HYDROLOGY ASSESSMENT
HORNBY ISLAND FIRE HALL

Prepared for:

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Prepared by:

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3060 Lake Road
Denman Island, BC V0R 1T0

July 10, 2015
H2O File: 14-60

EXECUTIVE SUMMARY

The site consists of a property located on the north side of Central Road on Hornby Island. The site is adjacent to Joe King Park to the southeast and a cleared area immediately to the north with undeveloped, forested land beyond to the east, north and west. Central Road is to the south and west with undeveloped forested land beyond. Regionally, the site slopes to the northeast with grades of approximately 4% to 6%.

The nearest house in the downgradient direction from the site is on the east side of Sollans Road, approximately 440 metres distant. Three wells were listed within a 300 metre radius of the location of the subject site. The nearest well downgradient is approximately 240 metres distant.

Generally, groundwater recharge on Hornby Island is dependent solely on precipitation. Approximately 20% of rainfall will enter the groundwater system to recharge the aquifers. At a 20% recharge rate, before development, 2,600 m^3/year would be returned to the groundwater system via infiltration on the site.

Eavestrough water, perimeter drains and wash basins will be directed to a bioswale/infiltration area beyond the wastewater dispersal field area to the northeast. Preliminary plans call for a bioswale of approximately 20 metres long by approximately 2 metres wide or 40 m^2 of infiltrative area. This area could conceivably allow infiltration of 180 m^3 over the course of one day.

Rainwater will also be directed to cisterns for use by the fire department for operations such as truck washing and irrigation, if necessary. Overflow from the cisterns will also be directed to the bioswale.

Due to the plans for drainage and re-integration of intercepted precipitation, H_2O estimates that 99% of the groundwater will be returned to the local groundwater regime, after minor evaporation and use by fire department operations via cistern supplies. The recharge rate at the site will not be significantly affected by the project impermeable areas.

Fire fighting foam concentrate, used in a 3% solution, is occasionally used in fighting fires and may sometimes be found in very small amounts on the trucks or on firefighter gear in a post-incident wash down. Foam ingredients are predominantly water and mineral salts. Dilution during use and then again during truck washing of the small amounts that may be found on the truck will aid in mitigating any impact on the groundwater. H_2O considers that there are very low environmental risks associated with this material in the groundwater after truck washing.

Turn-out gear may be washed occasionally at the fire hall. The substances from fires that will be washed out of the gear may include carbon residue and soot from wood ash. Infrequent washing occurrence, the dilution of the wash water and the low risk of the substances that may adhere to the turn-out gear contribute to make this operation a low environmental risk at the site.

Materials stored onsite will include oils, gasoline, diesel and other low impact cleaners. Proper containment for all hazardous materials, as per the BC Fire Code, will be constructed and strictly maintained and adhered to onsite. Following “Best Management Practices” will significantly reduce the potential risk of accidental spills of hazardous materials.

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1.0 INTRODUCTION

H_2O Environmental Ltd. (H_2O) was retained by Simcic and Uhrich Architects to provide this hydrological assessment of the crown land located on Central Road on Hornby Island, BC, that is the proposed site of the new Hornby Island Fire Hall being built for Hornby Island Fire Rescue (HIFR).

The current legal description of the site is a land tenure on Crown Land as follows: That part of the remainder of NW1/4, Section 11, Hornby Island, Nanaimo District, containing 1.0 hectares, more or less.

2.0 BACKGROUND

H_2O understands that the property is within an Environmental Development Permit Area designated by the Hornby Island Official Community Plan[1]. The development permit guidelines call for a hydrology study to:

"*identify any adverse impacts of a proposed development upon the groundwater recharge function of the land or upon the quantity or quality of the water resources of the existing users.*"

This report will assess the potential impact on the groundwater from the completion of a new fire hall for Hornby Island Fire Rescue.

3.0 SCOPE OF WORK

H_2O completed the following work:

- Desk study including review of information from published studies of similar situations, topographic maps, geologic maps and provincial data sets;
- Completion of multiple site visits to identify important hydrogeological features in the area;
- Review of geotechnical soil logs to assess soil characteristics;
- Review of current civil and architectural plans for stormwater management;
- Estimation of pre-development groundwater recharge rates for the site and surrounding properties;
- Estimation of post-development groundwater recharge rates for the site and surrounding properties;
- Recommendations for best-practices for fire department storage of materials;
- Evaluation of collected information within the context of the terms of reference for this study;
- Preparation of this report

4.0 DESK STUDY and SITE DESCRIPTION

The site consists of a property located on the north side of Central Road on Hornby Island. The site is adjacent to Joe King Park to the southeast and a cleared area immediately to the north with undeveloped, forested land beyond to the east, north and west. Central Road is to

[1] Hornby Island Official Community Plan, Bylaw 104, 2002

the south and west with undeveloped forested land beyond (Figure 1). There are no water courses on or adjacent to the site.

4.1 Drainage/Topography

Regionally, the site slopes to the northeast with grades of approximately 4% to 6%. There are shallow ditches on either side of Central Road. No other ditches were noted during the site walk over. The nearest house in the downgradient direction from the site is on the east side of Sollans Road, approximately 440 metres distant.

4.2 Climate

Hornby Island is situated within the Nanaimo Lowland Zone of Vancouver Island and the Coastal Douglas Fir biogeoclimatic zone. It is in the rain shadow of the Beaufort Mountain Range resulting in warm, dry summers and wet, mild winters. Typically, precipitation would be abundant in the winter months and scant during the summer months. Total annual precipitation published by Hornby Island Groundwater Pilot Project (1994) averages 1,370 mm, with approximately 75% of annual precipitation falling between October and March.

4.3 Surficial Geology

The surficial geology in this area reportedly consists of the Hillier classification of soils[2]. Hillier soils are usually developed in sandy gravelly colluvial or morainal deposits, usually less than 1 metre thick, overlying sandstone or conglomerate bedrock. The soils are rapidly drained and are usually made up of gravelly loamy sand in the upper horizons.

All testpits dug at the site during the preliminary wastewater and geotechnical evaluation completed by H_2O and Lewkowich Engineering Associates Ltd.(LEA) were found to have either sandstone or conglomerate bedrock at 80 centimetres (cm) or less below grade.

4.4 Bedrock Geology

The surficial deposits overlie bedrock geology made up of the Geoffrey Formation of the Nanaimo Group[3]. This formation consists predominantly of conglomerate interbedded with sandstone, including minor mudstone. The Nanaimo group consists of sedimentary rocks from the Cretaceous geologic period, approximately 97 to 65 million years old. The Nanaimo Group is a combination of mudstone, conglomerate and sandstone units deposited in an underwater environment in the form of alluvial fans and turbidite deposits. This bedrock is located below the soils encountered onsite and most likely is the basis of the topography in the area.

4.5 Wastewater System

The wastewater system for the new Fire Hall has been preliminarily designed by H_2O. Estimating the flows in a sporadic-use facility such as a volunteer fire hall consists of determining the flows in a worst-case scenario and then averaging that flow over a certain period of time. The flows are based on meetings once or twice a week for the HIFR, laundry use and the periodic use for community events. The flow used for the wastewater system design was 50 litres/person/day for “office, no cafeteria” designation and 20 members of the

[2] *Soils of Southern Vancouver Island*, MoE Technical Report No. 17, 1985
[3] BC Water Resources Atlas, Web Page:http://srmapps.gov.bc.ca/apps/wrbc/

fire department. A peaking factor of 1.5 has been added to this for a daily design flow (DDF) of 1500 litres/day. For community events at the site, where peak flows may exceed the DDF, additional effluent storage has been incorporated into the design.

The wastewater system will consist of a 4,546 litre 2 chamber concrete septic tank gravity fed to a 3,410 litre 2 chamber concrete tank set up as a pump chamber. An effluent pump will time dose the dispersal field via a control panel. The dispersal field will consist of a seepage bed of approximately 22 metres long by 3.2 metres wide. This field will be located to the northeast and downgradient of the new Fire Hall.

The system will be located more than the required 30 metres from any groundwater well[4].

5.0 LOCAL HYDROLOGIC CONDITIONS

5.1 Wells

The BC Water Resources Atlas lists registered wells in BC[5]. Three wells were listed within a 300 metre radius of the location of the subject site. The nearest is the well drilled for the Joe King park water supply (#74349). The other wells were listed under the Dept. of Highways (#36715) and the Hornby Island New Horizons Society (#41035). The logs from the water wells were reviewed to investigate local water supply characteristics and geology.

Well #74349 is reportedly completed in sandstone and shale at 90 feet deep and encountered water bearing strata at 80 feet. It has a capacity rated by the driller at the time of completion of approximately 1 gallon per minute (gpm).

The other two wells were also completed in sandstone and #36715 was rated at 10 gpm by the drillers, with a static level of 4 feet below grade and well #41035 was rated at 5 gpm with a static level of 95 feet.

A map showing locations of wells as mapped by MOE is attached as Figure 3. Wells locations are often not mapped accurately. Well logs are presented in Appendix 2.

5.2 Area Aquifer

Aquifer #438 was identified for the area of the site from the BC Water Resources Atlas.[6] This is a bedrock aquifer, known to be in the Geoffrey Formation of the Nanaimo Group, which is approximately 18.8 kilometres[2] in size and is rated as having a high demand, moderate productivity and high vulnerability. An aquifer map is attached as Figure 4.

5.3 Soil Physical Characteristics

To measure the *in-situ* permeability of the soils, permeameter tests were conducted by H_2O and LEA. Auger holes were advanced within the proposed wastewater disposal field to a maximum depth of 45 centimetres (cm). The permeameter test consists of a calibrated tube filled with water which is inserted into the auger hole allowing the water to escape at a flow

[4] *Sewerage System Regulation*, BC Reg. 326/2004 Deposited July 8, 2004, effective May 31, 2005, with amendments to 2010
[5] Ministry of Environment BC Water Resources Atlas www.maps.gov.bc.ca/ess/sv/wrbc
[6] Website: //srmapps.gov.bc.ca/apps/wrbc/

rate determined by the ability of the soil to transmit it away from the tube. The water flow out of the tube is measured and a field saturated hydraulic conductivity of the soil is calculated from the results.

The field saturated hydraulic conductivity is generally considered to be approximately ½ the actual hydraulic conductivity of the soils. The results of the permeability testing indicate an average hydraulic conductivity of approximately 4.5 metres/day.

6.0 GROUNDWATER RECHARGE

The aquifer in the vicinity of the subject site is a bedrock aquifer. The groundwater is stored in fractures that run throughout the formation. Domestic wells may intercept a fracture system and the water contained there supplies the water to the well.

Generally, groundwater recharge on Gulf Islands is dependent solely on precipitation. Recharge occurs in higher elevations and in stream beds. Reportedly, approximately 20% of rainfall will enter the groundwater system to recharge the aquifers[7]. The rest of the precipitation will evaporate, be used by the vegetation or runoff in overland flow in ditches or in streams to the Salish Sea. Groundwater recharge rates can vary significantly from place to place due to topography, forest cover, soil types and many other reasons.

The Fire Hall will be collecting rainwater from the roof and storing it in cisterns at the site. Approximately 10,000 imperial gallons will be stored onsite. This water will be used over the course of the year for non-potable fire department operations such as truck washing, irrigation and laundry.

6.1 Pre-Development Groundwater Recharge

Specifically, the subject site is approximately 1 hectare. In an average year, with 1.3 metres of precipitation, a total of 13,000 cubic metres (m^3) of rain will fall on the site. At a 20% recharge rate, this indicates that, before development, 2,600 m^3 /year would be returned to the groundwater system via infiltration on the site. This infiltration takes place via the storage in the soils onsite and transmission of moisture to the underlying bedrock. The groundwater will temporarily flow along the bedrock surface until encountering a fracture or crack, into which it can flow. Over large areas this slow infiltration is enough to recharge the aquifer system.

There is always a time lag before the rainfall can infiltrate to the bedrock system as the soil onsite will store water in pore spaces and then release it as more water is introduced into the system.

6.2 Post-Development Groundwater Recharge

Impermeable areas within the development are the concern for impacting the groundwater recharge rates onsite. There is approximately 600 square metres (m^2) of roof above the new fire hall. There will be paved areas that will also affect the discharge of the intercepted precipitation back to the soils. According to current plans, there will be a total of approximately 922 m^2 of impermeable area within the new development.

[7] D.M. Allen and G.P.Matsuo, 2002, *Results of the Groundwater Geochemistry Study on Hornby Island, British Columbia*

Using the figures from previous report sections, calculations show that the volume of precipitation this will impact will be on the order of 1,200 m^3 over a full year (922 m^2 area x 1.3 m yearly precipitation). If, at a minimum, 20% of that volume is to be re-introduced to the native soils, the facility will have to infiltrate 240 m^3 or 240,000 litres over the course of the year, predominantly in the winter months. Approximately 75% of this precipitation falls within the 6 month winter period and would be falling on saturated soil during rainy periods. This indicates that 180 m^3 (180,000 litres) needing to be infiltrated would be spread over 180 days, or about 1 m^3 (1,000 litres) per day on average.

The two year storm event rainfall for the Courtenay area is 11 mm in 1 hour and 72mm in 24 hours. This rainfall would generate approximately 10 m^3 and 66 m^3, respectively, of stormwater from the impermeable areas of the site.

Current plans call for eavestrough water, perimeter drains and wash basins to be directed to a bioswale/infiltration area beyond the wastewater dispersal field area to the northeast. A bioswale is a drainage structure created specifically to attenuate and treat runoff water and aid in the infiltration of the intercepted water back into the surficial soils. The bioswale is a drainage ditch with gently sloped sides which is allowed to revegetate, to aid in natural attenuation of minor contaminants.

From actual onsite testing of *in-situ* soil, the hydraulic conductivity of the soil is calculated to be approximately 4.5 metres/day (See Section 5.3). This effectively means that, per unit area, for instance 1 m^2, the soil can infiltrate a column of water 4.5 metres high in one day. Preliminary plans call for a bioswale of approximately 20 metres long by approximately 2 metres wide or 40 m^2 of infiltrative area. This area could conceivably allow infiltration of 180 m^3 over the course of 24 hours. Groundwater infiltration is never 100%, but, as calculated, the bioswale can infiltrate approximately 2.7 times the two year storm event volume that may be introduced to it within a day.

Precipitation during the summer will be easily absorbed by the soils within the bioswale. In rare rainfall events, if water were to flow through the entire length of the bioswale, it will be directed into the undeveloped land beyond, where it will slowly percolate back into the soil.

Additionally, overflow from the storage cisterns will be directed to the bioswale.

Semi-permeable areas, such as gravel parking spaces, will allow some runoff to the surrounding vegetation and some infiltration to the ground. These areas are not considered to be a significant contributor to recharge impact.

The bioswale is designed to accommodate and infiltrate volumes of water exceeding the intercepted precipitation, even during severe rainfall events.

Some of the volume of summer precipitation events may be lost due to evaporation. The fire department will be using rainwater collected from the roof for their non-potable water operations, but it is unknown at this time what the yearly use would be. H_2O estimates that 99% or more of the precipitation that impacts impermeable or semi-permeable surfaces at the

site will be returned to the local groundwater regime. The groundwater recharge rate at the site will not be significantly affected by the projected impermeable areas.

7.0 GROUNDWATER QUALITY

Wells in the area have been completed through thick deposits of sandstone. Water bearing bedrock has been found at 80 to 112 feet below grade in the vicinity of the subject site. This is a significant buffer for contaminants of concern. There was no indication of significant perched groundwater at the site during the soil investigation. The soils are loamy sands which will also provide filtration for removing silt and other rainwater contaminants. Groundwater quality should not be significantly impacted by the development if all outside drains and bioswales are maintained in good working order.

7.1 Truck Washing

Concerns have been raised in the community over potential contaminants being released into the environment through truck washing and laundering of turn-out gear after fire incidents. Generally speaking, fire trucks are not prone to being involved with contaminants from a fire due to the distance from the fire that they must maintain.

Fire fighting foam is occasionally used in fighting fires and may sometimes be found in small amounts on the trucks in a post-incident wash down[8]. It is essentially a surfactant used to smother fire when mixed with water. Normal use for the foam in a firefighting situation is in a 3% solution. This means that for every 100 litres of water, 3 litres of foam concentrate are used. The major components in the foam concentrate are water (85-90%), 1-2% magnesium sulfate and proprietary solvents and surfactants in small concentrations[9]. Magnesium sulfate is an inorganic salt which, in it's hydrated form, is epsom salt, which is harmless in the concentrations that might result from foam adhering to firefighter gear or trucks. Additional dilution during washing of the small amounts of foam that may be found on the truck will also aid in mitigating any impact on the groundwater. H_2O considers that there are very low environmental risks associated with this material in the groundwater after truck washing.

Hydrocarbon releases may sometimes occur at a fire and may, rarely, adhere to a truck. Current civil engineering plans call for a drain with a water/oil separator to be installed in the truck washing area. This separator will be equipped to have oil absorption pads inserted into a removable cage within the separator. These pads are hydrophobic and would preferentially absorb hydrocarbons that enter the drain while allowing water to pass. The pads are then removed and disposed of properly by the HIFR. The drain will be directed to the bioswale.

7.2 Turn-out Gear

Turn-out gear, worn by the fire fighters during an incident, may be washed occasionally at the fire hall. The substances from fires that will be washed out of the gear may include carbon residue or soot from wood ash. Structure fires do not occur often on Hornby Island, perhaps twice a year[10]. The turn-out gear will not generally be washed after every fire. The washing

[8] Personal communication with local Fire Chief
[9] Chemguard C-303 MSDS
[10] Ibid

machine water will dilute the minor traces of soot or carbon residue on the turn-out gear during the washing cycle and that water will then flow to the septic tank, where they will be diluted again, before being pumped to the dispersal field. The infrequent washing occurrence, the dilution of the wash water and the low risk of the substances that may adhere to the turn-out gear contribute to make this operation a low environmental risk at the site.

The wastewater system for the fire hall has been designed considering potential contaminants in suspension. There will be a layer of coarse sand under the infiltration chambers that will aid in the adsorption of minute solids, should they enter the dispersal field. This layer also filters a minor percentage of pathogens. The dispersal field is very long and narrow for optimum water re-introduction to native soils and aligned with the contours of the site to allow for optimal infiltration to the native soils.

7.3 Best Management Practices for Material Storage

Hornby Island Fire Rescue stores small quantities of oil to occasionally "top-up" levels in trucks. Additionally, there are minor amounts of gasoline stored in smaller containers for portable gas-driven tools used during response operations. These materials, as well as any paints or and other minor caustic cleaners will be stored in a secure cabinet on the property.

There will be an above-ground tank that holds both gasoline and diesel for re-fueling fire trucks. A proper secondary containment structure required for this tank will be constructed by the fire department, as per current BC Fire Code[11]. This structure will basically consist of a covered, paved containment area with integral curbs and containment equal to or exceeding 110% of the volume of the tank. No openings are allowed in the secondary containment, and as such, low environmental risk is associated with this structure.

The oil water separator will be maintained by periodic cleaning of the sediment basin and ensuring no impediments to flow are placed nearby. Hydrophobic pads will be collected after use and disposed of properly by fire department personnel.

8.0 CONCLUSIONS

The site consists of a property located on the north side of Central Road on Hornby Island. The site is adjacent to Joe King Park to the southeast and a cleared area immediately to the north with undeveloped, forested land beyond to the east, north and west. Central Road is to the south and west with undeveloped forested land beyond.

Regionally, the site slopes to the northeast with grades of approximately 4% to 6%. The nearest house in the downgradient direction from the site is on the east side of Sollans Road, approximately 440 metres distant.

Three wells were listed within a 300 metre radius of the location of the subject site. The nearest well downgradient is approximately 240 metres distant.

[11] Ministry of Municipal Affairs, OIC 1095, *The British Columbia Fire Code, 1998,* Sec 4.3.7

The results of the permeability testing indicate an average soil hydraulic conductivity of approximately 4.5 metres/day.

Approximately 20% of rainfall will enter the groundwater system to recharge the aquifers. This indicates that, before development, 2,600 m^3/year would be returned to the groundwater system via infiltration on the site. Approximately 75% of this precipitation falls within the 6 month winter period and would be falling on saturated soil.

Current plans call for eavestrough water, perimeter drains and wash basins to be directed to a bioswale/infiltration area beyond the wastewater dispersal field area to the northeast. Preliminary plans call for a bioswale of approximately 20 metres long by approximately 2 metres wide or 40 m^2 of infiltrative area. This area could conceivably allow infiltration of 180 m^3 over the course of one day.

Due to the plans for drainage and re-integration of intercepted precipitation, H_2O estimates that 99% of the groundwater will be returned to the local groundwater regime. The recharge rate at the site will not be significantly affected by the project impermeable areas.

Wells in the area have been completed through thick deposits of sandstone at 80 to 112 feet below grade. This is a significant buffer for infiltration of potential contaminants. There was no indication of significant perched groundwater at the site during the soil investigation.

Fire fighting foam concentrate is occasionally used in fighting fires and may sometimes be found in small amounts on the trucks or firefighter gear in a post-incident wash down. Dilution during use and then again during truck washing of the small amounts that may be found on the truck will aid in mitigating impact on the groundwater. H_2O considers that there are very low environmental risks associated with this material in the groundwater after truck washing.

Turn-out gear, worn by the fire fighters during an incident, may be washed occasionally at the fire hall. The substances from fires that will be washed out of the gear may include carbon residue and soot from wood ash. Infrequent washing occurrence, the dilution of the wash water and the low risk of the substances that may adhere to the turn-out gear contribute to make this operation a low environmental risk at the site.

Materials stored onsite will include oils, gasoline, diesel and other low impact cleaners. Proper containment for all hazardous materials, as per the BC Fire Code, will be constructed and strictly maintained and adhered to onsite. Following Best Management Practices will significantly reduce the potential risk of accidental spills of hazardous materials.

9.0 CLOSURE

Conclusions presented herein are based on information provided in part by others. This report has been prepared for Simcic and Uhrich, Architects, the Comox Valley Regional District and Islands Trust and is based on a scope of work requested by Islands Trust.

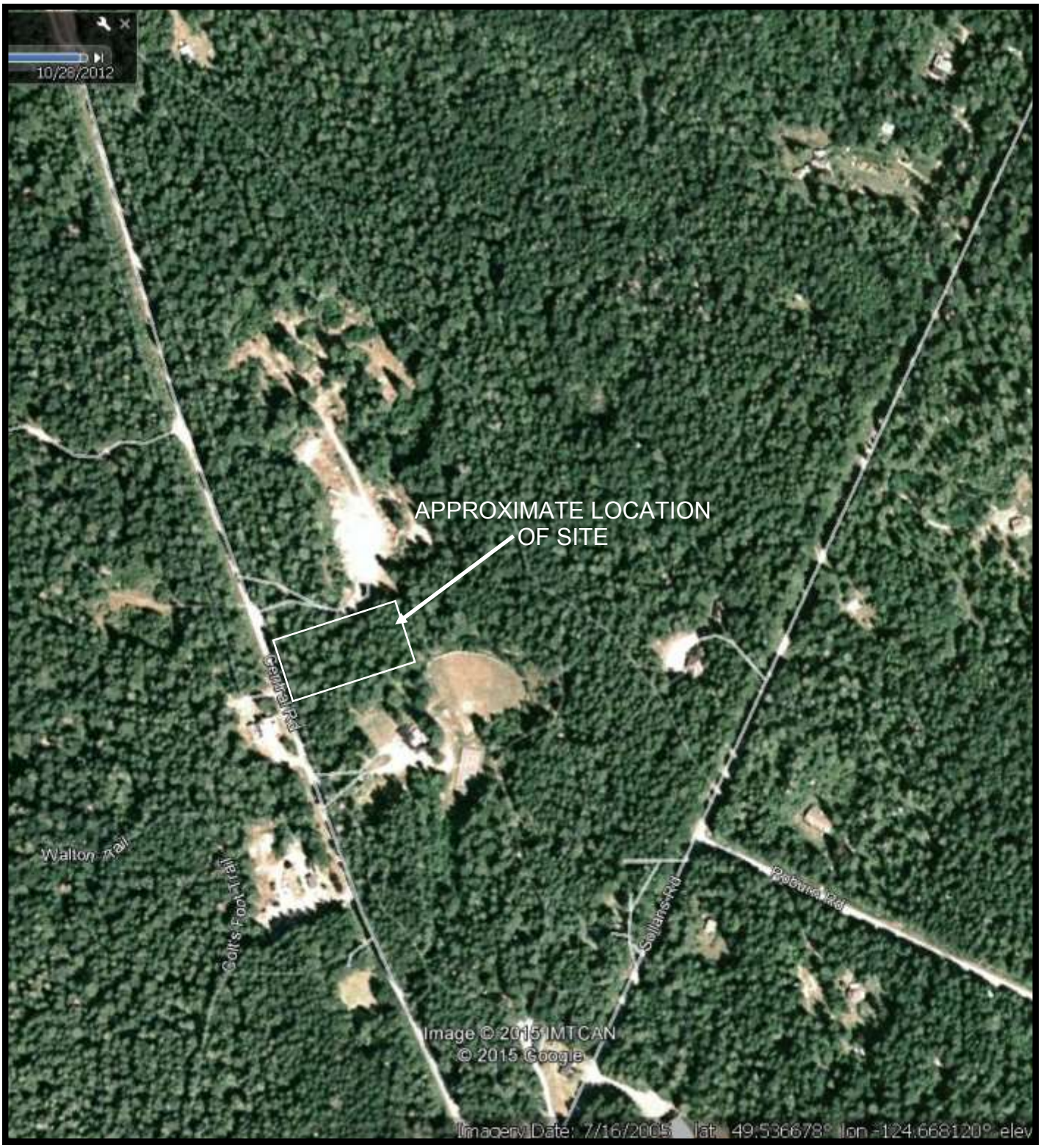
The assessment has been carried out in accordance with generally accepted professional practice. No hydrological investigation or well assessment can wholly eliminate uncertainty regarding the potential for unrecognized conditions in connection with an aquifer or water course. Performance of this assessment was intended to reduce, but not eliminate, uncertainty regarding the potential long term impact of the proposed development given the limits of the investigation and the reasonable limits of time and cost. No warranty expressed or implied is made. Reference should be made to the Standard Limitations included as Appendix 3.

H_2O trusts that this report satisfies your present requirements. Should you have any questions of comments, please contact our office at your convenience.
Respectfully Submitted;
H_2O Environmental Ltd.

Per:_____
Steven M. Carballeira, P.Geo.

APPENDIX 1
FIGURES

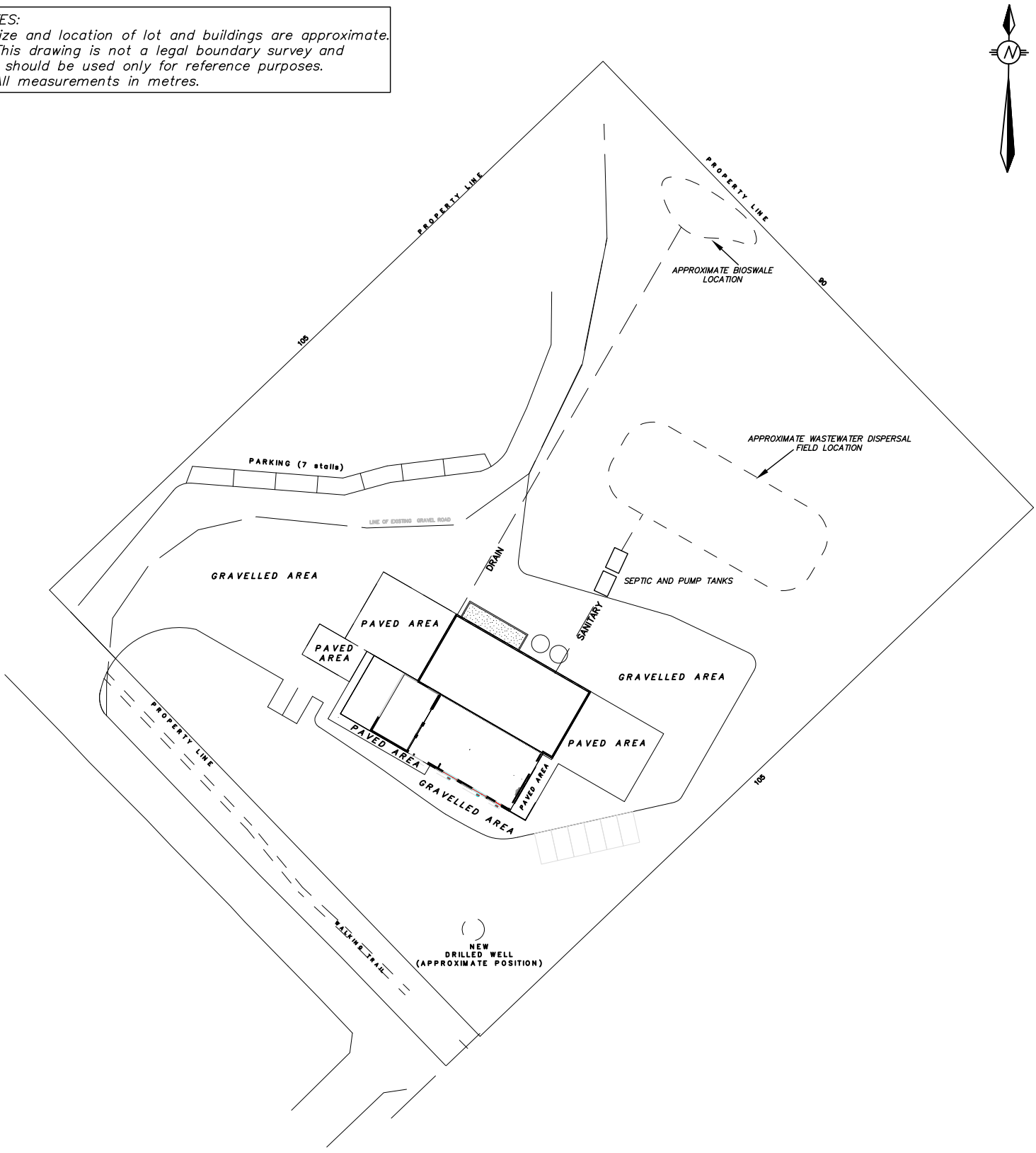
H2O ENVIRONMENTAL LTD.



PROJECT: HYDROLOGIC ASSESSMENT—NEW HORNBY ISLAND FIRE HALL					H_2O ENVIRONMENTAL LTD.
TITLE: SITE LOCATION					
CLIENT: SIMCIC AND UHRICH, ARCHITECTS					
DATE: MAY.20, 2015	FILE NO. 14-60	SCALE: NTS	TAKEN BY: SMC	REV. NO.:	Figure 1

H2O Environmental Ltd., 3060 Lake Road, Denman Island, BC, V0R 1T0 Phone 250-335-1864 Fax: 250-335-1846 Email: h2oenv@telus.net

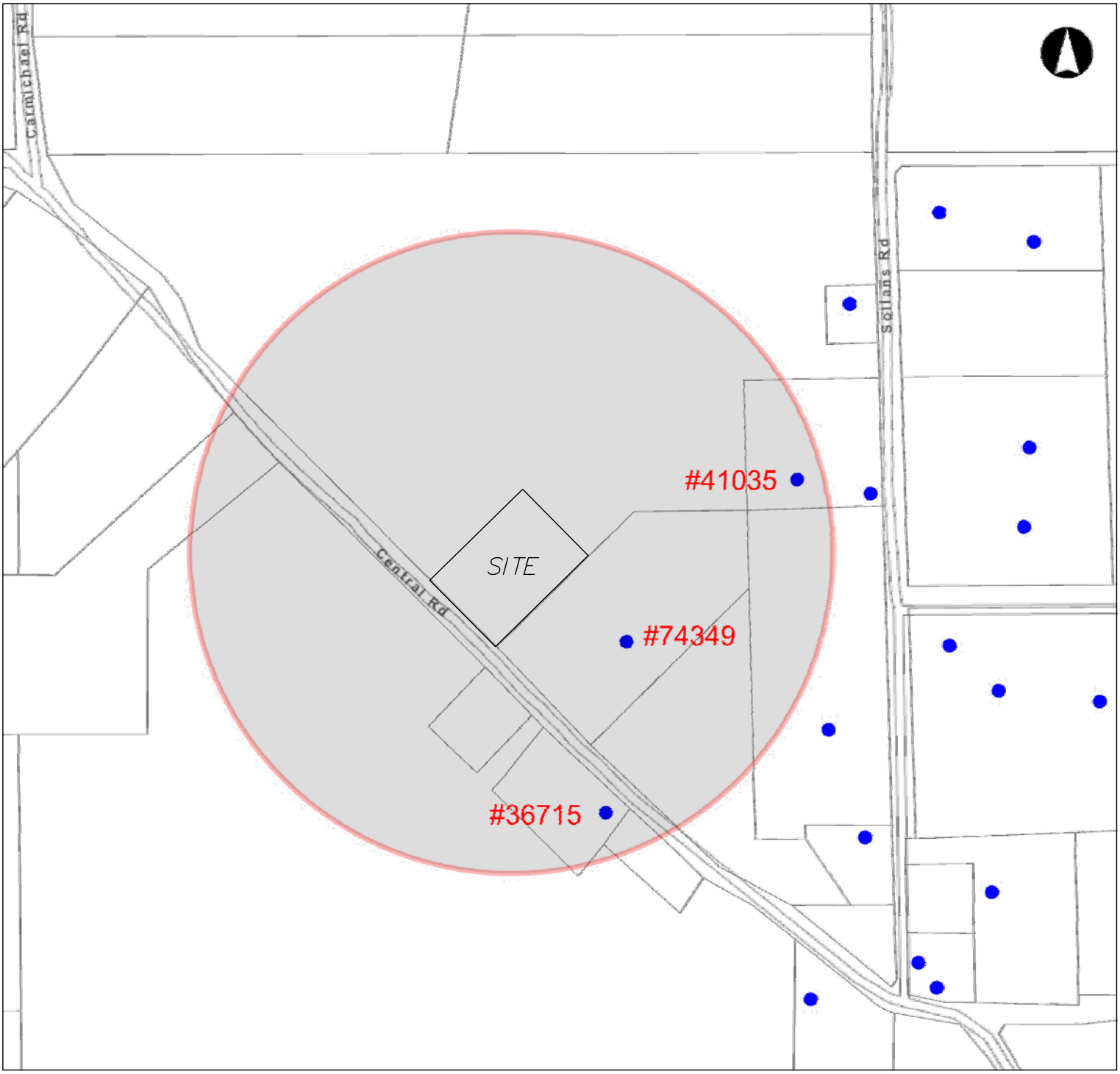
NOTES:
1. Size and location of lot and buildings are approximate.
2. This drawing is not a legal boundary survey and should be used only for reference purposes.
3. All measurements in metres.



BASE DRAWING COURTESY OF SIMCIC AND URICH, ARCHITECTS

TITLE: SITE PLAN		DATE: MAY 20, 2015	H2O ENVIRONMENTAL LTD.
		DRAWN BY: SMC	
PROJECT: HYDROLOGICAL ASSESSMENT HORNBY FIRE HALL		CHECKED BY: SMC	
		SCALE: AS SHOWN	
CLIENT: SIMCIC AND UHRICH, ARCHITECTS		PROJECT NO. 14-60	FIGURE 2

NOTES:
1. Size and location of lot and buildings are approximate.
2. This drawing is not a legal boundary survey.

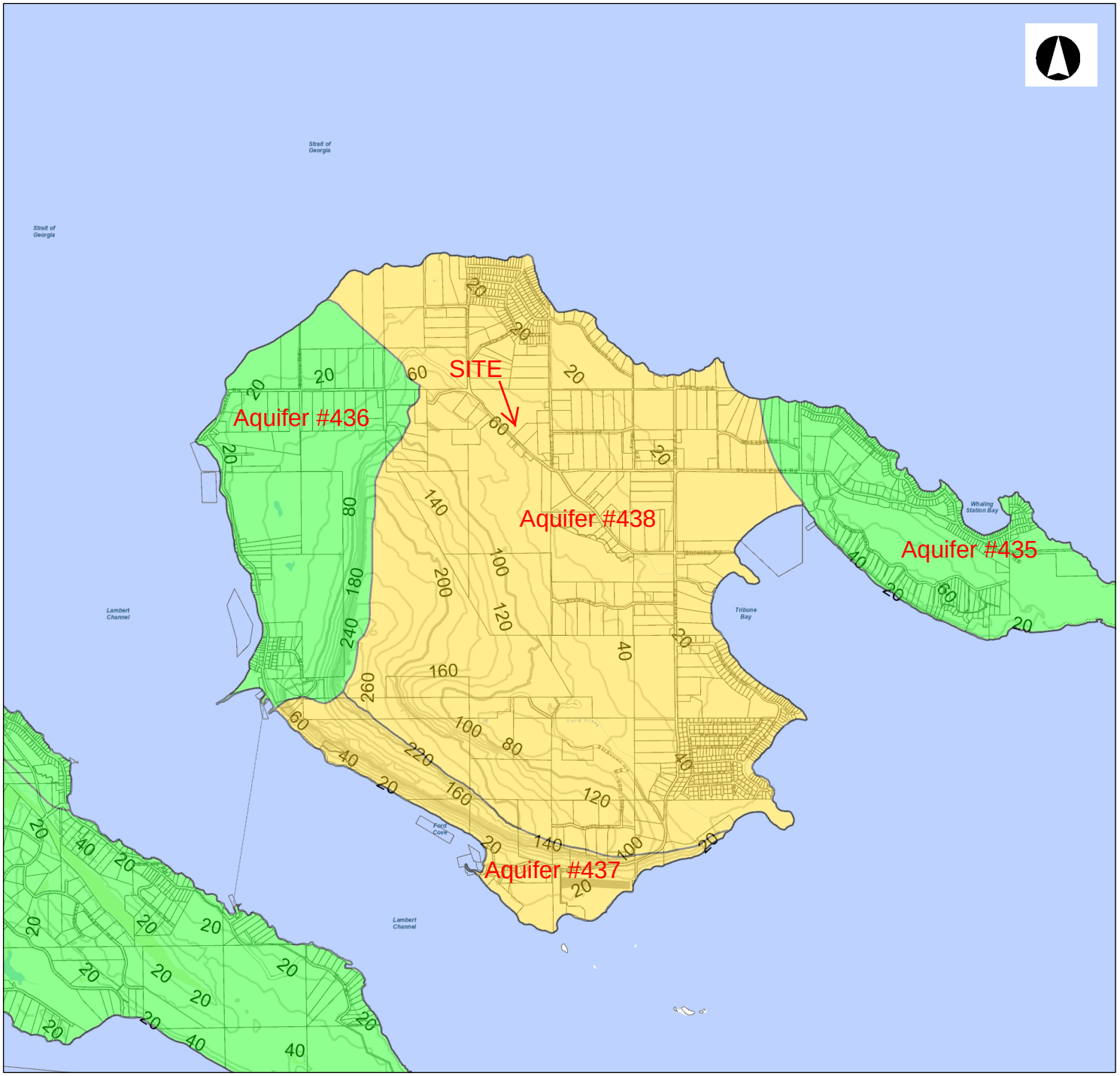


WELLS AS MAPPED BY MOE

	TITLE: WELL MAP	DATE: MAY 20, 2015	
		DRAWN BY: SMC	
	PROJECT: HYDROLOGY ASSESSMENT HORNBY ISLAND FIRE HALL	CHECKED BY: SMC	
		SCALE: AS SHOWN	
	CLIENT: SIMCIC AND UHRICH, ARCHITECTS	PROJECT NO. 14-60	FIGURE 3

H2O ENVIRONMENTAL LTD.

H20 ENVIRONMENTAL LTD. 3060 LAKE ROAD, DENMAN ISLAND, BC V0R 1T0 250-335-1864



BRITISH COLUMBIA

Aquifer 438

Legend

Aquifer Productivity - Colour

PRODUCTIVITY_CODE

- Bedrock High Productivity
- Bedrock Low Productivity
- Bedrock Moderate Productivity
- Unconsolidated High Productivit
- Unconsolidated Low Productivity
- Unconsolidated Moderate Produ

Integrated Cadastral Fabric

Contours (1:20,000)

FCODE

- Contour - Index
- Contour - Index Indefinite
- Contour - Index Depression

0 1.14 2.27 km

1: 55,949

Copyright/Disclaimer

Datum: NAD83

Projection: NAD_1983_BC_Environment_Albers

Key Map of British Columbia

APPENDIX 2
WELL LOGS

H2O ENVIRONMENTAL LTD.

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 36715	Construction Date: 1977-02-22 00:00:00
Owner: DEPT OF HIGHWAYS	Driller: Gulf Island Well Drillers
	Well Identification Plate Number:
Address:	Plate Attached By:
	Where Plate Attached:
Area:	
	PRODUCTION DATA AT TIME OF DRILLING:
WELL LOCATION:	Well Yield: 10 (Driller's Estimate) Gallons per Minute
NANAIMO Land District	Development Method:
District Lot: Plan: 28667A Lot: D	Pump Test Info Flag: N
Township: Section: 11 Range:	Artesian Flow:
Indian Reserve: Meridian: Block:	Artesian Pressure (ft):
Quarter:	Static Level: 4 feet
Island: HORNBY	
BCGS Number (NAD 83): 092F057232 Well: 5	WATER QUALITY:
	Character:
Class of Well:	Colour:
Subclass of Well:	Odour:
Orientation of Well:	Well Disinfected: N
Status of Well: New	EMS ID: E244597
Well Use: Unknown Well Use	Water Chemistry Info Flag:
Observation Well Number:	Field Chemistry Info Flag:
Observation Well Status:	Site Info (SEAM):
Construction Method: Drilled	
Diameter: 6.0 inches	Water Utility:
Casing drive shoe:	Water Supply System Name:
Well Depth: 137 feet	Water Supply System Well Name:
Elevation: 0 feet (ASL)	
Final Casing Stick Up: inches	SURFACE SEAL:
Well Cap Type:	Flag: N
Bedrock Depth: 5 feet	Material:
Lithology Info Flag: N	Method:
File Info Flag: N	Depth (ft):
Sieve Info Flag: N	Thickness (in):
Screen Info Flag: N	
	WELL CLOSURE INFORMATION:
Site Info Details:	Reason For Closure:
Other Info Flag:	Method of Closure:

Other Info Details:	Closure Sealant Material: Closure Backfill Material: Details of Closure:

Screen from	to feet	Type	Slot Size	
Casing from	to feet	Diameter	Material	Drive Sh

GENERAL REMARKS:
ESTIMATE 10 GPM

LITHOLOGY INFORMATION:

From	0	to	5 Ft.	overburden
From	5	to	9 Ft.	conglomerate
From	9	to	11 Ft.	brown sandstone
From	11	to	52 Ft.	sandstone
From	52	to	109 Ft.	sandstone with intermittent shale
From	109	to	124 Ft.	shale with intermittent sandstone
From	112	to	112 Ft.	water
From	124	to	131 Ft.	sandstone with intermittent shale
From	131	to	137 Ft.	sandstone

- Return to Main
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BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 41035	Construction Date: 1978-12-01 00:00:00
Owner: HORNBY ISLAND NEW HORIZONS SOCIETY	Driller: Gulf Island Well Drillers
	Well Identification Plate Number: 14313
Address: 1765 SOLLANS ROAD	Plate Attached By: PUBLIC HEALTH OFFICER
	Where Plate Attached: WELLHEAD
Area: HORNBY ISLAND	
	PRODUCTION DATA AT TIME OF DRILLING:
WELL LOCATION:	Well Yield: (Driller's Estimate)
NANAIMO Land District	Development Method:
District Lot: Plan: 31932 Lot: 1	Pump Test Info Flag: N
Township: Section: 11 Range:	Artesian Flow:
Indian Reserve: Meridian: Block:	Artesian Pressure (ft):
Quarter:	Static Level: 95 feet
Island: HORNBY	
BCGS Number (NAD 83): 092F057232 Well: 7	WATER QUALITY:
	Character:
Class of Well: Water supply	Colour:
Subclass of Well: Domestic	Odour:
Orientation of Well: Vertical	Well Disinfected: N
Status of Well: New	EMS ID:
Well Use: Water Supply System	Water Chemistry Info Flag:
Observation Well Number:	Field Chemistry Info Flag:
Observation Well Status:	Site Info (SEAM):
Construction Method: Drilled	
Diameter: 6 inches	Water Utility:
Casing drive shoe:	Water Supply System Name: HORNBY ISLAND NEW HORIZONS SOCI
Well Depth: 110 feet	Water Supply System Well Name: HORNBY ISLAND NEW HORIZONS
Elevation: 0 feet (ASL)	
Final Casing Stick Up: inches	SURFACE SEAL:
Well Cap Type:	Flag: N
Bedrock Depth: 3 feet	Material:
Lithology Info Flag: Y	Method:
File Info Flag: N	Depth (ft):
Sieve Info Flag: N	Thickness (in):
Screen Info Flag: N	
	WELL CLOSURE INFORMATION:
Site Info Details:	Reason For Closure:
Other Info Flag:	Method of Closure:

Other Info Details:	Closure Sealant Material: Closure Backfill Material: Details of Closure:

Screen from	to feet	Type	Slot Size	
Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:
WELL HAS NO SULPHUR ODOR. WATER QUANTITY IS FINE.

LITHOLOGY INFORMATION:

From	0	to	3	Ft. till
From	3	to	80	Ft. sandstone
From	80	to	95	Ft. shale
From	95	to	110	Ft. sandstone - 5 GPM
From	0	to	0	Ft.
From	0	to	0	Ft. Sources of water: 5 GPM at 95' - 100'
From	0	to	0	Ft. 300 GPH at 95' - 100'

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BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 74349	Construction Date: 1986-12-02 00:00:00
Owner: HORNBY ISLAND ATHLETIC ASSOCIATION	Driller: Gulf Island Well Drillers
	Well Identification Plate Number: 14363
Address: 3851 CENTRAL ROAD	Plate Attached By: PUBLIC HEALTH OFFICER
	Where Plate Attached: WELL HAND
Area: HORNBY ISLAND	
	PRODUCTION DATA AT TIME OF DRILLING:
WELL LOCATION:	Well Yield: 1 (Driller's Estimate) U.S. Gallons per M
NANAIMO Land District	Development Method:
District Lot: Plan: Lot:	Pump Test Info Flag: N
Township: Section: 11 Range:	Artesian Flow:
Indian Reserve: Meridian: Block: H	Artesian Pressure (ft):
Quarter: NW	Static Level: 10 feet
Island: HORNBY	
BCGS Number (NAD 83): 092F057232 Well: 31	WATER QUALITY:
	Character:
Class of Well: Water supply	Colour:
Subclass of Well: Domestic	Odour:
Orientation of Well: Vertical	Well Disinfected: N
Status of Well: New	EMS ID:
Well Use: Water Supply System	Water Chemistry Info Flag:
Observation Well Number:	Field Chemistry Info Flag:
Observation Well Status:	Site Info (SEAM):
Construction Method: Drilled	
Diameter: 6.0 inches	Water Utility:
Casing drive shoe:	Water Supply System Name: JOE KING PARK
Well Depth: 90 feet	Water Supply System Well Name: WELL 1
Elevation: 0 feet (ASL)	
Final Casing Stick Up: inches	SURFACE SEAL:
Well Cap Type:	Flag: N
Bedrock Depth: 5 feet	Material:
Lithology Info Flag: Y	Method:
File Info Flag: N	Depth (ft): 0 feet
Sieve Info Flag: N	Thickness (in):
Screen Info Flag: N	Liner from To: feet
Site Info Details:	WELL CLOSURE INFORMATION:
Other Info Flag:	Reason For Closure:

Other Info Details:	Method of Closure: Closure Sealant Material: Closure Backfill Material: Details of Closure:

Screen from	to feet	Type	Slot Size
0	0		0
0	0		0
0	0		0
0	0		0

Casing from	to feet	Diameter	Material	Drive Shoe
0	0	0	null	null

GENERAL REMARKS:
LOT IS LEASED FROM CROWN WATER AT 80'

LITHOLOGY INFORMATION:

From	0	to	5	Ft. GRAVEL & SAND
From	5	to	12	Ft. BROWN SANDSTONE
From	12	to	21	Ft. SANDSTONE
From	21	to	23	Ft. SHALE & SANDSTONE
From	23	to	80	Ft. SANDSTONE
From	80	to	90	Ft. SANDSTONE & SHALE

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APPENDIX 3
H_20 STANDARD LIMITATIONS

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STANDARD LIMITATIONS

1. The findings and conclusions documented in this report have been prepared for specific application to this project and have been developed in a manner consistent with that level of care normally exercised by environmental professionals currently practicing under similar conditions in the area.

2. No hydrogeological investigation or well assessment can wholly eliminate uncertainty regarding the potential for unrecognized conditions in connection with an aquifer or watercourse. Performance of this assessment was intended to reduce, but not eliminate, uncertainty regarding the potential long term impact of the proposed development given the limits of the investigation and the reasonable limits of time and cost. No warranty expressed or implied is made.

3. The findings of this report are based solely on data collected on site during this investigation and on the conditions of the site during the completion of the work. H_2O Environmental Ltd. has relied in good faith on information provided by individuals and sources noted in the report. No other warranty, expressed or implied, is made.

4. If new information is developed in future work that affects the conclusions of this report, H_2O should be contacted to re-evaluate the conclusions of this report and provide amendments as required.

5. The service provided by H_2O in completing this investigation is intended to assist the client in making a business decision. The liability of the site is not transferred to H_2O as a result of such services.