

***NORTH CEDAR IMPROVEMENT DISTRICT***

**AGENDA FOR THE OCTOBER 27, 2016**  
**COMMITTEE OF THE WHOLE MEETING**

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# North Cedar Improvement District

## ADMINISTRATION REPORT

**Prepared by:** Heather Sarchuk  
**Date:** October 20, 2016  
**Re:** Lack of Infrastructure Funding

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The Board Chair requested that this item be added to the agenda.



October 12, 2016  
P16-31

North Cedar Improvement District  
2100 Yellow Point Road  
Cedar, B.C.  
V9X 1W1

(Via email)

Attention: Mr. Jack Anderson

Re: Groundwater Investigation  
North Cedar Improvement District

GW Solutions Inc. (GW Solutions) is pleased to provide the following work plan outlining tasks required to assess the possibility of an alternative water source for the North Cedar Improvement District (NCID).

### Background

GW Solutions understand that the NCID water supply exceeds the water quality guidelines for turbidity for a short duration each year. This is the result of the connectivity of the wells to the Nanaimo River. As a result, the Vancouver Island Health Authority (VIHA) has requested that the NCID resolve the water quality issue and ensure the CCME guidelines are adhered to all year round and potable water is provided.

It is understood that there are two options available to the NCID, 1) to build a treatment facility, or 2) find an alternative source of water that meets the water quality guidelines.

The objective of GW Solutions' work is to assess a) the area surrounding the existing well field and b) an area where connection to the existing infrastructure would not be cost prohibitive, for the presence of a buried channel to determine if a deep confined

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aquifer is present. The deep buried aquifer would not be influenced by surface water and therefore would not require complex treatment.

### **Proposed Approach**

GW Solutions proposes to undertake the following tasks:

#### **Task 1. Review existing information and assess the possibility of accessing a deeper confined aquifer**

GW Solutions will review available information to assess the possibility of the presence of deeper aquifers beneath the existing well field and in the oval area identified in Figure 1. Data that will be reviewed will include but is not limited to:

- BC WELLS database
- Bedrock geology maps
- BC mapped aquifers
- Studies completed by NCID

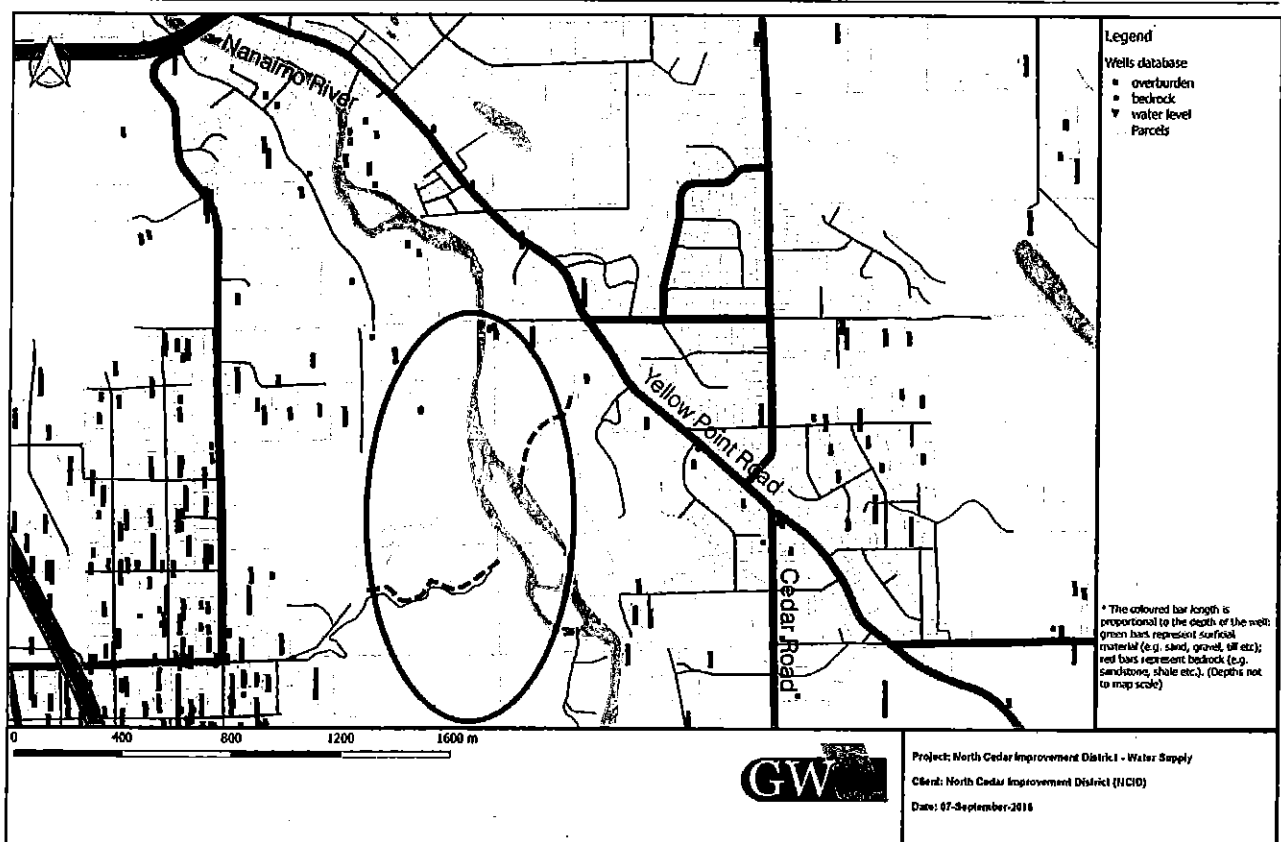


Figure 1: The area within the blue oval, south of the existing well field, to be explored by geophysical investigation along pink dashed lines for buried channel.

**Task 2. Coordinate geophysical investigation**

GW Solutions will coordinate a geophysical assessment with Frontier Geoscience Ltd. (Frontier Geoscience) around the area defined in Figure 1 and the existing well field (Figure 2). The intent of the geophysical assessment will be to:

1. Define the bedrock topography to determine if a deep bedrock valley is present at either location; and
2. Assess the potential for a deeper confined aquifer at either location.

Frontier Geoscience has proposed using a different method to achieve each objective. Seismic refraction would provide a profile of the bedrock and electrical resistivity would allow to refine the characteristics of the soil deposit and estimate the likelihood of having coarse permeable material (aquifer) at depth. Based on the results of Objective 1 (confirmation of a deep valley), GW Solutions will evaluate the likelihood of deeper aquifers being present and will recommended if it would be cost effective to proceed with Objective 2 (characterizing the soil deposits in the deep valley).

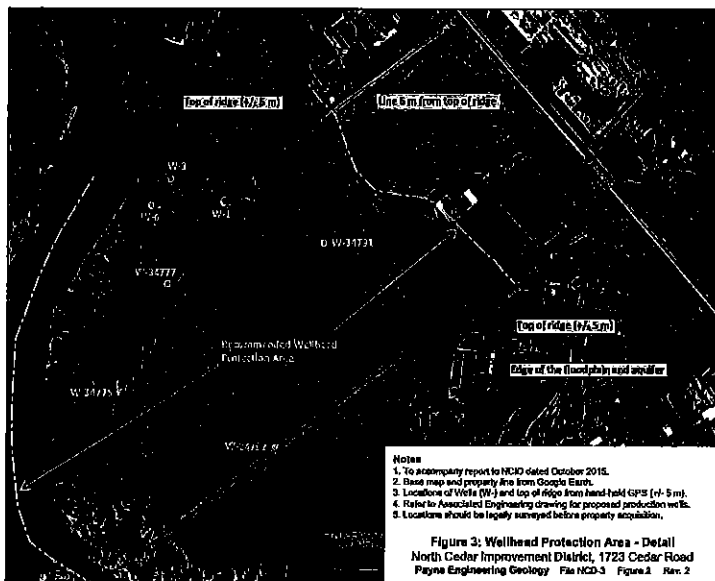


Figure 2: Pink dashed lines to have geophysical investigations conducted along

**Task 3. Reporting**

GW Solutions will prepare a short report presenting the following:

- Results of the geophysical investigation; and
- Recommendations for next steps based on the results of the investigation.

**Schedule**

The tasks proposed could be completed within two months of receiving written authorization to proceed (email is sufficient).

**Cost Estimate**

We estimate the cost of the proposed tasks to be approximately (excluding GST):

1. \$ 1,700 for Task 1 (data review);
2. \$ 18,000 for completing only the seismic refraction survey (Tasks 2a & 2b);
3. \$ 28,600 for completing both the seismic refraction and electrical resistivity surveys (Tasks 2a, 2b, and 2c);
4. \$ 2,500 for reporting and project management (Task 3); and
5. \$ 1,500 for project management.

The estimated costs are detailed in the following table.

Task	GW 225	Staff 140	Pages	Expenses	Frontier	Total
<b>Task 1 - Review existing information</b>						
Task 1a - Review available data	2	8	\$1,570			\$1,570
<b>Task 2 - Geophysical Investigation</b>						
Task 2a - Coordinate with Frontier Geoscience		2	\$280	\$300		\$580
Task 2b - Conduct investigation for objective 1	0.5	2	\$393		\$15,440	\$15,833
Task 2c - Conduct investigation for objective 2**		2	\$280		\$9,310	\$9,590
<b>Task 3 - Data Interpretation and reporting</b>						
Task 3a - Review results of geophysical investigation	0.5	2	\$393			\$393
Task 3b - Recommendations and reporting	2	8	\$1,570	\$300		\$1,870
<b>Project Management and Communication</b>	3	5	\$1,375			\$1,375
Subtotal			\$3,860	\$ 600	\$24,750	\$31,210
Contingency (10%)			\$586	\$60	\$2,475	\$3,121
<b>Total</b>			\$4,446	\$660	\$27,225	\$34,331
**Dependent on results from Phase 1					Total without Task 2c	\$23,782







# **FRONTIER GEOSCIENCES INC.**

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October 12, 2016

GW Solutions Inc.  
Unit 201 - 5180 Dublin Way  
Nanaimo, B.C.  
V9T 0H2

Attention: Johanna Wick, M.Sc., GIT  
Hydrogeologist

RE: Proposed Seismic Refraction Survey  
North Cedar Improvement District  
Nanaimo, B.C.

We are pleased to have this opportunity to provide our proposal for geophysical surveying of geological conditions in the North Cedar Improvement District. We understand that you require depth to bedrock information at two sites, over approximately 1020 metres. We propose to carry out the survey using the seismic refraction method, to delineate bedrock and identify overburden layering. We further understand you are interested in locating aquitards/aquifers under both sites. We have included an option for Electrical Resistivity Tomography (ERT), to assist in delineation of more permeable zones on the basis of their electrical resistivity.

## Seismic Refraction Survey

We propose to carry out the seismic refraction surveying utilising a Geometrics Geode signal enhancement seismograph. Refraction surveying would utilize Oyo Geospace 10 Hz geophones for data acquisition. Seismic energy would be provided from a Buffalo gun shotgun source firing 8 gauge, blank shotgun shells into hand-excavated shotholes

Field procedure would entail setting out the geophone cables in a straight line and implanting the geophones. Several shotpoints would be located within and off the ends of, each cable. The seismic source would be operated at each shotpoint and the recorded data checked for clarity before proceeding to the next shotpoint. Once all the data was recorded, the geophone array would be picked up and moved to the next survey line, where the procedure would be repeated.

Depth penetration of seismic refraction surveying is approximately 1/3 of the total line length. Five metre geophone spacings would be employed to provide high resolution data on overburden layering and the bedrock surface, while resulting in an exploration depth of approximately 30-40 metres.

The program we propose involves detailed shooting of the seismic lines. Each 24 geophone spread would record up to seven shots located at different positions along the seismic cables. These shots would enable layer thicknesses and bedrock depth calculations at each geophone location, which would provide high resolution geological sections.

Positioning information will be recorded in the field. Line locations will be recorded with reference to GPS readings, chainages and physical landmarks, together with annotation of any boreholes, or surveyor monuments. Points of line overlap or line intersections will also be noted, and relative elevation information will be recorded using inclinometer readings. Should absolute elevations be required, markers will be left in the field such that a land survey crew can establish detailed positions and elevations. It is assumed that the lines would be flagged and cut prior to the arrival of the seismic crew.

#### Electrical Resistivity Tomography

We propose to carry out high density electrical resistivity tomography using an 84 electrode resistivity system. The system is an automated microprocessor-controlled transmitter-receiver, which records eight receiver channels simultaneously to speed up data collection and obtain detailed electrical resistivity profiles. The high resolution, full waveform receiver records the entire waveform providing full, 24 bit waveforms for processing. Self-potential drift, transient effects, and several other noise sources are accurately identified and removed from the signal. This allows the full waveform system to provide better results in lower signal level situations, such as higher electrode spacings, and corresponding deeper penetration in a dipole-dipole survey, or in geologic settings with unfavourable signal-to-noise levels.

Field procedure entails laying out the resistivity cables along the survey line with the resistivity system positioned at the centre of the configuration. Metal electrodes are then driven into the ground. The electrodes are connected to the resistivity meter by a multi-conductor wire with addressable connections. During multi-electrode surveying, a central switching system is used to address this array of electrodes. A system of high voltage relays in the central switching system allows the transmitter to utilise any pair of electrodes for current injection. Similarly, the switching is accomplished by a multiplexer directing the signals from any of the field electrodes to the eight input channels of the receiver.

By means of a command file programmed in the receiver, electrode arrays including Schlumberger, Wenner, dipole-dipole, pole-dipole and pole-pole, or multiple combinations of arrays, may be chosen for execution by the system. The dipole-dipole electrode array would be used for this survey, which provides good lateral resolution of electrical resistivities.

Data reduction involves filtering of recorded data to remove negative data points and poor or unreliable data. The data are then processed on a workstation using the RES2DINV inversion program developed by M.H. Loke. This software utilizes a non-linear, least-squares inverse modelling approach to calculate the apparent resistivity values and depths that best fit the observed data. The model parameters are the electrical resistivity values of the subsurface model cells, while the data are the measured input currents and resulting electrical voltages measured between the surface electrodes. To increase the accuracy of the modelling process, the elevation of each electrode is incorporated into the input data file. Using the finite-element optimization method, an initial model is modified in an iterative manner so that the differences between the model responses and the data values are reduced.

Survey Costs

We have estimated costs to travel to Nanaimo and the site area and carry out the geophysical surveying. We have included in our cost estimate allowances for travel, geophysicist and crew, equipment, consummables (shotgun shells), meals and accommodations, data interpretation and report preparation. No allowance has been made in our estimates for line cutting and clearing (if necessary) or GST. In the unlikely event of crew standby due to severe weather or other causes, a standby rate would be charged at 70% of the crew day costs.

Seismic Refraction Program Costs

Survey Organization and Equipment Preparation	\$550.00
Seismic Refraction Crew Day Costs	
- 3 days @ \$3630.00 per day	10,890.00
Data Reduction and Interpretation - seismic refraction	
- 10 seismic spreads @ \$350.00 per spread	3,500.00
Survey Report	<u>500.00</u>
Estimated Program Cost	<u>\$15,440.00</u>

Optional Electrical Resistivity Tomography

Survey Organization and Equipment Preparation	\$350.00
Resistivity Crew Day Costs	
- 2 days @ \$3630.00 per day	7,260.00
Data Reduction and Interpretation - resistivity	
- 2 survey days @ \$850.00 per day	1,700.00
Estimated Option Cost	<u>\$9,310.00</u>

We trust that this is the information you require at present. Please don't hesitate to contact us should you have any questions regarding any aspect of our proposal.

Yours sincerely,  
Frontier Geosciences Inc.

Cliff Candy, P.Geo.

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