STORMWATER POLLUTION PREVENTION PLAN
BHP Potash Export Facility
at Fraser Surrey Docks

Prepared for:
BHP Billiton Canada Inc.
300-130 3rd Avenue South
Saskatoon, SK S7K 1L3

Prepared by:
Hemmera Envirochem Inc.
18th Floor, 4730 Kingsway
Burnaby, BC V5H 0C6

File: 1856-001.01
August 2018

Revision 2
August 3, 2018
Stormwater Pollution Prevention Plan
EXECUTIVE SUMMARY

Hemmera Envirochem Inc. (Hemmera) has been retained by BHP Billiton Canada Inc. (BHP) to prepare a Stormwater Pollution Prevention Plan (SPPP) for the proposed potash export facility (Project) located at 11060 Elevator Road in Surrey, British Columbia. The Project is located along the south bank of the South Arm of the Fraser River, and BHP will construct and operate the Project in conjunction with Fraser Surrey Docks (FSD).

The new facility will serve to export potash produced by the Jansen Mine in Saskatchewan via bulk ocean-going vessels. Key features of the proposed facility include:

- Receive shipments of product by rail from the proposed Jansen mine
- Offload products from rail cars to the conveyor system
- Store potash in the potash storage building
- Transfer products from the potash storage building via the conveyors to the ship loader and to a waiting vessel for export

This SPPP is intended to proactively and efficiently manage stormwater pollution risks during Project operation, integrate BHP operational procedures and complement existing FSD plan(s). To accomplish this, the SPPP has been prepared in accordance with Vancouver Fraser Port Authority (VFPA) guiding principles, which are presented as follows:

- Minimise the amount of stormwater discharged to the environment
- Prevent or minimise the pollutant loading of stormwater
- Treat or otherwise manage stormwater if pollutant loading cannot be prevented
- Integrate effectively with FSD’s stormwater system.

Mitigation for stormwater runoff during construction is addressed in the Project’s Construction Environmental Management Plan (Attachment 4.3-B).

This SPPP identifies best management practices that are considered sound, acceptable in cost, and applicable to a broad category of industries and types of pollutants. The best management practices discussed in this plan have been developed to address the quality of stormwater discharged from the facility and aid in the development, implementation, and evaluation of this SPPP. This plan is considered a living document, and will be updated with additional detail prior to Project operation.

To reduce the potential for harmful substances to affect stormwater, and the receiving environments, the following measures and practices will be undertaken for the Project:

- Implement a management strategy including good housekeeping, preventative maintenance, containment and reduction, spill prevention and response, and treatment measures.
• All machinery working at the site must minimize use or potential release of contaminants (e.g. oils or greases) that would enter into the potash product and/or environment. If equipment requires chemical products for operations, a containment system will be considered for design.

• Design all hazardous material (fuels, lubricants, oils, etc.) storage areas to provide secondary containment that achieves containment of 110 percent (%) of largest container within the facility, prevents the run-on and accumulation of storm or rain water, and segregates hydrocarbons from incompatible materials.

• If the secondary containment accumulates stormwater, inspect the water to confirm that it is free of oil, foam, or discolouration prior to being drained. Appropriately test and dispose of water if contamination is suspected and/or confirmed.

• Equip storage areas and secondary containment units with a risk-based detection system to ensure early detection of leaks or spills. Such a system will allow for:
  ▫ identification of highest risk components and failure significance for equipment,
  ▫ Implementation of spill monitoring equipment, and
  ▫ Establishing frequency of maintenance/inspection.

Implement emergency systems that will ensure early detection of leaks or spills such as manual and automatic emergency shutoff systems.

• Use fuel station with concrete apron and catch basin with efficient oil/water separators or pump-out system.

• Cover any fueling and hazardous storage areas and separate process area and stormwater systems with curbing.

This SPPP considers the Master Drainage Plan for the site, potential flood vulnerability, and FSD stormwater management with the goal to implement an integrated and efficient approach to preventing pollution by stormwater runoff.
# TABLE OF CONTENTS

## EXECUTIVE SUMMARY

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
</tr>
</tbody>
</table>

## ACRONYMS, ABBREVIATIONS, AND SYMBOLS

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
</tr>
</tbody>
</table>

## 1.0 INTRODUCTION

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

## 2.0 PROJECT OVERVIEW

### 2.1 PROJECT LOCATION

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

### 2.2 PROJECT DESCRIPTION

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

## 3.0 PROJECT SITE INVENTORY

### 3.1 EXISTING AND NEW STORMWATER INFRASTRUCTURE

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
</tr>
</tbody>
</table>

### 3.2 ACTIVITIES

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
</tr>
</tbody>
</table>

### 3.3 STORMWATER OUTLET RECONSTRUCTION

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
</tr>
</tbody>
</table>

### 3.4 MATERIALS THAT MAY INTERACT WITH STORMWATER

#### 3.4.1 Potash

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

#### 3.4.2 Fuels, Oils, and Lubricants

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

### 3.5 HYDROLOGICAL SETTING

#### 3.5.1 Sub-catchments

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
</tr>
</tbody>
</table>

#### 3.5.2 Storm Drainage Event

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
</tr>
</tbody>
</table>

#### 3.5.3 Water Quality Event

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
</tr>
</tbody>
</table>

## 4.0 ISSUES IDENTIFICATION AND RISK ANALYSIS

### 4.1 APPLICABLE STANDARDS, ACTS, AND REGULATIONS

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
</tr>
</tbody>
</table>

### 4.2 POTENTIAL POLLUTANT SOURCES

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
</tr>
</tbody>
</table>

### 4.3 POTENTIAL SENSITIVE RECEPTORS

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
</tr>
</tbody>
</table>

### 4.4 IDENTIFIED ISSUES

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
</tr>
</tbody>
</table>

### 4.5 IDENTIFIED POLLUTANT PATHWAYS

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
</tr>
</tbody>
</table>

## 5.0 MANAGEMENT STRATEGY

### 5.1 GOOD HOUSEKEEPING

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

### 5.2 STORAGE AND HANDLING

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
</tr>
</tbody>
</table>

### 5.3 PREVENTIVE MAINTENANCE

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
</tr>
</tbody>
</table>

### 5.4 CONTAINMENT AND REDUCTION

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
</tr>
</tbody>
</table>

### 5.5 SPILL PREVENTION AND RESPONSE PROCEDURES

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
</tr>
</tbody>
</table>

### 5.6 CONTAINMENT AND TREATMENT

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
</tr>
</tbody>
</table>
6.0 IMPLEMENTATION AND MONITORING ..................................................................................... 21
  6.1 ADAPTIVE MANAGEMENT AND CONTINUOUS IMPROVEMENT ............................................ 21
  6.2 REPORTING UPDATES........................................................................................................ 21
7.0 SUMMARY ..................................................................................................................................... 23
8.0 CLOSING ....................................................................................................................................... 24
9.0 REFERENCES ............................................................................................................................... 25

List of Tables
Table 1 Land Title Information ......................................................................................................... 4
Table 2 Project Hydrologic Parameters ............................................................................................ 11
Table 3 Proposed Stormwater Changes in the Project Development Area..................................... 15

List of Figures
Figure 1 Project Development Area .................................................................................................. 3
Figure 2 Site Overview Map ............................................................................................................ 6
Figure 3 Stormwater Drainage Network of the Project Development Area .................................... 8

List of Appendices
Appendix A Master Drainage Plan
Appendix B Existing Drainage Infrastructure Diagram
Appendix C Stormceptor STC-300 Typical Specification
Appendix D Storm and Water Main Infrastructure Drawing
### ACRONYMS, ABBREVIATIONS, AND SYMBOLS

<table>
<thead>
<tr>
<th>Acronym/ Abbreviation/ Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>percent</td>
</tr>
<tr>
<td>BATNEEC</td>
<td>Best Available Technology Not Entailing Excessive Cost</td>
</tr>
<tr>
<td>BC</td>
<td>British Columbia</td>
</tr>
<tr>
<td>BHP</td>
<td>BHP Billiton Canada Inc.</td>
</tr>
<tr>
<td>BMP</td>
<td>best management practices</td>
</tr>
<tr>
<td>FSD</td>
<td>Fraser Surrey Docks</td>
</tr>
<tr>
<td>Hemmera</td>
<td>Hemmera Envirochem Inc.</td>
</tr>
<tr>
<td>OGV</td>
<td>ocean-going vessel</td>
</tr>
<tr>
<td>PDA</td>
<td>Project development area</td>
</tr>
<tr>
<td>PER</td>
<td>Project and Environmental Review</td>
</tr>
<tr>
<td>Project</td>
<td>proposed potash export facility</td>
</tr>
<tr>
<td>SPPP</td>
<td>Stormwater Pollution Prevention Plan</td>
</tr>
<tr>
<td>VFPA</td>
<td>Vancouver Fraser Port Authority</td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

BHP Billiton Canada Inc. (BHP) is considering a portion of the Fraser Surrey Docks (FSD) at 11060 Elevator Road in Surrey, British Columbia (BC) as a potential site for the construction of a bulk potash export facility (Project). Hemmera Envirochem Inc. (Hemmera) has been retained by BHP to prepare a Stormwater Pollution Prevention Plan (SPPP) for the property, which is situated on the south bank of the South Arm of the Fraser River. Figure 1 shows the Project development area (PDA). The Project will serve to export potash produced by the Jansen Mine in Saskatchewan via bulk ocean-going vessels (OGVs). The proposed facility includes a new shiploader, rail car unloading station, conveyor system, potash storage building, and rail loop. BHP’s proposed facility will export potash produced by the Jansen Mine.

This SPPP is intended to proactively and efficiently manage stormwater pollution risks during Project operation, integrate BHP operational procedures, and complement existing FSD plan(s). To accomplish these objectives, the SPPP has been prepared in accordance with Vancouver Fraser Port Authority (VFPA) guiding principles, which are presented as follows:

- Minimise the amount of stormwater discharged to the environment
- Prevent or minimise the pollutant loading of stormwater
- Treat or otherwise manage stormwater if pollutant loading cannot be prevented
- Integrate effectively with FSD’s stormwater system.

The Project site is located entirely on federal lands within VFPA jurisdiction. Under the Canada Marine Act, SC 1998, c. 10, VFPA is responsible for the administration, management, and control of land and water within its jurisdiction. The Project and Environmental Review (PER) process applies to all proposed physical works and activities on federal lands and waters that are partially or wholly within VFPA’s jurisdiction.

Key features of the Project are described in Section 2.2. Proposed stormwater drainage for the Project is shown in Attachment 3-A (Drawings) of the Application (refer to drawing 40600-CL-DWG-00138 Rev. B) and in Appendix D of this report.

Mitigation for stormwater runoff during the Project’s construction phase is addressed in the Construction Environmental Management Plan (Attachment 4.3-B).

Stormwater is defined as water that originates from precipitation events (such as rainfall) and from snow and ice melt. Stormwater either ponds on the surface and eventually evaporates, infiltrates the ground, or flows over the ground surface as runoff, which ultimately enters nearby bodies of water. Stormwater runoff flows over land or impervious surfaces such as paved roadways, parking lots, and building rooftops. As it flows, it may accumulate debris, soil and sediment, and contaminants, which could adversely affect water quality in receiving bodies of water.
This SPPP identifies best management practices (BMPs) that are considered environmentally sound, acceptable in cost, and capable of maintaining or improving the quality of stormwater discharged from the facility. This plan has been developed in accordance with VFPA’s PER guidance document *Guidelines – Developing Your Stormwater Pollution Prevention Plan* (PMV 2015). It references stormwater drawings, presents background data that has been used, and explains key design assumptions.

The SPPP also provides guidance for operation and maintenance activities for stormwater management, including regular surface sweeping, treatment unit maintenance intervals, and ongoing operations and processes. Prior to Project operation, the SPPP will be updated with information defining key roles and responsibilities for managing, maintaining, and ensuring stormwater pollution prevention. See **Section 6.0 Implementation and Monitoring** for measures to be undertaken during implementation and monitoring of the plan.

Spill prevention and emergency response procedures are outlined in the **Spill Prevention and Emergency Response Plan** (Attachment 4.3-E).
This map is not intended to be a "stand-alone" document, but a visual aid of the information contained in the referenced report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Notes
1. This extent should be considered approximate only.

Sources
- PDA obtained from BHP Billiton Ref. 45690-LO-DWG-0613b.dwg
- Basemap: Ortho Imagery from City of Surrey.

1855-001-01
Production Date: October 19, 2017
Figure 1
2.0 PROJECT OVERVIEW

2.1 PROJECT LOCATION

The Project is located at 11060 Elevator Road, in the City of Surrey, BC. Land title and site information is provided in Table 1. Figure 1 shows the PDA and location.

Table 1 Land Title Information

<table>
<thead>
<tr>
<th>Civic Address</th>
<th>11060 Elevator Road, Surrey, BC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PID</td>
<td>023-512-547</td>
</tr>
<tr>
<td></td>
<td>000-725-234</td>
</tr>
<tr>
<td></td>
<td>023-512-539</td>
</tr>
<tr>
<td></td>
<td>023-512-521</td>
</tr>
<tr>
<td></td>
<td>023-512-512</td>
</tr>
<tr>
<td>Legal Description</td>
<td>Lot 4, Section 34, Block 5N, Range 3W, NWD PL LMP 29318</td>
</tr>
<tr>
<td></td>
<td>Parcel L Reference Plan 6744: Sections 34 &amp; 35, Block 5N, Range 3W Except: Firstly: part on Crown Grant 136463E; NWD</td>
</tr>
<tr>
<td></td>
<td>Lot 3, Sections 34 &amp; 35, Block 5N, Range 3W, NWD PL LMP29318</td>
</tr>
<tr>
<td></td>
<td>Lot 2, District Lot 14, Group 2 and of the bed of the Fraser River NWD PL LMP 29318</td>
</tr>
<tr>
<td></td>
<td>Lot 1, District Lot 12 &amp; 13, PL LMP39318 NWD</td>
</tr>
<tr>
<td>Registered Land Owner</td>
<td>Crown Federal</td>
</tr>
<tr>
<td>Geographical Coordinates (approximate)</td>
<td>49º 11' 08.31&quot; north, 122º 54' 57.22&quot; west</td>
</tr>
<tr>
<td>Area</td>
<td>Approximately (~) 29 hectares</td>
</tr>
<tr>
<td>Zoning</td>
<td>IL – Light Industrial</td>
</tr>
<tr>
<td>Percent Site Coverage (Developed)</td>
<td>~90 percent (%) of the site is asphalt, ~10% is buildings.</td>
</tr>
</tbody>
</table>

2.2 PROJECT DESCRIPTION

The Project will include rail receiving, onsite storage, and OGV loading facilities. The FSD site was chosen as a suitable location for the Project because it is an active port terminal with much of the required berthing and associated infrastructure already in place, and is well serviced by existing rail and road infrastructure.

The Project will facilitate potash exports by BHP as follows:

- Receive shipments of product by rail from the Jansen mine.
- Offload products from rail cars to potash storage buildings or directly to a waiting vessel.
- Store potash product in the potash storage building.
- Transfer potash via a conveyor system to the shiploader onto a waiting vessel for export.
Technically known as potassium chloride, potash is a naturally occurring mineral salt and a key ingredient in agricultural fertilizer, including common household garden fertilizers. Potash is non-flammable and non-combustible, and is considered non-toxic to aquatic species. Similar to table salt, potash is water soluble and mildly corrosive to metals, and thus requires dry storage.

The Project will occupy an approximately 29-hectare footprint, and will include Berth #9 and the existing container yard of the FSD site (Figure 1). Key components of the Project are shown on Figure 2 and include:

- Rail car unloading station
- Material handling and transfer systems
- Potash storage building
- Berth improvements and new shiploader
- Terminal rail loop
- Dust management systems
- Utility improvements and relocations (e.g., sanitary and stormwater).

This plan is intended to be used in conjunction with other operational management plans, including the Spill Prevention and Emergency Response Plan (Attachment 4.3-E).
This map is not intended to be a "stand-alone" document but is visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

2. This extent should be considered approximate only.

Sources
- Basemap: Ortho Imagery from City of Surrey.
3.0 PROJECT SITE INVENTORY

3.1 EXISTING AND NEW STORMWATER INFRASTRUCTURE

Existing stormwater infrastructure includes sumps, catch basins, manholes, associated piping, and ditches across and around the Project site. Project site drainage information is provided in Figure 3, and includes:

- Existing stormwater infrastructure (see Appendix A and B), new stormwater drainage infrastructure, collection points, and release points from the Project site. The Master Drainage Plan (Appendix A) is provided for reference to existing infrastructure only. Proposed Project flood mitigations measures are provided separately in the Flood Protection Assessment (Attachment 4.2-V) of the BHP PER Application.
- Downstream receiving water bodies
- Special features within the Project site.

New stormwater infrastructure that will tie into existing Project site drainage is based on Ausenco design and is shown on Figure 3. Additional detail is shown on Attachment 3-A (Drawing 40600-CL-DWG-00138 Rev. A) of the Application. As design progresses, BHP will consider opportunities to minimize discharge of stormwater from the Project. Key features of the new infrastructure are described below.

In accordance with VFPA guidance, all new catch basins will be Stormceptor STC-300 Inline or an acceptable equivalent. The standard STC-300 unit is cylindrical in shape, and a typical specification is provided in Appendix C. The unit is designed to trap most of the suspended sediment, up to 98 percent (%) of free oil and treat first flush runoff that has been shown to contain the majority of the pollutants. The infrequent large stormwater runoff events bypass the treatment to prevent large flows from flushing out accumulated oil and/or sediment. As part of detailed design, the drainage appliances will be sized in accordance with the predicted quantities of pollutants and technical performance standards will be finalized. Prior to construction, the SPPP will be updated accordingly.

An ordinary catch basin or a Stormceptor catch basin (described above), will collect stormwater runoff and discharge to a nearby existing storm sewer. To reduce potential brine contamination (i.e. high concentrations of potash dissolved in surface water) of stormwater at the rail car unloading station and at the transfer towers, sumps will be installed at surface level to allow interception of brine by vacuum truck prior to it entering the stormwater system. Collected sump water will be disposed off-site at a facility permitted to receive such waste.
This map is not intended to be a "hard-copy" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

The boundary, obtained from BHP Billiton Ref 10151-G-56-0142. This extent should be considered approximate only.

Watercourses and drainage structures and alluvium (i.e. Fish classifications and some names) from combined sources including; City of Surrey (COSWSD), Port of Vancouver (City Plan) and Hemmera (Field notes).

Imagery provided by Cosmos - City of Surrey

Figure 3

Legend

- Project Development Area
- Project Infrastructure
- Existing Culvert
  - Drainage Main (In Service/For Construction)
  - Existing Stormwater Management System
  - Existing Drainage Network to Receive Stormwater from Project
- New Project Stormwater Infrastructure
  - Stormceptor STC 300 Catch Basin
  - Class A - Fish-bearing (Year-round)
  - Class A(O) - Fish-bearing (Overwintering)
  - Class B - Contribute to food or nutrient inputs to downstream fish populations. Non-fish-bearing
  - Class C - Non-fish-bearing

Notes
3.2 ACTIVITIES

Project operation will primarily consist of receiving potash shipments via train, storing potash onsite, and loading potash to OGVs for export. Table 2 summarises the main processes associated with the receiving, transfer, and shipment of potash at the Project site, as well as potential for spills during each process. Other materials are discussed in Section 3.4 below.

The Project facility will be operational on a 24-hour basis, year-round. The potential for stormwater contamination includes failures in transfer or containment systems that could result in spills. If not contained, a spill could mobilise to the Fraser River, via direct run-off or via the stormwater system.

3.3 STORMWATER OUTLET RECONSTRUCTION

The existing stormwater outlet may be damaged during berth seismic improvements therefore a new outlet will be installed once densification activities are completed. Design specifications and details of the existing stormwater outlet are unavailable. The detailed design and methods for the stormwater outlet reconstruction will be developed in the next phase of engineering and underground survey work, after additional exploration has occurred.

- The stormwater outlet near berth 9 is the only portion of the stormwater system being modified. Based on current understanding, the construction plan for the reconstruction of the stormwater outlet is as follows: Pre-fabricate a replacement section of the outlet, assuming that approximately 40 m of existing outlet will be replaced, including the final catch basin ahead of the outlet.
- Schedule seismic improvements at Berth 9 for a low precipitation period, where possible.
- Install temporary stormwater detention and/or pumping prior to initiation of seismic improvements, to allow for potential stormwater flows while seismic improvements are underway, and during demolition of the existing stormwater outlet.
- Expose the existing stormwater outlet, following sediment and erosion control plans outlined in Section 5.9 of the Construction Environmental Management Plan as determined applicable with the EM, prior to commencement of seismic improvements.
- Demolition will preferably be scheduled for a low precipitation period. Temporary stormwater detention and/or pumping will remain in place.
- Install replacement outfall and catch basin to re-instate stormwater system.
- Complete any final modifications to the replacement outlet and replacement catch basin.
- Backfill excavation and repair paving.

The Contractor shall implement the mitigation measures outlined in Section 5.9 of the Construction Environmental Management Plan to prevent erosion and manage sediment during construction, as determined with the EM to be applicable.
3.4 MATERIALS THAT MAY INTERACT WITH STORMWATER

Materials used during Project operation and with the highest potential to interact with stormwater are hydrocarbons (e.g., fuels, oils, lubricants, and associated wastes) and potash. Should other materials be identified for use during Project operation that could interact with stormwater, the information in this section will be updated.

3.4.1 Potash

Potash will be generally contained during all handling and storage to, from, and within the site. Scenarios where potash could be available to interact with stormwater would occur during unloading and loading operations, if it accumulates at transfer points in the Project area (e.g., around the shiploader or the rail car unloading station). Accumulated potash may mix with stormwater runoff and be directed towards catch basins. Spilled potash has the potential to increase salinity of stormwater if the appropriate controls are not in place.

Effects are likely to be minimal given the nature of potash. When potash enters water, it causes a localised increase in salinity, which may adversely affect aquatic life that is intolerant of salinity changes. Other than the localised salinity change during which salinity would dilute and dissipate rapidly as the potash dissolves, potash is generally non-toxic. The salinity of the Fraser River at FSD varies dynamically with the tidal cycle and seasonal flows (e.g., freshet); nevertheless, prevention of accidental releases of potash solids or dissolved potash to the Fraser River will be managed through BMPs, as described in Section 5.0 to minimise the risk of release into the receiving environment, and in the Spill Prevention and Emergency Response Plan (Attachment 4.3-E of the Application).

Any potential potash spillage will be swept up and managed as off-spec material. Table 2 summarises the main processes associated with Project receiving, transfer, and shipment of potash, as well as the potential for spills during each process. Of the four process steps, potash transfer to the storage facility and ship loading have the greatest potential for release of potash to the environment. Given that the rail car unloading station and storage facilities are all fully enclosed, the transfer mechanisms pose the greatest risks for spillage. Since potash is corrosive, if regular maintenance is not conducted on the equipment there is potential for failures, which could lead to spills; however, design of the facility includes use of materials resistant to corrosion to mitigate this potential effect.

For spilled potash that is in solution with rainwater, sumps will be located as shown on drawing 40600-CL-DWG-00138 Rev. A. These sumps will be isolated from the stormwater system and will be monitored and maintained as described in Sections 5.0 and 6.0.

3.4.2 Fuels, Oils, and Lubricants

Petrochemical materials such as fuels, oils, and lubricants will be used during Project operation, and could affect stormwater if not managed appropriately. Types of interactions are described in Section 4.2.
3.5 HYDROLOGICAL SETTING

The following section provides information on the Project sub-catchments, storm drainage event and water quality event used for design of the Project stormwater system.

3.5.1 Sub-catchments

As shown on Drawing 40600-CL-DWG-00207 in Attachment 3-A as well as in Appendix D of this report, the Project site is divided into three sub-catchment areas: A, B, and C. The basic hydrologic parameters for each sub-catchment are shown in Table 2.

Table 2 Project Hydrologic Parameters

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Area (m²)</th>
<th>Percent impervious</th>
<th>Avg slope</th>
<th>Time of concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>118,500</td>
<td>90</td>
<td>1%</td>
<td>15 min</td>
</tr>
<tr>
<td>B</td>
<td>224,400</td>
<td>90</td>
<td>1%</td>
<td>15 min</td>
</tr>
<tr>
<td>C</td>
<td>161,900</td>
<td>90</td>
<td>1%</td>
<td>15 min</td>
</tr>
</tbody>
</table>

The sub-catchments are further sub-divided as shown on Drawing 40600-CL-DWG-00207 and include associated design volumes.

3.5.2 Storm Drainage Event

The Canada Climate Normals Station data for the time frame from 1981 to 2010 were reviewed to determine the environmental precipitation loads to the Project site. The closest weather station is located in Surrey at Kwantlen Park, approximately 4.7 kilometres northeast of the Project. The precipitation volumes from this weather station are presented below.

Rainfall

- Maximum daily precipitation – 139.7 millimetres (January)
- Annual rainfall total – 1,521.5 millimetres
Ground Snow

- Maximum daily snowfall - 38 centimetres (December)
- Annual snowfall total – 40.8 centimetres

A Master Drainage Plan forms the basis of FSD's stormwater management, and is included in Appendix A and Appendix B. The Master Drainage Plan consolidates the known information about the existing site drainage; assesses the drainage and flood protection at the site; assesses the potential effects of onsite and offsite development; and identifies future improvements for site drainage. The Master Drainage Plan (Appendix A) is provided for reference to existing infrastructure only.

For design of stormwater infrastructure and contingency of potential future climate change, a factor of 1.17 will be applied to rainfall intensities, based on Metro Vancouver's Stormwater and Wastewater Infrastructure Case Study (Ouranos 2008). This factor will be incorporated into detailed design drawings of drainage infrastructure and an updated SPPP, that will be provided prior to construction.

The Project site has been assessed for flood vulnerability. Northwest Hydraulic Consultants Ltd. completed a Flood Protection Assessment (Attachment 4.2-V of the Application), which assessed how extreme flood events (e.g., 200-year and 500-year) would inundate the site, which is undiked. Ausenco has prepared a Flood Mitigation Summary Memorandum (Appendix A of Attachment 4.2-V), which identifies design measures to lower the risk of vulnerable commodity damage and associated environmental contamination due to flooding.

3.5.3 Water Quality Event

A water quality event is a time period over which water with anomalous characteristics is detected. Substances accumulated on site during dry periods can be picked up by the next rainfall and quickly moved into the drainage system and receiving environment. Such ‘first flush’ discharges are potentially detrimental to the environment, as pollutant concentrations may be elevated. Key characteristics of the water quality design event are as follows:

- Representative of a relatively small, but frequently occurring event that is large enough to account for the majority of average annual runoff and ‘first flush’ of larger storm events.
- A typical water quality event is 50% of the 2-hour duration, 1 in 2-year event, with a peak rainfall intensity corresponding to a 15 minute time of concentration.
- A higher standard (larger event) may be advisable for the water quality event if particularly high risk conditions are identified.

For the purposes of this report, the design event is defined as follows:

- 50% of 2-hour duration, 1 in 2-year, with a peak rainfall intensity of 27 mm/hr corresponding to a 15 minute time of concentration.
4.0 ISSUES IDENTIFICATION AND RISK ANALYSIS

4.1 APPLICABLE STANDARDS, ACTS, AND REGULATIONS

In addition to the references in Section 3.3.1 regarding petroleum products, the following relevant legislation and standards are applicable, given the potential stormwater pollution risks identified for the Project’s operation phase.

- **BC Environmental Management Act**, SBC 2003, c. 53 (current to July 26, 2017), governs the unauthorised release of substances into the environment (e.g. spills reporting) and quality standards for contamination (for provincial lands).

- Waste Discharge Regulation (BC Reg. 320/2004) includes amendments up to BC Reg. 54/2016, March 2, 2016 regarding the storage, handling, and disposal of hazardous materials and waste.

- **BC Workers’ Compensation Act**, RSBC 1996, c. 492, governs worker safety to prevent accidents, exposure to specific materials and chemicals, and incident reporting.


- **Fisheries Act**, RSC 1985, c. F-14 (current to July 7, 2017 and last amended on April 5, 2016), governs the deposition of deleterious substance in waters frequented by fish.

- Port Authorities Operations Regulations (SOR/2000-55), current to August 27, 2017 and last amended on March 29, 2016, apply in respect of the navigable waters of a port, works and activities in a port, and the property managed, held, or occupied by a port authority.


4.2 POTENTIAL POLLUTANT SOURCES

Project-related operational activities were assessed to identify materials and practices that could add measurable levels of pollutants to stormwater or potentially result in the discharge of pollutants during dry weather from the storm sewer draining the site.
Without proper controls in place, potential events that could result in contamination to stormwater during Project operation include:

- Potash may be spilled during product handling activities as described in Table 2.
- Fuel, oil, or coolant from service vehicles and trains may leak from damage, normal wear and tear, or during maintenance.
- Fuel may drop or spill from diesel or gasoline fuel tanks during service truck fueling or if tanks are damaged.
- Hydraulic oil or lubricating oil may be spilled during maintenance activities, or from leaks in oil-filled equipment.
- Solid waste, fuel, new or used oil and grease, paints, and cleaning solvents may be accidentally spilled, or spills may occur due to improper storage.
- Train derailment within the Project area.
- Site may become flooded during extreme hydrological event (e.g., 200-year flood).

### 4.3 Potential Sensitive Receptors

Environmental receptors potentially affected by Project operation-phase activities are described in the following sections. Figure 3 shows the existing stormwater drainage network of the Project, the infrastructure that will require updates due to the Project, and the aquatic habitat surrounding the PDA. From the PDA, there are three main outputs of stormwater to the surrounding environment, from north to the south:

1. Berth 10 drainage (culverted)
2. Berth 9 drainage (culverted)
3. Elevator Road culvert to Gunderson Slough.

The Project engineering drawings do not indicate where water within the smaller drainage network infrastructure flows, but the major outputs are shown as these three locations. Given that the PDA is mostly paved, with curbs and catch basins acting as the major collectors of stormwater, the final destination of stormwater will be the Fraser River to the west, and Gunderson Slough to the south via these three major outputs. The sanitary line enters the PDA from the east and services the middle portion of the site and the potash storage building (see Figure 3). Stormwater is not likely to enter the sanitary system based on the existing and proposed infrastructure for the Project. Given that there will be no substantive change in impervious surface, volume of stormwater will likely remain similar to existing conditions. A minor change to discharge may occur at the south end of the site due to replacement of vegetated area with the new rail loop.
Table 3 describes watercourses that are directly affected by the Project, with the watercourse classifications included from the City of Surrey (COSMOS 2017) and potential effects. Additional detail is available in the Aquatic Resources Assessment Report (Attachment 4.2-W).

### Table 3  Proposed Stormwater Changes in the Project Development Area

<table>
<thead>
<tr>
<th>Watercourse Name</th>
<th>Watercourse Classification1</th>
<th>Watercourse Location</th>
<th>Potential Change to Stormwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraser River shoreline</td>
<td>n/a</td>
<td>The Fraser River shoreline borders the Project site.</td>
<td>Potential spill to this waterbody via shiploader, conveyor system spills, or from site-wide drainage. Potential operation-phase effects include increased salinity due to dissolved potash. Aquatic life would be exposed to localized salinity increases. However, given the naturally occurring brackish waters in this area, changes in water flow and salinity and associated effects to aquatic life will likely be low.</td>
</tr>
<tr>
<td>Open water west of Project site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berth 10 Drainage (Culverted)</td>
<td>Green, C, non-fish bearing</td>
<td>Outfall of the City of Surrey drainage network running along the north side of the Project site.</td>
<td>The west end of the existing storm sewer that crosses the Project site will be reconstructed following conveyor construction. Potential operation-phase effects include increased salinity due to dissolved potash, and effects to aquatic life. Aquatic life would be exposed to localized salinity increases. However, given the naturally occurring brackish waters in this area, changes in water flow and salinity and associated effects to aquatic life will likely be low.</td>
</tr>
<tr>
<td>Berth 9 Drainage (Culverted)</td>
<td>Yellow, B, non-fish bearing but contributes to fish habitat</td>
<td>Located east of the Project site and east of Robson Road, parallel to the roadway.</td>
<td>The east end of the storm sewer that crosses the Project site will be re-routed to avoid new storage building construction. The west end (outfall to the Fraser River) will be slightly re-positioned. Potential operation-phase effects include increased salinity due to dissolved potash, and effects to aquatic life. Aquatic life would be exposed to localized salinity increases. However, given the naturally occurring brackish waters in this area, changes in water flow and salinity and associated effects to aquatic life will likely be low.</td>
</tr>
<tr>
<td>Gunderson Slough</td>
<td>High productivity habitat (FREMP 2015)</td>
<td>Gunderson Slough is located approximately 120 metres south of the Project site.</td>
<td>The slough will receive stormwater via Robson Ditch, Bekaert South Ditch, and Elevator Road culvert. Potential operation-phase effects include slight increase to stormwater quantity flow to the slough, increased salinity, and effects to aquatic life. Due to a minor change to the Project site’s impervious surface, effects will likely be low.</td>
</tr>
</tbody>
</table>

1See Aquatic Resources Assessment Report (Attachment 4.2-W) for City of Surrey watercourse classification details.
4.4 IDENTIFIED ISSUES

Key pollutants that could adversely affect stormwater quality are spills of:

- Petrochemicals used on site
- Potash that could then become dissolved in stormwater.

No large tank-type bulk fuel storage will be required onsite during Project operation. A storage area in a centralised location will be built with secondary containment for small amounts of fuels, coolants, hydraulic oils, and lubricating oils used for maintenance purposes. Any accidental release of these pollutants into the environment would most likely occur primarily during maintenance operations (either planned or from equipment failure). Maintenance crews will immediately clean up and report all spills in accordance with the Project’s Spill Prevention and Emergency Response Plan (Attachment 4.3-E).

4.5 IDENTIFIED POLLUTANT PATHWAYS

The stormwater drainage network is shown on Figure 3, with Table 3 summarising the potential effects to the surrounding watercourses. As discussed in Section 4.3, there are three main stormwater outflows from the PDA to the surrounding watercourses:

1. Berth 10 drainage (culverted)
2. Berth 9 drainage (culverted)
3. Elevator Road culvert to Gunderson Slough.

With the Project site paved and graded, and with flow directed towards stormwater catch basins, stormwater will flow to the drainage network and discharge to one of these outputs from the Project site to the Fraser River via the Berth 9 drainage and Berth 10 drainage, and to Gunderson Slough via the Robson Ditch and the Elevator Road culvert. Potential effects to these waterbodies have been included in Table 3.

The two main outfalls from the PDA are to the Fraser River, Berth 9 drainage, and Berth 10 drainage, which will also have their alignment affected slightly by the Project. These ditches are also most likely to be affected by the potash handling and transfer systems at the Project site. Although they are culverted ditches, they are main drainages from the Project site and could become pathways for Project stormwater outputs offsite.

The outfall to the south towards Gunderson Slough will also receive Project stormwater, with the network of ditches and drainage affected due to the construction of the rail line. The ditches and stormwater management network that flows to Gunderson Slough are mostly open, and there is a risk of potential inputs to this network via overland flow due to spills from the rail line. Water flow via Robson Ditch, flowing to Gunderson Slough to the south, could become a pathway for Project stormwater outputs offsite.
5.0 MANAGEMENT STRATEGY

The Project’s stormwater pollution prevention strategy is to implement a set of BMPs that will target the potential pollutants identified in Section 4.2. These practices will encompass prevention, containment, reduction, and treatment during the Project’s operation phase. A review of the Best Available Technology Not Entailing Excessive Cost (BATNEEC) (refer to Appendix A of Attachment 4.1-D in the Application) was completed for the Project by Ausenco, and includes these technologies and the effective implementation of the Spill Prevention and Emergency Response Plan (Attachment 4.3-E). Following implementation of these measures, the risk of introducing chemical pollutants to the environment will be decreased. Refer to the Construction Environmental Management Plan (Attachment 4.3-B) for mitigation measures specific to Project construction.

The BATNEEC report recommends various technologies for the Project that represent the best solutions available for minimising environmental effects. This included design recommendations for:

- Conveyor system
- Dust control and collection
- Receiving systems and processes, including the rail car unloading station and rail car handling processes
- Potash storage building design and construction
- Shiploading
- Project site operation
- Stormwater management.

The BATNEEC report includes recommendations relevant to stormwater for incorporation into Project design, which would assist in reducing spill and pollution potential.

5.1 GOOD HOUSEKEEPING

Maintenance of work areas that may contribute pollutants to stormwater will be the most effective management practice for pollution prevention at the Project site. Good housekeeping practices are not only beneficial in terms of limiting exposure of materials to stormwater, they also improve worker safety and often contribute to reducing losses of products, thereby lowering operational and capital costs.

Good housekeeping will be practiced during all Project phases, and exposed areas of the Project site will be maintained in a clean and orderly manner. Trash and other waste products will be regularly removed from the Project site, and routine inspections will be conducted to monitor the quality and timing of housekeeping practices.
To mitigate the effects of potential potash releases to the stormwater drainage system, the following measures will be implemented:

- Good housekeeping practices will be followed in areas where potash is stored or transported, including regular surface sweeping to prevent accumulation.
- Potash will be stored in enclosed storage facilities and covered conveyors that limit the potential for their release.
- Routine inspections will be conducted on areas where potash will be stored and transported, including conveyor systems, to verify that there are no leaks or damage to the infrastructure that could lead to potential spills.
- Sumps at the rail car unloading station and at transfer towers will be routinely inspected and, as required, emptied of brine by vacuum truck. Collected sump water will be disposed off-site at a facility permitted to receive such waste.
- Routine inspections will be conducted on the rail line, rail cars, and associated infrastructure to ensure it is in good working order with no damage or potential issues that could lead to derailments.

### 5.2 Storage and Handling

Storage and handling practices for petroleum products, fuels, oils, and lubricants, many of which are flammable, will comply with industry best practices and regulatory requirements of the BC *Workers Compensation Act*, RSBC 1996, c. 492, as well as all other applicable regulations and guidelines, including the Occupational Health and Safety Regulation (BC Reg. 296/97), Workplace Hazardous Materials Information System (WorkSafe BC 2015), and the Workers’ Compensation Board of British Columbia’s Prevention Manual (WorkSafe BC 2014). The storage and handling of flammable substances must comply with:

- Occupational Health and Safety Regulation Part 5 – Chemical and Biological Substances, Flammable and Combustible Substances
- Environmental Code of Good Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products (CCME 2013); and,

Fuel handling and storage facilities will also comply with the provincial *Fire Services Act* RSBC 1996, c. 144, and its regulations. All workers will adhere to established fire prevention and response protocols. Preparations will include spill response procedures, equipment and training, containment berms, and security. The storage facilities described will be used during both the construction and operation phases.

Spill or soil contamination occurring at storage facilities is under the jurisdiction of Transport Canada and the Port Authorities Operations Regulations (SOR/2000-55). In the unlikely event that a spill migrates from federal jurisdiction, the BC *Environmental Management Act*, SBC 2003, c. 53, and its regulations apply. Reporting requirements under federal and provincial legislation are identified in Appendix D of the *Spill Prevention and Emergency Response Plan*. 


5.3 **PREVENTIVE MAINTENANCE**

All machinery working in the nearshore area of the Fraser River must be in good working order. A preventive maintenance program will be in place to guide Project activities, which will include regularly scheduled inspections, testing, maintenance, and repairs of facility equipment and systems that could result in degradation of water quality in stormwater discharge. Since potash is corrosive, all equipment and structures will be confirmed suitable for a potash environment, and additional measures will be in place including using stainless steel; painting with a high-quality, three-part paint system; hot-dip galvanising; and providing additional depth of concrete cover for foundations will minimise maintenance requirements during operations.

A table showing maintenance intervals by equipment type will be provided in an updated version of this SPPP, prior to initiation of the operation phase. Additional detail on ongoing operations and processes will also be described.

Routine maintenance (e.g., checks, clean-outs) of drainage appliances such as Stormceptors and oil-water interceptors will be built into the operation-phase maintenance schedule. The frequency of maintenance on the stormwater treatment infrastructure and volume/frequency of brine water removal, by vacuum truck at the rail car unloading station and transfer towers will be provided in an updated version of the SPPP, prior to construction.

5.4 **CONTAINMENT AND REDUCTION**

As part of the SPPP, appropriate containment and reduction of potentially hazardous materials must be completed at the Project site. The following practices are proposed for the Project:

- All machinery working at the site must minimize use or potential release of contaminants (e.g. oils or greases) that would enter into the potash product and/or environment. If equipment requires chemical products for operations, a containment system will be considered for design.

- Design all hazardous material (fuels, lubricants, oils, etc.) storage areas to provide secondary containment that achieves containment of 110% of the largest container within the facility, prevents the run-on and accumulation of storm or rain water, and segregates hydrocarbons from incompatible materials.

- If the secondary containment accumulates stormwater, inspect the water to confirm that it is free of oil, foam, or discoloration prior to being drained. Appropriately test and dispose of water if contamination is suspected and/or confirmed.

- Equip hydrocarbon storage with manual and automatic emergency shutoff systems.

- Equip storage areas and secondary containment units with a risk-based detection system (i.e. identify highest risk components and failure significance for equipment, implement spill...
monitoring equipment, and establish frequency of maintenance/inspection) to ensure early detection of leaks or spills.

- Implement emergency systems that will ensure early detection of leaks or spills such as manual and automatic emergency shutoffs.

- Use fuel stations with concrete apron and catch basin as well as efficient oil/water separators or pump-out system.

- Cover any fueling and hazardous storage areas.

In areas where solid contaminants could enter a wastewater drain, the drain will be equipped with a screen to reduce the volume of solids entering the storm drain.

5.5 **Spill Prevention and Response Procedures**

Spill kits will be maintained onsite in accessible locations. Spill prevention and emergency response procedures are outlined in the *Spill Prevention and Emergency Response Plan (Attachment 4.3-E)*.

5.6 **Containment and Treatment**

During Project operation, potash effects to surface water are likely to be minimal since all conveyors will be covered and transfers will consist of enclosed chutes with dust collection. Transfer tower designs will include concrete foundations with curbs to contain any potentially contaminated water, along with sumps that can be emptied by sucker truck if a potash spill occurs due to equipment malfunction. Collected sump water will be disposed off-site at a facility permitted to receive such waste. Due to this effective containment, treatment ponds are not contemplated for the Project.
6.0 IMPLEMENTATION AND MONITORING

All operations staff will receive training on implementation of the SPPP to enable proper assessment of conditions and activities potentially affecting Project stormwater quality and to evaluate effectiveness of management practices. The training will clearly convey that all staff will be responsible for recognising ineffective stormwater BMPs and reporting them to their supervisor or site management personnel to ensure prevention actions are timely, triggers for action are clear, and action responses are appropriate and proportional to risk.

Prior to the start of the operation phase, the SPPP will be updated with an organisational chart indicating the roles and responsibilities for managing, maintaining, and ensuring stormwater pollution prevention. Brief summaries of key duties and roles in stormwater pollution prevention will also be provided. Key personnel will be assigned responsibilities around stormwater management, and the SPPP emergency contact list will be updated to include established team members and other critical emergency contacts. An SPPP manager and other key personnel will be designated to oversee implementation of and compliance with the SPPP.

Required maintenance activities will also be included in the updated SPPP as infrastructure is finalised and operations are initiated. Maintenance activities will be described and will include frequency and duration of maintenance. Plans to test stormwater design and mitigation measures (e.g., sampling stormwater/outfall to ensure potassium levels are adequate prior to discharge) will be detailed in the SPPP prior to construction and the SPPP will be updated as required, based on test results.

6.1 ADAPTIVE MANAGEMENT AND CONTINUOUS IMPROVEMENT

A key process in effective SPPP implementation is the ability to change mitigation measures or actions as site conditions warrant to protect stormwater quality. This approach, generally termed as adaptive management, is a planned and systematic process for continuously improving environmental management practices by learning about their outcomes.

Compliance and effectiveness of the SPPP will be reviewed yearly to track effectiveness, and corrective actions will be taken to improve the SPPP. To enable continuous improvement of the stormwater system, the SPPP will also be reviewed as site-specific stormwater conditions warrant. The SPPP will be accordingly revised and updated should initial response actions fail and adaptive measures are needed to mitigate stormwater contamination or pollutant release. If BMPs are not working effectively or additional mitigation efforts are needed, the SPPP will be updated and re-issued.

6.2 REPORTING UPDATES

As noted in Section 6.1, the SPPP will be reviewed annually to determine whether updates are required, and will be updated in the following instances:
• Change to VFPA requirements for stormwater pollution prevention plans
• Change to stormwater design
• Construction of new stormwater infrastructure
• Material changes during Project operation
• Changes to Project site sub-catchments.

A revision log will be appended to the SPPP with a summary of the changes, date of revision issue, and the SPPP distribution list for the revision.
7.0 SUMMARY

This SPPP is intended to proactively and efficiently manage stormwater pollution risks during Project operation, integrate BHP operational procedures, complement existing FSD plan(s), and be consistent with VFPA guiding principles for stormwater management.

Mitigation for stormwater runoff during construction is addressed in the Project’s Construction Environmental Management Plan (Attachment 4.3-B of the Application).

The SPPP contains a site inventory of activities and materials, identifies issues and potential risks of source materials on sensitive receptors, and identifies pollutant pathways based on Ausenco’s proposed drainage layout for the Project. Strategies for stormwater management include good housekeeping, storage and handling; containment and reduction; spill prevention and response; and treatment. These improvements to existing infrastructure are intended to bring stormwater management within the PDA to current standards. The SPPP also identifies the basic requirements for implementation and monitoring including provisions for continuous improvement. The SPPP will be updated following detailed design of drainage infrastructure prior to construction as well as routinely in response to changes in legislation, drainage infrastructure, or site management practices.

This SPPP considers the Master Drainage Plan for the site, potential flood vulnerability and FSD stormwater management with the goal to implement an integrated and efficient approach to preventing pollution by stormwater runoff.
8.0 CLOSING

This work was performed in accordance with contract number 8500085638 (contract) between Hemmera and BHP, dated September 11, 2015. This report has been prepared by Hemmera, based on fieldwork conducted by Hemmera, for the sole benefit of and use by BHP. In performing this work, Hemmera has in good faith relied on information provided by others, and has assumed that the information provided by those individuals is both complete and accurate. This work was performed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale. The results presented herein should be considered within the context of the scope of work and Project terms of reference; further, the results are time-sensitive, and are considered valid only at the time the report was produced. The results contained in this report are based on the applicable guidelines, regulations, and legislation existing at the time the report was produced; any subsequent changes in the regulatory regime may alter the results.

Report prepared by:
Hemmera Envirochem Inc.

Report peer reviewed by:
Hemmera Envirochem Inc.

Report peer reviewed by:
Hemmera Envirochem Inc.

for:
Matthew Beveridge, P.Eng.
Environmental Engineer

Michael Choi, B.Sc., P.Chem.
Business Leader Physical Sciences/Yukon

Robin Taylor, M.R.M., E.P.
Senior Environmental Assessment Manager
9.0 REFERENCES


APPENDIX A

Master Drainage Plan
A Report
To:

Fraser River Port Authority

For:

Surrey Dock Lands
Master Drainage Plan

AUGUST 2004
EB3612
# Table of Contents

1. **PURPOSE** ..................................................................................................................................... 1

2. **BACKGROUND** ............................................................................................................................. 2
   2.1 FRPA Surrey Lands ...................................................................................................................... 2
   2.2 Regulatory Framework .................................................................................................................. 2
   2.3 Time Frame ................................................................................................................................... 3

3. **EXISTING DRAINAGE PATTERNS** .............................................................................................. 4
   3.1 Drainage Patterns ......................................................................................................................... 4
   3.2 Drainage Issues ............................................................................................................................ 5
   3.3 Design Criteria ............................................................................................................................. 5
   3.4 Fraser River Flood Risk ................................................................................................................. 6
   3.5 General Site Characteristics ......................................................................................................... 7
   3.6 Drainage Area Assessments ......................................................................................................... 7

4. **CONCLUSIONS** ............................................................................................................................ 15
   4.1 General ........................................................................................................................................ 15
   4.2 Fraser River Flood Risk ................................................................................................................. 15
   4.3 Creek Systems .............................................................................................................................. 15
   4.4 Ponding and Localized Drainage ................................................................................................. 16

5. **RECOMMENDATIONS** .................................................................................................................. 17
   5.1 General ........................................................................................................................................ 17
   5.2 Fraser River Flood Protection ....................................................................................................... 17
   5.3 City of Surrey and Off-Site Upland Development ....................................................................... 18
   5.4 Proposed Site Improvements ........................................................................................................ 18

### Appendices

- **Appendix 1** Photos
- **Appendix 2** IDC & Lot East of Shed 6 – Preliminary Design
- **Appendix 3** Timberland Road – Conceptual Cross-section
1. PURPOSE

This Master Drainage Plan (MDP) was prepared for the Fraser River Port Authority (FRPA) for their lands in and adjacent to the Fraser Surrey Docks. The purpose was to consolidate the known information about the existing site drainage, assess the drainage and flood protection on the lands, assess the potential impact of on-site and off-site development or other changes to the site drainage, and plan the necessary improvements. The plan includes:

- Background information that summarizes the geographic, historical, and regulatory framework for the site;
- A summary of the existing drainage patterns on the FRPA lands and adjacent lands;
- A list of drainage issues that may impact flood protection at the FRPA lands, including on-site issues and external drainage issues;
- Conclusions;
- Recommended improvements or other actions to reduce flood risk and accommodate planned development.

The FRPA lands are intended to be used as industrial port lands characterized by extensive impervious surfaces right up to the edge of the Fraser River. This MDP focuses on site drainage and flood protection in this industrial context, and does not address fish habitat and other social values attributed to watercourses. Nevertheless, we understand that it is the FRPA's practice to install oil/silt separators wherever practical in new installations.
2. BACKGROUND

2.1 FRPA Surrey Lands

The location of the FRPA Surrey lands is shown in Figure 1, Location Plan. The lands run in a south-west to north-east direction. For simplicity, this report will refer to the Fraser River as north of the site, instead of north-west.

The lands include approximately 140 ha of federal industrial lands managed by the FRPA who in turn lease out portions of the lands to a variety of leaseholders and land management firms. A large portion of the lands is occupied by Fraser Surrey Docks (FSD), a break-bulk and container terminal.

The majority of the lands are contiguous and are bounded by the Fraser River to the north, the Surrey/Delta border to the west, the Manson Canal to the east, and the CN and BN rail lines, South Fraser Way, and River Road to the south. A smaller group of lots is located east of Manson Canal and is within an area bounded by the Fraser River to the north, Manson Canal to the west, the CN & BNR rail lines to the south, and Old Yale Road to the east. This report will refer to these lands as the Tannery Road Lands.

A breakwater separates the shipping berths and port waterfront from the main channel of the Fraser River from and Tannery Road to Berth 7 as shown on Figure 2.

2.2 Regulatory Framework

The FRPA Surrey lands lie within the City of Surrey (City) in the Province of British Columbia. As federal lands, they are subject to federal laws and are not legally subject to the same city by-laws and provincial regulations as adjacent non-federal land. However, some FRPA lands are part of larger City drainage catchments and the FRPA generally cooperates with the City in the planning and design of shared drainage infrastructure. The objective of this MDP is to cooperatively plan and design such facilities and generally conform to local municipal and provincial practices.

Under the authority of the Dike Maintenance Act, the Ministry of Water, Land and Air Protection regulates the operation and maintenance of flood protection structures by Diking Authorities through the Deputy Inspectors of Dikes Offices. Under common law and in accordance with pertinent legislation and/or agreements, responsibility for operation and maintenance (including inspection and emergency response) is vested with the City of Surrey.
2.3 Time Frame

The draft of this Master Drainage Plan was submitted in September, 2003. The significant increase in the FSD container traffic has resulted in a rapid succession of improvement construction and drainage changes between the dates of the draft Plan and this final report. The most pressing issue that precipitated this study was the pending development of the IDC lands and associated road and gate improvements. The final MDP reflects the conditions that existed up to September 2003 to remain consistent with the original intent.
3. **EXISTING DRAINAGE PATTERNS**

FRPA, City, and related as-built records were reviewed to determine the configuration of the existing drainage facilities and features on and adjacent to the lands. Multiple field inspections were performed to verify, clarify and correct records. Elevations were also collected from a number of recent surveys performed on site; however, they did not cover all areas of interest.

### 3.1 Drainage Patterns

The existing drainage patterns are presented in **Figure 2**, Existing Drainage. This figure presents the known drainage infrastructure overlain onto a site orthophoto. The drainage boundaries for each storm outlet are shown in their approximate locations with arrows indicating typical flow patterns.

In general, most of the land is fairly flat with portions lying below the 200 year flood level. Due to the flat grading, many portions of the site are subject to some steady and some periodic ponding, and some low lying areas and ditches are subject to continuous ponding. Most of the upland City drainage is channelled away from the site, although Delta Creek may overflow into the site. **Figure 1** and **Figure 2** show a number of creeks and a canal that is channelled either east or west around the lands.

To assist discussion about each area, the individual drainage areas are listed below and assigned names corresponding to the primary feature within them.

**Table 1**: Drainage Areas.

<table>
<thead>
<tr>
<th>No.</th>
<th>Area Name</th>
<th>Area Within FRPA (ha)</th>
<th>Land Use</th>
<th>Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Berth 1</td>
<td>10.5</td>
<td>Lumber yard, 70% impervious (imp.)</td>
<td>Open outfall</td>
</tr>
<tr>
<td>2</td>
<td>Berth 2</td>
<td>4.0</td>
<td>Storage yard &amp; berth, 100% imp.</td>
<td>Open outfall</td>
</tr>
<tr>
<td>3</td>
<td>Berth 3</td>
<td>4.3</td>
<td>Storage yard, shed &amp; berth, 100% imp.</td>
<td>Open outfall</td>
</tr>
<tr>
<td>4</td>
<td>Titan</td>
<td>18</td>
<td>Sheds &amp; storage yards, 60% imp.</td>
<td>Outfall w/ flap</td>
</tr>
<tr>
<td>5</td>
<td>Berth 5</td>
<td>3.4</td>
<td>Storage yard &amp; berths, 100% imp.</td>
<td>Open outfall</td>
</tr>
<tr>
<td>6</td>
<td>Berth 6</td>
<td>14</td>
<td>Storage yard, sheds &amp; berth, 100% imp.</td>
<td>Open outfall</td>
</tr>
<tr>
<td>7</td>
<td>Berth 7</td>
<td>0.8</td>
<td>Storage yard &amp; berth</td>
<td>3 open outfalls</td>
</tr>
<tr>
<td>8</td>
<td>Berth 8</td>
<td>1.0</td>
<td>Storage yard &amp; berth</td>
<td>4 open outfalls</td>
</tr>
</tbody>
</table>
### 3.2 Drainage Issues

The record and field review clarified our understanding of most of the drainage system. It also identified missing information and areas of concern. The understanding for each area and the related issues are described below. General issues that apply to all areas are described first.

### 3.3 Design Criteria

As a reference, the following design criteria are proposed. It is consistent with the criteria listed in the City of Surrey’s Master Servicing Plan (February 2003).

- The subsurface conveyance system (minor) shall be sized and configured to maintain the peak 1:5 year event below ground surface.
- Sufficient subsurface or surface flow paths must be provided for the 1:100 year (major) design flows without causing risk to public health or private property.
- All buildings shall be flood proofed in accordance with the Ministry of Water, Land and Air Protection requirements of ensuring that minimum building elevations are higher than the 200 year flood level plus 0.6 m freeboard. The 200 year flood level is 3.8 m and the minimum flood proof elevation for the lands, inclusive of the 0.6 m freeboard, is 4.4 m. Similarly, dykes and similar structures at the River’s edge should be constructed to 4.4 m.

For historical reference, the record extreme high water level was 4.5 m set in June 1948, prior to regular deep dredging of the river.
The level of responsibility the FRPA plans to take in the design of drainage infrastructure varies with the leasing arrangement, similar to the difference between managing private and public lands. Long-term commercial lease holders are treated in a manner similar to a City treating private property. Facilities constructed by long-term lease holders must meet acceptable design criteria, and are designed, constructed and maintained by the lease holders. For these tenants, the FRPA takes responsibility for the drainage after it crosses the lease area boundary.

Other lands, such as the shared roadway, short term lease lands, and the FSD lands are managed more actively by the FRPA. Facilities in these lands are typically designed and constructed by the FRPA, with maintenance responsibilities depending on the lease agreement.

3.4 Fraser River Flood Risk

The Surrey lands lie within the low lying flood plain of the Fraser River. The lands are partially protected by a dyke network and pump station, but most drain by gravity to the River. Portions of the lands are below the 200 year flood level with open outfalls to the Fraser River. Figure 2 shows the known areas below 3.8 m and buildings below 4.4 m. The low rail elevations account for a large portion of the low lying lands. Most of the tracks remain under 3.8 m and therefore form low lying interconnecting flow paths if flooding should occur. Some of the CN and BNR main tracks are even under 3.0 m.

Figure 2 also shows some of the elevations along the berth faces. In general, the berth face elevations start at 4.1 m at the east end of Berth 9, drop to about 3.8 m elevation at Berth 5, and continue to drop to about 3.5 m at the west side at Berth 2. East of Berth 9, an unimproved dyke right of way exists with variable elevations. West of Berth 2, the ground elevations at the River’s edge are also highly variable.

High river levels could overtop the berth faces in some locations. In other locations, they could backflow into the open storm sewers, flooding the low areas connected by the low-lying rails.

A breakwater separates the shipping berths and port waterfront from the main channel of the Fraser River between Berth 7 and Tannery Road (see Photo 15, Appendix 1). This breakwater protects the berths from the high velocities in the main channel. The elevation and design of this breakwater was not assessed to determine if it is sufficient to protect the area from bank erosion during a 200 year flood.
3.5 General Site Characteristics

The site is fairly level, with elevations between 3 m and 5 m. Ponding is common, especially along the CN and BN tracks to the south, at the south-west corner of the proposed IDC site, on the unpaved road surfaces, and in the undeveloped fields. Photos 16, 18, 19, 20, 23, 24, and 29 show many of these areas. A mix of open ditches and storm sewers collect and channel stormwater to outfalls along the Fraser River. Some areas are graded to directly drain to the river over the ground surface.

The water table was observed at approximately 2.4 m at the proposed IDC site following an extensive dry period.

3.6 Drainage Area Assessments

♦ Area 1: Berth 1 (see Photo 1, Appendix 1)

This 10.5 ha area is used for an Interfor lumber storage yard and Rivtow tug and barge facilities, and includes Berth One. The surface is around 50% impervious. The drainage boundaries are bounded by the limits of these activities. As a long term lease area with its own self-contained drainage system including an outfall to the river, drainage responsibility is appropriately assigned to the lease holders. The know elevations for this area were below the 200 year flood elevation of 3.8 m. The remainder of the area appears to be consistently below 3.8 m. Therefore, this area is susceptible to flooding during an extreme freshet event (200 year flood).

No changes are expected in the near term. If a change of tenant or other facility improvements are planned, a more detailed review and redesign to current standards would be appropriate.

♦ Area 2: Berth 2 (see Photo 2, Appendix 1)

This 4.0 ha area is used for steel and other storage, and includes Berth Two. The surface is almost 100% impervious. The area is one portion of the larger FSD site and includes catch basins (CB’s), storm sewers, and an open outfall to the river. Figure 2 shows that approximately one third of area is known to be below the 200 year flood elevation of 3.8 m, including a few administration trailers. The berth face is approximately 3.5 m in elevation. Therefore, this area and the buildings are susceptible to flooding during an extreme freshet event.
No changes are expected in the near term. If facility improvements are planned, a more detailed review and redesign to current standards would be appropriate. To reduce this risk of flooding, the most reliable approach is to raise the lands above 3.8 m, raise the berth face to 4.4 m, and raise the building grades to 4.4 m. Alternatively, the dyke or berth face could be raised to 4.4 m, flap gates added to the storm outfalls, and emergency pumps installed.

**Area 3: Berth 3**

This 4.3 ha area is used for uncovered storage, Shed 1, and Berth 3. The surface is almost 100% impervious. The area is one portion of the larger FSD site and includes CB’s, storm sewers, and an open outfall to the river. Figure 2 shows that a strip of land along the rail line south of Shed One is below the 200 year flood elevation of 3.8 m, and the berth face is around 3.5 m elevation. This area is susceptible to flooding during an extreme freshet event.

No changes are expected in the near term. If facility improvements are planned, a more detailed review and redesign to current standards would be appropriate. To reduce this risk of flooding, improvements would include raising the rail and lands above 3.8 m and the berth face to 4.4 m.

**Area 4: Titan** (see Photos 3 and 4, Appendix 1)

This 17.5 ha area consists of:

- Titan Steel sheds, storage, parking, and administration building;
- FSD parking, storage yards, and Shed Four;
- BC Cleanwood buildings, storage, and parking; and
- Undeveloped land.

The surface is around 60% impervious and includes storm sewers, large open ditches, and an outfall with a flap gate to Gunderson Slough. Figure 2 shows that a large portion of this area near Gunderson Slough lies below the 200 year flood elevation of 3.8 m. Much of the remaining area is suspected of lying below the 3.8 m elevation, but was not confirmed by survey. Shed four is included in this low lying land and is well below the building flood design elevation of 4.4 m. The adjacent berth faces at Berths 3, 4, and 5 are at 3.5 m. These low lying areas and buildings are susceptible to flooding during an extreme freshet event.

Robson Road may undergo changes with the expected closure of the connection to Timberland Road, and the empty field is available for development. New facilities should be designed to current standards. To reduce this risk of flooding, the most reliable approach is to raise the lands above 3.8 m and the building slab elevations above 4.4 m.
Steady flow from the main Titan Steel shed into a fenced pond and ditch was observed during very dry periods. This may be due to groundwater pumping or process water, and may have water quality impacts on Gunderson Slough.

Armstrong Creek connects to Kendale Creek which flows into Gunderson Slough. The connections were not successfully confirmed by field observations due to thick overgrowth that could also impair drainage. Any diversion or overflow to the Titan drainage area could result in increase flood risk to FRPA lands in Area 4. Upgrades to Armstrong Creek culverts were identified in the City of Surrey South Westminster Master Servicing Plan.

✿ **Area 5: Berth 5** (see Photo 5, Appendix 1)

This 3.4 ha area is used for steel and other storage, and includes Berth 4 and Berth 5. The surface is almost 100% impervious. The area is one portion of the larger FSD site and includes CB’s, storm sewers, and an open outfall to the river. **Figure 2** shows that most of this area is known to be below the 200 year flood elevation of 3.8 m, including the berth face at 3.47 m. These low lying areas are susceptible to flooding during an extreme freshet event.

No changes are expected in the near term. If facility improvements are planned, a more detailed review and redesign to current standards would be appropriate. To reduce this risk of flooding the most reliable approach is to raise the lands above 3.8 m and the berth face above 4.4 m.

✿ **Area 6: Berth 6** (see Photo 6, Appendix 1)

This 3.4 ha area is used for a variety of purposes including storage, Shed 2, Shed 5, the Dip Tank Shed, and a garage. It also includes Berth 6. The surface is around 100% impervious. The area is one portion of the larger FSD site and includes CB’s, storm sewers, and an open outfall to the river. **Figure 2** shows that areas of land adjacent to the rails are known to be below the 200 year flood elevation of 3.8 m, the cafeteria building is below the flood design elevation of 4.4 m, and the berth face is at 4.05 m. These low lying areas and buildings are susceptible to flooding during an extreme freshet event. A major overflow from Delta Creek could also flood the low-lying portions of this area via the low rail lines unless City improvements to Colliers canal are made.

Rail and facility relocations are proposed for the near future. If facility improvements are planned, a more detailed review and redesign to current standards would be appropriate. To reduce this risk of flooding the most reliable approach is to raise the lands above 3.8 m and the building slab elevation above 4.4 m.
Areas 7 and 8: Berths 7 and 8 (see Photo 7, Appendix 1)

Area 7 includes 0.8 ha of storage area behind Berth 7. It includes three separate minor drainage areas with separate CB’s and open outlets through the Berth 7 retaining structure. Berth 8 is similar with four drainage areas with a combined area of 1.0 ha. Areas 7 and 8 were assigned separate names only to keep the naming consistent with the adjacent berths. Figure 2 shows that areas of land adjacent to the rails are known to be below the 200 year flood elevation of 3.8 m and the berth face is approximately 4.05 m. These low lying areas are susceptible to flooding during an extreme freshet event.

Area 9: Berth 9 (see photos 9, 16, 17, 18, 19, and 20, Appendix 1)

Area 9 includes approximately 36 ha of FRPA land plus about 4 ha of City lands. The FRPA lands include Shed 3, half of Shed 6, the Main Trucking Gate, container and other storage, the proposed IDC site, the Chemetron site, parts of Timberland Road, the CTL site, the south west corner of the Westran site, and rail yards. The off-site lands include CNR lands, BNR lands, and portions of South Fraser Way, with possible overflow from the Delta Creek watershed. The drainage is collected and conveyed through CB’s, storm sewers, and a 1050mm diameter concrete storm sewer that runs from the proposed IDC site to an outfall with a flap gate in the retaining wall under Berth 9.

Figure 2 shows that portions of the area parallel to the existing tracks are below the 200 year flood elevation of 3.8 m, Shed 3 lies below the flood design elevation of 4.4 m, and the berth face is at 4.08 m. These low lying areas and building are susceptible to flooding during an extreme freshet event.

The 1050 mm storm sewer does not have adequate excess capacity to drain the proposed IDC site or overflow from the City’s Delta Creek. This system appears to receive steady drainage from portions of South Fraser Way. The culverts under the tracks are lower than the inlet to the 1050 mm pipe and the water table, resulting in steady ponding and periodic flooding around the tracks. The channel bed in Delta Creek where it meets Colliers Canal is approximately 1m below the overflow to this system. A significant runoff event in Delta Creek would likely result in overflows to the FRPA drainage system and a significant increased risk of flooding primarily in the CN and BNR rights of way, and partially into areas 4, 6, and 13. This flooding would likely drain along the CN and BNR tracks to the Manson canal before spreading beyond the areas noted.
The City of Surrey South Westminster Master Servicing Plan identified “reduced channel capacity from sedimentation” in Collier’s Canal due to City development and identified upgrades to help address the insufficient capacity. The plans did not, however, address the ponding and flooding along the tracks. Although most of the tracks are not on FRPA lands, many are and the operation of the CNR and BNR tracks impacts on the operations of the FSD. Additional City development without significant City drainage improvements will increase the flooding risk further.

A potential canal diversion through FRPA lands was also identified. This cannot be accommodated in existing FRPA facilities, but it could address the rail flooding problem if designed appropriately. Pumping would likely be required which suggests that improvements to conveyance to the Manson Pump Station may be more efficient.

To reduce this risk of flooding from the Fraser River, the most reliable approach is to raise the lands above 3.8 m and the building slab elevations above 4.4 m. Due to limitations in the existing storm sewer capacity, additional drainage should not be directed to the Area 9 storm sewers.

**Area 10: Shed 6** (see Photos 10, 21, 22, 23, 24 and 29, Appendix 1)

This 8.2 ha area is used for half of Shed 6, parking, and a gravel storage yard. The surface is around 25% impervious. The area is one portion of the larger FSD site and includes an open ditch that flows into the river.

The surface elevations vary, with some areas below the flood levels as shown on Figure 2. Development of the gravel storage yard with a paved surface is expected in the near future. A storm water collection system with an outfall with a flap gate is desired. This outfall can be constructed to also accommodate the IDC development on the adjacent lands, a new Truck Entrance Gate and reconstruction of a portion of Timberland Road. To reduce the risk of flooding, the redevelopment of this area should also include raising the dyke level to 4.4 m. This outfall will also reduce the risk of flooding described in Area 9. An overflow connection to a future Timberland road storm sewer to Manson Canal would provide pumped backup drainage in the event of a major freshet event. Preliminary drawings for the proposed storm water system are provided in Appendix 2. A proposed cross-section for Timberland Road is provided in Appendix 3.
Area 11: Sylvan (see Photo 11, Appendix 1)

This 14.9 ha area is used for the Sylvan site and the R16 Lease Area, including sheds, parking, and storage yards. The surface is around 85% impervious. The area is one portion of the larger FSD site and includes two open outfalls to the river. The Sylvan surface elevations and storm drainage system were recently constructed and appear to be designed to acceptable standards, but the remaining areas are lower and more prone to flooding. The Sylvan storm sewer and the R16 ditches flow to two outfalls that are only a short distance apart and are interconnected. As two or more long term lease areas with a shared contained drainage system, including the interconnected outfalls to the river, the responsibility for most of the drainage system can be left with the lease holders. However, the interconnected outfalls may be considered FRPA facilities. To eliminate this ambiguity, the interconnection could be eliminated and R16 could be drainage solely through its own existing outfall.

No changes are expected in the near term. If a change of tenant or other facility improvements are planned, a more detailed review and redesign to current standards would be appropriate.

Area 12: Dock Road (see Photos 12 and 25, Appendix 1)

This 10.6 ha area is used for the Agwood Station facilities, including sheds, parking, and storage yards, the relocated MS&G site, and a shared road between them. The surface is around 30% impervious. Due to the flatness of the road, the drainage direction is easily reversed. During a storm, flow was observed to split north and south near the rail crossing. The portion of the area next to the River was observed to drain directly to the River through an open outfall just west of the loading barge. The existing shared road is partially paved with extensive ponding. The poor condition of the road and drainage may be worsened with the increase in heavy truck traffic to the new MS&G site.

Survey information was not available along Dock Road, but nearby higher grades along Timberland Road were recorded lower than 3.8 m. Therefore, Dock Road, Timberland Road, the SRY lease area, and possibly the adjacent buildings are susceptible to flooding during an extreme freshet event. To reduce this risk of flooding the most reliable approach is to raise the lands above 3.8 m and the dyke/shoreline and building slab elevations above 4.4 m. During reconstruction of Dock Road and Timberland Road, a new outfall with a flap gate could be constructed to drain the new roads by gravity. The storm sewer could be connected to an overflow to Manson Canal to provide back-up drainage during a major freshet event.
Area 13: Manson (see Photos 13, 28 and 31, Appendix 1)

The Manson Pump Station drains a large area of City land along with three disconnected FRPA lands:

- The east portion of main FRPA lands, including the Timberland Road east of CTL and west of Manson Canal, the Westran site, and the south and east edge of the MS&G site.
- The Tannery Road lands west of Tannery Road and south of Timberland Road; and
- The Tannery Road lands east of Tannery Road and north of Timberland Road.

The Westran and Tannery Road areas can be considered long-term lease lots responsible for their own internal drainage out to the adjacent road and drainage systems.

The FRPA is responsible for drainage along Timberland Road up to the Manson Canal. Timberland Road is planned to be reconstructed incorporating curb & gutters and storm sewers in the near future. During reconstruction of Timberland Road and Dock Road, a new outfall with a flap gate could be constructed to drain Timberland Road by gravity out the foot of Dock Road. The storm sewer could be connected to an overflow to Manson Canal to provide back-up drainage during a major freshet event.

The FRPA as built records for the Tannery Road Lands include two similar but different pipeline configurations. Since the records were similar but underground, the correct layout could not be determined without a more time consuming survey and/or flow tests. This should be addressed by the lease holder and is therefore out of the scope of this report. At their perimeters, these lots are serviced by a network of City ditches and storm sewers that convey drainage to the Manson Canal.

Portions of the Westran lease area, CTL lease area, Dock Road and Timberland Road are known to be below the 200 year flood level of 3.8 m. The full area is drained by the Manson Pump Station and is partially protected by a dyke. However, an extreme freshet event could still flood these areas through adjacent low areas like Dock Road, the SRY lease area, Timberland Road, the CTL lease area and rail lines. Manson Pump Station could be relied upon to drain all of Area 13 during a freshet if the 4.4 m dyke elevation were extended to Sylvan and the hydraulic links to other unprotected areas were severed by creating high points over 3.8 m in the connecting rails and roads.
Area 14: Alaska Way (see Photos 14 and 30, Appendix 1)

This 2.0 ha area is used for Alaska Way and a number of leased buildings with parking adjacent to small docks on Gunderson Slough. The surface is around 80% impervious with two outfalls on record. The majority of land is suspected to drain overland across the leased lots into Gunderson Slough. The leased lots are responsible for their own drainage and flood protection.

Alaska Way is a dedicated road within the Corporation of Delta’s borders. The existing surface drainage from Alaska Way onto the leased lots may not be satisfactory to the FRPA or the lease holders. The road drainage should be intercepted and drained to the slough without drainage across the surfaces of the adjacent lots.

The only known elevations for this area are below the 200 year flood elevation of 3.8 m, and the remainder of the area is believed to also be below 3.8 m. Therefore, this area is susceptible to flooding during an extreme freshet event. No changes are expected in the near term. If a change of tenant or other facility improvements are planned, a more detailed review and redesign to current standards would be appropriate.

Area 15 Elevator Road (see Photo 30, Appendix 1)

This 1.3 ha area is used for Elevator Road, Robson Road and Alaska Way, and is part of the much larger Kendale Creek watershed. The surface is around 50% impervious. The roads drain to Kendale Creek as it enters Gunderson Slough. Similar to Area 4, the Armstrong Creek connection to Kendale Creek is poorly defined. Area 15 is susceptible to flooding from Kendale Creek, and City upgrades are identified in the South Westminster Master Servicing Plan. All or portions of these roads may be the responsibility of the City of Surrey and Delta.

No changes are expected in the near term. If facility improvements are planned, a more detailed review and redesign to current standards would be appropriate.
4. CONCLUSIONS

The FRPA Surrey Lands are exposed to flood risks from external watercourses such as the Fraser River, and internal grading and drainage deficiencies. Conclusions about these risks and methods to address them are summarized below in categories, starting with the most general and large scale issues, and working down to the smaller localized issues.

4.1 General

The FRPA lands have been developed over time with various standards employed and various responsibilities assigned to leaseholders and the FRPA. Drainage improvements are best planned with a consistent set of approaches applied across the FRPA lands, including:

- Formal assignment of responsibility between lease holders and the FRPA to remove ambiguity; and
- Uniform design standards that are consistent with City drainage criteria and MWLAP flood protection criteria.

4.2 Fraser River Flood Risk

Flooding from the Fraser River during extreme freshet events remains a risk to the FRPA lands due to low site elevations and open drainage outfalls. The breakwater typically reduces scouring and erosion along the shoreline, but may not be high or large enough to provide this protection during a 1:200 year event. Options to reduce the risk of major flooding include:

- Raise site elevations over 3.8 m;
- Raise dykes, building grades and berth faces over 4.4 m;
- Add flap gates to storm sewer outfalls where the storm sewers connect to low lands (less than 3.8 m) behind a dyke;
- Increase the size of the breakwater;
- Armour the shoreline;
- Divert overflow drainage to the Manson pump station; and
- Add pump stations.

4.3 Creek Systems

Delta Creek can currently overflow into the FRPA lands. The existing system is not sufficient to convey this overflow to the river. Additional upland off-site development will potentially negatively impact on the FRPA land drainage unless offset by drainage improvements. City improvements to Colliers Canal may address the Delta Creek overflow issues if designed...
appropriately. Diverting the IDC drainage to a new outfall will reduce the risk of flooding to both the Berth 9 area and the IDC site.

The Armstrong Creek flow path to the river is uncertain and is identified in the City of Surrey South Westminster Master Servicing Plan as an area of concern for planned City upgrades. Further investigation and coordination with the City may address the potential flood risk this creek poses to Drainage Areas 4 and 15.

4.4 Ponding and Localized Drainage

Localized ponding occurs at various locations around the lands, especially in poorly graded gravel surfaced areas and low areas. These can be addressed during site redevelopment and road reconstruction. Specific areas to address and projects planned in the near future include:

- Development of the IDC site;
- Timberland Road closure and reconstruction;
- Relocation of MS&G east of Dock Road;
- Dock Road reconstruction;
- Redevelopment of the lot east of Shed 6;
- Truck Gate relocation;
- Various rail removals and additions;
- Ponding in CN & BNR lands;
- Non-storm flow discharges from the Titan Steel shed; and
- Elevator Road drainage through lease areas.

Significant ponding occurs along the rail rights of way and may impact the operation of these lines. It is mainly a rail issue, but can impact port operations. The City of Surrey South Westminster Master Servicing Plan does not propose a solution to this. Potential solutions include raising the track and ground elevations, pumping, or deep canals to the Manson Pump Station. The potential Collieries Canal Diversion proposed in the City’s Plan could be designed to address this ponding as well as IDC and Shed 6 drainage. This option is worth discussing with the City, but will likely require CN’s or BNR’s involvement to resolve.
5. **RECOMMENDATIONS**

Proposed improvements and related recommendations are described below. *Figure 3* shows the proposed future drainage plan, with drainage boundary revisions and proposed improvements.

### 5.1 General

Adapt the design criteria noted in this report as design standards for use on FRPA lands in the absence of mandatory Municipal or Provincial regulations. Install oil/silt separators wherever vehicle storage or maintenance areas or similar areas with high oil concentrations are planned.

Establish a policy to deal with drainage on leased lands that establishes lease holder responsibility to design, construct, and maintain internal drainage facilities. Keep central records of the as-built drawings up to date. Lease holders and facility operators should be informed of the flood risks associated with the site so that they can take appropriate risk management measures such as insurance to protect themselves in case of an extreme event and to protect the FRPA from liability.

### 5.2 Fraser River Flood Protection

The following actions are recommended to provide flood protection from the Fraser River consistent with Provincial and City standards:

- Raise the dyke along the shoreline to 4.4 m as opportunities arise;
- Investigate the capacity of the breakwater to provide protection during a 1:200 year event. Alternatively, the scour protection along the full shoreline should be assessed and upgraded to prevent bank failure.
- During site redevelopment, adhere to the design criteria by raising site elevations, & armouring the shoreline.
- Install flap gates to protect low areas behind dykes and provide overflow drainage to the Manson Canal for areas 10, 11, and 12, where the Manson Pump Station can provide emergency drainage when the river rises above the flap gates and the low site elevations.
- Eliminate or raise rail lines to eliminate flow channels between the lands protected by the dyke and the pump station and the low lands directly exposed to the river.
- Request BNR and CN to raise their lines above 3.8 m for their own protection and to eliminate the flood path they create from the Fraser River.
5.3 **City of Surrey and Off-Site Upland Development**

Coordinate shared drainage infrastructure plans with the City of Surrey, including:

- City improvements to address the Delta Creek overflow and Manson Pump Station capacity improvements.
- Planned City upgrades to Armstrong Creek culverts to address the potential flood risk this creek poses to Drainage Areas 4 and 15.
- The lack of any plans to address ponding and flooding along the rail tracks. The potential Collieries Canal Diversion proposed in the City’s Plan could be designed to address this ponding. Since the lowest rail tracks are on CN and BNR lands, they should either lead or at least be involved in upgrading their site grading or drainage.

5.4 **Proposed Site Improvements**

Complete designs and construct the following improvements:

- Development of the IDC site: Direct the IDC drainage to a new outfall east of Shed Six. The preliminary design is included in [Appendix 2](#).
- Development of the lot east of Shed 6: Design the previously described outfall to accommodate full paving of the lot east of Shed Six. Design the grading and drainage for this site.
- Dock Road reconstruction: Design and reconstruct the Dock Road between the relocated MS&G site and the R16 lease area. Direct the drainage to a reconstructed outfall directly to the River with a flap gate, and tie it into the storm sewer in Timberland Road with overflows to Manson Canal.
- Timberland Road closure and reconstruction: Design and construct drainage associated with the Timberland Road closure and reconstruction. A typical cross section is shown in Appendix 3 and the flow direction is indicated on Figure 3.
- Truck Gate relocation: Design and construct drainage facilities associated with the Truck Gate relocation as indicated on Figure 3.
- Various rail removals and additions: Ensure drainage is addressed in rail additions and removals. Raise the tracks above 3.8 m where possible.
- Non-storm flow discharges from the Titan Steel shed: Investigate the significant non-storm discharges from the Titan Steel shed further to ensure adherence to DFO and other regulations.
- Elevator Road drainage through lease areas: Design and construct storm sewers or ditches to intercept runoff from Elevator Road to prevent it from flowing into leased lots and buildings. Determine if this is a City of Surrey, Delta or FRPA responsibility.
Appendix 1

Photos
1. Drainage Area 1 - Berth 1 Outfall

2. Drainage Area 2 - Berth 2 Outfall
3. Drainage Area 4 - Titan Outfall & Drainage Area 15 - Elevator Road - Outfall 7 Creek

4. Drainage From Titan Steel Shed
PHOTOGRAPHS OF EXISTING CONDITIONS

5. Drainage Area 5 - Berth 5 Outfall

6. Drainage Area 6 - Berth 6 Outfall
7. Drainage Area 7 - Berth 7 Outfall (Similar for all 7 Berth 7 & 8 Outfalls)

8. Drainage Area 9 - Berth 9 Outfall with Flap Gate
9. Drainage Area 9 - Berth 9 Ponding Between Rail Lines

10. Drainage Area 10 - Shed 6 Ditch Outlet
PHOTOGRAPHS OF EXISTING CONDITIONS

11. Drainage Area 11 - Sylvan Outfall

12. Drainage Area 12 - Dock Road
13. Drainage Area 13 - Manson Pump Station

14. Drainage Area 14 - Alaska Way Outfall
15. Breakwater Protecting Berths From Main Fraser River Channel

16. Ponding at Culverts Connecting Surrey Drainage to Drainage Area 9 - Berth 9
17. Delta Creek - South Fraser Way Bridge

18. Ponding up to Rail Ballast
20. Ponding / Water Table at Proposed IDC Site
21. Proposed Storm Sewer Alignment For IDC, Shed 6 & Lot East of Shed 6

22. Timberland Road
23. Ponding Along Timberland Road, West of Sylvan (Area 10)

24. Ponding at Fraser Surrey Docks Parking South of Shed 6 (Area 10)
PHOTOGRAPHS OF EXISTING CONDITIONS

25. Dock Road Ditch Flowing South (Area 12)

26. Sylvan Outfall (Area 11)
27. Van Isle Barge Ditch, Culvert and Connection to Sylvan Outfall (Area 11)

28. Ditch North of Westran and CTL (Area 13)
29. South West Corner of Westran Drainage to CTL (Area 10)

30. Elevator Road
31. City Ditch and Culvert Network Along Faulkner Road and Tannery Road (Area 13)
Appendix 2

IDC & Lot East of Shed 6
Preliminary Design
Appendix 3

Timberland Road
Conceptual Cross-Section
LEGEND:

- Existing Fraser Port Lands

**FIGURE 1:** LOCATION PLAN

FRASER RIVER PORT AUTHORITY
SURREY LAND MASTER DRAINAGE PLAN

**FRASER RIVER PORT AUTHORITY**
SURREY LAND MASTER DRAINAGE PLAN

**FIGURE 1:** - LOCATION PLAN

LEGEND:

- Existing Fraser Port Lands

Approximate extent of 200 Year Design Flood (Elevation 4.4m including 0.6m freeboard. From Urban Systems Servicing Study, November 2002)
Figure 2: Known Surface Elevations Under 3.8m
Proposed Ditch Improvements

Catchment Boundary

Future Catchment Boundary

Existing Fraser Port Lands Boundary

Existing Storm Sewer

Existing Ditch

Existing Culvert

LEGEND:

EB - 3612

CTL LEASE

FIGURE 3
FIGURE 2

Known Surface Elevations Under 3.8m
Proposed Ditch Improvements

Catchment Boundary
Future Catchment Boundary
Existing Fraser Port Lands Boundary
Existing Storm Sewer
Existing Ditch
Existing Culvert

LEGEND:

EB - 3612
CTL LEASE

FIGURE 3