

AECOM Canada Ltd.  
3292 Production Way  
Suite 330  
Burnaby, BC V5A 4R4  
Canada

**To:**  
Mr. Christopher Boys, M.Sc., P.Geo.  
Senior Environmental Specialist  
Parkland Refining (B.C.) Ltd.  
1000 2025 Willingdon Ave,  
Burnaby B.C V5J 0J3

T: 604.444.6400  
F: 604.294.8597  
aecom.com

**Project name:**  
2024 Foreshore Monitoring and  
Sampling Program

**Project Ref:**  
60704318

**From:**  
Tracy Wang, M.Sc., G.I.T.  
Leslie Southern, M.Sc., P.Ag.

**Date:**  
June 10, 2024

# Memo

**Subject:** July 2023 through March 2024 Foreshore Passive Treatment System Inspection Memo

## 1. Introduction

AECOM Canada Ltd. (AECOM) has prepared this memo for Parkland Refining (B.C.) Ltd. (Parkland) to summarize results from inspections of the Foreshore Passive Treatment System (FPTS) completed by AECOM on July 05, 2023, September 29, 2023 and March 13-14, 2024. The FPTS is located along the Foreshore area of Burrard Inlet down slope from the Eastern Impounding Basin (EIB), Area 2 of the Parkland Burnaby Refinery (hereafter referred to as the "Site"). Previous inspections in January and March 2023, in addition to the March 2023 sampling event completed at the Site, were reported in the Foreshore 2023 Monitoring Report Below Area 2 – Eastern Impounding Basin (AECOM, 2023). A Site Plan is included as **Figure 1**.

The post-construction FPTS monitoring program is detailed in the 2022 FPTS Monitoring and Maintenance Plan (MMP) (AECOM, 2022a); this report fulfills annual reporting requirements in accordance with the FPTS MMP and the Vancouver Fraser Port Authority's (VFPA's) request for annual reports.

## 2. Background

### 2.1 FPTS Construction

The FPTS was constructed between July 10 and October 30, 2017 and was designed to be the final remedial action to address any free-phase and dissolved phase hydrocarbon and sheens at the Site. The FPTS consists of permeable subsurface treatment cells for the mitigation of free-phase non-aqueous phase liquid (NAPL) and dissolved phase hydrocarbons in porewater and contains an oleophilic biobarrier (OBB) for the prevention of sheens. The FPTS construction followed the BC Ministry of Environment and Climate Change Strategy (ENV) supported Foreshore Remedial Action Plan (AECOM, 2016) and is in accordance with the Construction Environmental Management Plan (AECOM, 2017a). In summary, the FPTS consists of a larger Eastern section (60 m) and a smaller Western section (20 m) and consists of the following components:

- A subsurface treatment cell with Aquagate+Organoclay;
- An adjacent, down slope subsurface treatment cell with Aquagate+Powdered Activated Carbon;
- Baffles in the treatment cells;
- Contingency delivery piping into the treatment cells;
- Monitoring wells;
- A polyethylene liner to direct groundwater into the treatment cells;
- An Oleophilic Bio-Barrier; and
- Cobbles and a boulder embankment to protect the wells and other components.

In total, 33 porewater wells, divided into four distinct types (Up Gradient Wells, Performance Wells, Sentry Wells and Compliance Wells), were installed at the Site in 2017 to assess the performance of the FPTs (AECOM, 2017b).

Since construction of the FPTs was completed in 2017, AECOM has completed inspections to check the integrity of the FPTs on a monthly basis until April 2018, when the frequency of inspections was reduced to quarterly. As of July 2023, the frequency of inspections has been further reduced to semi-annual (see Section 2.2).

## 2.2 2021 FPTs Maintenance

Inspections completed at the Site over 2020 and 2021 indicated the cobble mat at the contact point between the rip rap and cobble interface was thinning. This resulted in the exposure of portions of the geogrid and geotextile layers along the northern extent of both the Eastern and Western FPTs (AECOM, 2021). During the inspections completed in December 2020 and March 2021, the rip rap which had been placed around one of the Contingency Biodegradation Points (CBP-6) was observed to have shifted exposing the base of the concrete protector (AECOM, 2021).

On September 27, 2021, maintenance of the FPTs was completed by the placement of 170 metric tonnes (MT) of rock material comprised of 110 MT of rip rap (24" x 36") and 60 MT of filter rock (4" x 9"). The objectives of the maintenance were to cover the exposed portions of geogrid and geotextile materials and cover the exposed bases of concrete well protectors of monitoring wells and Contingency Biodegradation Points (CBP). The maintenance was completed under VFPA Project Permit 21-076.

After the maintenance was completed, the October 15, 2021 inspection indicated that all exposed concrete protector bases and areas of exposed geogrid and geotextile layers previously observed were covered, except for one small area approximately 0.67 m x 0.05 m in size located at the western extent of the Eastern FPTs, which was covered with cobbles by hand by AECOM during the inspection event. The work was documented in the 2021 Foreshore Passive Treatment System Maintenance and Inspection Memo (AECOM, 2022b).

In December 2022, AECOM submitted a request for approval to reduce the frequency of sampling and inspections of the FPTs as per the 2022 FPTs Monitoring and Maintenance Plan (AECOM, 2022a), which was approved by the ENV on July 05, 2023 (ENV, 2023). Starting in September 2023, the frequency of inspections of the FPTs has been reduced from quarterly to semi-annual, and the frequency of sampling has been reduced from annual to biennial (every two years).

## 2.3 Tasks completed between January and March 2023

During the annual monitoring completed in March 2023, none of the 33 wells associated with the FPTs contained a measurable thickness of NAPL. Porewater samples were analyzed for contaminants of concern (COC) associated with the Site, including benzene, toluene, ethylbenzene, and xylenes (BTEX), volatile petroleum hydrocarbons in water (VPH<sub>w</sub>), light extractable petroleum hydrocarbons in Water (LEPH<sub>w</sub>), benzo(a)pyrene, naphthalene, dissolved copper, and dissolved zinc. Concentrations of COCs were below their applicable Risk-Based Management Targets (RBMTs) for all samples collected from 33 porewater wells.

The FPTs was inspected during two inspection events on January 27, 2023 and March 24, 2023. Small weeds were observed south of the barrier, and overhanging vegetation was encroaching from the southern side, but no growth was observed on top of the treatment cells or the OBB layer. Most Sentry and Compliance Wells were covered in barnacles and seaweed, and some concrete protectors exhibited minor chipping. No significant damage to monitoring wells was observed. Overall, the inspections indicated that there were no significant deficiencies associated with either the Eastern or Western FPTs. No significant concerns were noted during these inspections and the FPTs is performing as designed.

## 2.4 Modifications to the FPTs Monitoring and Maintenance Plan

Based on the data collected post-construction of the FPTs, AECOM recommended the frequency of sampling be reduced to biennial (every two years) in 2023, and inspections of the FPTs be reduced from quarterly to semi-annual in 2023. In December 2022, a request for approval to reduce the frequency of sampling and inspections of the FPTs, along with the 2022 FPTs MMP, was submitted to ENV for their review and approval. On July 5, 2023, ENV responded with their approval to reduce sampling from annual to biennial, and a reduction in the frequency of inspections of the FPTs from quarterly to semi-annual based on their review of annual reports demonstrating continued compliance and low, stable porewater concentrations (ENV, 2023).

## 3. Objectives

The objectives for the inspections of the FPTs were as follows:

- Monitor for the presence of NAPL in 12 select monitoring wells at the Site; and,
- Maintain the integrity of the FPTs by checking the protective rip rap and cobbles of the FPTs and managing vegetation as required.

## 4. Scope of Work

AECOM's scope of work for semi-annual inspections of the FPTs included the following tasks:

- Visual inspection of the components of the FPTs, including the layer of rip rap above the treatment cells (i.e., maintaining a thickness of approximately 1.4 m) and layer of cobbles above the OBB surface layer (i.e., maintaining a thickness of approximately 0.4 m).
- Visual inspection of the FPTs to make sure vegetation is not growing above the treatment cells or the OBB surface layer.
- Inspect and gauge 12 select porewater monitoring wells (including eight Up Gradient Wells [PW17-01, PW17-04, PW17-09, PW17-13, PW17-16, PW17-21, PW17-26, and PW17-31] and four Organoclay Performance Wells [PW17-05, PW17-17, PW17-22, and PW17-27]) during quarterly inspections at the Site to confirm presence/absence of NAPL using an oil/water interface probe along with the collection of combustible headspace vapours using a flame ionization detector (e.g. Eagle RKI).
- Prepare this memo summarizing the maintenance of the FPTs and inspections completed after March 2023.

### 4.1 Modifications to Scope of Work

In March 2024, AECOM monitored and inspected all 33 porewater monitoring wells at the Site to assess for potential damage to the wells since the previous inspection was conducted in September 2023. Prior to September 2023, Site visits had occurred quarterly, so a more thorough inspection was conducted to confirm well integrity at the start of the transition to semi-annual inspections.

## 5. Foreshore Inspections

The FPTs was inspected during three inspection events completed on July 05, 2023, September 29, 2023 and March 13-14, 2024, which are summarized below. Monitoring results are presented in **Table 1**. Results of inspections of the FPTs are presented in **Table 2**. Photos collected during inspections are presented in **Appendix A**.

### 5.1 July 05, 2023 Inspection

During the July 5<sup>th</sup> inspection, none of the 12 wells monitored contained a measurable thickness of NAPL<sup>1</sup>. Well vapour headspace readings ranged from 0 to 10 parts per million (ppm). The thickness of rip rap was observed to be a minimum of

1.4m of depth and cobbles above the OBB surface layer was observed to be 0.4m in depth. No significant deficiencies in the Eastern and Western FPTS were found during the inspection.

At both the Eastern and Western sections of the FPTS, weeds were observed growing on the south side of the barrier, and there was overhanging vegetation along the south side. No vegetation growth was observed on top of the treatment cells or OBB layer. Overhanging bushes were trimmed to prevent further encroachment over the treatment cells. The Eastern and Western FPTS are shown in photos 1 and 2 in **Appendix A**.

Most of the Sentry and Compliance Wells were covered in barnacles and seaweed and minor chipping to the well casing and lids was noted. No significant damage to the monitoring wells was observed.

Graffiti was observed on the concrete protectors of six wells in the upper barrier of the Eastern FPTS (PW17-16, PW17-17, PW17-21, PW17-22, PW17-26, and PW17-27). The graffiti was first observed during the October 2022 inspection (AECOM, 2022b). No damage or disturbance to the wells (e.g., writing on the inside surfaces of the concrete protectors) was observed at the time of inspection and they did not appear to have been tampered with.

## 5.2 September 29, 2023 Inspection

During the September 29<sup>th</sup> inspection, none of the 12 wells monitored contained a measurable thickness of NAPL<sup>1</sup>; sheens or odours were not observed. Well vapour headspace readings ranged from 0 to 10 ppm. The thickness of rip rap was observed to be a minimum of 1.4m of depth and cobbles above the OBB surface layer were observed to be 0.4m in depth. No significant deficiencies in the Eastern and Western FPTS were found during the inspection.

At the Eastern section of the FPTS, weeds were observed growing on the south side of the barrier, and there was overhanging vegetation along the south side (refer to photo 3 in **Appendix A**). No vegetation was observed on the barrier of the Western FPTS (refer to photo 4 in **Appendix A**). There was no vegetation growth on top of the treatment cells or OBB layer of either the Eastern or Western FPTS.

Most of the Sentry and Compliance Wells were covered in barnacles and seaweed and no significant damage to monitoring wells was observed, though minor chipping to the well casing and lids was noted. The concrete lid of well PW17-30 was chipped and the well cap was not present; barnacles were observed inside the well. AECOM staff cleared off the barnacle growth and replaced the cap on well PW17-30.

The concrete protectors of six wells in the upper barrier of the Eastern FPTS (PW17-16, PW17-17, PW17-21, PW17-22, PW17-26, and PW17-27) had graffiti on them. No damage or disturbance to the wells was observed at the time of inspection and they did not appear to have been tampered with.

## 5.3 March 13-14, 2024 Inspection

During the March 13-14<sup>th</sup> inspection, none of the 33 wells monitored contained a measurable thickness of NAPL<sup>1</sup>; sheens or odours were not observed. Well vapour headspace readings ranged from 0 to 10 ppm. The thickness of rip rap was visually observed to be a minimum of 1.4m of depth and cobbles above the OBB surface layer were observed to be 0.4m in depth. No significant deficiencies in the Eastern and Western FPTS were found during the inspection.

At the time inspection, there was no vegetation growth observed on top of the treatment cells or OBB layer of either the Eastern or Western FPTS. Some overgrowth was observed extending from the Canadian Pacific Railway (CPR) Right of Way onto the treatment cells at both sections of the FPTS (refer to photos 5 and 6 in **Appendix A**). Cutting of vegetation is suggested to reduce this overgrowth along the southern extents of the eastern and western FPTS in proximity to the Up Gradient wells.

Most of the Sentry and Compliance Wells are covered in barnacles and seaweed and no significant damage to monitoring wells was observed, though minor chipping to the well casing and lids was noted.

One well in the upper barrier of the Western FPTS (PW17-6) was found with its concrete lid not covering the well at the time of inspection; the lid was located near to the well and placed back into position by AECOM field staff.

As observed during previous inspections, the concrete protectors of six wells (PW17-16, PW17-17, PW17-21, PW17-22, PW17-26, and PW17-27) had graffiti on them. Photo 7 in **Appendix A** shows an example of the graffiti. In addition, the

<sup>1</sup> As per ENV Protocol 16, NAPL is considered to be present if a thickness greater than 2 mm is measured in a monitoring well. BC ENV, 2021. Protocol 16. Determining the Presence and Mobility of Nonaqueous Phase Liquids and Odorous Substances (Version 3.0). Victoria, BC.

[https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p16\\_jan\\_2021\\_revisions\\_final\\_signed.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/p16_jan_2021_revisions_final_signed.pdf)

concrete lids and cases of some of these wells were chipped. No other damage or disturbance to the wells was observed at the time of inspection and they did not appear to have been tampered with.

## 6. Summary

The FPTS inspections completed between July 2023 and March 2024 are summarized below:

- During inspections completed in July 2023, September 2023 and March 2024, none of the gauged monitoring wells contained a measurable thickness of NAPL.
- No significant concerns were noted during inspections of the FPTS completed between July 2023 and March 2024. Most Sentry and Compliance Wells are covered in barnacles and seaweed. No significant damage to monitoring wells was observed.
- Graffiti on the concrete protectors of six wells associated with the Eastern FPTS, first observed during the October 2022 inspection, was continually noted throughout the inspections from July 2023 to March 2024. No damage or disturbance to the wells were observed during these inspections; they did not appear to have been tampered with.
- Some overhanging vegetation from the Canadian Pacific Rail Right of Way was observed to be encroaching on the Eastern and Western FPTS and is suggested to be cut.

## 7. References

AECOM, 2016. Foreshore Remedial Action Plan below Area 2 Eastern Impounding Basin – Chevron Burnaby Refinery, Burnaby, BC. AECOM, October 27, 2016.

AECOM, 2017a. Foreshore Final Remedy Construction Environmental Management Plan, Parkland Burnaby Refinery, British Columbia. AECOM, June 28, 2017.

AECOM, 2017b. Foreshore Passive Treatment System Monitoring and Maintenance Plan, Down Slope from the Eastern Impounding Basin, Area 2, Parkland Burnaby Refinery, Burnaby, BC. Appendix K of the Foreshore Passive Treatment System Construction Report, Parkland Burnaby Refinery, Burnaby, BC. AECOM, December 21, 2017.

AECOM, 2022a. 2022 Foreshore Passive Treatment System Monitoring and Maintenance Plan – Foreshore Area of Burrard Inlet Located Down Slope from the Eastern Impounding Basin, Area 2, Parkland Burnaby Refinery, Burnaby, B.C. AECOM, December 8, 2022.

AECOM, 2022b. 2021 Foreshore Passive Treatment System Maintenance and Inspection Memo, AECOM, January 26, 2022.

AECOM, 2022c. 2022 Foreshore Passive Treatment System Inspection Memo. AECOM, November 14, 2022.

AECOM, 2023. Foreshore 2023 Monitoring Report Below Area 2 – Eastern Impounding Basin, Parkland Burnaby Refinery, Burnaby, British Columbia, AECOM, June 08, 2023.

BC Ministry of Environment and Climate Change Strategy (ENV), 2023. Letter from Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV) to Christopher Boys of the Parkland Burnaby Refinery, July 05, 2023.

Authors



Stephen Dickin for Tracy Wang, M.Sc., G.I.T.  
Hydrogeologist  
Author

AECOM Canada Ltd.



Leslie Southern M.Sc., P.Ag.  
Environmental Scientist / Project Manager  
Reviewer

AECOM Canada Ltd.

**Attachments**

- |                   |  |
|-------------------|--|
| <b>Figures</b>    | Figure 1: Map and Foreshore Sampling Locations (Post-Maintenance)  |
| <b>Tables</b>     | Table 1: Porewater Monitoring Data (July 2023 – March 2024), Foreshore Post FPTS Construction, Parkland Burnaby Refinery             |
|                   | Table 2: Foreshore Passive Treatment System Inspections (July 2023 – March 2024), Post FPTS Construction, Foreshore Parkland Burnaby |
| <b>Appendices</b> | Appendix A: Photographic Log   |

## Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of Parkland Refining B.C. Ltd. ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

AECOM shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. AECOM accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

AECOM agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but AECOM makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by AECOM represent AECOM's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since AECOM has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, AECOM, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by AECOM and Client; (2) as required by-law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

AECOM accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of AECOM to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

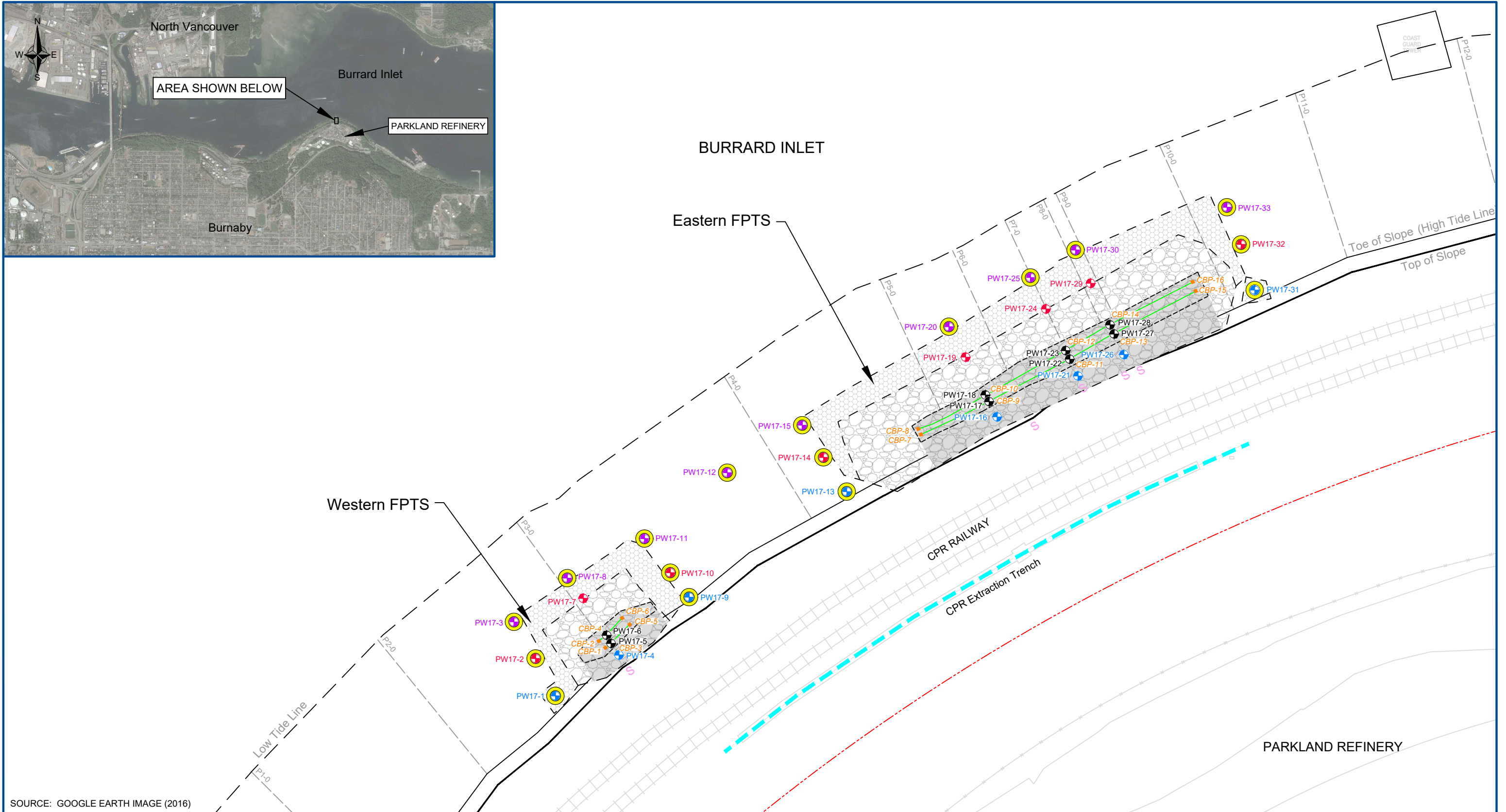
This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

*AECOM: 2015-04-13*

*© 2009-2015 AECOM Canada Ltd. All Rights Reserved.*

## Figures





SOURCE: GOOGLE EARTH IMAGE (2016)

LEGEND:

Property Line		Impermeable Sheet	
Fence Line		Cobble Mat	
Foreshore Sampling Transect		Rip Rap Embankment	
CPR Extraction Trench		French Drain	
		NAPL Seep Observed in 2010	
		Contingency Biodegradational Piping	

POREWATER SAMPLES

Compliance Well	
Sentry Well	
Performance Well	
Up Gradient Well	
ENV Requires Notifications <sup>3</sup>	

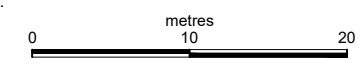
ABBREVIATIONS:

COC	Contaminants of Concern
CPR	Canadian Pacific Railway
ENV	BC Ministry of Environment & Climate Change Strategy
NAPL	Non-Aqueous Phase Liquid
RBMT	Risk-Based Management Targets

NOTES:

1. The Foreshore Passive Treatment System (FPTS) was installed between July 12 and October 21, 2017.
2. The FPTS was upgraded with additional material on September 27, 2021.
3. BC ENV requires written notification within 30 days of exceedances of COCs above RBMTs in select wells.
4. BC ENV requires immediate verbal and written notification of COCs above Upper Cap Concentrations (Protocol 11) in all wells.

GRID NORTH



SITE MAP AND FORESHORE SAMPLING LOCATIONS

2023-2024 Foreshore Passive Treatment System Inspection Memo

PARKLAND REFINING (B.C.) LTD.

DATE:	PROJECT NO.:	DRAWN BY:	REVISION NO.:	DRAWING NO.:
April 2024	60704318	SGC	0	FIGURE 1



## Tables

**TABLE 1  
POREWATER MONITORING DATA (JULY 2023 - MARCH 2024)  
FORESHORE POST FPTs CONSTRUCTION  
PARKLAND BURNABY REFINERY**

Sample ID	Date Sampled	Sample Time	Low Tide	Total Depth of Well (m from TOC) <sup>2</sup>	Top of Casing Elevation (TOC, mASL) <sup>1</sup>	Well Diameter (mm)	Screened Interval (m bgs)	Headspace Vapour Concentration (ppm unless otherwise noted)	Depth to Product (m from TOC)	Apparent Product Thickness (mm)	Depth to Water (DTW, m from TOC)	Porewater Elevation (mASL) <sup>1</sup>	Observations
PW17-01	05-Jul-23	10:40	13:00	1.326	29.12	50	0.85-1.15	0	---	ND	0.529	28.59	
PW17-01	29-Sep-23	10:59	11:00	1.318	29.12	50	0.85-1.15	5	---	ND	0.682	28.44	
PW17-01	13-Mar-24	14:01	15:43	1.32	29.12	50	0.85-1.15	0	---	ND	0.758	28.36	
PW17-02	13-Mar-24	14:06	15:43	1.2	27.72	50	0.85-1.15	0	---	ND	0.570	27.15	Algae on lid
PW17-03	13-Mar-24	14:10	15:43	1.335	27.24	50	0.85-1.15	0	---	ND	0.305	26.94	Barnacle growth on case
PW17-04	05-Jul-23	10:44	13:00	3.376	31.19	50	0.45-0.75	0	---	ND	2.869	28.32	
PW17-04	29-Sep-23	10:49	11:00	3.373	31.19	50	0.45-0.75	10	---	ND	2.920	28.27	
PW17-04	13-Mar-24	13:57	15:43	3.374	31.19	50	0.45-0.75	0	---	ND	2.861	28.33	
PW17-05	05-Jul-23	10:45	13:00	3.098	30.22	50	0.64-1.00	5	---	ND	1.681	28.54	
PW17-05	29-Sep-23	10:55	11:00	3.075	30.22	50	0.64-1.00	5	---	ND	1.948	28.27	
PW17-05	13-Mar-24	13:53	15:43	3.069	30.22	50	0.64-1.00	0	---	ND	1.640	28.58	
PW17-06	13-Mar-24	13:49	15:43	3.11	29.79	50	0.84-1.20	0	---	ND	1.810	27.98	Concrete lid wasn't on the concrete case; Lid chipped
PW17-07	13-Mar-24	14:13	15:43	1.1	27.29	50	0.70-1.00	0	---	ND	0.485	26.81	Algae on lid, barnacle growth on case
PW17-08	13-Mar-24	14:17	15:43	1.343	26.6	50	0.84-1.20	0	---	ND	0.272	26.328	Barnacle growth on lid and case
PW17-09	05-Jul-23	10:48	13:00	1.365	28.55	50	0.85-1.15	0	---	ND	0.246	28.30	
PW17-09	29-Sep-23	10:43	11:00	1.356	28.55	50	0.85-1.15	0	---	ND	0.335	28.22	
PW17-09	13-Mar-24	13:29	15:43	1.351	28.55	50	0.85-1.15	0	---	ND	0.385	28.17	
PW17-10	13-Mar-24	9:00	15:43	NM	27.25	50	0.85-1.15	NM	---	ND	NM	NC	Water level on top of well; Algae on lid, barnacle growth on case
PW17-11	13-Mar-24	14:25	15:43	1.415	26.72	50	0.74-1.10	5	---	ND	0.205	26.52	Barnacle growth on lid and case
PW17-12	13-Mar-24	14:29	15:43	1.445	27.03	50	0.85-1.15	5	---	ND	0.581	26.45	Barnacle growth on lid and case
PW17-13	05-Jul-23	10:51	13:00	1.323	28.9	50	0.85-1.15	0	---	ND	0.378	28.52	
PW17-13	29-Sep-23	10:36	11:00	1.302	28.9	50	0.85-1.15	0	---	ND	0.406	28.49	
PW17-13	13-Mar-24	13:23	15:43	1.31	28.9	50	0.85-1.15	0	---	ND	0.448	28.45	Algae on lid
PW17-14	13-Mar-24	14:31	15:43	1.38	27.83	50	0.85-1.15	0	---	ND	0.120	27.71	Algae on lid, barnacle growth on case
PW17-15	13-Mar-24	14:34	15:43	1.385	27.03	50	0.84-1.20	0	---	ND	0.648	26.38	Barnacle growth on lid and case
PW17-16	05-Jul-23	10:54	13:00	3.266	31.44	50	0.45-0.75	5	---	ND	2.694	28.75	
PW17-16	29-Sep-23	10:20	11:00	3.225	31.44	50	0.45-0.75	10	---	ND	2.711	28.73	
PW17-16	13-Mar-24	13:03	15:43	3.209	31.44	50	0.45-0.75	0	---	ND	2.590	28.85	Graffiti outside
PW17-17	05-Jul-23	10:55	13:00	3.194	30.73	50	0.64-1.00	5	---	ND	2.026	28.70	
PW17-17	29-Sep-23	10:30	11:00	3.190	30.73	50	0.64-1.00	10	---	ND	2.054	28.68	
PW17-17	13-Mar-24	13:08	15:43	3.160	30.73	50	0.64-1.00	0	---	ND	1.930	28.80	Graffiti outside; Concrete lid chipped
PW17-18	13-Mar-24	13:13	15:43	3.390	30.6	50	0.84-1.20	0	---	ND	1.796	28.80	Concrete lid chipped
PW17-19	13-Mar-24	14:40	15:43	0.93	28.210	50	0.87-1.15	0	---	ND	0.282	27.93	Algae on lid, barnacle growth on case
PW17-20	13-Mar-24	14:37	15:43	1.455	27.58	50	0.64-1.00	0	---	ND	0.260	27.32	Algae on lid, barnacle growth on case
PW17-21	05-Jul-23	11:00	13:00	3.359	31.38	20	0.45-0.75	5	---	ND	2.549	28.83	
PW17-21	29-Sep-23	9:52	11:00	3.720	31.38	20	0.45-0.75	10	---	ND	2.529	28.85	
PW17-21	14-Mar-24	12:35	16:27	3.358	31.38	20	0.45-0.75	0	---	NM	2.179	29.20	Some graffiti outside
PW17-22	05-Jul-23	10:59	13:00	3.522	31.14	50	0.64-1.00	10	---	ND	2.371	28.77	
PW17-22	29-Sep-23	10:13	11:00	3.495	31.14	50	0.64-1.00	10	---	ND	2.410	28.73	
PW17-22	13-Mar-24	12:52	15:43	3.486	31.14	50	0.64-1.00	0	---	ND	2.355	28.79	Graffiti outside
PW17-23	13-Mar-24	12:57	15:43	3.202	30.58	50	0.84-1.20	0	---	ND	1.731	28.85	
PW17-24	13-Mar-24	14:47	15:43	2.31	28.12	50	0.85-1.15	0	---	ND	0.493	27.63	Algae on lid, barnacle growth on case

**TABLE 1  
POREWATER MONITORING DATA (JULY 2023 - MARCH 2024)  
FORESHORE POST FPTS CONSTRUCTION  
PARKLAND BURNABY REFINERY**

Sample ID	Date Sampled	Sample Time	Low Tide	Total Depth of Well (m from TOC) <sup>2</sup>	Top of Casing Elevation (TOC, mASL) <sup>1</sup>	Well Diameter (mm)	Screened Interval (m bgs)	Headspace Vapour Concentration (ppm unless otherwise noted)	Depth to Product (m from TOC)	Apparent Product Thickness (mm)	Depth to Water (DTW, m from TOC)	Porewater Elevation (mASL) <sup>1</sup>	Observations
PW17-25	13-Mar-24	14:43	15:43	1.265	27.430	50	0.85-1.15	5	---	ND	0.255	27.18	Algae on lid, barnacle growth on case
PW17-26	05-Jul-23	11:10	13:00	3.815	31.81	50	0.45-0.75	5	---	ND	2.998	28.81	
PW17-26	29-Sep-23	10:00	11:00	3.776	31.81	50	0.45-0.75	10	---	ND	3.001	28.81	
PW17-26	13-Mar-24	12:26	15:43	3.776	31.81	50	0.45-0.75	0	---	ND	2.827	28.98	Graffiti outside
PW17-27	05-Jul-23	11:09	13:00	3.791	31.4	50	0.64-1.00	5	---	ND	2.652	28.75	
PW17-27	29-Sep-23	10:07	11:00	3.803	31.4	50	0.64-1.00	0	---	ND	2.660	28.74	
PW17-27	13-Mar-24	12:31	15:43	3.775	31.4	50	0.64-1.00	0	---	ND	2.485	28.92	Graffiti outside
PW17-28	13-Mar-24	12:35	15:43	3.196	30.53	50	0.84-1.20	0	---	ND	1.570	28.96	Concrete case chipped
PW17-29	13-Mar-24	14:54	15:43	1.385	28.24	50	0.85-1.15	5	---	ND	0.385	27.86	
PW17-30	13-Mar-24	14:50	15:43	1.046	27.39	50	0.84-1.20	0	---	ND	0.213	27.18	Algae on lid, barnacle growth on case; Concrete lid chipped
PW17-31	05-Jul-23	11:14	13:00	1.265	29.31	50	0.85-1.15	5	---	ND	0.498	28.81	
PW17-31	29-Sep-23	9:41	11:00	1.255	29.31	50	0.85-1.15	0	---	ND	0.520	28.79	
PW17-31	13-Mar-24	15:03	15:43	1.255	29.31	50	0.85-1.15	0	---	ND	0.475	28.84	Concrete lid chipped
PW17-32	13-Mar-24	15:00	15:43	1.335	27.58	50	0.85-1.15	10	---	ND	0.305	27.28	Algae on lid, barnacle growth on case
PW17-33	13-Mar-24	14:58	15:43	1.265	27.53	50	0.85-1.15	0	---	ND	0.275	27.26	Algae on lid, barnacle growth on case

**Notes:**

1 - Elevations are in Parkland Datum = Geodetic Datum + 91.52 feet.

**Abbreviations:**

**m** - metres  
**m bgs** - metres below ground surface  
**mASL** - metres above sea level  
**mg/L** - milligrams per liter  
**mm** - millimetres  
**ppm** - parts per million  
 --- - no observations  
**TOC** - top of casing

**Acronyms:**

**DTW** - depth to water  
**FPTS** - Foreshore Passive Treatment System  
**NA** - not applicable  
**NC** - not calculated  
**NM** - not measured  
**ND** - not detected

**TABLE 2**  
**FORESHORE PASIVE TREATMENT SYSTEM INSPECTIONS (JULY 2023 - MARCH 2024)**  
**FORESHORE POST FPTS CONSTRUCTION**  
**PARKLAND BURNABY REFINERY**

Date	FPTS	Rip Rap layer maintained at 1.4m	Cobble layer above OBB surface layer maintained at 0.4m	Rip Rap or Cobble replacement Required	Vegetation present above treatment cells or OBB surface layer	Vegetation Removal Required	Damaged Monitoring Wells	Comments
05-Jul-23	Eastern	Yes	Yes	No	Weeds growing on south side of barrier. Overhanging vegetation along southern side. No growth on top of OBB or treatment layer.	No	No	Most concrete well protectors outside barrier have barnacle growth., minor chipping. As reported in previous inspections, wells on the East FPTS upper barrier have graffiti on the outside; no damage or writing on the inside.
	Western	Yes	Yes	No	Weeds growing on south side of barrier. Overhanging vegetation along southern side. No growth on top of treatment or OBB layer.	No	No	
29-Sep-23	Eastern	Yes	Yes	No	Weeds growing on south side of barrier. Overhanging vegetation along southern side. No growth on top of OBB or treatment layer.	Yes	No	Most concrete well protectors outside barrier have barnacle growth. As reported in previous inspections, wells on the East FPTS upper barrier have graffiti on the outside; no damage or writing on the inside.
	Western	Yes	Yes	No	Weeds not growing on south side of barrier. No growth on top of treatment or OBB layer.	No	No	
14-Mar-24	Eastern	Yes	Yes	No	No growth on top of treatment cells or OBB surface layer. Some overgrowth extending from the railroad bank onto cells.	Yes	No	Most concrete well protectors outside of the barriers have barnacle growth and algae. Some have minor chipping. As reported in previous inspections, wells on East FPTS in upper barrier have graffiti on the outside, and some of them are chipped (lids and case); no damage or writing on the inside.
	Western	Yes	Yes	No	No growth on top of treatment cells or OBB surface layer. Some overgrowth extending from the railroad bank onto cells.	Yes	No	

**Notes**

1. The FPTS was installed at the Foreshore Site between July 10 through October 30, 2017.
2. Additional rock material was added to the Foreshore Site on September 27, 2021.

**Abbreviations:**

**FPTS** - Foreshore Passive Treatment System      **NA** - Not applicable  
**NM** - Not monitored      **m bgs** - metres below ground surface  
**OBB** - Oleophilic biobarrier

# **Appendix A**

## **Photographic Log**

**APPENDIX A: PHOTOGRAPHIC LOG**

<b>Client Name:</b> Parkland Refining (B.C.) Ltd.	<b>Site Location:</b> Foreshore – Downgradient Area 2, Parkland Refinery, Burnaby, BC	<b>Project Number:</b> 60704318
--	--	------------------------------------

<b>Photo No.</b> 1	<b>Date:</b> July 05, 2023
<b>Direction Photo Taken:</b> Northeast	

<b>Description:</b> Eastern FPTS.
--------------------------------------





<b>Photo No.</b> 2	<b>Date:</b> July 05, 2023
<b>Direction Photo Taken:</b> Southwest	

<b>Description:</b> Western FPTS.
--------------------------------------



APPENDIX A: PHOTOGRAPHIC LOG

<b>Client Name:</b> Parkland Refining (B.C.) Ltd.		<b>Site Location:</b> Foreshore – Downgradient Area 2, Parkland Refinery, Burnaby, BC	<b>Project Number:</b> 60704318
<b>Photo No.</b> 3	<b>Date:</b> September 29, 2023		
<b>Direction Photo Taken:</b>  Northeast			
<b>Description:</b>  Eastern FPTS showing overhanging vegetation.			
<b>Photo No.</b> 4	<b>Date:</b> September 29, 2023		
<b>Direction Photo Taken:</b>  Southwest			
<b>Description:</b>  Western FPTS.			



**APPENDIX A: PHOTOGRAPHIC LOG**

<b>Client Name:</b> Parkland Refining (B.C.) Ltd.	<b>Site Location:</b> Foreshore – Downgradient Area 2, Parkland Refinery, Burnaby, BC	<b>Project Number:</b> 60704318
--	--	------------------------------------

<b>Photo No.</b> 5	<b>Date:</b> March 14, 2024
-----------------------	--------------------------------

**Direction Photo Taken:**  
Southwest

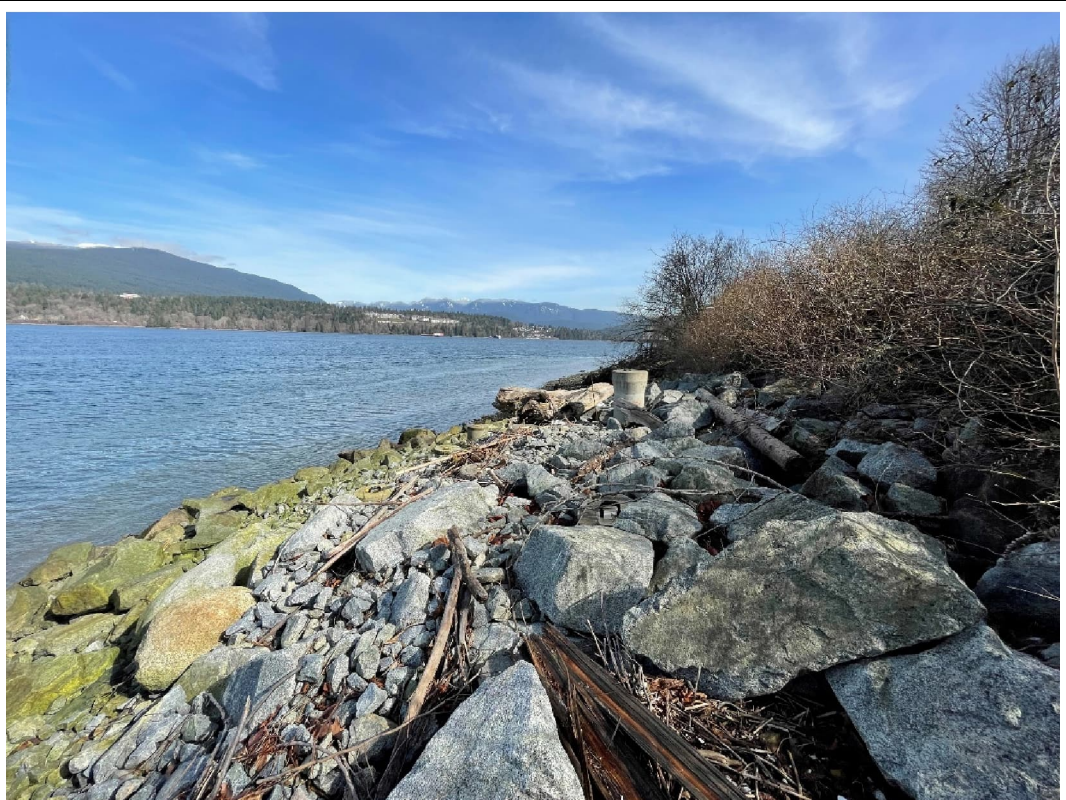
**Description:**  
Eastern FPTS showing overhanging vegetation and concrete well protectors with graffiti.



<b>Photo No.</b> 6	<b>Date:</b> March 14, 2024
-----------------------	--------------------------------

**Direction Photo Taken:**  
Northeast

**Description:**  
Western FPTS.



**APPENDIX A: PHOTOGRAPHIC LOG**

<b>Client Name:</b> Parkland Refining (B.C.) Ltd.	<b>Site Location:</b> Foreshore – Downgradient Area 2, Parkland Refinery, Burnaby, BC	<b>Project Number:</b> 60704318
--	--	------------------------------------

<b>Photo No.</b> 7	<b>Date:</b> March 13, 2024
-----------------------	--------------------------------

<b>Direction Photo Taken:</b>  Northeast
--

<b>Description:</b>  Graffiti on some Eastern FPTS wells.
---



<b>Photo No.</b> 8	<b>Date:</b> March 13, 2024
-----------------------	--------------------------------

<b>Direction Photo Taken:</b>  Down
---

<b>Description:</b>  Barnacle and seaweed growth on concrete well protector, as well as minor chipping on concrete well lid.
--

