

Human Health Risk Assessment Summary



PARKLAND

Parkland Refining (B.C.) Ltd. (Parkland) operates the Burnaby refinery and tank farm (the refinery) under the authorization of Metro Vancouver (MV) air discharge permit GVA0117, which is set to expire on July 31, 2022. With the expiration date approaching, Parkland is well underway in the application process to renew and amend the existing permit to align with Parkland's commitment to investing in new technologies and infrastructure to reduce air emissions. As part of the permit application process, Parkland retained WSP Canada Limited (WSP) to prepare a Human Health Risk Assessment (HHRA).

A HHRA is a scientific process that predicts the nature and likelihood of harmful health effects that may occur should people be exposed to chemicals in the environment. The current HHRA was formally requested by Fraser Health Authority (FHA) in December 2020 in anticipation of Parkland's permit amendment application. Pursuant to

this request, a HHRA workplan describing the proposed approach and methodology for completing the HHRA was submitted to MV, the FHA, and the First Nations Health Authority for review on June 22, 2021 and was accepted by all of these agencies on or before August 20, 2021. Following the accepted workplan, WSP has conducted the HHRA, incorporating comments and feedback received from consultation with the aforementioned agencies, the Parkland Community Advisory Panel (CAP), members of the general public, the City of Burnaby, Vancouver Coastal Health, and Tsleil-Waututh Nation.

PROBLEM FORMULATION

The HHRA problem formulation defines the “where, what, when, who, how” of the assessment. Two previous health risk assessments for the refinery completed in 2002 and 2013 provided important guidance in establishing the following problem formulation for the current assessment:



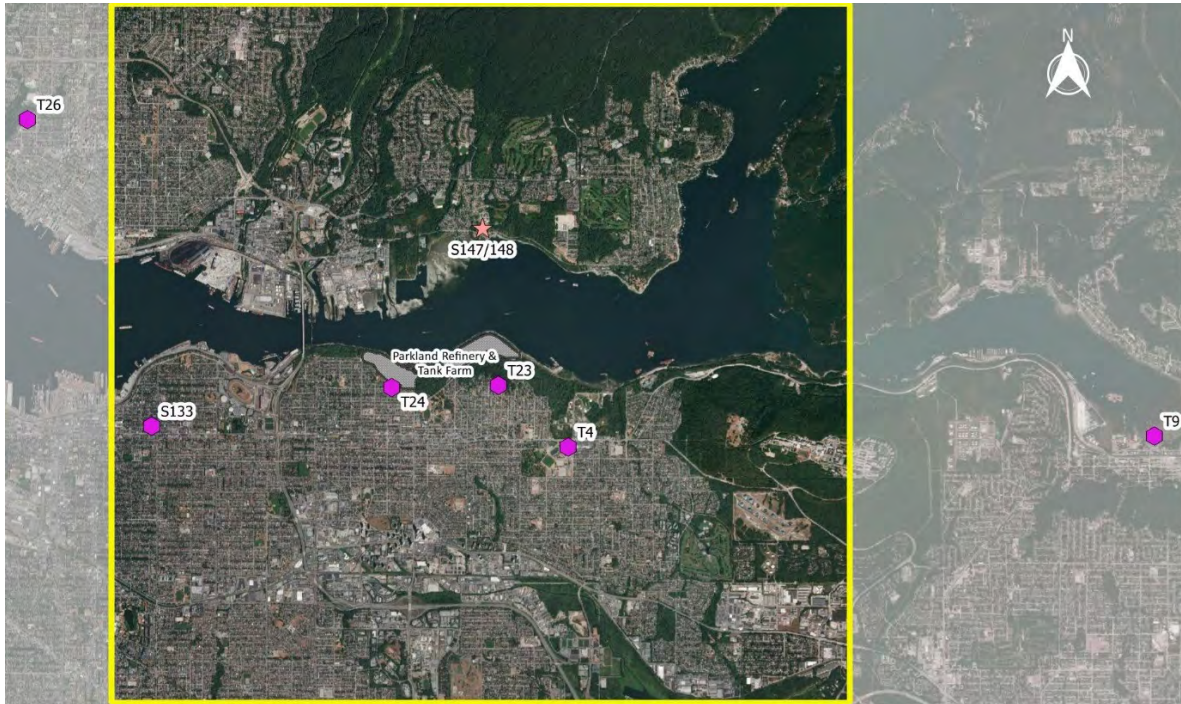


Figure: HHRA study area (outlined in yellow), showing the refinery location and location of MV permanent (hexagon) and special study (star) air quality monitoring stations used in the study.

Where: a 10-kilometre (km) x 10 km study area centered on the refinery, which encompasses all locations predicted by the AQA to potentially experience elevated levels of refinery-source contaminants of potential concern (COPC). This assessment area is significantly larger than previous assessments, which focused more narrowly on the North Burnaby area near the refinery.

What: COPCs included in this assessment include sulphur dioxide (SO₂), nitrogen dioxide (NO₂), fine particulate matter (PM_{2.5}), the three pollutants for which the permit amendment is requesting reductions in emissions limits. Volatile Organic Compounds (VOC) benzene and 1,3-butadiene are also included. The previous 2002 and 2013 assessments identified SO₂, benzene and 1,3-butadiene as key COPC.

When: 2017-2019 air quality monitoring data from MV stations surrounding the refinery were utilized for one of the 4 HHRA scenarios (more detail in the following “Exposure Assessment” section), and air quality dispersion modelling output data based on meteorological inputs from May 1, 2018 through April 30, 2019 were utilized for the other 3 modelled scenarios.

Who: The term “receptor” refers to a hypothetical person that may be exposed to the COPC assessed in the study. Receptor groups included in the study were residents of the study area including seniors in long term care, attendees of daycares, schools and hospitals in the study area, adults who work near the refinery, visitors/recreational

users of areas near the refinery, and Tsleil-Waututh Nation members using their lands for cultural practices.

How: The exposure pathways identified for the assessment included inhalation of COPC emitted into ambient air, and skin contact / ingestion of COPC deposited onto assessment area soils. A screening assessment of the deposition rates of refinery emissions indicated that deposition levels were below applicable thresholds, and as such, skin contact and ingestion were not assessed further.

EXPOSURE ASSESSMENT

The exposure assessment estimates levels of COPC that receptors throughout the study area are exposed to. Four exposure assessment scenarios were defined to identify potential changes in health impacts associated with Parkland’s permit amendment application. Three of the four scenarios rely on air quality dispersion modelling, which utilizes a complex computer model to predict ambient concentrations of COPC based on emissions from the refinery and the meteorology within the study area. The dispersion model used for this study followed BC Provincial modelling guidelines, as well as a modelling plan that was reviewed and approved by MV.

Scenario 1 – 2017-2019 Ambient Monitoring: Exposure data from MV monitoring network stations located within the HHRA Study Area. The most recent three years of validated monitoring data (2017-2019) for SO₂, NO₂, PM_{2.5}, benzene and 1,3-butadiene were used to derive exposure concentrations.

Scenario 2 – Current Permit Maximum: Estimated exposure data from air quality dispersion modelling results for maximum emissions authorized under MV Permit GVA0117 dated January 27, 2021 for all refinery sources of SO₂, nitrogen oxides (NO_x), PM_{2.5}.

Scenario 3 – Amended Permit Maximum: Estimated exposure data from dispersion modelling results for maximum emissions limits requested in Parkland's permit amendment application to MV for all refinery sources of SO₂, NO_x, PM_{2.5}. These limits incorporate emission reductions associated with Fluid Catalytic Cracker (FCC) SO₂ and NO_x reduction additives, future installation of the Tail Gas treatment Unit (TGTU) and CO Boiler flue gas recirculation, and past installation of the FCC Third Stage Separator (TSS).

Scenario 4 – Amended Permit Normal: Estimated exposure data from dispersion modelling results for expected normal operating levels for all refinery sources of SO₂, NO_x, PM_{2.5}, following the implementation of all changes detailed in Scenario 3.

HAZARD ASSESSMENT

The hazard assessment identifies the potential health effects associated with short-term (acute) and long-term (chronic) exposures to COPCs selected for assessment, utilizing health agency databases and academic literature to establish toxicological reference values (TRV) that are protective of non-cancer and cancer health endpoints. For this assessment, health-protective TRVs were established for acute exposure to SO₂, NO₂, PM_{2.5}, benzene and 1,3-butadiene, and for chronic exposure to NO₂, PM_{2.5}, benzene and 1,3-butadiene.

RISK CHARACTERIZATION / RESULTS

The risk characterization brings together the results of the Exposure Assessment and Hazard Assessment to estimate the health risks associated with COPC exposures for each receptor group throughout the study area. These risks are expressed as a Hazard Quotient (HQ) for non-cancer risks, and Incremental Lifetime Cancer Risk (ILCR) for cancer risks. For both metrics, exceedance of a value of 1.0 indicates risks beyond acceptable levels. **Section 6** of [the full HHRA report](#) provides tables and maps detailing the Risk Characterization results, which are summarized by pollutant below:

SO₂: Air quality monitoring data (Scenario 1) indicate infrequent, limited duration periods with Acute HQ greater than 1.0 for the MV Burnaby Capitol Hill monitoring station, with a total of 25 hours (hrs) exceeding over the three years of monitoring. Dispersion modelling data similarly indicates infrequent, very short periods with Acute HQ greater than 1.0 for receptors near the refinery for Scenario 2 (current permit maximum), with 4 hours per year exceeding for the maximally exposed receptor.



These exceedances are eliminated for all but a single recreational receptor very near the refinery for Scenario 3 (amended permit maximum), and completely eliminated for Scenario 4, highlighting the significant positive impact of the 45% SO₂ emission reductions associated with the permit amendments.

NO₂: Air quality monitoring data (Scenario 1) indicate no monitoring stations for which the Acute HQ is greater than 1.0, and one station for which the long term (chronic) HQ is slightly above 1.0, though the exceeding station is MV T9 (Port Moody), which is quite distant from the refinery. Regardless of the station locations and their respective proximity to the refinery, both acute and chronic HQs were near 1.0, indicating high background / non-refinery NO₂ levels. Dispersion modelling data indicates that refinery-only risks do not exceed a HQ of 1.0 for any identified receptor group for either acute or chronic NO₂ exposures. However, due to the high baseline / non-refinery NO₂ levels (Acute HQ is 0.95) indicated above, cumulative refinery plus background Acute HQ greater than 1.0 for many receptors in the study area are predicted for 8-15% of the year depending on the modelled scenario. NO_x emission reductions associated with the permit amendment (18%) produce modest reductions in cumulative HQ. Health risks due to exposure to ambient NO₂ within the HHRA study area are driven primarily by high baseline NO₂ levels, which are out of the control of the refinery.

PM_{2.5}: Air quality monitoring data (Scenario 1) indicate no monitoring stations for which acute or chronic HQ is greater than 1.0. Dispersion modelling data similarly indicate no sensitive receptors for which HQ is greater than 1.0 for both refinery-only and cumulative exposures. Emissions reductions associated with the permit amendment (23%) produce modest reductions in cumulative HQ. The results of the HHRA indicate that baseline levels of PM_{2.5} contribute significantly to the cumulative HQ.

Benzene & 1,3-Butadiene: Air quality monitoring data (Scenario 1) indicate no monitoring stations for which Acute HQ is greater than 1.0 and Chronic ILCR is greater than 1 per 100,000. Review of ambient monitoring data from 1999 to 2019 shows a strong downward trend in both benzene & 1,3-butadiene concentrations.

MITIGATION MEASURES

Based on previous air quality assessments conducted by WSP for Parkland, as well as the results of this HHRA, key mitigation actions are as follows:

- Continued reduction of SO₂ emissions from key sources including the FCC and SRU. The emissions reductions incorporated into Scenarios 3 and 4 (45% reduction for amended permit maximum relative to current permit maximum) in the HHRA will lead to significant reductions in the extent and frequency of elevated SO₂ levels, and their associated respiratory health risks.
- Continued reduction of NO_x emissions from key sources including the FCC and COB. The emissions reductions incorporated into Scenarios 3 and 4 (18% reduction for amended permit maximum relative to current permit maximum) in the HHRA will lead to modest reductions in the extent and frequency of elevated NO₂ levels very near the refinery, along with their associated respiratory health risks.
- Continued reduction of PM_{2.5} emissions from the key refinery source: the FCC. The emissions reductions incorporated into Scenarios 3 and 4 (23% reduction for amended permit maximum relative to current permit maximum) in the HHRA will lead to modest reductions in PM_{2.5} levels very near the refinery, along with their associated health risks.
- Improved monitoring coverage for SO₂, NO₂ and PM_{2.5} throughout the HHRA study area with the addition of a new Parkland-funded permanent MV monitoring location on the north shore of Burrard Inlet and addition of SO₂, NO₂ and PM_{2.5} monitors to existing MV stations. For VOCs, Parkland will leverage the fence-line VOC monitoring installed in early 2022 to better characterize near-site VOC levels.
- Continued utilization of operation and maintenance programs focused on emissions control, including the SO_x Curtailment Event procedure, FCC sulphur scavenging catalyst inversion event procedure, and VOC leak detection and repair program.
- Ongoing engagement with community stakeholders, including the CAP, on questions and concerns related to refinery air quality and human health impacts.
- Ongoing engagement with Tsleil-Waututh Nation, on questions and concerns related to refinery air quality and human health impacts.

In addition to these mitigation measures, WSP recommends updates of this HHRA in support of future permit amendments for the refinery that result in significant changes to emissions.

Contact us

For more information, please visit our website [\[3\]](#), [\[4\]](#) and sign up to receive updates on the study. Our Community Contact Line **604-257-4040** is available for you to register your concerns regarding the Burnaby Refinery. Alternatively, you can email us at CommunityBC@parkland.ca.