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December 12, 2019
Project No.: 60601814

Parkland Refining (BC) Limited
355 North Willingdon Avenue
Burnaby, BC V5C 1X4

Attention: Mr. Christopher Boys, P.Geo.
Environmental Specialist

RE: ADDENDUM TO FORESHORE PASSIVE TREATMENT SYSTEM MONITORING AND MAINTENANCE PLAN DOWN SLOPE OF AREA 2, PARKLAND BURNABY REFINERY, BURNABY, B.C.

Dear Mr. Boys:

AECOM Canada Ltd. (AECOM) on behalf of Parkland Refining B.C. Ltd (Parkland) has prepared this addendum to the Foreshore Passive Treatment System (FPTS) Monitoring and Maintenance Plan (MMP) (AECOM, 2017) for the FPTS installed along the Foreshore (hereafter referred to as "the Site") area of Burrard Inlet, down slope from the Eastern Impounding Basin (EIB), Area 2 of the Parkland (formerly Chevron) Burnaby Refinery (Figure 1).

The FPTS was installed at the Site between July 10 through October 30, 2017 and was designed and constructed to be the final remedial action to address any free-phase and dissolved phase hydrocarbon and sheens along the Foreshore of Burrard Inlet. The FPTS MMP (AECOM, 2017) was prepared to maintain and assess the performance of the FPTS and was based on the Ministry of Environment and Climate Change Strategy's (ENV) supported Remedial Action Plan (RAP) prepared in 2016 (AECOM, 2016). The FPTS MMP is considered as equivalent to a Performance Verification Plan as defined in ENV's Administration Guidance 14 even though Parkland is currently not seeking a legal instrument or site profile release for the Site.

As indicated in the FPTS MMP Sampling Schedule, the MMP will be reviewed and updated after 3 years, which will be in 2021. A copy of the FPTS MMP is appended to this letter.

This addendum to the FPTS MMP (AECOM, 2017) has been prepared to:

1) include reporting requirements for the Site requested by ENV; and
2) capture modifications to the Foreshore Monitoring and Sampling Program in 2019.

Reporting Requirements Requested by ENV

On April 25, 2018, the ENV responded to the FPTS MMP, and requested the following:

1. *Monitoring for the presence of NAPL must be done in all monitoring wells.*
2. *Porewater samples from the French drains (otherwise known as contingency biodegradational points [CBP]) must be collected and analyzed for contaminants of concern to verify that they are not acting as preferential pathways for contaminant migration.*
3. *Any changes to the sampling frequency or termination of parts or the whole of the sampling program requires the approval of the Ministry of Environment and Climate Change (ENV).*
4. *Exceedances of contaminants of concern observed in porewater wells above the Risk-Based Management Targets (RBMT) require written notification to ENV within 30 (thirty) days from the date of observation. Exceedances of Upper Cap Concentrations (Protocol 11) require immediate verbal and written notification to ENV.*

ENV requires the following to be included in the Foreshore Annual Monitoring Reports:

- *Maintain up-to-date records of monitoring, inspections and maintenance of any works. The records shall be summarized annually in a report and results provided to the ministry for review. The report shall include the following:*
    - *A summary of remedial activities undertaken during the reporting period;*
    - *Assessment of overall remediation progress, including evaluation in comparison to the remediation plan and schedule;*
    - *Interpretation of current and cumulative results from the monitoring program, including groundwater, surface water, soil, etc., as appropriate; and*
    - *Supporting documentation (e.g. analytical reports, tables and figures, records of inspection, maintenance of treatment works, etc.).*

Regarding item number 2, on May 15, 2018, Chris Boys of Parkland responded to Lavinia Zanini of ENV indicating the French drains are contained within the FPTS, and therefore will not act as preferential pathways outside of the FPTS. Per AECOM's suggestion, sampling of the contingency biodegradational piping as requested will be completed for the remainder of 2018, with a review of the utility of continuing such sampling in early 2019 (Parkland, 2018a). Eight select French drain (aka CBPs) locations were sampled in June, September and December, 2018; none of the samples collected contained concentrations of benzene, toluene, ethylbenzene, xylenes, volatile petroleum hydrocarbons, light extractable petroleum hydrocarbons, naphthalene, benzo(a)pyrene, dissolved copper or dissolved zinc above the applicable RBMTs and in many instances were below their respective reported detection limits, the data are presented in 2018 Annual Foreshore Monitoring Report (AECOM, 2019). On November 25, 2019 Lavinia Zanini of ENV provided approval to discontinue sampling the CBPs as sampling in 2018 indicated that concentrations at these locations were below management targets and in many cases below laboratory detection limits (ENV, 2019b).

Regarding item number 4, on July 11, 2018, Lavinia Zanini of ENV responded to Chris Boys of Parkland and specified notification of exceedances above RBMTS in Compliance Wells and the following Up Gradient and Sentry Wells (PW17-1, PW17-2, PW17-9, PW17-10,

PW17-13, PW17-14, PW17-31 and PW17-32) must be provided to ENV in writing within 30 days (ENV, 2018b). The wells specified by ENV for notification in the event of an exceedance are highlighted in Figure 1 attached.

Modifications to the Foreshore Monitoring and Sampling Program

The Foreshore Monitoring and Sampling Program is performed under the oversight of ENV and the Vancouver Fraser Port Authority (VFPA) under VFPA Permit 16-180.

In accordance with the recommendations included within the 2018 Annual Foreshore Monitoring Report (AECOM, 2019), submitted to both the ENV and VFPA, the following modifications were made to the Foreshore Monitoring and Sampling Program in 2019:

1) The frequency of porewater sample collection at the Site was reduced from quarterly to semi-annual. ENV was notified of this modification to the sampling program on November 28, 2018 (Parkland, 2018b); ENV provided approval on December 7, 2018 (ENV, 2018c).

2) The collection of surface water sampling at the Site was discontinued. ENV was notified of this modification to the sampling program on January 30, 2019 (Parkland, 2019a); ENV provided approval on February 25, 2019 (ENV, 2019a).

3) The collection of porewater samples from the French drains (aka CBPs) was discontinued. ENV was notified of this modification to the sampling program on May 9, 2019 (Parkland, 2019b); ENV provided approval on November 25, 2019 (ENV, 2019b).

Yours very truly,

AECOM

per:

Leslie Southern, M.Sc., P.Ag.
Program Manager

Robert Horwath, CA PG
Senior Geologist
Senior Project Manager

Lesley Reid, M.Eng., P.Eng. CSAP
Environmental Engineer

Attachments:

Figure 1 – Site Plan
Appendix - Foreshore Passive Treatment System (FPTS) Monitoring and Maintenance Plan (MMP) (AECOM, 2017)

References

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

AECOM, 2017. Foreshore Passive Treatment System Monitoring and Maintenance Plan Down Slope from the Eastern Impounding Basin, Area 2 Parkland Burnaby Refinery, Burnaby, B.C., December 21, 2017.

AECOM, 2019. Foreshore 2018 Annual Monitoring Report (January – December 2018) Below Area 2 Eastern Impounding Basin, Parkland Refinery, Burnaby, British Columbia. AECOM, April 11, 2019.

ENV, 2018a. Letter from Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV) to Christopher Boys of the Parkland Burnaby Refinery, April 25, 2018.

ENV, 2018b. Email Correspondence between Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV) and Christopher Boys of the Parkland Burnaby Refinery, May 25, 2018.

ENV, 2018c. Email Correspondence between Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV) and Christopher Boys of the Parkland Burnaby Refinery, December 7, 2018.

ENV, 2019a. Email Correspondence between Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV) and Christopher Boys of the Parkland Burnaby Refinery, February 25, 2019.

ENV, 2019b. Email Correspondence between Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV) and Christopher Boys of the Parkland Burnaby Refinery, November 25, 2019.

Parkland, 2018a. Email Correspondence between Christopher Boys of the Parkland Burnaby Refinery and Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV), May 15, 2018.

Parkland, 2018b. Email Correspondence between Christopher Boys of the Parkland Burnaby Refinery and Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV), November 28, 2018.

Parkland, 2019a. Email Correspondence between Christopher Boys of the Parkland Burnaby Refinery and Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV), January 30, 2019.

Parkland, 2019b. Email Correspondence between Christopher Boys of the Parkland Burnaby Refinery and Lavinia Zanini of the BC Ministry of Environment and Climate Change Strategy (ENV), May 9, 2019.

Limitations

The findings and conclusions documented in this report have been prepared for specific application to this project and have been developed in a manner consistent with that level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area, and in accordance with AECOM's standard terms and conditions. No other warranty, expressed or implied, is made. This addendum is for the exclusive use of Parkland Refining (BC) Limited, the Vancouver Fraser Port Authority, the Tsleil-Waututh Nation, and ENV, who may rely upon this report.

Testing conducted on the site was in locations and for parameters consistent with the identified contamination for the subject property uses. Furthermore, the sampling was of sufficient quantity and location to provide adequate spatial coverage. However, as conditions between sampling locations may vary, a potential always remains for the presence of unknown, unidentified, or unforeseen surface and subsurface contamination. Further evidence against such potential site contamination would require additional surface and subsurface exploration and chemical analytical testing.

Conclusions and recommendations in this report are based on comparison of chemical analytical results to the BC ENV Contaminated Sites Regulation (2017). In the event these standards are changed, new standards are introduced, or new information is developed in future site work, AECOM should be contacted to re-evaluate the conclusions of this report, and to provide amendments as required.

AECOM's objective is to perform our work with care, exercising the customary thoroughness and competence of earth science, environmental, and engineering consulting professionals, in accordance with the standard for professional services at the time and location those services are rendered. It is important to recognize that even the most comprehensive scope of services may fail to detect environmental liability on a particular site. Therefore, AECOM cannot act as insurers and cannot "certify" or "underwrite" that a site is free of environmental contamination, and no expressed or implied representation or warranty is included or intended in our reports, except that our work was performed, within the limits prescribed by our client, with the customary thoroughness and competence of our profession.

FIGURE

BURRARD INLET

Eastern Seep Area (ESA)

Inbetween Area (IBA)

Western Seep Area (WSA)

PW17-1 PW17-2 PW17-3 PW17-4 PW17-5 PW17-6 PW17-7 PW17-8 PW17-9 PW17-10 PW17-11 PW17-12 PW17-13 PW17-14 PW17-15 PW17-16 PW17-17 PW17-18 PW17-19 PW17-20 PW17-21 PW17-22 PW17-23 PW17-24 PW17-25 PW17-26 PW17-27 PW17-28 PW17-29 PW17-30 PW17-31 PW17-32 PW17-33

CBP-1 CBP-2 CBP-3 CBP-4 CBP-5 CBP-6 CBP-7 CBP-8 CBP-9 CBP-10 CBP-11 CBP-12 CBP-13 CBP-14 CBP-15 CBP-16

P1-0 P2-0 P3-0 P4-0 P5-0 P6-0 P7-0 P8-0 P9-0 P10-0 P11-0 P12-0

Low Tide Line

Toe of Slope (High Tide Line)

Top of Slope

CPR RAILWAY

CPR Extraction Trench

PARKLAND REFINERY

SOURCE: GOOGLE EARTH IMAGE (2016)

LEGEND:

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

POREWATER SAMPLES

- Compliance Well
- Sentry Well
- Performance Well
- Up Gradient Well
- ENV Requires Notifications[2]

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. BC ENV requires written notification within 30 days of exceedances of COCs above RBMTs in select wells.
3. BC ENV requires immediate verbal and written notification of COCs above Upper Cap Concentrations (Protocol 11) in all wells.

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AECOM

SITE MAP AND FORESHORE SAMPLING LOCATIONS

Addendum to Foreshore Passive Treatment System Monitoring and Maintenance Plan
Down Slope of Area 2 Parkland Burnaby Refinery, Burnaby, B.C.

PARKLAND REFINING (B.C.) LTD.

DATE:	PROJECT NO.:	DRAWN BY:	REVISION NO.:	DRAWING NO.:
December 2019	6061814	NT	0	FIGURE 1

FILE NAME: H:\URS-CHEVRON\60601814 2019 Foreshore Monitoring\500-Deliverables\503 Addendum to FS MMP\20191024 F01 Addendum to Foreshore Passive Trement System M&M.dwg

APPENDIX

FORESHORE PASSIVE TREATMENT SYSTEM MONITORING AND MAINTENANCE PLAN

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December 21, 2017
Project No.: 60542455

Parkland Refining (B.C.) Ltd.
355 North Willingdon Avenue
Burnaby, BC V5C 1X4

Attention: Mr. Christopher Boys, P.Geo.
Senior Environmental Specialist

RE: FORESHORE PASSIVE TREATMENT SYSTEM
MONITORING AND MAINTENANCE PLAN
DOWN SLOPE FROM THE EASTERN IMPOUNDING BASIN, AREA 2,
PARKLAND BURNABY REFINERY, BURNABY, B.C.

Dear Mr. Boys:

AECOM has prepared this Foreshore Passive Treatment System (FPTS) Monitoring and Maintenance Plan (MMP) to maintain and assess the performance of the recently installed FPTS along the Foreshore (hereafter referred to as "the Site") area of Burrard Inlet, down slope from the Eastern Impounding Basin (EIB), Area 2 of the Parkland (formerly Chevron) Burnaby Refinery (Figure 1).

The MMP is based on the Ministry of Environment and Climate Change Strategy's (ENV) supported Remedial Action Plan (RAP) prepared in 2016 (AECOM 2016b). This MMP is considered as equivalent to a Performance Verification Plan as defined in ENV's Administration Guidance 14 even though Parkland is currently not seeking a legal instrument or site profile release for the Site.

Contents

SUMMARY OF THE FORESHORE PASSIVE TREATMENT SYSTEM

The FPTS was designed and constructed to be a final remedial action to address free-phase and dissolved phase hydrocarbons and sheens at the Site. The FPTS was installed between July and October 2017 and consisted of the removal of the existing Eastern and Western Interim Remedial Action (IRA) Barriers and the installation of a multicomponent FPTS comprised of permeable subsurface treatment cells for the mitigation of free-phase (aka non-aqueous phase liquids [NAPL]) and dissolved phase hydrocarbons impacted porewater. The FPTS also contains an oleophilic biobarrier (OBB) surface layer for the prevention of sheens. To assess the performance of the FPTS, four distinct types of monitoring wells, Upslope Wells, Performance Wells, Sentry Wells and Compliance Wells were installed and will be monitored under this MMP.

Further information on the FPTS may be found in Appendix A and in the FPTS Construction Report (AECOM 2017).

OBJECTIVES OF THE MONITORING AND MAINTENANCE PLAN

The objectives of the MMP are as follows:

- Collect samples from, and present the data for, the Compliance Wells;
- Assess the presence/absence of NAPL and the concentrations of dissolved phase contaminants of concern (COCs) in the water at the Site;
- Assess the performance of the remedial treatment cells and OBB surface layer installed in 2017; and
- Maintain the integrity of the FPTS by checking and, where needed, replacing the protective rip-rap, cobbles and monitoring wells, and by managing vegetation as required.

SCOPE OF WORK

The scope of work for the MMP is as follows:

- Ensure all required authorizations are obtained and followed;
- Inspect and gauge the 33 monitoring wells on the Foreshore and coordinate repairs or replacements for damaged wells;
- Monitor and sample the 33 monitoring wells as per the schedule provided below;
- Screen water samples for color, clarity, temperature, pH, dissolved oxygen (DO), salinity, electrical conductivity, oxidation reduction potential (ORP), turbidity, and total dissolved solids (TDS);
- Collect water samples from monitoring wells, and surface water samples within the vicinity of the FPTS. Samples will be analyzed for the following COCs: benzene, toluene, ethylbenzene, xylenes (BTEX), volatile petroleum hydrocarbons in water (VPHw), light extractable petroleum hydrocarbons in water (LEPHw), benzo(a)pyrene, naphthalene, dissolved copper and dissolved zinc. In addition, surface water samples will also be analyzed for total copper and zinc;
- Complete trend analysis of the COC concentrations and compare analytical results to their respective Risk-Based Management Target (RBMT, see Appendix B);

- Monitor for the presence of sheens on the surface water in Burrard Inlet at the Site during surface water sampling;
- Maintain the integrity of the treatment cells and the OBB surface layer, which will include inspection and maintenance of the rip-rap, cobbles, vegetation and monitoring wells; and
- Provide analysis and science-based recommendations that address the well monitoring and sampling frequency after three years of monitoring.

MONITORING COMPONENTS OF THE MMP

Monitoring Wells

Thirty-three (33) monitoring wells (PW17-1 through PW17-33) were installed at the Site during construction of the FPTS (refer to Figure 1 and Tables 1 and C-1). Previous monitoring wells in the Eastern and Western IRA Barriers were destroyed during the FPTS construction activities. As indicated in the introduction, the new monitoring wells are divided into the following four types:

1. Upslope Wells: monitoring wells installed upslope of the treatment cells. These wells will be used to monitor porewater concentrations entering the Site.
2. Performance Wells: monitoring wells installed within the treatment cells. These wells will be used to evaluate the ability of the treatment cells to reduce petroleum hydrocarbon concentrations through adsorption and degradation.
3. Sentry Wells: monitoring wells located down slope of the treatment cells, but still within the FPTS. These wells will be used to evaluate the performance of the treatment cells, but also provide an early warning if elevated concentrations of dissolved COCs have migrated past the treatment cells.
4. Compliance Wells: monitoring wells installed twelve meters north of the toe of the slope and beyond the limit of the FPTS.

TABLE 1
FORESHORE MONITORING WELLS

Well Type	Well Name
Upslope Wells (8)	PW17-1, PW17-4, PW17-9, PW17-13, PW17-16, PW17-21, PW17-26, and PW17-31
Performance Wells (8)	PW17-5, PW17-6, PW17-17, PW17-18, PW17-22, PW17-23, PW17-27 and PW17-28
Sentry Wells (8)	PW17-2, PW17-7, PW17-10, PW17-14, PW17-19, PW17-24, PW17-29, and PW17-32
Compliance Wells (9)	PW17-3, PW17-8, PW17-11, PW17-12, PW17-15, PW17-20, PW17-25, PW17-30, and PW17-33

Generally, all wells were screened between 0.45 and 1.2 m bgs with a 0.3 m length screened interval and in some instances a 0.36 m length screen (stainless steel prepacked screens) as presented in the FPTS Construction report (AECOM 2017).

The area between the Eastern and Western IRAs is referred to as the In-Between Area (IBA), as shown in Figure 1. As previously communicated to the ENV (AECOM, 2017b), benzene concentrations in IBA well P4.2-3D increased in early 2016 but became stable since then. In order to continue to monitor this area of the IBA, a porewater monitoring well, PW17-12 was installed to 1.4 metres below ground surface (bgs), and screened between

0.85 and 1.15 m bgs, down slope of the former location of P4.2-3D during FPTS construction.

Surface Water

Surface water samples will be collected from six surface water locations (Figure 1, Table 1). Two samples will be collected from each location; a near bottom surface water and near top surface water sample for a total of twelve surface water samples. It should be noted that there is the potential for surface water samples to be impacted by non-refinery anthropogenic sources within Burrard Inlet.

A boom encompassing the entire FPTS installation area will be in place for one year after construction.

Analytical Program

Water samples collected from the monitoring wells will be submitted to a Canadian Association for Laboratory Accreditation (CALA) certified laboratory on a standard turn-around-time basis, for the following laboratory analyses:

- BTEX and VPHw
- LEPHw
- Benzo(a)pyrene and naphthalene
- Dissolved copper and dissolved zinc

Surface water samples will be submitted for the same analysis as samples collected from the monitoring wells, but will also be analysed for total copper and zinc.

Sampling Schedule

The sampling schedule for the first three years is summarized in Table 2. Following the construction of the FPTS, monitoring described in this MMP was started in November 2017.

During the first six months following installation of the FPTS, additional monitoring and sampling events may be completed. During the first year (Year 1) after installation of the FPTS, monitoring well sampling will be completed on a quarterly basis (March, June, September and December)[1]. In the second and third years (Year 2 and 3), monitoring well sampling will be completed on a semi-annual basis (June and December), after which the program will be reviewed.

Surface water sampling and sheen monitoring will be completed quarterly during the first year, after which the surface water monitoring program will be reviewed.

[1] Monitoring well sampling will be during falling and low tide events whenever possible.

TABLE 2
MONITORING WELL DESIGNATION AND SAMPLING SCHEDULE

Well / Location	Designation	Frequency Year 1[1,2]	Frequency Year 2	Frequency Year 3
Western Seep Area				
PW17-1	Upslope Well	Quarterly	Semi-annual	Semi-annual
PW17-2	Sentry Well	Quarterly	Semi-annual	Semi-annual
PW17-3	Compliance Well	Quarterly	Semi-annual	Semi-annual
PW17-4	Upslope Well	Quarterly	Semi-annual	Semi-annual
PW17-5	Performance Well	Quarterly	Semi-annual	Semi-annual
PW17-6	Performance Well	Quarterly	Semi-annual	Semi-annual
PW17-7	Sentry Well	Quarterly	Semi-annual	Semi-annual
PW17-8	Compliance Well	Quarterly	Semi-annual	Semi-annual
PW17-9	Upslope Well	Quarterly	Semi-annual	Semi-annual
PW17-10	Sentry Well	Quarterly	Semi-annual	Semi-annual
PW17-11	Compliance Well	Quarterly	Semi-annual	Semi-annual
In-between Area				
PW17-12	Compliance Well	Quarterly	Semi-annual	Semi-annual
Eastern Seep Area				
PW17-13	Upslope Well	Quarterly	Semi-annual	Semi-annual
PW17-14	Sentry Well	Quarterly	Semi-annual	Semi-annual
PW17-15	Compliance Well	Quarterly	Semi-annual	Semi-annual
PW17-16	Upslope Well	Quarterly	Semi-annual	Semi-annual
PW17-17	Performance Well	Quarterly	Semi-annual	Semi-annual
PW17-18	Performance Well	Quarterly	Semi-annual	Semi-annual
PW17-19	Sentry Well	Quarterly	Semi-annual	Semi-annual
PW17-20	Compliance Well	Quarterly	Semi-annual	Semi-annual
PW17-21	Upslope Well	Quarterly	Semi-annual	Semi-annual
PW17-22	Performance Well	Quarterly	Semi-annual	Semi-annual
PW17-23	Performance Well	Quarterly	Semi-annual	Semi-annual
PW17-24	Sentry Well	Quarterly	Semi-annual	Semi-annual
PW17-25	Compliance Well	Quarterly	Semi-annual	Semi-annual
PW17-26	Upslope Well	Quarterly	Semi-annual	Semi-annual
PW17-27	Performance Well	Quarterly	Semi-annual	Semi-annual
PW17-28	Performance Well	Quarterly	Semi-annual	Semi-annual
PW17-29	Sentry Well	Quarterly	Semi-annual	Semi-annual
PW17-30	Compliance Well	Quarterly	Semi-annual	Semi-annual
PW17-31	Upslope Well	Quarterly	Semi-annual	Semi-annual
PW17-32	Sentry Well	Quarterly	Semi-annual	Semi-annual
PW17-33	Compliance Well	Quarterly	Semi-annual	Semi-annual
Surface Water Samples[3]				
Well / Location	**Designation**	**Frequency Year 1**	**Frequency Year 2**	**Frequency Year 3**
P3-3	-	Quarterly	No Sampling	No Sampling
P3-12	-	Quarterly	No Sampling	No Sampling
P6-3	-	Quarterly	No Sampling	No Sampling
P6-12	-	Quarterly	No Sampling	No Sampling
P8-3	-	Quarterly	No Sampling	No Sampling
P8-12	-	Quarterly	No Sampling	No Sampling

Notes:
1. During the first six months following installation of the FPTS, additional monitoring and sampling events may be completed.
2. Quarterly sampling events should occur in March, June, September and December.
3. Two surface water samples will be collected from each location (near top surface and near bottom surface).

Water sampling collection methodologies are presented in Appendix D.

To assure integrity and reliability of the data collected, rigorous quality assurance/quality control (QA/QC) protocols will be observed during sample collection. QA/QC protocols are presented in Appendix F.

PROGRAM REVIEW

Due to disturbance during construction of the FPTS, elevated concentrations in the water samples are anticipated in the first year after installation. This is a lesson learned from previous IRA Barrier construction activities (URS, 2012). Therefore, there will not be any action if elevated concentrations above screening levels in Compliance Wells occur during Year 1.

The Risk-Based Management Targets (RBMTs), which are set out in Appendix B, will be used as screening levels for Compliance Wells after Year 1. Action will be taken if any of the following conditions occur:

- If there is an exceedance above a RBMT in porewater collected from a Compliance Well, the well will be re-sampled twice immediately (e.g., twice within the month following the exceedance).
- If there are two consecutive exceedances (semi-annual in Years 2 and 3) in a Compliance Well above an RBMT, data from adjacent Compliance, Sentry, Performance and Upslope Wells will be assessed to determine if this exceedance is indicative of a wider issue and what further action is required, if any. This will occur in consultation with ENV.

The FPTS includes contingency piping into which bioremediation enhancements (e.g., nutrients, sulphate and nitrate) may be applied as appropriate to further aid the breakdown of petroleum hydrocarbons. If bioremediation enhancements are applied, they will be recorded in the Annual FPTS Monitoring Report.

After three years, the data collected will be reviewed to assess what Site monitoring and sampling frequency will be proposed for subsequent years. The frequency of future Site monitoring and sampling will be assessed based on the absence, decrease, stabilization, or increase of concentrations of contaminants of concern (COCs) in porewater, primarily in the down slope Compliance Wells.

Based on this trend analysis, the following are three potential example scenarios that could arise:

- COCs concentrations are not detected above their respective reported detection limit (RDL) in any of the Compliance Wells – *monitoring and sampling could be discontinued in all wells.*

- COCs concentrations are detected above half of their respective RBMTs in select Compliance Wells – *monitoring and sampling of only these particular wells could continue on a semi-annual basis. The program would then be re-evaluated at the end of each year.*

- COCs concentrations are detected above half of their respective RBMT on an intermittent basis in over half of the Compliance Wells – *monitoring of all wells at the*

FPTS could continue on a semi-annual basis. The program would then be re-evaluated at the end of each year.

REMEDY INTEGRITY INSPECTION AND MAINTENANCE

To maintain integrity of the remedy, regular inspections of the FPTS will be completed during the quarterly and semi-annual monitoring. The inspections and actions will include:

- Visual inspection of the system to check that two layers of rip-rap are above the treatment cells (i.e., maintaining a thickness of approximately 1.4 m) and two layers of cobbles are above the OBB surface layer (i.e., maintaining a thickness of 0.4 m).
    - If necessary, replacing and adding rip-rap and/or cobbles as required to maintain the required thickness.
- Visual inspection of the FPTS to make sure vegetation is not growing above the treatment cells or the OBB surface layer. The roots of the vegetation may puncture the liner, reducing the system effectiveness.
    - If necessary, removing any vegetation that may affect the treatment cells or the OBB surface layer.
- Inspection of the monitoring well network for damage.
    - If necessary, replacing/repairing any wells that are destroyed or damaged.

REPORT

Annual FPTS Monitoring Reports will be prepared and will contain the following key elements:

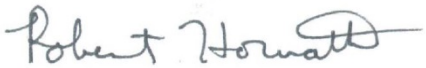
- Summary
- Statement of Objectives
- Description of Sampling
- Presentation of Data
- Presentation of any remedy monitoring and maintenance
- Interpretation and Evaluations
- Recommendations

The Annual FPTS Monitoring Reports will be prepared under the direction of a Contaminated Sites Approved Professional (CSAP).

Yours very truly,

AECOM

per:



Leslie Southern, M.Sc., P.Ag.
Environmental Scientist

Robert Horwath, CA PG
Senior Geologist
Senior Project Manager

Rob Dickin, M.Sc., P.Geo., CSAP, FGC
Technical Leader - Hydrogeology

Attachments:

Figure 1 – Site Map and Foreshore Sampling Locations
Table 1 – Foreshore Monitoring Wells
Table 2 – Monitoring Well Designation and Sampling Schedule
Table B-1 – Foreshore Risk Based Management Targets

Appendix A – Background
Appendix B – Regulatory Context
Appendix C – Foreshore Monitoring Wells Construction Details
Appendix D – Sample Collection Methodologies
Appendix E – Port of Vancouver Permit No.16-180
Appendix F – Quality Assurance Quality Control Protocols

REFERENCES

AECOM (2017a). *Foreshore Final Remedy Remediation Report, Parkland Refinery, Burnaby, British Columbia,* AECOM, December 22, 2017.

AECOM (2017b). *Dissolved Benzene Concentrations in Porewater in Foreshore Monitoring Well P4.2-3D, Chevron Burnaby Refinery, Burnaby, B.C.* AECOM, June 13, 2017.

AECOM (2016a). *Foreshore 2014 Annual Report Below Area 2 Eastern Impounding Basin, Chevron Burnaby Refinery, British Columbia* AECOM, July 13, 2016.

AECOM (2016b). *Foreshore Remedial Action Plan Below Area 2 Eastern Impounding Basin* – Chevron Burnaby Refinery, Burnaby, BC. October 27, 2016.

AECOM (2016c). *Foreshore 2015 Annual Report Below Area 2 Eastern Impounding Basin, Chevron Burnaby Refinery, British Columbia* AECOM, December 21, 2016.

AquaBlok (2010a). *AquaGate+ORGANOCLAY. AquaBlok Ltd.* January 1, 2010. Accessed February 22, 2016: http://www.aquablok.com/clientuploads/library/Aquagate/AG+OC%20Spec%20Sheet_07-30-10.pdf

AquaBlok (2010b). *AquaGate+PAC. AquaBlok Ltd.* January 1, 2010. Accessed February 22, 2016: http://www.aquablok.com/clientuploads/library/Aquagate/AG+PAC%20Spec%20Sheet_01-01-10.pdf

BC Ministry of Environment (ENV) 2014. Letter from Lizzy Mos of the ENV to Christopher Boys of Chevron regarding approval of SLRs Foreshore derived RBMTs, August 28, 2014.

SLR (SLR Consulting Canada) (2014). *Risk-Based Management Targets, Seep Area Foreshore Down Slope of the East Impounding Basin, Chevron Burnaby Refinery, Burnaby BC.* Vancouver, BC: SLR Consulting Canada, February 28, 2014.

SLR (SLR Consulting Canada) (2016). *Human Health and Ecological Risk Assessment of Seep Area Foreshore Down Slope of the East Impounding Basin, Chevron Burnaby Refinery, Burnaby BC.* Vancouver, BC: SLR Consulting Canada, May, 2016.

URS (2011). *Foreshore Detailed Site Investigation Below Area 2 East Impounding Basin, Chevron Burnaby Refinery, Burnaby BC*. URS Canada Inc., September 30, 2011.

URS (2012). *Foreshore 2012 First Semi-Annual Report Below Area 2 Eastern Impounding Basin, Chevron Burnaby Refinery, British Columbia* URS Canada Inc., December 19, 2012.

URS (2013). *Foreshore 2012 Second Semi-Annual Report Below Area 2 Eastern Impounding Basin, Chevron Burnaby Refinery, British Columbia* URS Canada Inc., March 26, 2013.

URS (2014). *Foreshore 2013 First Semi-Annual Report Below Area 2 Eastern Impounding Basin, Chevron Burnaby Refinery, British Columbia* URS Canada Inc., October 30, 2014.

URS (2015). *Foreshore 2013 Second Semi-Annual Report Below Area 2 Eastern Impounding Basin, Chevron Burnaby Refinery, British Columbia* URS Canada Inc., August 27, 2015.

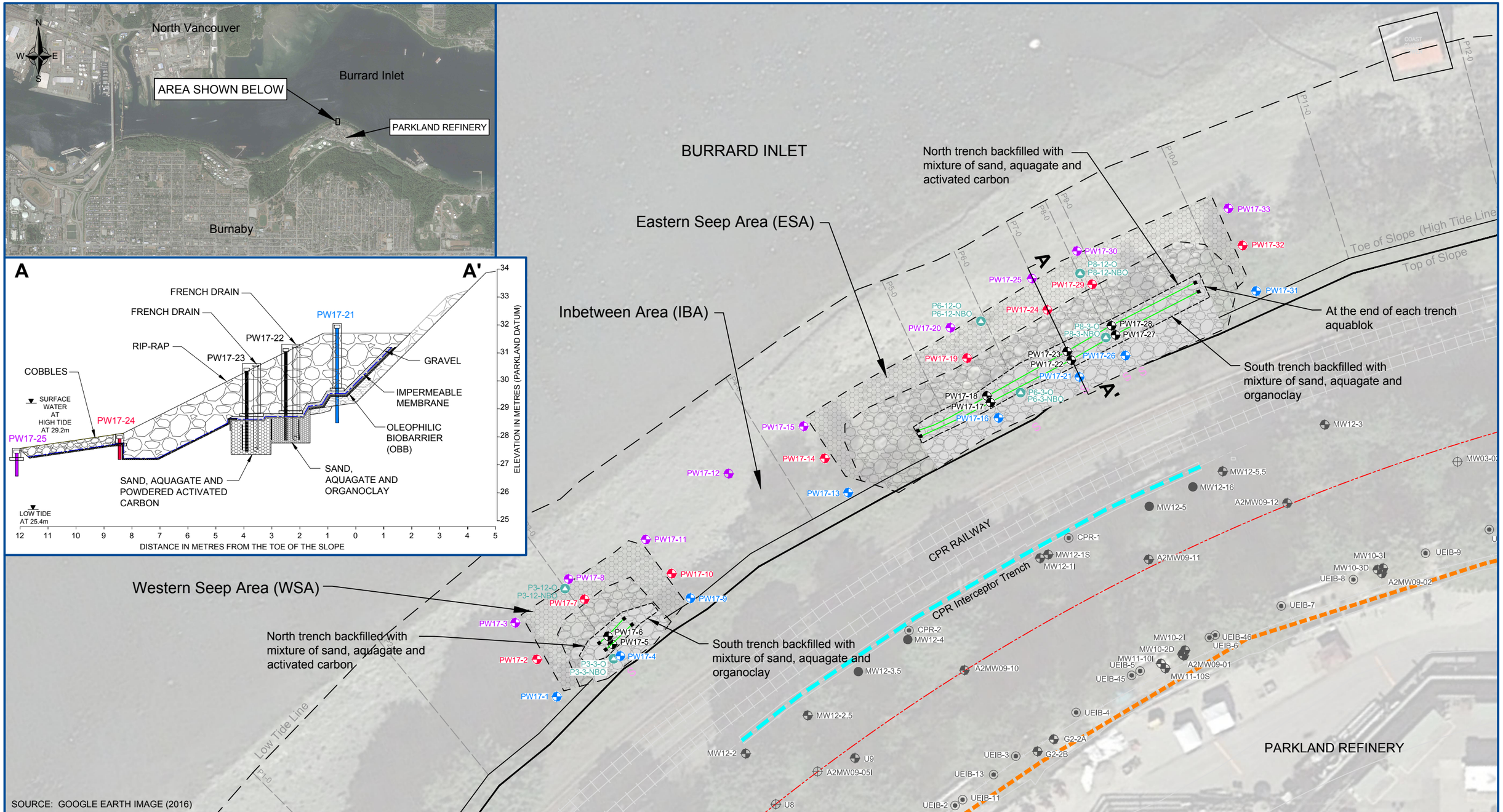
LIMITATIONS

The findings and conclusions documented in this report have been prepared for specific application to this project and have been developed in a manner consistent with that level of

care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area, and in accordance with AECOM's standard terms and conditions. No other warranty, expressed or implied, is made. This report is for the exclusive use of Parkland Refining (B.C.) Ltd, ENV and VFPA, who may rely upon this report.

AECOM's objective is to perform our work with care, exercising the customary thoroughness and competence of earth science, environmental, and engineering consulting professionals, in accordance with the standard for professional services at the time and location those services are rendered. It is important to recognize that even the most comprehensive scope of services may fail to detect environmental liability on a particular site. Therefore, AECOM cannot act as insurers and cannot "certify" or "underwrite" that a site is free of environmental contamination, and no expressed or implied representation or warranty is included or intended in our reports, except that our work was performed, within the limits prescribed by our client, with the customary thoroughness and competence of our profession.

FIGURE



LEGEND:

- Property Line
- Fence Line
- Foreshore Sampling Transect
- CPR Interceptor Trench
- Refinery Extraction System
- Impermeable Sheet
- Cobble Mat
- Rip Rap Embankment
- French Drain
- Drain Cleanout
- NAPL Seep Observed in 2010
- Surface Water Sample
- POREWATER SAMPLES
- Compliance Well
- Sentry Well
- Performance Well
- Up Gradient Well
- Monitoring Well
- Sentry Monitoring Well
- Extraction Well

ABBREVIATIONS:

O	Ocean - Near Top Surface Water
NBO	Ocean - Near Bottom Surface Water
NAPL	Non-Aqueous Phase Liquid
CPR	Canadian Pacific Railway

GRID NORTH

N W E S

metres 0 10 20

AECOM

SITE MAP AND FORESHORE SAMPLING LOCATIONS

Monitoring & Maintenance Plan
Foreshore Below Area 2 - Parkland Refinery, Burnaby, BC

PARKLAND REFINING (B.C.) LTD.

DATE:	PROJECT NO.:	DRAWN BY:	REVISION NO.:	DRAWING NO.:
December 2017	60542455	TS	0	FIGURE 1

FILE NAME: H:\URS-CHEVRON\60542455.Final Remedy Installation\5. Deliverables\MM Plan\Figures\Working files\20171218 01 Maintenance Monitoring Plan.dwg

APPENDIX A

BACKGROUND

APPENDIX A – BACKGROUND

Chevron Canada Limited (CCL) first observed NAPL seeps on the north, downward slope of the Parkland (formerly Chevron) Burnaby Refinery towards Burrard Inlet during an inspection on April 21, 2010. The seeps were immediately reported by CCL to the Provincial Emergency Program and addressed using soaker pads and booms. The source of the NAPL is unknown but believed to be associated with historical Refinery operations and the north process sewer (decommissioned in June 2011).

A Preliminary Site Investigation (PSI) was conducted in June 2010, followed by a Detailed Site Investigation (DSI) in April 2011 (URS, 2011a). The Eastern and Western IRA Barriers, comprised of a sand-organoclay mixture and a CETCO Reactive Core Mat (RCM) were constructed in February and March 2011. The Eastern IRA Barrier was refurbished in March and April 2012 by extending the sand-organoclay downgradient into the anchor trench. Porewater, porewater ecologically active zone (EAZ) samples (containing water from wells that are located from ground surface to 1 metre below ground surface), surface water from Burrard Inlet, and ambient air samples, have been collected from the Site on a regular basis in accordance with the Foreshore Monitoring Plan (URS, 2012a).

AECOM completed air, porewater and/or surface water monitoring and sampling in the ESA and WSA from 2011 to 2016. Details of the monitoring and sampling from 2011 to 2016 are included in seven reports completed by AECOM (URS 2011, URS 2012, URS 2013, URS 2014, URS 2015, AECOM 2016a, and AECOM 2016b).

From July to October 2017, the Eastern and Western IRA Barriers were excavated and removed from the Site and taken to an off-site licensed disposal facility. Two Foreshore Passive Treatment Systems (FPTS) were constructed and installed at the Site; one in the Eastern Seep Area and the second in the Western Seep Area. The FPTSs each consist of two subsurface treatment cells; the first up slope treatment cell contains a mixture of sand and AquaGate+Organoclay (AG+OC); the second, down slope treatment cell will contain a mixture of sand and AquaGate+Powdered Activated Carbon (AG+PAC) (AquaBlok, 2010a; AquaBlok 2010b). The subsurface cells are protected by rip-rap which is calculated to withstand the wave forces generated by a 100-year storm event and by local ships. The sheen control layer, which extends down slope of the treatment cells, consists of an OBB layer, which is anchored with 0.2 metre diameter cobbles. Refer to the Remedial Action Plan for further details (AECOM, 2016b). Monitoring wells were installed within and around the remedy and have been discussed within the text of this plan.

APPENDIX B

REGULATORY CONTEXT

APPENDIX B - REGULATORY CONTEXT

The British Columbia Ministry of Environment and Climate Change Strategy (ENV) approved the Stage 10 Amendment (Omnibus) to the Contaminated Sites Regulation (CSR) on October 27, 2016. The Stage 11 (Housekeeping) amendments to the CSR were approved on October 31, 2017. Pursuant to the CSR, standards for aquatic life water use apply to groundwater located within 500 metres of a surface water body containing aquatic life. Standards for aquatic life water use also apply where there is the potential for contaminated groundwater to flow through preferential corridors that discharge directly to a surface water body containing aquatic life.

In 2014, SLR Consulting (Canada) Ltd (SLR) derived Risk Based Management Targets (RBMTs) for the Site and in 2016 completed a Human Health and Ecological Risk Assessment (HHERA) for the contaminants associated with the seeps (SLR 2014 and 2016). The HHERA was submitted to ENV, Port of Vancouver (POV – formerly Port Metro Vancouver) and Fraser Health. The RBMTs are intended to be used as a risk management tool to assess the performance of the FPTS. The RBMTs were developed to be protective of aquatic plants and invertebrates at the community level and fish at the population level. The HHERA did not find any significant risk to human health; therefore, RBMTs were not needed for human receptors.

These RBMTs were established and accepted by the ENV in 2014 (ENV, 2014).

RBMTs for Site porewater were developed for benzene, ethylbenzene, toluene, xylenes, benzo(a)pyrene, naphthalene, VPHw, LEPHw, dissolved copper, and dissolved zinc. The results of SLR's HHERA indicated that all other previously identified COCs were no longer considered to be a concern to humans or marine aquatic life. Concentrations of COCs reported in surface water and porewater samples will be screened against the RBMTs.

The RBMTs for the Site are presented in Table B-1 below.

TABLE B-1 FORESHORE RISK BASED MANAGEMENT TARGETS

Parameter	RBMT micrograms per litre (µg/L)
LEPHw	300
VPHw	1,500
Benzene	2,100
Toluene	770
Ethylbenzene	320
Xylenes	330
Naphthalene	44
Benzo(a)pyrene	0.28
Dissolved copper	6.2
Dissolved zinc	90

APPENDIX C

Foreshore Monitoring Wells Construction Details

APPENDIX C - FORESHORE MONITORING WELLS CONSTRUCTION DETAILS

TABLE C-1
FORESHORE MONITORING WELLS CONSTRUCTION DETAILS

Monitoring Well	Well Type	Total Depth (m bgs)	Top of Well Screen (m bgs)	Bottom of Well Screen (m bgs)	Screen type
PW17-1	Upslope	1.20	0.85	1.15	PVC
PW17-2	Sentry	1.20	0.85	1.15	PVC
PW17-3	Compliance	1.20	0.85	1.15	PVC
PW17-4	Upslope	0.80	0.45	0.75	PVC
PW17-5	Performance	1.10	0.64	1.00	SS
PW17-6	Performance	1.30	0.84	1.20	SS
PW17-7	Sentry	1.05	0.7	1.00	PVC
PW17-8	Compliance	1.30	0.84	1.20	SS
PW17-9	Upslope	1.20	0.85	1.15	PVC
PW17-10	Sentry	1.25	0.85	1.15	PVC
PW17-11	Compliance	1.20	0.74	1.10	SS
PW17-12	Compliance	1.20	0.85	1.15	PVC
PW17-13	Upslope	1.20	0.85	1.15	PVC
PW17-14	Sentry	1.20	0.85	1.15	PVC
PW17-15	Compliance	1.30	0.84	1.20	SS
PW17-16	Upslope	0.80	0.45	0.75	PVC
PW17-17	Performance	1.10	0.64	1.00	SS
PW17-18	Performance	1.30	0.84	1.20	SS
PW17-19	Sentry	1.20	0.87	1.15	PVC
PW17-20	Compliance	1.10	0.64	1.00	SS
PW17-21	Upslope	0.80	0.45	0.75	PVC
PW17-22	Performance	1.10	0.64	1.00	SS
PW17-23	Performance	1.30	0.84	1.20	SS
PW17-24	Sentry	1.20	0.85	1.15	PVC
PW17-25	Compliance	1.25	0.85	1.15	PVC [1]
PW17-26	Upslope	0.80	0.45	0.75	PVC
PW17-27	Performance	1.10	0.64	1.00	SS
PW17-28	Performance	1.30	0.84	1.20	SS
PW17-29	Sentry	1.20	0.85	1.15	PVC
PW17-30	Compliance	1.30	0.84	1.20	SS
PW17-31	Upslope	1.20	0.85	1.15	PVC
PW17-32	Sentry	1.20	0.85	1.15	PVC
PW17-33	Compliance	1.20	0.85	1.15	PVC

Notes:
m bgs - metres below ground surface
SS - Stainless steel wrapped screen prepacked with 20/40 sand
PVC - Schedule 40 - 10 slot screen
1 - Screen consisted of a 3" - 10 slot screen surrounding a 2" - 10 slot screen prepacked with 20/40 filter sand (manufactured by Bluemax Drilling)

APPENDIX D

SAMPLE COLLECTION METHODOLOGIES

APPENDIX D - SAMPLE COLLECTION METHODOLOGIES

MONITORING, WELL PURGING AND WATER SAMPLING METHODOLOGY

There are 33 monitoring wells at the Site (Figure 1 and Table 1).

Porewater monitoring will include recording the time of day, depth to water (DTW), depth to product (DTP) and total depth of the well (TD). The DTW and DTP will be measured using an interface probe which will be decontaminated between monitoring wells to prevent cross contamination.

Porewater samples will be collected from each monitoring well using dedicated high-density polyethylene and silicone tubing attached to a peristaltic pump, to ensure minimal entrainment of silt in the sample as well as minimal losses of volatile constituents. Prior to sample collection, water will be purged from the well for approximately 5 to 10 seconds until clear. During purging, field parameters including pH, temperature, electrical conductivity, salinity, TDS, ORP, DO, and turbidity will be monitored and documented. During purging and sample collection, care will be taken to remove water from near the top of the water column to minimize any disturbance and subsequent entrainment of solids near the base of the well. Samples will be placed into a cooler containing blue or wet ice, and were kept under chain-of-custody procedures until delivery to ALS Laboratories (ALS).

SURFACE WATER SAMPLING METHODOLOGY

A total of 48 surface water samples from 12 locations will be collected the first year after installation of the Final Remedy. Surface water samples will be collected on a quarterly basis. Similar to the historical monitoring programs at the Site, surface water samples were only collected at three transect locations (P3 at the Western Seep Area and P6 and P8 both at the Eastern Seep Area) on the Foreshore, resulting in 12 samples per quarterly event.

Surface water samples will be collected by placing the sample bottles near the surface of the water. Near bottom samples will be collected by placing and opening sample bottles at the sediment-water interface approximately five centimetres above the sediment surface during a falling tide to collect water being emitted from the subsurface sediments of the Foreshore. Samples will only be collected when any turbulence in the water had dissipated and minimal sediment was present in the water column. Care will be taken to preclude the introduction of particulates into the sample container.

The surface water samples will be field screened for colour, clarity, pH, temperature, electrical conductivity, salinity, TDS, ORP, DO and turbidity. Samples will be placed into a cooler containing blue or wet ice, and were kept under chain-of-custody procedures until delivery to ALS.

Sample IDs for surface water samples will follow a similar convention as past investigations at the Site; the sample ID will contain an “O” for surface ocean and “NBO” for near bottom surface samples.

DECONTAMINATION

All non-disposable water monitoring and sampling equipment (i.e., interface probes and YSI multimeters) will be decontaminated between sample locations as follows:

- Washing external and internal surfaces of the sampling equipment with amended water[2]; scrubbing as necessary to remove dirt, grime, grease, and oil;
- Rinsing with de-ionized water; and
- Double rinsing with de-ionized water.

[2] Amended water is a 0.5% solution of an environmentally friendly cleaner labelled Liquinox and de-ionized water.

APPENDIX E

PORT OF VANCOUVER PERMIT NO.16-180

APPENDIX E - PORT OF VANCOUVER PERMIT NO.16-180

The Port of Vancouver issued Permit No.16-180 for construction of the Final Remedy. The permit is valid from May 24, 2017 to May 31, 2022. All contractors will have a copy of Permit No.16-180 when on Site. Conditions within Permit No.16-180 will be adhered to during monitoring and sampling events and maintenance activities (i.e., replacement of protective rip-rap, cobbles and/or monitoring wells, and managing vegetation).

PORT of vancouver	**VANCOUVER FRASER PORT AUTHORITY PROJECT AND ENVIRONMENTAL REVIEW REPORT AND PERMIT**
PER No.:	**16-180**
Tenant:	**Chevron Canada Limited**
Project:	**Chevron Refinery Foreshore Final Remedy**
Project Location:	**5201 Penzance Drive, Burnaby**
VFPA SID No.:	**BBY089**
Land Use Designation:	**Port Water**
Applicant(s):	**AECOM, on behalf of Chevron Canada Limited**
Applicant Address:	**3292 Production Way, Burnaby, BC, V5A 4R4**
Category of Review:	**B**
Date of Approval:	**May 24, 2017**
Date of Expiry:	**May 31, 2022**

1 INTRODUCTION

The Vancouver Fraser Port Authority (VFPA), a federal port authority, manages lands under the purview of the *Canada Marine Act*, which imparts responsibilities for environmental protection. VFPA accordingly conducts project and environmental reviews of works and activities undertaken on these lands to ensure that the works and activities will not likely cause significant adverse environmental effects. This project and environmental review report and project permit (the Permit) documents VFPA's project and environmental review of PER No. 16-180: Chevron Refinery Foreshore Final Remediation (the Project) proposed by AECOM working on behalf of Chevron Canada Limited (the Applicant).

This project and environmental review was carried out to address VFPA's responsibilities under the *Canada Marine Act*, and to meet the requirements of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), as applicable. The proposed Project is not a CEAA 2012 "designated project" and an environmental assessment as described in CEAA 2012 is not required. However, VFPA authorization is required for the proposed Project to proceed and in such circumstances, where applicable, Section 67 of CEAA 2012 requires federal authorities to assure themselves that projects will not likely cause significant adverse environmental effects. This review provides that assurance. In addition, VFPA considers other interests, impacts and mitigations through the project and environmental review.

The project and environmental review considered the application along with supporting studies, assessments and consultations carried out or commissioned by the Applicant, as well as other information provided by the Applicant. In addition, this project and environmental review considered other information available to VFPA and other consultations carried out by VFPA. A full list of information sources germane to the review is provided in the following pages of this report.

This Permit is the authorizing document allowing the Applicant to proceed with the Project subject to the listed project and environmental conditions.

Canada

2 PROJECT DESCRIPTION

The Project is the final step in Chevron's Foreshore Remedial Action Plan (RAP) to remediate soil and groundwater near Chevron's Burnaby Refinery at 5201 Penzance Drive, Burnaby, BC. The Project is to mitigate environmental risk by managing the non-aqueous phase liquid (NAPL) and associated contaminants of concern in porewater and surface water in the vicinity of the NAPL seeps. The site of the NAPL seepage and of the Project is located in the northern portion of the refinery in and near the foreshore of Burrard Inlet. The proposed work will be conducted within 250m of archaeological site DhRr-0230.

After the initial observation of the seeps in April 2010, contaminants of concern were recorded in sediment, air, and ground and surface water, including petroleum hydrocarbons and select metals. The seeps were identified as two areas: Western Seep Area (WSA) and Eastern Seep Area (ESA), which are approximately 30m apart. Interim interceptor trenches were first installed in 2011, at both the WSA and ESA, as an interim measure to manage the seeps while more permanent solutions were studied. VFPA issued Permit 10-161 for the interim remediation project.

The works for the remediation activities are planned early July 2017 to late September 2017 at low tide during the day at normal operation hours. The footprint of the work site (including the ESA, WSA, rip-rap, and monitoring wells) is approximately 140m x 30m, or 4200m^2. The excavation footprint will range from 950m^2 to 1500m^2, depending on the extent of contaminated soils in the WSA. The site is not accessible by road; therefore, all equipment will be loaded on a barge and mobilized via Burrard Inlet to the site.

The Project consists of removing the interim remediation barriers installed in 2011 in the foreshore, and installing new permanent remediation measures. The ESA will have subsurface treatment cells installed; the WSA is not expected to require subsurface treatment cells and will be backfilled with appropriate matching subgrade material, provided no contaminated soils are found. If contaminated soils are discovered in the WSA, the size of the WSA excavation will be expanded and subsurface treatment cells will be installed in the same manner as the ESA. Rip-rap will be installed on the foreshore to protect the remediation structures and also to prevent scouring of the slope near the CP Rail right-of-way. Approximately 23 monitoring wells are proposed to be installed. A qualified remediation contractor will conduct these works.

The Applicant completed a *Fisheries Act* self-assessment and submitted a Request for Project Review to Fisheries and Oceans Canada (DFO). DFO responded that a *Fisheries Act* authorization is not required for the project given that serious harm to fish can be avoided by following standard measures. The Applicant will only work in the foreshore during low tide to keep works dry. No equipment or open excavations will be left in intertidal areas overnight or during high tides.

The Applicant has prepared a Construction Environmental Management Plan (CEMP) that includes measures to mitigate potential environmental impacts including: sediment transport and turbidity, contaminated soil and groundwater, riparian vegetation, and spills and leaks. An Environmental Monitor will ensure compliance with the CEMP, this Permit, and applicable environmental regulations. The Environmental Monitor will prepare weekly reports. A qualified archaeological monitor will be on site during ground disturbance to native soils. Aboriginal groups will be given the opportunity to participate in archaeological and environmental monitoring during the Project.

Confirmatory excavation sampling will follow the BC Ministry of Environment's *Technical Guidance 1 Site Characterization and Confirmation Testing (2009)* with samples collected every metre vertically and every 5 metres horizontally from the base and side walls of excavations. Soils and groundwater that are confirmed to be contaminated will be removed and transported to an

Canada

approved disposal site. Confirmed contaminated soil will be removed to the extent allowed without affecting geotechnical stability of the CP Rail slope and right-of-way.

The Applicant plans to monitor contamination for a minimum of three (3) years post-construction. The Applicant will conduct ongoing vegetation maintenance and management near the Project site over the life of the remediation structures (~30 years). Rip-rap replacement may be required in the future, subject to a separate subsequent approval by VFPA.

The BC Ministry of Environment (BC MOE) has reviewed the Project and supports the planned works, as outlined in their letter to Chevron dated September 9, 2016.

In this project permit, the Project means the physical activities authorized by VFPA to be carried out pursuant to **PER No. 16-180**, as described below.

2.1 Proposed Works

1. Access to foreshore by loading equipment on a barge and mobilizing via Burrard Inlet to the site, and returning equipment to the barge prior to high-tide.
2. Removal of an estimated 150m^2 of riparian vegetation, including trees, shrubs, and ferns. Vegetation maintenance will be performed over the lifetime of the remedy to prevent damage to the remedy structures.
3. Removal of the boom near the ESA.
4. Excavation and removal of the existing interim remediation barriers (approximately 44m) from the WSA and ESA. The excavations will be staged in 5 to 10 metre segments along the length of the foreshore. Each segment will be excavated, backfilled and covered by the end of each work day before the tide covers the site; there will be minimal in-water works.
5. Contaminated soil and groundwater will be removed and transported on a barge in polypropylene super sack bags. All disposals will be at approved disposal sites.
6. Installation of the new permanent remediation barrier at the ESA within trench segments (5 to 10 metres) in the foreshore. This includes imported fill (e.g., gravel, sand, clay), geogrid filter fabric, and poly sheeting. The ESA subsurface treatment cells will be covered by an oleophilic biobarrier geocomposite to capture potential NAPL sheens. A layer of cobbles 20 centimetres (cm) thick will anchor the oleophilic biobarrier composite.
7. Installation of natural, non-leaching rip-rap of a median 0.7 metres in diameter and total rip rap thickness of 1.4 metres to protect the ESA remediation structures and for scour protection of the CP Rail right-of-way slope from wave forces generated by 100-year storm events and ship wakes.
8. The WSA trench segments will be backfilled with appropriate matching subgrade materials unless additional contamination is discovered, upon which the WSA excavation area will be extended and will receive similar remedy structures as the ESA.
9. Installation of 23 monitoring wells with concrete risers to protect them from shifting rip-rap. Porewater wells will be placed up slope, within and down slope of the ESA and WSA to monitor performance and establish compliance with applicable standards.

3 VANCOUVER FRASER PORT AUTHORITY INTERNAL REVIEWS

The following VFPA departments have reviewed the application and support approval of the Project subject to the listed project and environmental conditions.

☒ Planning	☒ Environmental Programs	☒ Engineering
☒ Marine Operations	☒ Project Communications	☒ Aboriginal Affairs

Canada

4 ABORIGINAL CONSULTATION

VFPA Aboriginal Affairs reviewed the proposed works and determined that the project may have the potential to adversely impact Aboriginal rights.

Scope of Consultation

- Tsleil-Waututh Nation
- Squamish Nation
- Musqueam Indian Band
- Sto:lo Nation
- Hul'qumi'num Treaty Group
    - Halalt First Nation
    - Lake Cowichan First Nation
    - Lyackson First Nation
    - Penelakut Tribe
    - Cowichan Tribes
    - Stz'uminus First Nation

All Aboriginal groups listed above were consulted on the proposed project.

Overview of Consultation Activities

On December 14, 2016, a referral package was sent to each of the Aboriginal groups listed above. The referral package included:

- Referral Letter
- Permit Application
- Project Overview Map
- Project Remedial Action Plan

Comments were requested from Aboriginal groups within 40 business days, by February 10, 2017. VFPA elected to extend the review period from the usual 30 business days to account for office closures over the December holiday in some Aboriginal communities.

On January 12, 2017, VFPA sent an update email, reminding Aboriginal groups about the project review and requesting comments by the February 10, 2017 deadline.

VFPA received comments from Aboriginal groups via letters and email. VFPA responded to all comments from Aboriginal groups.

Summary of Issues

Below is a table summarizing comments received by VFPA and how they were considered as part of the project and environmental review.

Issue	VFPA Considerations	Action Required
Current use of lands and resources for traditional purposes		
Contamination of Burrard Inlet	The project involves installing barriers to impede remaining contamination from entering the inlet, and installing long-term monitoring wells to monitor contamination and to assess whether or not further action needs to be taken. This project will reduce contamination and provide an overall environmental benefit to Burrard Inlet. In acknowledgement of the concerns of Aboriginal groups about the contamination, the Applicant committed to making communications relating to monitoring available.	VFPA included the following permit condition (no. 43): The Applicant shall make monitoring reports available to Aboriginal groups.
Presence of Aboriginal group environmental monitors on-site during installation	VFPA acknowledges that the environmental health of Burrard Inlet is of high importance to Aboriginal groups. VFPA is interested in working with Aboriginal groups to allow environmental monitors to be on-site during project works.	VFPA included the following permit condition (no. 25): The Applicant shall make opportunities available for Aboriginal groups to participate in environmental monitoring during project works.
Monitoring and Sampling of Project Area	The Applicant will undertake a monitoring and sampling program for three years, after which the program will be reviewed. Monitoring will likely occur for five years or more, but likely at a reduced frequency, subject to the analytical results from the first three years. The Applicant committed to copying Aboriginal groups on communications related to this issue.	VFPA included the following permit condition (no. 43): The Applicant shall make monitoring reports available to Aboriginal groups.
Preservation of sandy beach	The Applicant has completed the remedial design to limit the amount of sandy beach that will be altered while still installing a robust system that is protective of the environment.	None

Issue	VFPA Considerations	Action Required
Principle of net environmental gain, rather than no net environmental loss	VFPA continues to seek opportunities to work with Aboriginal groups and others to improve environmental management practices and to provide net environmental benefits through various initiatives. VFPA is also keen to continue identifying shared interests and to focus on collaborative projects with Aboriginal groups that will result in net environmental gains within Burrard Inlet. The Applicant provided a response recognizing that Aboriginal groups are leaders in environmental stewardship in Burrard Inlet. Chevron is working with Aboriginal groups and others on environmental initiatives that benefit Burrard Inlet.	None
Monitoring of future cumulative effects of ground and surface water contamination	The Applicant will undertake a monitoring and sampling program for three years, after which the program will be reviewed. Monitoring will likely occur for five years or more, but likely at a reduced frequency, subject to the analytical results from the first three years. The Applicant committed to copying Aboriginal groups on communications related to this issue. The Applicant developed risk-based management targets (RBMTs) which were finalised in 2014 and approved by the BC MOE. The RBMTs are site-specific concentration limits for the parameters of concern in the site porewater, and are designed to be protective of aquatic life that may experience potentially long-term exposures. As long as the concentrations of the parameters are below the RBMTs (which the remedy is designed to ensure), the ecological function and viability of aquatic life in the foreshore will be maintained. The RBMTs form an integral part of the performance monitoring program described in the RAP.	VFPA included the following permit condition (no. 43): The Applicant shall make monitoring reports available to Aboriginal groups.
Impacts to fish and fish habitat as a result of ground and surface water contamination	Impacts to fish and fish habitat are not expected as a result of the project. An analysis of the potential effect on the physical fish habitat was completed and submitted to Fisheries and Oceans Canada as part of the Request for Review process. That analysis showed that the physical changes to the Foreshore area would not result in significant harm to fish.	None

Issue	VFPA Considerations	Action Required
Loss of riparian vegetation resulting from lowering of groundwater levels	The drawdown from the Perimeter Extraction System is limited to 10 to 30 meters from the well. The wells are located far enough from Burrard Inlet to affect the water table near the inlet. Therefore, the project is not expected to have an effect on riparian vegetation as a result of lowering groundwater levels.	None
Loss of wildlife habitat resulting from lowering groundwater levels	The drawdown from the Perimeter Extraction System is limited to 10 to 30 meters from the well. The wells are located far enough from Burrard Inlet to affect the water table near the inlet. Therefore, the project is not expected to have an effect on wildlife habitat as a result of lowering groundwater levels.	None
Cultural Heritage		
Project area holds high cultural value for TWN	VFPA acknowledges the importance of the area to Aboriginal groups. The Applicant recognizes the cultural sensitivity of the site and has been working with an Aboriginal-owned business to ensure all activities are carried out in regards to this sensitivity.	None
Impacts to archaeological resources	VFPA understands that the Applicant is working with Aboriginal groups to address potential impacts to archaeology. This includes the use of Aboriginal cultural monitors during project works.	VFPA included the following permit condition (no. 24): The Applicant shall make opportunities available for Aboriginal groups to provide archaeological monitors during project works.
Additional Issues		
Outstanding project design considerations	VFPA will endeavor to share details around materials used with Aboriginal groups when they become available from the Applicant. This may occur through a post-construction report, which will be shared with Aboriginal groups.	None

Based on the record of consultation, VFPA is of the view that the duty to consult has been met.

5 NOTIFICATIONS

5.1 Community Notification

The proposed Project was assessed by VFPA to have minimal or no potential impacts to community interests in the surrounding area either during construction or once the project is completed. Therefore no community consultation or construction notification was required.

6 INFORMATION SOURCES

VFPA has relied upon the following sources of information in its review of the Project.

- Application form and materials submitted by the Applicant on behalf of the tenant on November 23-December 16, 2016.
- Foreshore Remedial Action Plan Below Area 2 Eastern Impounding Basin – Chevron Burnaby Refinery, Burnaby, BC" October 27, 2016, AECOM
- Letter titled "Final Remediation Action Plan Below Area 2 Eastern Impounding Basin – Chevron Refinery", September 9, 2016, Lavinia Zanini of the BC Ministry of Environment
- Email dated 2016-10-04, from Michael Engelsjord of DFO to Chris Boys of Chevron, "Serious harm to fish can be avoided or mitigated."
- Draft Construction Environmental Management Plan (CEMP) for the Foreshore Final Remedy submitted by Aecom February 3, 2017.
- Email correspondence from Michael Gill May 15, 2017 re: Cost Proposal for tree planting at EIB in Area 2.
- All plans and drawings labelled PER No. 16-180-A to D.

7 PROJECT AND ENVIRONMENTAL CONDITIONS

VFPA has undertaken and completed a review of the Project in accordance with the *Canada Marine Act* and Section 5 of the Port Authorities Operations Regulations and, as applicable, Section 67 of the *Canadian Environmental Assessment Act, 2012*.

If at any time the Applicant fails to comply with any of the project and environmental conditions set out in the project permit (the Permit) below, or if VFPA determines that the Applicant has provided any incomplete, incorrect or misleading information in relation to the Project, VFPA may, in its sole and absolute discretion, cancel its authorization for the Project or change the project and environmental conditions to which such authorization is subject.

Pursuant to Section 29 of the Port Authorities Operations Regulations, VFPA may also cancel its authorization for the Project, or change the project and environmental conditions to which such authorization is subject, if new information is made available to VFPA at any time in relation to the potential adverse environmental and other effects of the Project.

The following are the minimum conditions that must be followed by the Applicant to mitigate potential or foreseeable adverse environmental and other effects.

No.	GENERAL CONDITIONS
1.	This Permit is conditional on a valid tenure agreement with respect to the subject premises being in place. **No construction or any other physical activities may commence in the absence of a valid tenure agreement.**
2.	This Permit is granted subject to the fulfillment of all other requirements of VFPA, relating to the Project. Furthermore, prior to commencing construction or any other physical activities the Applicant shall ensure that it has complied with all other necessary legal requirements and that all necessary regulatory approvals have been obtained.
3.	This Permit in no way endorses or warrants the design, engineering, or construction of the Project and no person may rely upon this Permit for any purpose other than the fact that VFPA has permitted the construction of the Project, in accordance with the terms and conditions of this Permit.

4.	In consideration of the granting of this Permit by VFPA the Applicant agrees to indemnify and save harmless VFPA against any and all actions, claims, loss, damages or other expenses in any way arising or following from or caused by the granting of this Permit or the construction or operation of the Project as contemplated by this Permit.
5.	The Applicant is responsible for locating all existing site services and utilities including any located underground and to employ best practices and meet applicable code requirements with respect to protection of existing site services and clearance between existing and proposed site services. The Applicant is responsible for repair or replacement of any damage to existing site services and utilities, to the satisfaction of VFPA, that result from construction and operation of the Project.
6.	The Applicant shall undertake and deliver the Project to total completion in a professional, timely and diligent manner in accordance with the Application submitted by the Applicant and the applicable standards and specifications set out in the sections above entitled Project Description and Information Sources. The Applicant shall not carry out any other physical activities unless expressly authorized by VFPA.
7.	The Applicant shall establish a spill prevention, containment and clean-up plan for hydrocarbon products (including fuel, oil and hydraulic fluid) and any other deleterious substances using standards, practices, methods and procedures to a good commercial standard, conforming to applicable law and using that degree of skill and care, diligence, prudence and foresight which would be reasonably and ordinarily expected from a qualified, skilled and experienced person engaged in a similar type of undertaking under the same or similar circumstances. The Applicant shall ensure that appropriate spill containment and clean-up supplies are available on site at all times and that all personnel working on the project are familiar with the spill prevention, containment and clean-up plan.
8.	The Applicant shall have due regard to the potential application of the *Migratory Birds Convention Act* (Canada) and/or the *Wildlife Act* (British Columbia). To reduce the risk of Project-related harm to birds and/or their active nests and eggs, the Applicant may wish to avoid certain physical activities during the general bird breeding season, which falls between **April 1 and July 31**, or outside of this time span if occupied nests are present. The Applicant shall exercise all due diligence to avoid causing harm to birds and/or their active nests and eggs. The Applicant shall also have due regard to nests of those species of birds protected by Applicable Law at all times of the year, regardless of the time of year or whether or not the nests are occupied. The Applicant should, where circumstances warrant, retain the services of qualified environmental professionals to assist in developing and undertaking appropriate bird nest surveys immediately before, during and after the general bird breeding season.
9.	The Applicant shall cooperate fully with VFPA in respect of any review by VFPA of the Applicant's compliance with these conditions including, without limitation, providing any information or documentation required by VFPA.
10.	The Applicant shall make a copy of this Permit available to all employees, agents, contractors, licensees and invitees prior to commencing any physical activities. The Applicant shall be solely responsible for ensuring that all such employees, agents, contractors, licensees and invitees comply with these conditions.

Canada

11.	The Applicant shall make available upon request by any regulatory authority (such as a Fishery Officer) a copy of this Permit.	
12.	Unless otherwise noted, the Applicant shall submit all documents required for VFPA approval to **email: per@portvancouver.com; fax: 1-866-284-4271 and referencing PER No.16-180.**	
	CONDITIONS – PRIOR TO COMMENCING CONSTRUCTION OR ANY PHYSICAL ACTIVITIES	**SUBMISSION TIMING (business days)**
13.	The Applicant shall notify the Fisheries and Oceans Canada (DFO), Conservation and Protection Field Supervisor for Fraser Valley West in Langley, British Columbia (tel: 604-607-4150; fax: 604-607-4199). The Applicant shall copy VFPA Environmental Programs and the Harbour Master on this notification EnvironmentalPrograms@portvancouver.com and Harbour_Master@portvancouver.com; or fax 1-866-284-4271.	2 days before commencing construction or any physical activities
14.	The Applicant shall submit signed and sealed drawings for proposed works approved for construction by a professional engineer licensed to practice in the Province of British Columbia.	5 days before commencing construction or any physical activities
15.	The Applicant shall distribute a construction notice to the City of Burnaby describing the works and activities, hours of construction, and contact information. The Applicant shall copy VFPA when the construction notice is distributed.	10 days before commencing construction or any physical activities
16.	Prior to the commencement of any vessel-related activities, the Applicant shall contact the appropriate Canadian Coast Guard ("CCG") Marine Communications and Traffic Services ("MCTS") centre regarding the issuance of a Notice to Shipping ("NOTSHIP") to advise the marine community of potential hazards associated with the Project. The Applicant must advise CCG that works are planned to occur near a CCG-owned radar tower.	As per Coast Guard requirements
17.	The Applicant shall submit a Vegetation Compensation Plan to the satisfaction of VFPA. The Vegetation Compensation Plan must include a description of the type and area of vegetation to be removed and describe how impacts will be compensated.	10 days before commencing construction or any physical activities
18.	The Applicant shall submit a finalized Construction Environmental Management Plan (CEMP) to the satisfaction of VFPA.	10 days before commencing construction or any physical activities
	CONDITIONS – DURING CONSTRUCTION OR ANY PHYSICAL ACTIVITIES	
19.	The Applicant shall notify VFPA upon commencement of construction or any physical activities of the Project.	

20.	The Project shall be monitored by an appropriately qualified Environmental Monitor. The Environmental Monitor shall be empowered in writing to direct works to ensure compliance with this Permit and the Construction Environmental Management Plan. Monitoring events shall occur when the Environmental Monitor deems it appropriate but in no case less than weekly, and shall be full time during works with potential to cause adverse effects on fish or fish habitat.
21.	The Environmental Monitor shall provide monitoring reports to VFPA on a weekly basis or more frequently if circumstances warrant. The VFPA reserves the right to rule on the adequacy of the monitoring and the content of the reports.
22.	All general construction and physical activities related to the Project shall be conducted from **Monday to Saturday** between the hours of **7:00am and 8:00pm.** No construction and physical activities shall occur during Sundays or holidays. These hours shall not be modified without prior approval from VFPA.
23.	The Applicant shall ensure that an appropriately qualified archaeological monitor be on site at all times during ground disturbing activities that may intrude into native soils.
24.	The Applicant shall make opportunities available for Aboriginal groups to provide archaeological monitors during project works.
25.	The Applicant shall make opportunities available for Aboriginal groups to participate in environmental monitoring during project works.
26.	In the event that evidence of what is suspected to be an archaeological resource is encountered, the Applicant shall: a) Immediately stop any activities that might disturb the archaeological resource or the site in which it is contained ("Site"). b) Not move or otherwise disturb the artifacts or other remains present at the Site. c) Stake or flag off the Site to prevent additional disturbances. d) Immediately notify VFPA.
27.	The Applicant shall not, directly or indirectly: (a) deposit or permit the deposit of a deleterious substance of any type in water frequented by fish in a manner contrary to Section 36(3) of the *Fisheries Act*; or (b) adversely affect fish or fish habitat in a manner contrary to Section 35(1) of the *Fisheries Act*.
28.	The Applicant shall ensure that debris and waste material resulting from the Project are contained, collected, and disposed of at suitable upland locations using standards, practices, methods and procedures to a good commercial standard, conforming to applicable law and using that degree of skill and care, diligence, prudence and foresight which would be reasonably and ordinarily expected from a qualified, skilled and experienced person engaged in a similar type of undertaking under the same or similar circumstances.
29.	The Applicant shall ensure that all equipment is in good mechanical condition and maintained free of fluid leaks, invasive species, and noxious weeds.

30.	The Applicant shall not permit barges or other vessels used during the Project to ground on the foreshore or seabed or otherwise disturb the foreshore or seabed (including disturbance as a result of vessel propeller wash), excepting only such disturbance as is reasonably required to complete the Project.
31.	Works in shoreline shall be limited to the project area as defined in the Construction Environmental Plan and PER No. 16-180-A to D. The Applicant shall be responsible for the repair of any damage, contamination, or erosion resulting from disturbance to the intertidal foreshore during the Project.
32.	Existing native riparian vegetation shall be retained where possible, and disturbance or clearing of vegetation shall be staged and strictly limited to that required for Project implementation.
33.	Works in the intertidal area shall be undertaken in the dry (i.e., above the water surface).
34.	The Applicant shall use a clean excavator bucket. The bucket and any portion of the excavator arm that will be in contact with or near Burrard Inlet shall be clean prior to the start of works.
35.	The direct or indirect release or deposit of sediment or sediment laden water into the aquatic environment shall be minimized during the works. In this regard, reference should be made to the water quality criteria described in the British Columbia Water Quality Guidelines (Criteria): May 2015 Edition produced by the BC Ministry of Environment.
36.	Should contaminated materials be encountered, the Applicant shall ensure that all contaminated materials, including contaminated drill cuttings and equipment wash water, are removed, contained, and disposed of at appropriate off-site facilities using standards, practices, methods and procedures to a good commercial standard, conforming to Applicable Law and using that degree of skill and care, diligence, prudence and foresight which would be reasonably and ordinarily expected from a qualified, skilled and experienced person engaged in a similar type of undertaking under the same or similar circumstances. Suspect materials should be treated as contaminated or stockpiled until their environmental quality has been determined.
37.	Materials brought onto the property to be used for backfilling, site preparation, or other uses shall be from sources demonstrated to be clean and free of environmental contamination.

Canada

38.	During any vessel-related activities, the Applicant shall: a) Position vessels and equipment associated with the Project in such a manner so as not to obstruct line of sight to navigational aids or markers. b) As per the International Regulations for Preventing Collisions at Sea, exhibit the appropriate lights and day shapes at all times. c) Monitor the VHF channel used for MCTS communications in the respective area at all times and participate as necessary. d) Be familiar with vessel movements in areas affected by the Project. The Applicant shall plan and execute the Project in a manner that will not impede navigation or interfere with vessel operations. e) During night hours, unless working 24 hrs per day, the rig and associated equipment shall be moored outside the navigation channel and lit in accordance with all applicable regulations.	
	CONDITIONS – UPON COMPLETION	**SUBMISSION TIMING (Business Days)**
39.	The Applicant shall notify VFPA upon completion of the Project.	Within 10 days of completion
40.	The Applicant shall provide record drawings, in both AutoCAD and Adobe (PDF) format to VFPA.	Within 40 days of completion
41.	The Applicant shall confirm the Project was constructed within the tenured area by providing to VFPA: a) Digital photographs of the tenured area, both before and after construction of the Project, from the land and water side of the tenured area. b) A survey plan. c) A letter from an engineer confirming the Project was constructed within the tenured area.	Within 40 days of completion
42.	The Applicant shall submit a comprehensive post-construction report, to VFPA's satisfaction, which shall include: • A description of any known or suspected contamination that remains at the site, and any new contamination characteristics that can be attributed to the site; • A summary of all environmental monitoring and environmental incidents for the Project; • Copies of all manifest for contaminated soils and groundwater removed from the Project location; and • Plans and schedules for post-construction monitoring as detailed in "Section 8: Performance Verification Plan" of the Applicant's Foreshore Remedial Action Plan dated October 27, 2016.	Within 40 days of completion

Canada

43.	The Applicant shall provide VFPA all future environmental monitoring data and reports that are related to the Project until such time that environmental monitoring at the Project site is completed. Monitoring data and reports shall include, at minimum, monitoring as detailed in "Section 8: Performance Verification Plan" of the Applicant's Foreshore Remedial Action Plan dated October 27, 2016. The Applicant shall also make monitoring reports available to Aboriginal groups and the BC MOE.	Within 30 days of each monitoring period

VFPA reserves the right to rescind or revise these conditions at any time that new information warranting this action is made available to VFPA.

LENGTH OF PERMIT VALIDITY

The Project must be completed no later than May 31, 2022 (the Expiry Date).

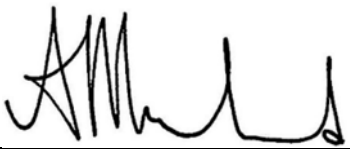
AMENDMENTS

- Details of any material proposed changes to the Project, including days and hours when construction and any physical activities will be conducted, must be submitted to VFPA for consideration of an amendment to this Permit.
- For an extension to the Expiry Date, the Applicant must apply in writing to VFPA no later than 30 days prior to that date.

Failure to apply for an extension as required may, at the sole discretion of VFPA, result in termination of this Permit.

8 ENVIRONMENTAL REVIEW DECISION

In completing the environmental review, VFPA has reviewed and taken into account relevant information available on the proposed project, has considered the information and proposed mitigations provided by the Applicant and other information as listed elsewhere in this document, and concludes that with the implementation of proposed mitigation measures and conditions described in the project and environmental conditions section above, the Project is not likely to cause significant adverse environmental effects.



ANDREA MACLEOD
MANAGER, ENVIRONMENTAL PROGRAMS

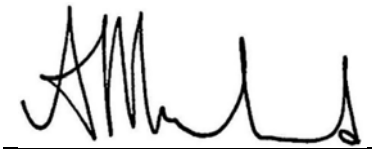
May 24, 2017
DATE OF DECISION

9 CONCLUSION

In completing the project and environmental review, VFPA concludes that with the implementation of proposed mitigation measures and conditions described in the project and environmental conditions section above, the Project has appropriately addressed all identified concerns.

PROJECT AND ENVIRONMENTAL REVIEW DECISION

Project Permit PER No. 16-180 is approved by:



ANDREA MACLEOD
MANAGER, ENVIRONMENTAL PROGRAMS

May 24, 2017
DATE OF APPROVAL

CONTACT INFORMATION

Vancouver Fraser Port Authority (VFPA)
100 The Pointe, 999 Canada Place
Vancouver BC V6C 3T4 Canada

Project & Environmental Review
Tel.: 604-665-9047
Fax: 1-866-284-4271
Email: PER@portvancouver.com
Website: www.portvancouver.com

Canada

PER No. 16-180-A

Chevron Refinery Foreshore Final Remedy

PER #16-180

Proposed Project Area

VFPA Boundary

N

20 10 0 20 m

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VFPA Spatial Data Group
May 2017
PLAN # G2016-133

Any areas marked "proposed" represent approximate locations.

PER No. 16-180-B

VANCOUVER FRASER PORT AUTHORITY

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B NORTH

B' SOUTH

RECEPTORS

HUMAN HEALTH
Recreational Users

ECOLOGICAL
Aquatic

ELEVATION (metres)
(Chevron's Mill Datum)

40 (10)
35 (5)
30 (0)
25 (-5)
(masl)

Approximate Low Tide Line

Approximate Mid Tide Line

Toe of Slope and Approximate High Tide Line

BURRARD INLET

Boom Location

P6-12D

P6-8D

P5.25-5

P5.5-3R

Infrequent sheens & odours

NAPL Detection Core Samples April, 2012

CPR Interceptor Trench

CPR ROW

MW12-1S*

Culverts

Perforated Pipe

MW12-1S
July, 2012
NAPL last observed

January 2011
CP Rail Ditch
NAPL last observed

Foreshore
April, 2010
NAPL last observed

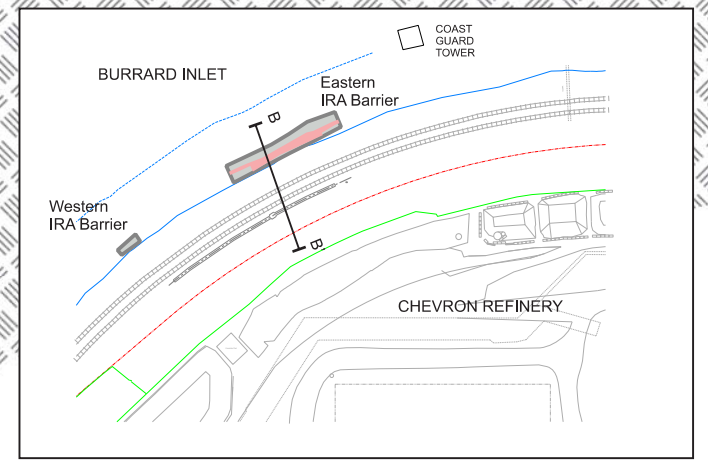
September, 2011
NAPL last observed

Porewater Elevation (High Tide)

Porewater Elevation (Low Tide)

Original Foreshore IRA March, 2011

Foreshore IRA Refurbishment March, 2012



LEGEND:

Borehole/ Monitoring Well

Screened Interval

Groundwater Elevations

Beach Sand

Fill/Alluvium/Colluvium: sand, some gravel, silt and clay imported fill in areas

Till: sandy silt, trace gravel, dense, grey

Organoclay and beach sand mixture

Organoclay and imported sand mixture

Excavation Limit

Geogrid/Filter Fabric

Solid Poly Sheeting

Geogrid and Oleophilic Biobarrier (OBB)

Rip-Rap boulders

Groundwater Table & Flow Direction

NAPL Last Observed Historically

Pump

ABBREVIATIONS:

IRA	Interim Remedial Action
CPR	Canadian Pacific Railway
ROW	Right-of-Way
NAPL	Non-Aqueous Phase Liquid
masl	metres above sea level

NOTE: Chevron Mill Datum = Geodetic Datum + 27.85 metres (91.37 feet)

* NAPL detected in CPR ROW Investigation MW12-1S was detected in soil sampes with ultraviolet light.

0 5 10m
HORIZONTAL

AECOM

FORESHORE CONCEPTUAL SITE MODEL

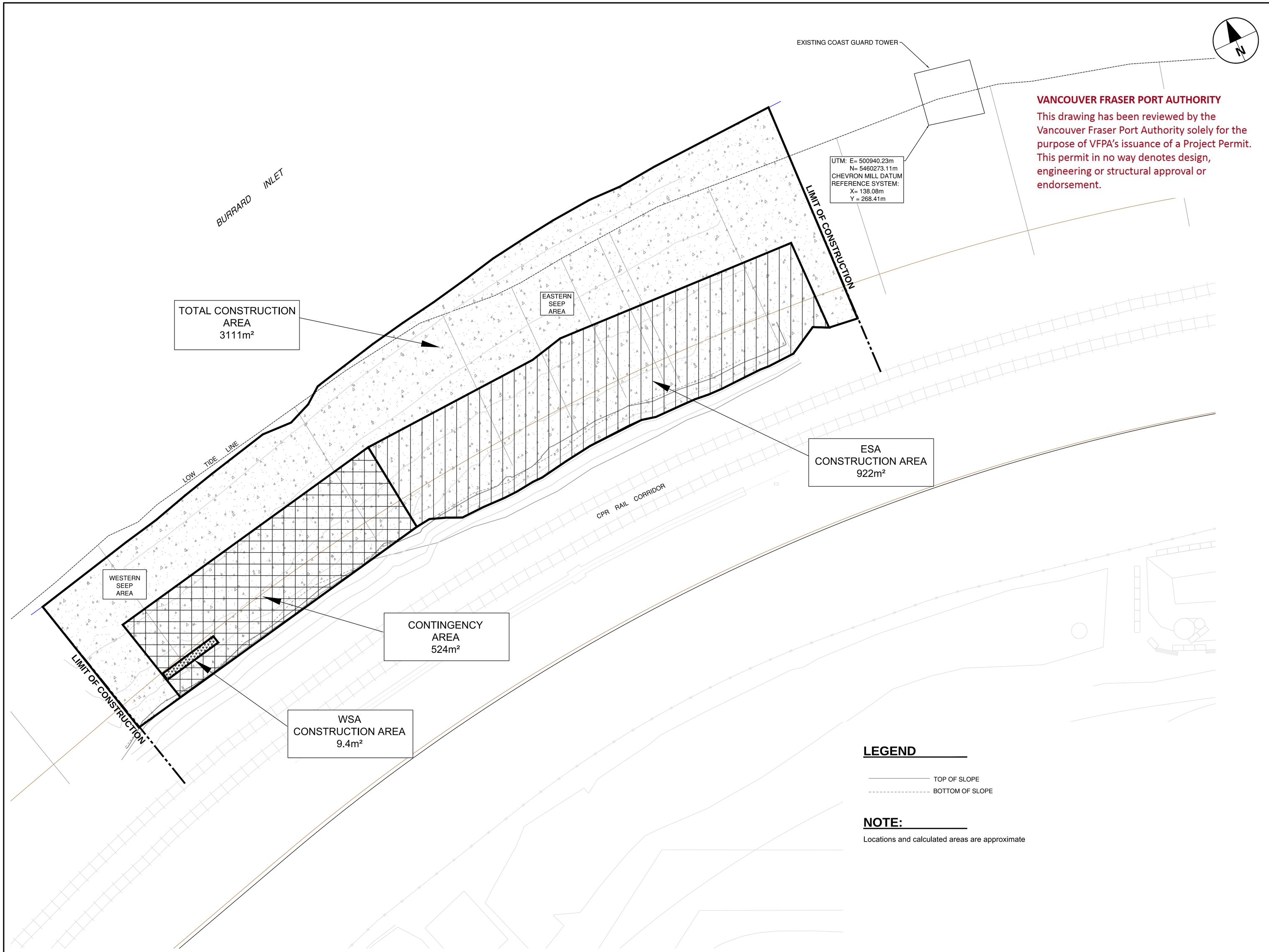
Remedial Action Plan
Foreshore Below Area 2 - Chevron Refinery, Burnaby, BC

CHEVRON CANADA LIMITED

DATE:	PROJECT NO.:	DRAWN BY:	REVISION NO.:	DRAWING NO.:
July 2016	60347433	TS	0	FIGURE 3

H:\URS-CHEVRON\39549154.CCL Foreshore Final Remedy\5. Deliverables\April 2013 Presentation\Figures.J-03 CSM.cdr

PER No. 16-180-C



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LEGEND

TOP OF SLOPE

BOTTOM OF SLOPE

NOTE:

Locations and calculated areas are approximate

PLAN

0 6.25 12.5 m

1:250

NOT FOR CONSTRUCTION

PROJECT

FORESHORE REMEDIAL ACTION PLAN
BELOW AREA 2 EASTERN IMPOUNDING BASIN
CHEVRON BURNABY REFINERY

CLIENT

Chevron Canada Limited
Burnaby Refinery
355 North Willingdon Avenue
Burnaby BC V5C 1X4

CONSULTANT

AECOM
3292 Production Way
Burnaby, BC
1.604.444.6400 tel 1.604294.8597 fax
www.aecom.com

PROJECT NUMBER

60347433

TITLE

FOR PORT OF VANCOUVER
PERMIT REFERENCE

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Project Management Initials: ____ Designer: ____ Checked: ____ Approved: ____ ISO A1 594mm x 841mm
Last saved by: TIM.SMYTH(2016-12-14) Last Plotted: 2016-12-14
Filename: H:\URS-CHEVRON\60347433.3954\9154.CO_FORESHORE FINAL REMEDY\3. WORKING FILES\2016 CONTRACT DESIGN\900-CAD, GIS\910-CAD\05-MODELS\CPORT OF VANCOUVER PERMIT APPLICATION\60347433-CONSTRUCTION AREAS.DWG
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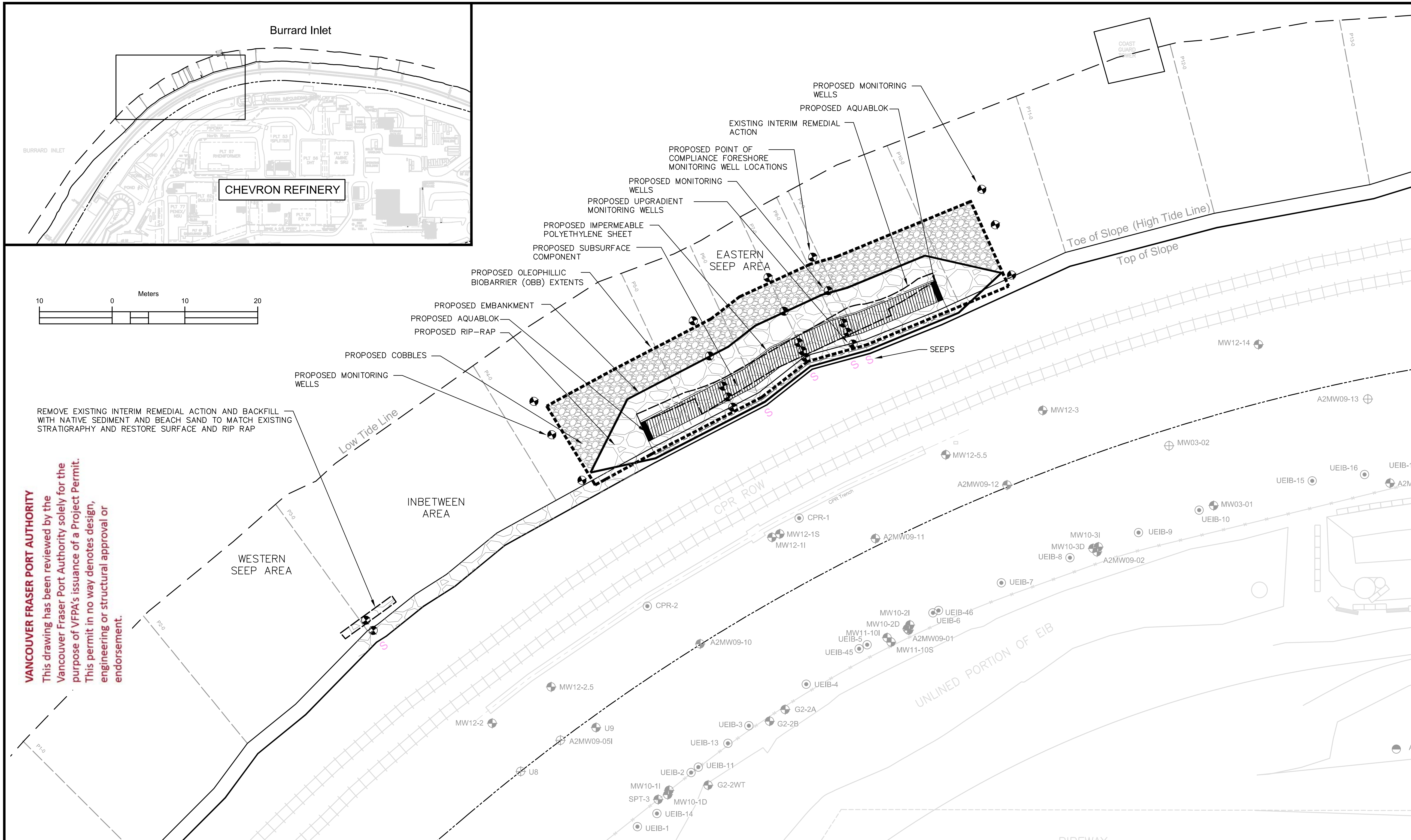
PER No. 16-180-D



Burrard Inlet
CHEVRON REFINERY
BURRARD INLET
Meters
10 0 10 20
PROPOSED MONITORING WELLS
PROPOSED AQUABLOK
EXISTING INTERIM REMEDIAL ACTION
PROPOSED POINT OF COMPLIANCE FORESHORE MONITORING WELL LOCATIONS
PROPOSED MONITORING WELLS
PROPOSED UPGRADIENT MONITORING WELLS
PROPOSED IMPERMEABLE POLYETHYLENE SHEET
PROPOSED SUBSURFACE COMPONENT
PROPOSED OLEOPHILLIC BIOBARRIER (OBB) EXTENTS
PROPOSED EMBANKMENT
PROPOSED AQUABLOK
PROPOSED RIP-RAP
PROPOSED COBBLES
PROPOSED MONITORING WELLS
REMOVE EXISTING INTERIM REMEDIAL ACTION AND BACKFILL WITH NATIVE SEDIMENT AND BEACH SAND TO MATCH EXISTING STRATIGRAPHY AND RESTORE SURFACE AND RIP RAP
SEEPS
EASTERN SEEP AREA
INBETWEEN AREA
WESTERN SEEP AREA
Low Tide Line
Toe of Slope (High Tide Line)
Top of Slope
CPR ROW
CPR Trench
UNLINED PORTION OF EIB
PIPEWAY
MW12-14
MW12-3
A2MW09-13
MW03-02
MW12-5.5
A2MW09-12
UEIB-16
UEIB-17
UEIB-15
MW03-01
UEIB-10
UEIB-9
MW10-3I
MW10-3D
UEIB-8
A2MW09-02
UEIB-7
CPR-1
MW12-1S
MW12-1I
A2MW09-11
CPR-2
MW10-2I
MW10-2D
MW11-10I
UEIB-46
UEIB-6
UEIB-5
UEIB-45
A2MW09-01
MW11-10S
A2MW09-10
UEIB-4
G2-2A
G2-2B
MW12-2.5
MW12-2
U9
A2MW09-05I
UEIB-3
UEIB-13
U8
UEIB-11
UEIB-2
G2-2WT
MW10-1I
SPT-3
MW10-1D
UEIB-14
UEIB-1
A2

VANCOUVER FRASER PORT AUTHORITY
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REFERENCES		REVISIONS							REVISIONS						
DRAWING NO.	TITLE	NO.	DESCRIPTION	BY	CHK.	APR.	DATE	CLIENT	NO.	DESCRIPTION	BY	CHK.	APR.	DATE	CLIENT

SCALE:	AS SHOWN
DESIGNED BY:	RH
DRAWN BY:	TS
CHECKED BY:	RK
PROJECT MNGR:	MG
CLIENT:	

AECOM
3292 Production Way
Burnaby, BC
T 1.604.444.6400 F 1.604.294.8597

Chevron Canada Limited
Burnaby Refinery

Foreshore Final Remedy

FINAL REMEDY MAP VIEW

PROJECT NO.	
FIGURE NO.	16
REV NO.	1
DATE	July 2016

filename: h:\urs-chevron\60347433_39549154.cd foreshore final remedy\5. deliverables\remedial action plan\figures\20160713 16 alternative 3 plan view.dwg Tuesday, September 27, 2016 6:21:38 AM

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Vancouver Fraser Port Authority
100 The Pointe, 999 Canada Place
Vancouver, B.C. Canada V6C 3T4
portvancouver.com

September 28, 2017

Mr. Michael Gill
Senior Environmental Engineer
AECOM
3293 Production Way
Burnaby, BC V5A 4R4

Dear Mr. Gill:

Re: **VFPA Project Permit No. 16-180**
Chevron Refinery Foreshore Final Remedy
Request for Extended Hours of Work

The Vancouver Fraser Port Authority (VFPA) has received AECOM's September 19, 2017 request to undertake Project Permit No. 16-180 shoreline remediation activities within VFPA jurisdiction during extended hours of work at night Monday to Saturday 12am to 7am in Burnaby, BC. This constitutes an exemption to Condition 22 of the Permit.

Extended hours of work are understood to be limited to the following dates: from September 28 to November 15, 2017. The shoreline remediation activities proposed during these hours include:

- Minor rip rap placement;
- Excavation and backfill to 0.4 m depth from 8 m to 12 m from the original toe of the slope;
- Placement of a geotextile;
- Placement of 200 mm cobbles on top of geotextile to grade; and
- Installation of monitoring wells using an excavator mounted auger.

Due to AECOM's need to work within the low tide window to mitigate the in-water dispersal of suspended contaminated sediments in conjunction with their Project Permit, **VFPA will allow extended hours of work during the above noted windows provided the following conditions are met:**

1. AECOM shall ensure the scope of works undertaken during extended hours is limited to the activities outlined in their September 20 and 21, 2017 emails detailing the request.

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2. AECOM must implement all proposed mitigation measures and activities outlined in their September 20 and 21, 2017 emails including a construction notification email to the City of Burnaby and the Tsleil Waututh First Nation prior to extended work hours. VFPA must approve the content of the email prior to distribution. It is understood that the proposed works were communicated to the Chevron Burnaby Community Advisory Panel during their September 20, 2017 meeting and that no concerns were raised.

3. All Project Permit No. 16-180 conditions shall be strictly adhered to during extended work windows.

VFPA reserves the right to cancel or revoke authorization for remediation work within the port authority's jurisdiction during extended periods should noise levels or disturbances to surrounding residents exceed reasonable levels.

Should you have any questions please contact Spencer Chaisson, Environmental Coordinator at 604-665-9389 or spencer.chaisson@portvancouver.com.

Yours truly,

VANCOUVER FRASER PORT AUTHORITY

Greg Yeomans
Director, Planning & Development

cc Tegan Smith, Manager, Planning, VFPA
Andrea Macleod, Manager, Environmental Programs
Spencer Chaisson, Environmental Programs, VFPA
Barbara Yandel, Real Estate, VFPA
Jessica Davies, Aboriginal Affairs, VFPA
Cherryl Lam, Project Communications, VFPA

Gauthier, Ken

From: Chaisson, Spencer <Spencer.Chaisson@portvancouver.com>
Sent: Tuesday, November 07, 2017 3:43 PM
To: Southern, Leslie
Cc: Gauthier, Ken; Kannappan, Ram; Horwath, Robert; Gill, Michael (Vancouver); christopher.boys@parkland.ca
Subject: RE: VFPA Permit 16-180 - future sampling events

Hi Leslie,

VFPA has decided that additional approval for ongoing monitoring, during night or day, is not required so long as there are no new intrusive works. This does not limit any of the conditions or requirements of VFPA Permit 16-180.

Several restrictions will apply:

1. Crossing other lease boundaries for access will continue to require prior approval – specifically if you plan night time access across the Penzance rail tracks, which is not a public crossing. You have stated that access will be by boat but we must be alerted if that changes.
2. Share the well sampling/monitoring schedule with the Chevron/Parkland Community Advisory Panel so that they are aware of planned night time works.
3. For all night time works that require access by boat – myself and Marine Operations (Harbour_Master@portvancouver.com) must be notified 2 days in advance via email.

These requirements will be reiterated after VFPA receives the plans and schedules for post-construction monitoring as detailed in condition 42 of VFPA Permit 16-180.

Thank you,

Spencer Chaisson
Environmental Coordinator
Environmental Programs
P 604.665.9389
E spencer.chaisson@portvancouver.com

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From: Chaisson, Spencer
Sent: Friday, November 03, 2017 12:10 PM
To: 'Southern, Leslie' <leslie.southern@aecom.com>
Cc: Gauthier, Ken <ken.gauthier@aecom.com>; Kannappan, Ram <ram.kannappan@aecom.com>; Horwath, Robert <robert.horwath@aecom.com>; Gill, Michael (Vancouver) <michael.gill@aecom.com>; christopher.boys@parkland.ca
Subject: RE: VFPA Permit 16-180 - November sampling event

Hello Leslie.

Thank you for providing this information. By way of this email, provided the ongoing activities consist of monitoring and sampling the wells at the site (i.e., no new intrusive works), the period of validity for VFPA Permit 16-180 extended work hours as stated in the attached 2017-09-28 letter is hereby extended to November 16, 2017.

As project construction nears completion and you move on to monitoring, please be sure to fulfill conditions 39 to 43 of VFPA Permit 16-180.

Thank you,

Spencer Chaisson
Environmental Coordinator
Environmental Programs
P 604.665.9389
E spencer.chaisson@portvancouver.com

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From: Southern, Leslie [mailto:leslie.southern@aecom.com]
Sent: Friday, November 03, 2017 11:43 AM
To: Chaisson, Spencer <Spencer.Chaisson@portvancouver.com>
Cc: Gauthier, Ken <ken.gauthier@aecom.com>; Kannappan, Ram <ram.kannappan@aecom.com>; Horwath, Robert <robert.horwath@aecom.com>; Gill, Michael (Vancouver) <michael.gill@aecom.com>; christopher.boys@parkland.ca
Subject: VFPA Permit 16-180 - November sampling event

Spencer,

As discussed, we plan on collecting porewater samples from the wells on the Foreshore in November 14-16, approximately 6:30pm to 11:00pm). The sampling must be completed at night, when the tide allows access. A subcontractor will provide access to the site via boat. They will bring a generator and light stands to illuminate the work area - which is comprised of the two barriers. A barge and heavy equipment will not be at the site.

The exemption to condition 22 of the permit provided on September 28, to allow for extended work hours expires on November 15, 2017. Can this be extended to November 16?

Thank you,

Leslie

Leslie Southern M.Sc., P.Ag.
Environmental Scientist
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APPENDIX F

QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

APPENDIX F - QUALITY ASSURANCE AND QUALITY CONTROL PROTOCOLS

1. DATA QA/QC

In order to assure the integrity and defensibility of the data collected, rigorous QA/QC protocols will be observed. These protocols ensure that all samples are properly collected, identified, stored, shipped, and documented. Standard operating procedures (SOPs) for sample collection and storage, equipment decontamination, and sample chain of custody protocols will be followed. Porewater and surface water samples will be collected using sampling techniques presented in Section 6. The use of these methods will ensure the quality, soundness, and defensibility of the data obtained. The laboratory analytical data, once generated, will be proofed for inconsistencies and anomalies. Field duplicates, trip blanks, and rinsate blanks will be collected for QA/QC purposes.

1.1. Field Duplicate Samples

Field duplicate samples are two identical samples that are submitted to the laboratory with no indication that they are the same. The analysis of field duplicate samples provides an indication of the total precision of the sampling and analysis process. Field duplicate samples will be collected and analyzed at a rate of approximately 10% of samples for a given analytical suite.

1.2. Trip Blanks

Trip blanks are samples of clean deionized, distilled (Reagent Grade Type II) water that are prepared in the laboratory, taken to the field, retained on site throughout sample collection, returned to the laboratory, and analyzed with the environmental samples. The QA/QC review identifies trip blanks with detections of target analytes and evaluates the effect of the detections on associated sample results for possible cross-contamination during transport. One trip blank will be included for analysis in every cooler submitted to the laboratory.

1.3. Rinsate Blanks

Rinsate blanks are samples of deionized and distilled analyte free (Reagent Grade Type II) water that are prepared in the field by pouring water over or through decontaminated field sampling equipment, prior to the collection of the environmental samples. The QA/QC review identifies rinsate blank detections of target analytes and evaluates the effect of the detections on associated sample results for possible cross-contamination during sample collection. Rinsate blank samples will be collected and analyzed at a rate of approximately 5% of samples for petroleum hydrocarbon parameters (BTEX, VPHw, and LEPHw).

QUALITY ASSURANCE/QUALITY CONTROL

2. Precision

Precision measures the reproducibility of repetitive measurements and is usually expressed in terms of imprecision. It is strictly defined as the degree of mutual agreement among multiple independent measurements as the result of repeated application of the same process under similar conditions.

Analytical precision is a measurement of the variability associated with the duplicate (*i.e.,* two) or replicate (*i.e.,* more than two) analyses of the same sample in the laboratory, and is determined by the analysis of matrix spike duplicate or laboratory duplicate samples.

Total precision is a measurement of the variability associated with the entire sampling and analysis process. It is determined by the analysis of duplicate or replicate field samples and incorporates any variability introduced by the analytical procedure, sample collection and handling procedures, and matrix factors. Precision data must be interpreted by taking into consideration these possible sources of variability.

Duplicate field samples will be collected, and duplicate spiked or unspiked samples will be analyzed to assess analytical precision. The results will be assessed using the relative percent difference (RPD) between duplicate measurements. The equation used to calculate RPD for duplicate samples is:

$$RPD = \frac{(A - B)}{((A + B)/2)} \times 100$$

where:

A	=	analytical result
B	=	duplicate result.

Note that for RPDs the result can be a positive or a negative value. RPDs are often presented as *absolute* RPDs, in which case the absolute value of the RPD is reported, always resulting in a positive number. Reporting the absolute RPD results in a reduction in information, since, for instance, if a duplicate sample consistently returns higher results than the original sample, all RPD values would be negative and it may be an indication of a precision problem. In this case, if absolute RPD was reported, no indication would be forthcoming.

Total precision will be determined by collecting field duplicate samples. These samples will be collected and analyzed at a rate of approximately 10% of total samples for each analytical suite.

Analytical precision will be determined in the laboratory by running matrix spike/matrix spike duplicate (MS/MSD) pairs, or by running laboratory duplicate analyses. These samples will be

analyzed at a rate of approximately 5% for each analytical suite.

3. Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (*e.g.,* variability due to imprecision) and systematic error (*e.g.,* bias). Therefore, accuracy reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ beyond acceptable limits from the true value or known concentration of the spike or standard. Acceptance criteria are indicated in the individual standardized analytical methods.

Analytical accuracy is typically measured by determining the percent recovery of known target analytes that are spiked into a field sample (*i.e.,* a surrogate or matrix spike), or reagent water (*i.e.,* laboratory control sample [LCS] or blank spike) before extraction at known concentrations. Percent recovery is calculated as:

$$\%REC = \frac{A}{B} \times 100$$

where:

A = obtained value
B = true value.

Analytical accuracy will be determined in the laboratory by the running of MS samples or laboratory control samples. These samples will be analyzed at a minimum rate of 5% for each analytical suite.

4. Completeness

Completeness for the investigation will be defined as the percentage of valid analytical results. Results made uncertain due to missed hold times, improper calibration, blank contamination, or poor calibration verification results would be deemed invalid. Results that may be flagged due to matrix effects are not considered invalid. Completeness for projects should exceed 90%. Completeness is calculated by:

$$completeness = \frac{A}{B} \times 100$$

where:

A = number of valid analytical results
B = total number of analytical results.