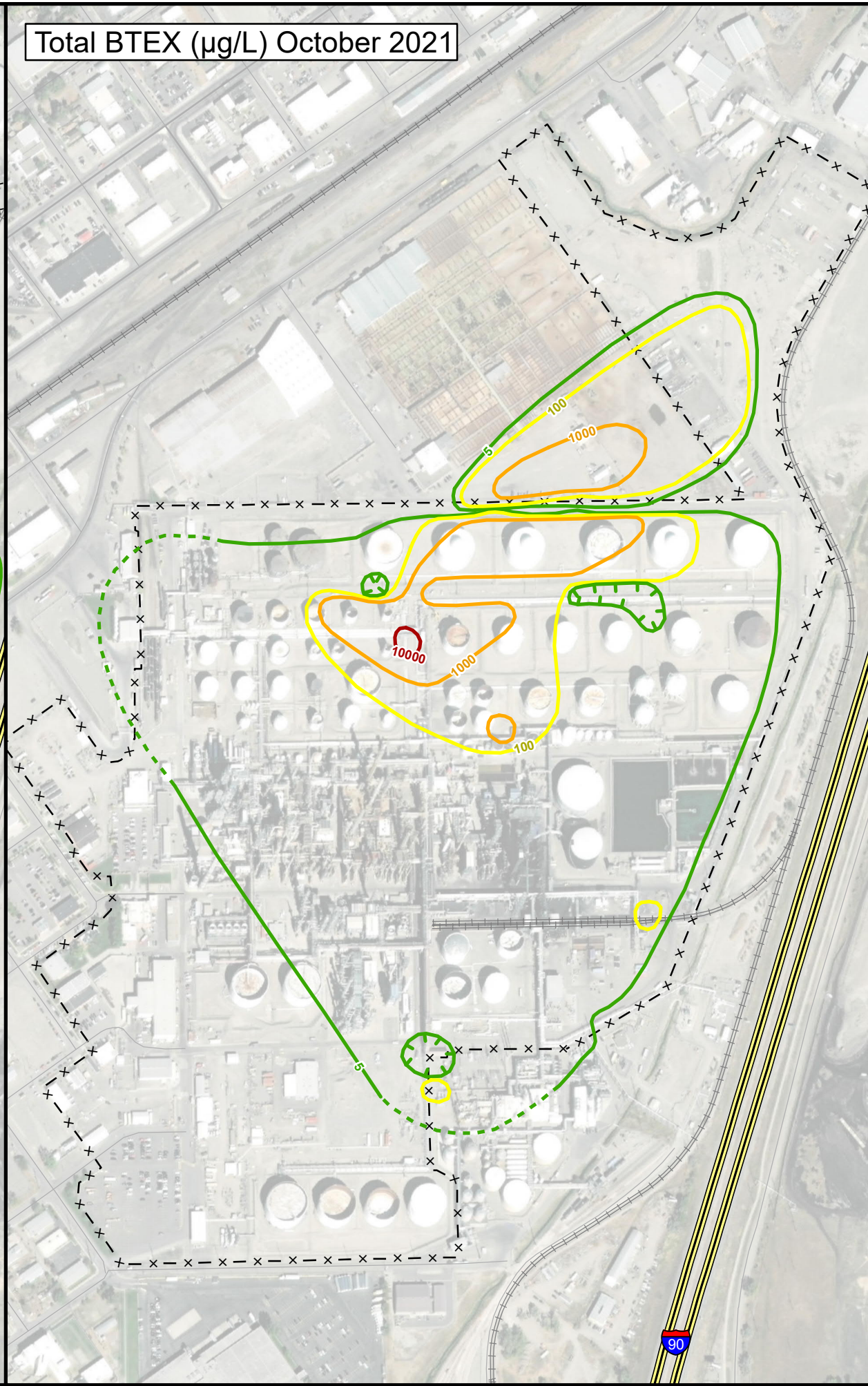
- ### Notes:
1. 2.6 = VC concentration
 2. Concentrations shown in micrograms per liter ($\mu\text{g/L}$).
 3. VC = vinyl chloride
 4. J = Estimated value
 5. <math>< </math> = Analyte was not detected above the respective Laboratory Method Detection Limit



AECOM		
Title: Vinyl Chloride Isoconcentration Map - October 2021		
Project: DRAFT Statement of Basis		
Location: Phillips 66 Company Billings Refinery Billings, Montana (RM Site No. 6052 and 6058)		
Project No.:	Date:	Figure:
60675209	2/3/2022	6

Total BTEX (µg/L) July 2014

Total BTEX (µg/L) October 2021



Legend

Total BTEX Isoconcentration Contour

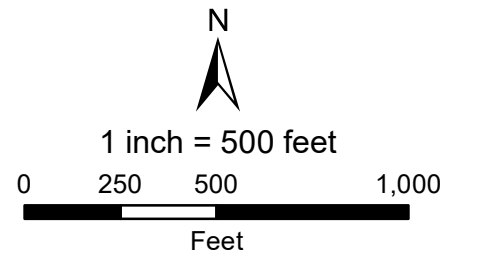
- 5 µg/L
- 100 µg/L
- 1,000 µg/L
- 10,000 µg/L

Universal Symbology

- - - Inferred Isoconcentration Contour
- Cone of depression
- ××× Refinery Fence Line

DEQ-7 HHS ¹ (µg/L)	
Benzene	5
Toluene	1,000
Ethylbenzene	700
Xylenes	10,000

- Notes:**
- HHS = Human Health Standard from Circular DEQ-7, Montana Numeric Water Quality Standards. Department of Environmental Quality (DEQ). June 2019.
 - µg/L = micrograms per liter



AECOM

Title: **Total BTEX Isoconcentration Comparison 2014 to 2021**

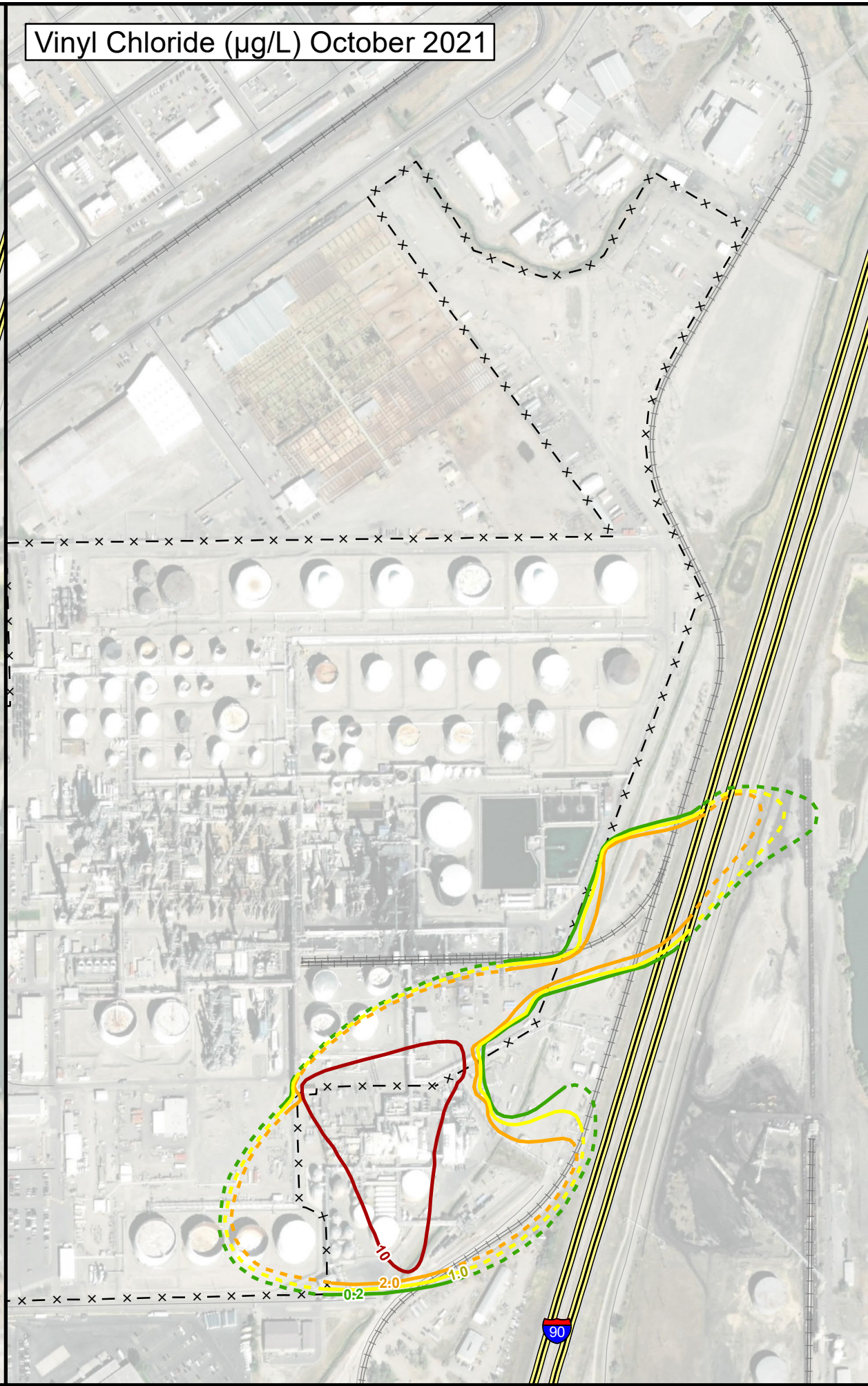
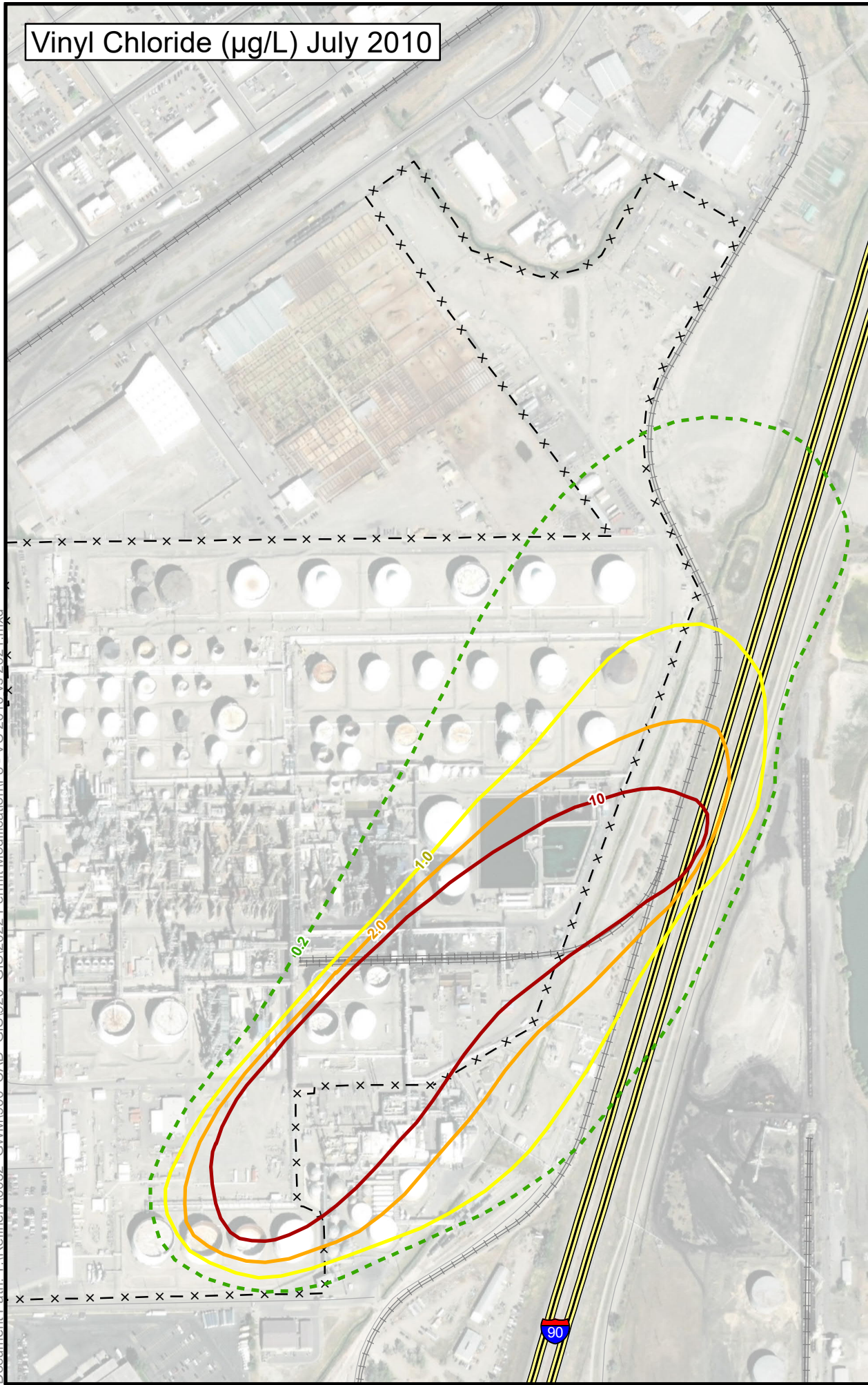
Project: **DRAFT Statement of Basis**

Location: **Phillips 66 Company Billings Refinery Billings, Montana (RM Site No. 6052 and 6058)**

Project No.: **60675209** Date: **2/3/2022** Figure: **7**

Vinyl Chloride ($\mu\text{g/L}$) July 2010

Vinyl Chloride ($\mu\text{g/L}$) October 2021



Legend

Vinyl Chloride Isoconcentration Contour

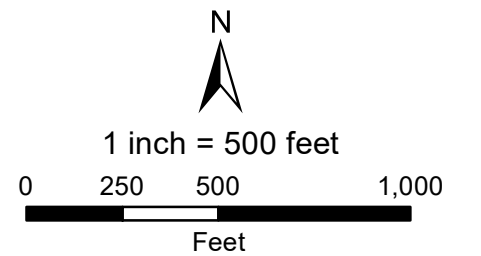
- 0.2 $\mu\text{g/L}$
- 1.0 $\mu\text{g/L}$
- 2.0 $\mu\text{g/L}$
- 10 $\mu\text{g/L}$

Universal Symbology

- - - - Inferred Isoconcentration Contour
- ┌ x - x ┐ Refinery Fence Line

DEQ-7 HHS ¹ ($\mu\text{g/L}$)	
Vinyl Chloride	0.2

- Notes:**
- HHS = Human Health Standard from Circular DEQ-7, Montana Numeric Water Quality Standards. Department of Environmental Quality (DEQ). June 2019.
 - $\mu\text{g/L}$ = micrograms per liter



AECOM

Title: **Vinyl Chloride Isoconcentration Comparison 2010 to 2021**

Project: **DRAFT Statement of Basis**

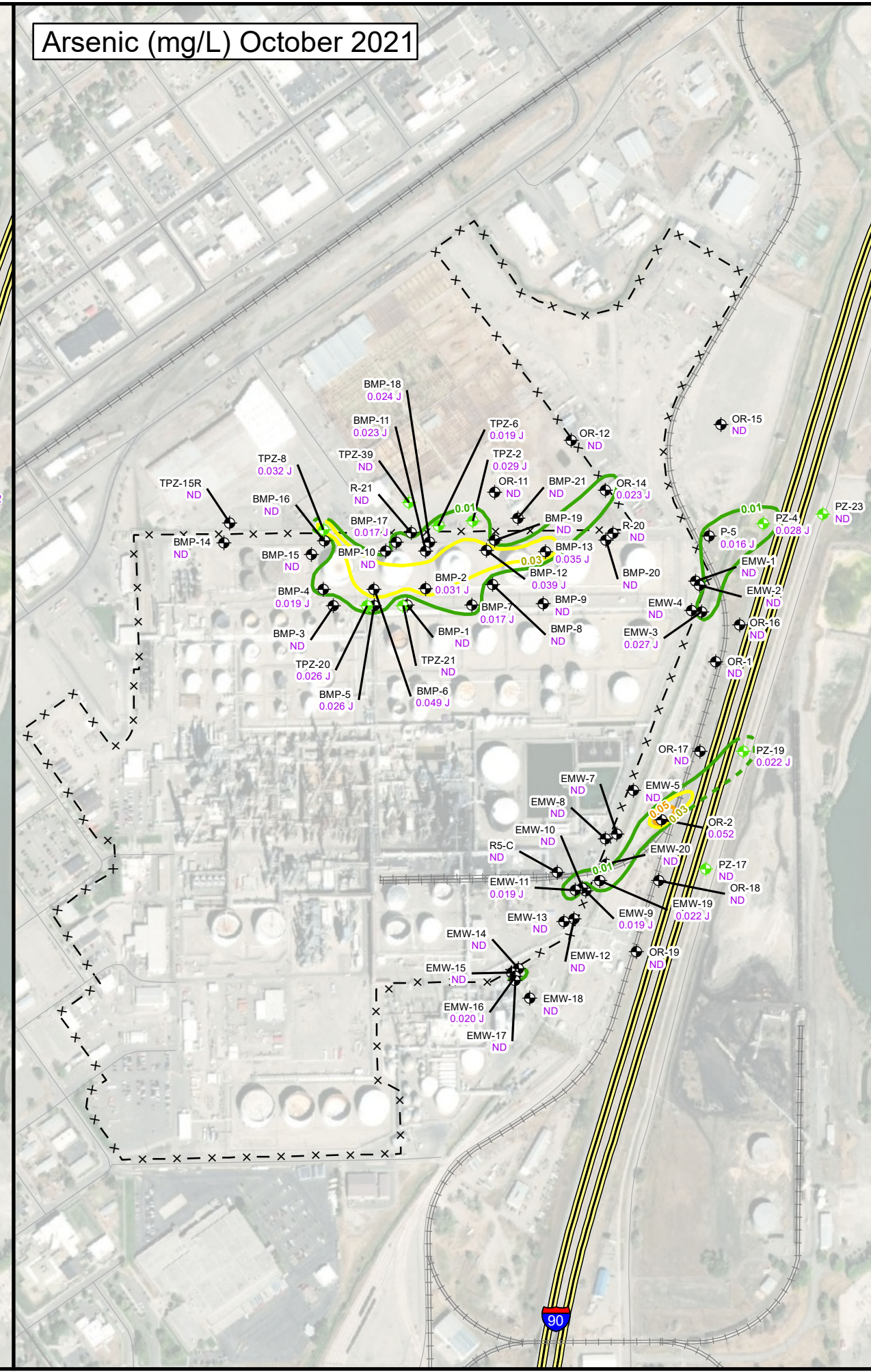
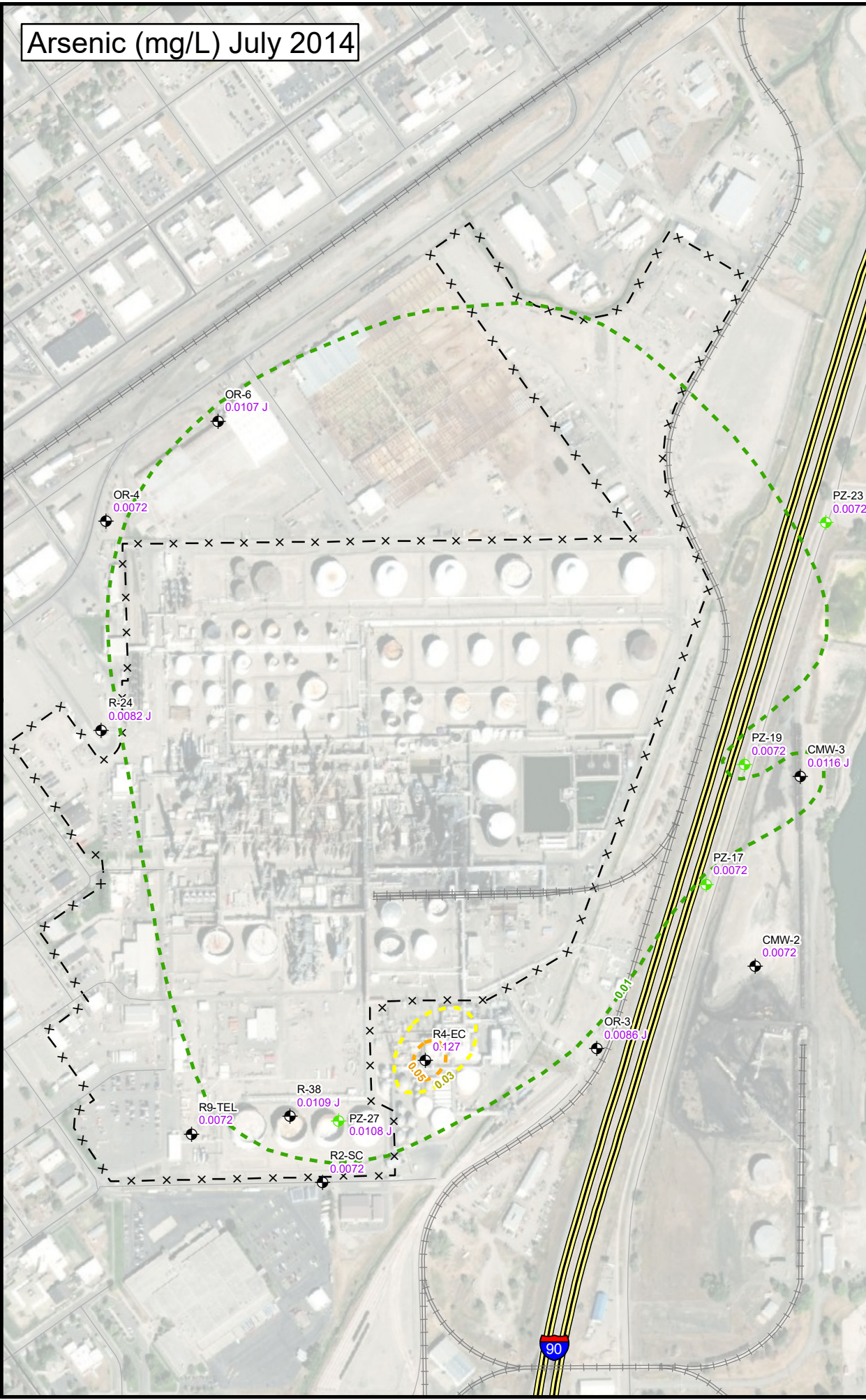
Location: **Phillips 66 Company Billings Refinery Billings, Montana (RM Site No. 6052 and 6058)**

Project No.: 60675209	Date: 2/3/2022	Figure: 8
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Arsenic (mg/L) July 2014

Arsenic (mg/L) October 2021

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Legend

- Monitoring Well
- Piezometer

Arsenic Isoconcentration Contour

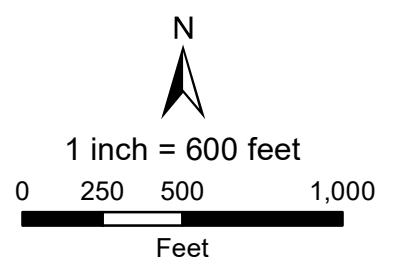
- 0.01 mg/L
- 0.03 mg/L
- 0.05 mg/L

Universal Symbology

- Inferred Isoconcentration Contour
- Refinery Fence Line

DEQ-7 HHS ¹ (mg/L)	
Arsenic	0.01

- Notes:**
- HHS = Human Health Standard from Circular DEQ-7, Montana Numeric Water Quality Standards. Department of Environmental Quality (DEQ). June 2019.
 - mg/L = milligrams per liter
 - 0.0072 = arsenic concentration
 - ND = not detected above laboratory method detection limit
 - J = estimated value



AECOM

Title: **Arsenic Isoconcentration Comparison 2014 to 2021**

Project: **DRAFT Statement of Basis**

Location: **Phillips 66 Company Billings Refinery Billings, Montana (RM Site No. 6052 and 6058)**

Project No.: 60675209	Date: 2/4/2022	Figure: 9
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