APPENDIX D

Bear Mountain Monitoring Data

THURBER ENGINEERING LTD.

BEAR MOUNTAIN WELLS
WATER LEVELS

BEAR MOUNTAIN
Groundwater Monitoring
File Number: 19-3713-5

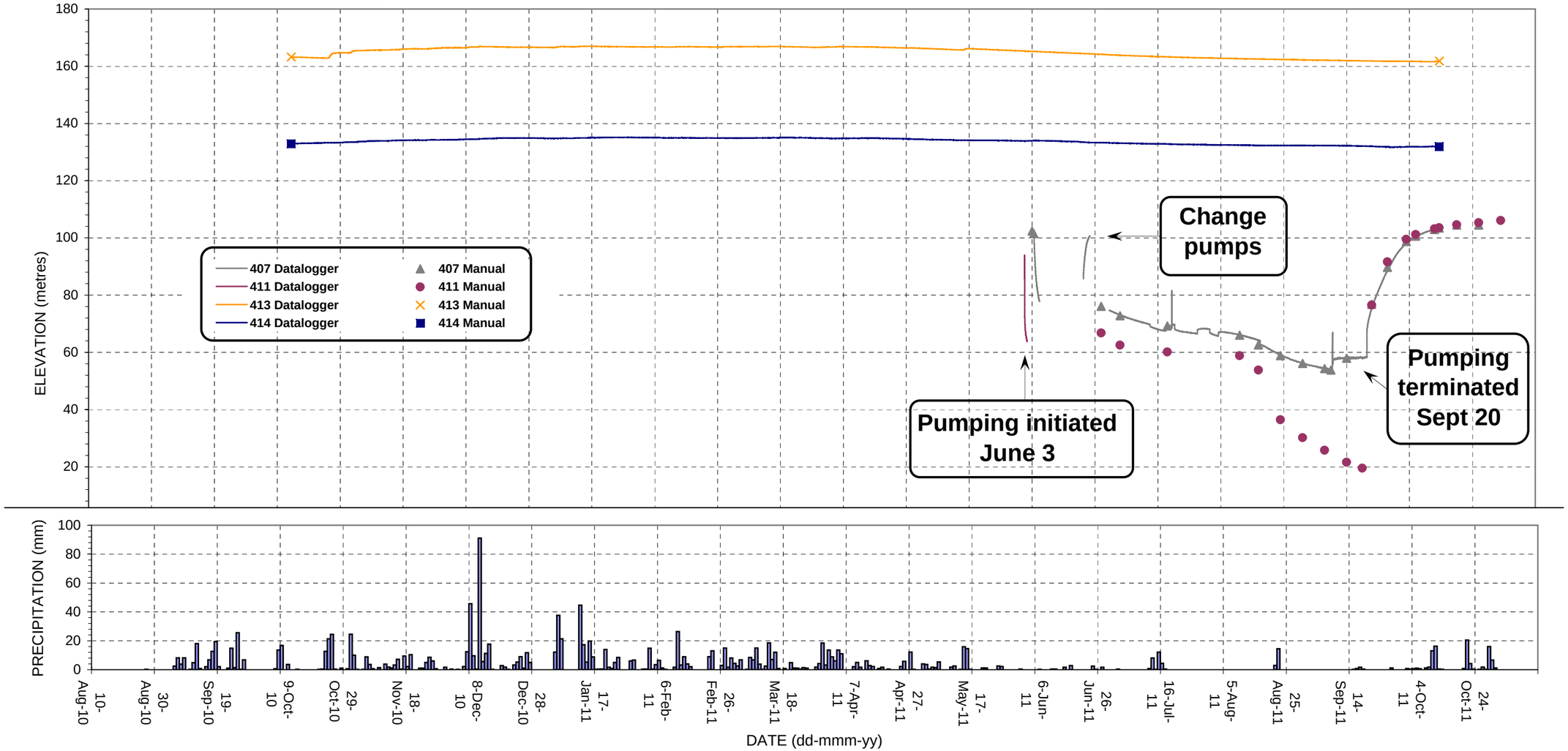

FIGURE 2

Client: Bear Mountain Land Holdings Ltd.
File No.: 19-3713-5
E file: cwp_19-3713-5_tbl_2010-10(Oct)-13 to 2011-10(Oct)-13 Precip and WLs.xls

Date: November 2, 2011

APPENDIX E

Groundwater Use Information

Table E-1
Estimated Groundwater Use by Large Volume Users
District of Highlands, BC

User	Well No.[1]	Well Tag No.	Current Groundwater Use	Comments
Hanington Creek Estates Subdivision	409 (active) 500 (backup)	85183 85184	**Current Development:** 48 single family homes, one duplex **Water consumption[2]:** Average water use, winter 2011[3]: 291.4 m^3/week = **41.6 m^3/day** Average water use, summer 2011[4]: 693.5 m^3/week = **99.1 m^3/day** *note: Hanington Creek Water System currently includes a 360,000 US gallon reservoir (1,363 m^3) that is sourced primarily (over 98%) from Well No. 409 (Well Tag No. 85183)*	**Future development:** at full build out 58 single family homes, one duplex **Water consumption estimates for future development[5]:** Average water use, winter: 349.7 m^3/week = **49.9 m^3/day** Average water use, summer 2011[6]: 832.2 m^3/week = **118.9 m^3/day**

[1] Well No. refers to number provided in previous reports (not on the BC Water Resources Atlas)

[2] Data provided by Hanington Creek Water Utility Ltd.

[3] January – April, 2011

[4] May – September, 2011

[5] Calculated as water consumption data for 2011 multiplied by projected future population at full build out

[6] May – September, 2011

Table E-1
Estimated Groundwater Use by Large Volume Users
District of Highlands, BC

User	Well No.[1]	Well Tag No.	Current Groundwater Use	Comments
Bear Mountain Golf Course	407 411	81690 95749	**Water consumption[7]:** Well 407 average summer water use: **556 m^3/day** Well 411 average summer water use: **858 m^3/day** *note: flow meters installed on production wells on July 7, 2012. Wells operated until September 20.*	Groundwater monitoring program includes flow monitoring for production wells (no.s 407 and 411) and water level monitoring for production wells and observation wells (no.s 413 and 414)
Millstream Industrial Park 2015 Millstream Road		80726 80741 85630 85633 85634 95755	**Water consumption[8]:** Estimated water use, winter: **3.8 m^3/day** Estimated water use, summer[9]: **22 m^3/day**	Pumping assumed to be supplied by six wells on site Operator advised that the property will be connected to the CRD municipal system in the future
Top Line Roofing / Independent Concrete Ltd. 2023 Millstream Road		29408 89602 90940	**Water consumption[10]:** Estimated water use, winter: **3.8 m^3/day** Estimated water use, summer: **22 m^3/day**	Based on operations similar to those in Millstream Industrial Park

[7] Flow rates provided by Bear Mountain Golf Course for the period July 20 through September 20, 2012

[8] Approximate flow rates estimated by Millstream Industrial Park facility manager, 2012

[9] Estimated additional water used for dust suppression in the summer months

[10] Based on similar operations as Millstream Industrial Park

Table E-1
Estimated Groundwater Use by Large Volume Users
District of Highlands, BC

User	Well No.[1]	Well Tag No.	Current Groundwater Use	Comments
Highwest Waste Recycler 1943 Millstream Road				Operator advised that they do not use groundwater at the site
All Fun Recreation 2207 Millstream Road		75658 75659 75592 93669 100331	Current operations include a recreation vehicle park and race track: RV park: estimated at equivalent to 45 permanent residences (est. 1.7 people per residence) and 55 transient residences in the summer Race track includes concession and restroom facilities Estimated water use, winter[11]: **20.8 m^3/day** Estimated water use, summer: **77.4 m^3/day**	Wells 75592, 75659, 75658, 93669 and 100331 inferred to supply common water system

[11] Combined RV park and race track facilities – see calculations below

Calculations for All Fun Recreation Facility:

RV Park:

Winter consumption: 45 permanent residences × 1.7 people/residence × 265 L/c/day = **20.3 m^3/day**

Summer consumption[12]: (45 permanent + 55 seasonal residences) × 1.7 people/residence × 450 L/c/day = **76.5 m^3/day**

Concession and restroom facilities:

Race track: approx. 30 events at estimated avg. attendance of 800 people/event at 6 L/person (assume 30% usage of restroom facilities at 18 L/use and 0.6 L for concession) = 24,000 people x 6 L/person / 365 days = **0.4 m^3/day**

Flea market: approx. 24 events at estimated avg. attendance of 200 people/event at 4.2 L/person (assume 20% usage of restroom facilities at 18 L/use and 0.4 L for concession) = 4,800 people x 4 L/person / 365 days = **0.1 m^3/day**

Batting cages, gocarts, etc.: approx. 100 people/day for approx. 150 day season at 4.2 L/person (assume 20% usage of restroom facilities at 18 L/use and 0.4 L for concession) = 15,000 people x 4 L/person / 150 days = **0.4 m^3/day**

Winter consumption: 0.4 m^3/day + 0.1 m^3/day = **0.5 m^3/day**

Summer consumption: 0.4 m^3/day + 0.1 m^3/day + 0.4 m^3/day = **0.9 m^3/day**

[12] Assumed that increase in outdoor water use during the summer for RV residences is similar to demand from residents in secondary suites

Appendix E-2
Estimated Current Residential Groundwater Use
District of Highlands, BC

1. INTENSIVE RESIDENTIAL LAND USE AREA[1]:

Population in Hanington Creek Estates Subdivision, 2011:	157
Private residences in Hanington Creek Estates, 2011[2]:	50
Average water use – winter 2011[3]:	291.4 m^3/week = 41.6 m^3/day
Average water use – summer 2011[4]:	693.5 m^3/week = 99.1 m^3/day

Average Residential groundwater use in Intensive Land Use area:

Winter: 41.6 m^3/day / 157 = **265 L/capita/day**

Summary: 99.1 m^3/day / 157 = **631 L/capita/day**

[1] Data provided by Hanington Creek Water Utility Ltd.

[2] Currently 48 single family units, one duplex

[3] January – April, 2011

[4] May – September, 2011

2. RURAL AND RURAL RESIDENTIAL LAND USE AREAS:

Highlands population in 2011 census[5]: 2,293 – 157 = 2,136

Private residences in 2011 census: 830 – 50 = 780

Total number of developed lots (principal residences)[6]: 750 – 50 = 700

Estimated number of secondary suites: = 780 – 700 = 80

Estimated population in secondary suites: = 80 × 1.5 people/suite = 120

Estimated population in principal residences: = 2,136 – 120 = 2,016

Average Residential groundwater use in Rural and Rural Residential Land Use areas:

Winter: Estimated water consumption for principal and secondary residences[7]: 265 L/c/day

Total residential groundwater use: = (2,136 × 265 L/c/day) = 566.0 m^3/day

= 566.0 m^3/day / 700 lots = **0.81 m^3/day/developed lot**

Summer: Estimated water consumption for principal residences[8]: 631 L/c/day

Estimated water consumption for secondary residences[9]: 450 L/c/day

Total residential groundwater use: = (2,016 × 631 L/c/day) + (120 × 450 L/c/day) = 1,326.1 m^3/day

= 1,326.1 m^3/day / 700 lots = **1.89 m^3/day/developed lot**

[5] Data from BC Stats Census data: http://www.bcstats.gov.bc.ca/census.asp): total population 2, 293 in the Highlands, including people living in secondary suites, minus the population in the Hanington Creek Estates Subdivision

[6] Highlands Cadastral map information, 2011. Exclusive of Hanington Creek Estates Subdivision

[7] Based on winter 2011 water meter data from Hanington Creek Estates Subdivision

[8] Based on summer 2011 water meter data from Hanington Creek Estates Subdivision

[9] Approximately 40% of residential water use during summer is estimated to be for outdoor use (correspondence with CRD Water Services, 2012). Therefore, water use by primary residences is reduced by 40% for residents in secondary suites.

Estimated Future Residential Groundwater Use
District of Highlands, BC

RESIDENTIAL GROUNDWATER USE AT FULL BUILD-OUT WITH 20% SECONDARY SUITES

1. Rural and Rural Residential Land Use Areas:

Total principal residences at full build-out[1]: 1,045 – 60 – 150 = 835

Principal residence population at full build-out[2]: 835 × 2.88 = 2,405 principal residents

Full build-out with 20% secondary suites: 835 × 20% = 167 secondary suites

Secondary residence population at full build-out: 167 × 1.5 = 251 secondary suite residents

Estimated Total Residential Groundwater Use for Rural and Rural Residential Properties at Full Build-Out:

Winter: = (2,405 + 251) × 265 L/c/d = **703.8 m^3/d**

Summer: = (2,405 × 631 L/c/d) + (251 × 450 L/c/d[3]) = **1,630.1 m^3/d**

2. Intensive Residential Land Use Area (Hanington Creek Estates Subdivision[4])

Winter: = (60 units × 3.14 residents × 265 L/c/day) = **49.9 m^3/d**

Summer: = (60 units × 3.14 residents × 631 L/c/day) = **118.9 m^3/d**

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[1] Full build-out currently includes approximately 1,030 developed lots. With consideration of current rezoning applications, full build-out could increase to 1,045 (applications have not been approved). For the purposes of the numerical groundwater model, full build-out was conservatively estimated as 1,045. This number includes Hanington Creek Estates (60 = 58 homes + 1 duplex) that is serviced by Hanington Creek Water Utility Ltd. (sourced from wells 409 and 500), and 150 single dwelling lots for the Bear Mountain development that are not permitted to be sourced by groundwater (will be on municipal sewer)

[2] Based on 2011 census population of 2,016 estimated population in 700 principal residences is 2.88 residents/principal residence

[3] Based on summer 2011 water meter data from Hanington Creek Estates Subdivision; approximately 40% of residential water use during summer is estimated to be for outdoor use (correspondence with CRD Water Services, 2012). Therefore, water use by primary residences reduced by 40% for secondary suites

[4] Based on current population of approximately 157 residents for 50 units (48 single family units and one duplex), ratio of 3.14 people per residence projected to full build-out at 60 units (58 single family, one duplex)

RESIDENTIAL GROUNDWATER USE AT FULL BUILD-OUT WITH 50% SECONDARY SUITES

1. Rural and Rural Residential Land Use Areas:

Total principal residences at full build-out[5]: 1,045 – 60 – 150 = 835

Principal residence population at full build-out: 835 × 2.88 = 2,405 principal residents

Full build-out with 50% secondary suites: 835 × 50% = 418 secondary suites

Secondary residence population at full build-out: 418 × 1.5 = 627 secondary suite residents

Estimated Total Residential Groundwater Use for Rural and Rural Residential Properties at Full Build-Out:

Winter: = (2,405 + 627) × 265 L/c/d = **803.5 m^3/d**

Summer: = (2,405 × 631 L/c/d) + (627 × 450 L/c/d[6]) = **1,799.7 m^3/d**

2. Intensive Residential Land Use Area (Hanington Creek Estates Subdivision[7])

Winter: = (60 units × 3.59 residents × 265 L/c/day) = **57.1 m^3/d**

Summer: = (60 units × 3.59 residents × 631 L/c/day) = **135.9 m^3/d**

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[5] Full build-out currently includes approximately 1,030 developed lots. With consideration of current rezoning applications, full build-out could increase to 1,045 (applications have not been approved). For the purposes of the numerical groundwater model, full build-out was conservatively estimated as 1,045. This number includes Hanington Creek Estates (60 = 58 homes + 1 duplex) that is serviced by Hanington Creek Water Utility Ltd. (sourced from wells 409 and 500), and 150 single dwelling lots for the Bear Mountain development that are not permitted to be sourced by groundwater (will be on municipal sewer)

[6] Based on summer 2011 water meter data from Hanington Creek Estates Subdivision; approximately 40% of residential water use during summer is estimated to be for outdoor use (correspondence with CRD Water Services, 2012). Therefore, water use by primary residences reduced by 40% for secondary suites

[7] Ratio of 3.59 people per residence includes current estimate of 3.14 people/residence plus an estimated increase of 18 secondary suites [(50% - 20%) × 60 units] at 1.5 people per suite

APPENDIX F

Summary of Water-Related Legislation in British Columbia

December 18, 2012
Report No. 0714140014-501-R-Rev2-3000

Appendix F
Summary of Water-Related Legislation in British Columbia

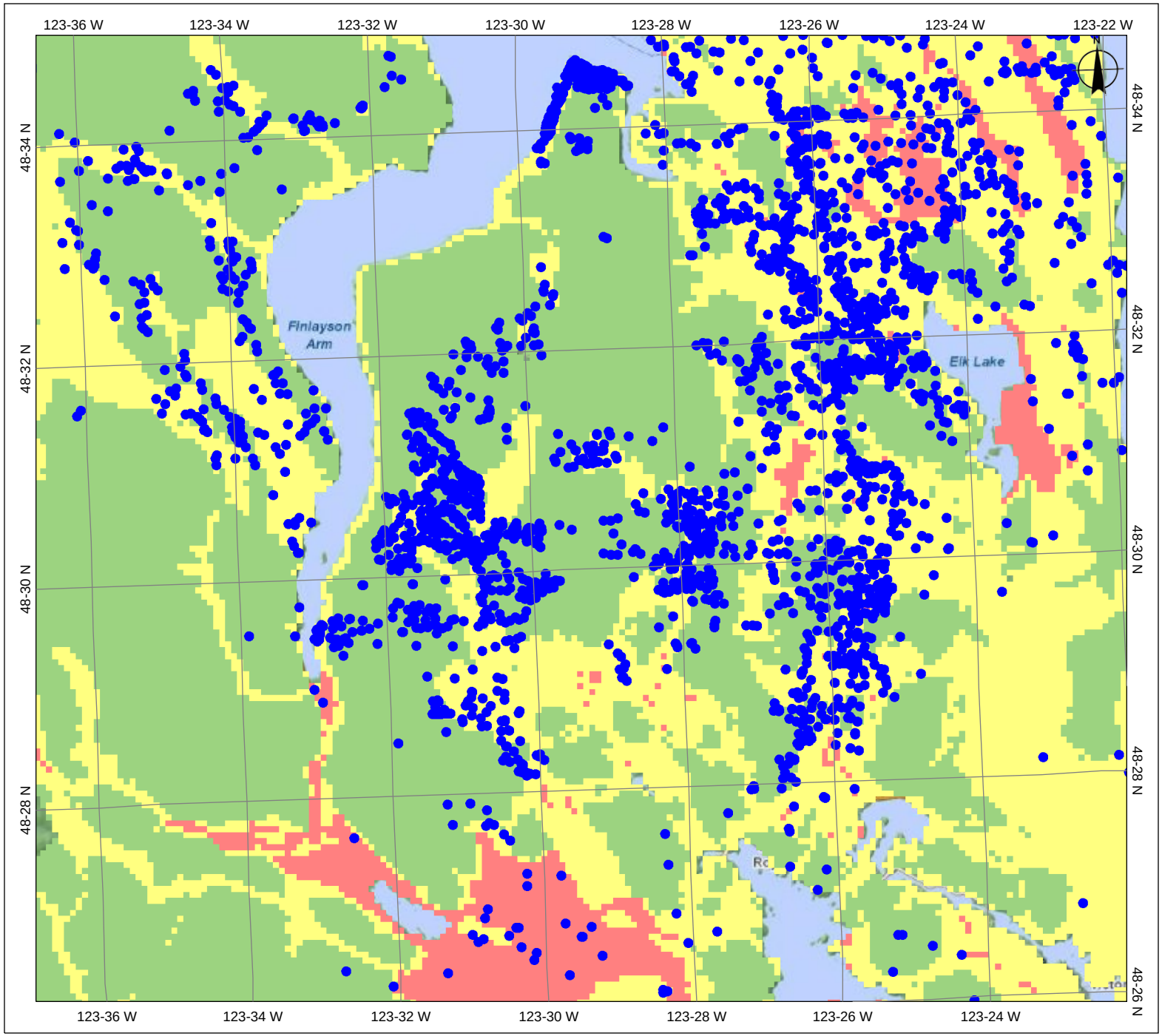
Legislation	Description
Water Protection Act and *Water Act*	The *Water Protection Act* and the *Water Act* assert ownership of water resources to the Province. The *Water Protection Act* prohibits the bulk export of water and large-scale water transfers between watersheds and the *Water Act* includes provisions for the allocation and management of surface water through a licensing process. Pursuant to the *Water Act* and the supporting Water Regulation, licensing, diversion and use of water are currently only applied to surface water. Although the Ground Water Protection Regulation (GWPR) addresses groundwater protection through well construction requirements, groundwater use is currently unregulated in BC. Groundwater users are currently not required to measure or report extraction volumes and, as such, there are no systems in place to assess the cumulative impacts of individual wells that are operated within an aquifer or geographic area. The Province is currently in the process of modernising the *Water Act* to respond to current and future water management challenges, including regulation of groundwater use.
Environmental Assessment Act	The *Environmental Assessment Act* currently requires that an environmental assessment be conducted for a well or well field that will extract groundwater at a rate of 75 litres per second [L/s; 1,189 US gallons per minute (US gpm)] or greater. Potential impacts to groundwater from major projects (e.g., industrial, water management, energy, waste disposal, mine or transportation projects) are also assessed through the environmental assessment process.
Drinking Water Protection Act	The *Drinking Water Protection Act* is the primary legislation for the protection of drinking water. The *Act* regulates water supply systems and does not apply to domestic water systems that serve one single-family residence. The *Drinking Water Protection Act* and Drinking Water Protection Regulation are administered by the Ministry of Health (MoH) through the Local Health Authorities. The *Act* and regulation require water supply systems to supply potable water and are intended to provide a framework for the protection of the province's drinking water from "source-to-tap". The *Drinking Water Protection Act* and regulation outline requirements for water systems including construction and operating permits, system operator certification, emergency response and contingency plans, water monitoring requirements, water system assessments and plans, and drinking water protection measures and plans. Under the provisions of the *Act*, a health officer may also designate an area for the development of a drinking water protection plan a wellhead or an aquifer protection plan that could prohibit drilling, altering or operating water wells in the designated area.

Appendix F
Summary of Water-Related Legislation in British Columbia

Legislation	Description
Environmental Management Act	The *Environmental Management Act* represents the legislative framework for regulating waste discharge, pollution and contamination. Under the *Act*, a number of regulations are provided to address specific activities, including: ■ The Hazardous Waste Regulation defines minimum siting standards, operational requirements and management practices for hazardous waste facilities. ■ The Municipal Sewage Regulation (MSR) outlines requirements for the treatment, reuse and discharge of sewage, wastewater or liquid waste generated by municipal, regional or private waste water treatment systems. Pursuant to the MSR, the registration process requires that an Environmental Impact Study (EIS) be conducted to demonstrate that the proposed system will meet specified water quality guidelines and will not adversely affect groundwater. The MSR also includes requirements for liquid waste management plans to address combined sewer systems (i.e., systems designed to collect, transport, treat or dispose of a combination of municipal sewage and stormwater). ■ The Contaminated Sites Regulation (CSR) defines criteria for identifying and assessing contaminated sites and specifies applicable uses of land, water and sediment. The CSR defines numerical remediation standards for soil, sediment, water and vapour. Water quality standards are defined for the protection of aquatic life and specific water uses (i.e., drinking water, irrigation and livestock). ■ The Agricultural Waste Control Regulation outlines practices for using, storing and managing agricultural waste.
Public Health Act	The *Public Health Act* establishes a comprehensive framework for all matters pertaining to health and disease prevention. Pursuant to the *Act*, the MoH has the authority to protect drinking water quality through a number of regulatory mechanisms. The Sewerage System Regulation (SSR) regulates the treatment, handling and discharge of sewage not serviced by municipal or regional waste water treatment systems. The SSR prescribes minimum setback requirements between wells and sewerage systems and the *Public Health Act* Transitional Regulation prescribes minimum setback distances between wells and dwellings and possible sources of contamination such as cemeteries or dumping grounds.
Local Government Act	The *Local Government Act* provides local governments with the authority to represent the interests of communities, including the protection of water resources.

APPENDIX G

DRASTIC Vulnerability Map



BRITISH COLUMBIA

DRASTIC Vulnerability Map

Legend

- Water Wells
- Intrinsic Aquifer Vulnerability
  - High
  - Moderate
  - Low

0 1300 2600 m.

Scale: 1:93,741

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Datum/Projection: NAD83, Albers Equal Area Conic

Key Map of British Columbia

APPENDIX H

Supplemental Information for Emergency Response Planning

Appendix H-1
Summary of Methods for Recovery of Spilled Liquids

Recovery Method	Description	Requirements
Berming and pumping	Berms of soil, absorbent, or other material are placed around the spill to limit its lateral spread on the ground surface. The liquid is pumped from the containment area into containment (drums or tank) as soon as possible.	Berm material, pump with screen, drums or other containers
Interception trenches	A trench dug through and around the spill area to below the liquid level in the soil. A pump or vacuum tanker truck is used to pump the recovered liquid into a suitable storage vessel.	An excavator, sump pump with screen and drums or containers. Note – in the Highlands, a trench should not be excavated through the overburden materials thereby exposing the bedrock aquifer. A contaminant hydrogeologist should be consulted.
Product recovery wells	Well points are advanced into and around the spill zone to capture the liquid contaminant and pump it to suitable containers. This method is beneficial when the product has reached depths not readily accessible by an excavator.	A groundwater drill rig, groundwater well supplies, pump and tankage. Note – wells should be designed and constructed in a manner that does not cause the contamination to spread. A contaminant hydrogeologist should be consulted.
Mass excavation	The entire spill area is excavated using characteristics of the contaminant (e.g., odour, colour, pH, etc.) to guide the extent of the excavation. Method is appropriate when the spill volume is not very large and the excavation can proceed faster than the infiltration of the liquid.	An excavator, liner material for placement of the excavated soil, dump trucks for soil removal, location to take the soil, sorbents and other liquid collection equipment for liquid draining from the soil.

Appendix H-2
Summary of Groundwater Mitigation Methods

Mitigation Method	Description
Stop pumping from the well head	This will change the hydraulic gradient and, therefore, the groundwater velocity towards the well. Both the speed of groundwater movement and, possibly, the direction will change if the pump is stopped. This will provide additional time for treatment or removal of the contaminants before they reach the well head.
Install groundwater pump-and-treat wells between the source and the well head	These wells extract the groundwater within their vicinity, upgradient from the well head. The water pumped from the recovery wells would be run through an appropriate treatment train to remove the contaminants and, likely, reinjected into the ground. Groundwater pump-and-treat systems typically have very long terms of operation and it may be more cost effective to drill a new well.
In situ treatment of contaminated soil and groundwater	Depending upon the contaminant, it may be possible to install an in situ treatment technology that removes the contaminants from the water without having to pump water. For example, for a gasoline spill, air sparging into the groundwater and vapour extraction of the overlying soils is a proven method of removing the hydrocarbons.
Well head treatment	May be used as a polishing step or as treatment method if significant assurance of treatment can be provided. A typical polishing step would be to pass the groundwater through a series of activated carbon filters to remove traces of hydrocarbons. Significant safeguards are required in such a system since a failure in the system could lead to contamination of all the water in the distribution system.

Appendix H-3
Summary of Resources Required to Establish and Implement Emergency Response Measures for Groundwater Protection

Resource	Description
Existing Emergency Response Program	Review and update existing Highlands Emergency Response Program to establish clear roles and responsibilities, and revise Hazard-Specific Plans to include groundwater prevention measures.
Personnel and technical resources	An ***Emergency Call Roster***, ***Personnel List*** and ***Employee / Volunteer Experience Table*** should be compiled. These lists should be updated regularly and distributed to the Fire Department and key people identified in the Highlands Emergency Response Program. An ***Emergency Contacts*** list should be regularly updated with phone numbers for the Ministry of Environment, Vancouver Island Health Authority, Police, Ambulance, Fire Department, etc.
Equipment and materials resources	In the event of an emergency, the Highlands should have a list of technical specialists, bulk/bottled water suppliers and contractors that provide spill response, remediation and water treatment services. Names and phone numbers of qualified operators of the respective equipment should be placed in the ***Employee / Volunteer Experience Table***. The Highlands may also consider establishing contracts with contractors that outline the contractual arrangements under which a contractor would be retained, if required to provide services in the event of an emergency.
Public communications/ community relations	May be used as a polishing step or as treatment method if significant assurance of treatment can be provided. A typical polishing step would be to pass the groundwater through a series of activated carbon filters to remove traces of hydrocarbons. Significant safeguards are required in such a system since a failure in the system could lead to contamination of all the water in the distribution system.

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