Alberni-Clayoquot Regional District

WEST COAST COMMITTEE MEETING
THURSDAY, MAY 14, 2015, 10:00 AM
UCLUELET COMMUNITY CENTRE

AGENDA

PAGE #

1. **CALL TO ORDER**

Recognition of Traditional Territories.

2. **APPROVAL OF AGENDA**
(motion to approve, including late items requires 2/3 majority vote)

3. **CORRESPONDENCE FOR ACTION**

4. **CORRESPONDENCE FOR INFORMATION**

a. Ocean Networks Canada **3**
Tsunami Detection: WERA Radar Proposal

5. **DISCUSSION**

a. **Long Beach Airport Production Well**
David Dennis, Tla-o-qui-aht First Nation, Council Member, Tla-o-qui-aht First Nation, Dale Redford, Jackie Godfrey, Parks Canada in attendance
- McGill & Associates Engineering Ltd. Brief on Long Beach Airport Water System **4-42**

6. **REQUEST FOR DECISIONS & BYLAWS**

a. **REQUEST FOR DECISION** **43-47**
Re: West Coast Committee Draft New Terms of Reference

THAT the West Coast Committee recommend that the Alberni-Clayoquot Regional District Board of Directors approve the Terms of Reference for the West Coast Committee as presented.

7. **REPORTS**

a. Long Beach Airport Update (verbal) – R. Dyson
b. West Coast Landfill Update (verbal) – R. Dyson

THAT the West Coast Committee receive verbal reports a-b.

8. UNFINISHED BUSINESS

9. LATE BUSINESS

10. ADJOURN

TSUNAMI DETECTION: WERA RADAR Proposal

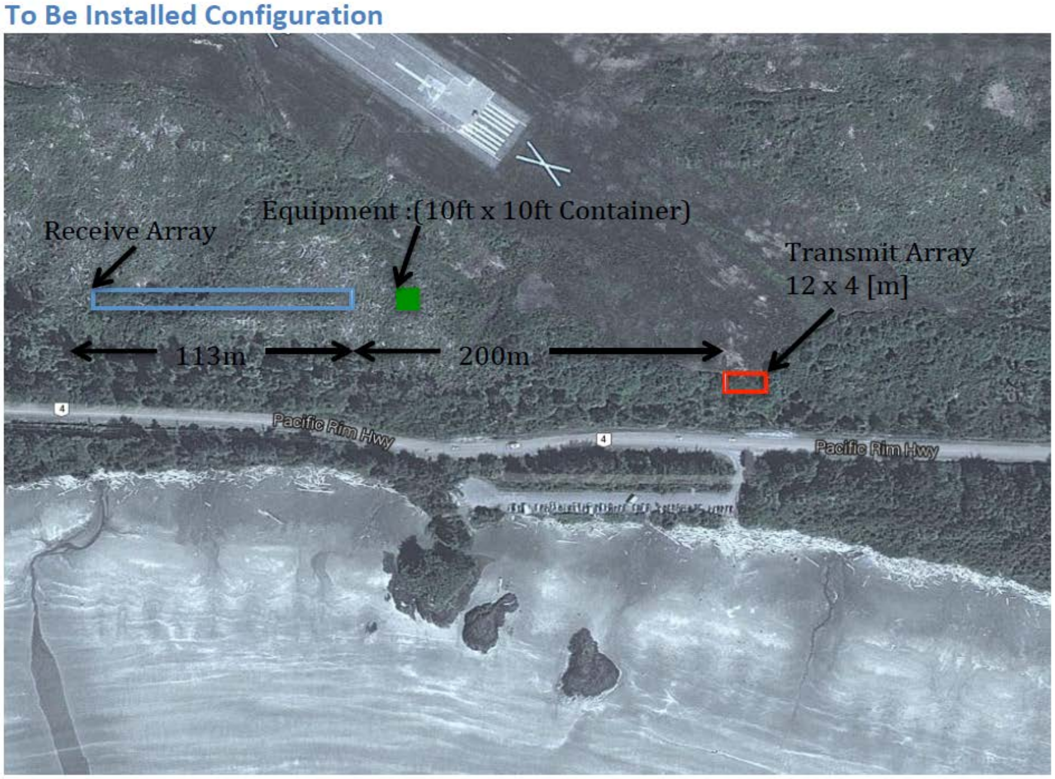
A Wellen[1] radar (WERA) array is a high-frequency radar that uses electromagnetic waves, within a specific frequency range, to measure surface ocean currents, ocean waves, and wind speed. After the Tōhoku earthquake and tsunami, it was demonstrated that WERA data were able to identify tsunami waves from as far offshore as ~100 kilometers. Detection at such a distance could provide critical information up to 20 minutes prior to tsunami impact in coastal communities like Tofino and about an hour prior to impact in Port Alberni.

Ocean Networks Canada is testing the WERA system for real-time tsunami detection on the west coast of British Columbia to augment the system of bottom pressure sensors already in place off our coast. In addition to the potential for the WERA system to detect an incoming tsunami, it can also measure sea-state in real-time, which is important information for improving day-to-day safety of coastal visitors and community members.

The system comprises a linear array of 12 receive antennas and four transmit antennas. The total system footprint spans about 300 metres in length depending upon the site configuration (see proposed layout below).

Ocean Networks Canada is proposing that the radar be installed at the Tofino/Long Beach Airport and has been in contact with airport authorities towards this goal. Once the proposal is considered, permits are approved and installation completed, a public forum will be held in the Tofino area to learn about the system and what it means for the local community and for the coast of BC.

To Be Installed Configuration



McGILL & ASSOCIATES ENGINEERING LTD.
Consulting Engineers
4610 Elizabeth Street, Port Alberni, BC V9Y 6L7 Phone 250-724-3400

May 5, 2015 Ref. 2883

Alberni Clayoquot Regional District
3008 5th Avenue
Port Alberni, B.C.
V9Y 2E3

Attention: Russell Dyson
Chief Administrative Officer

Re: Long Beach Airport Water System

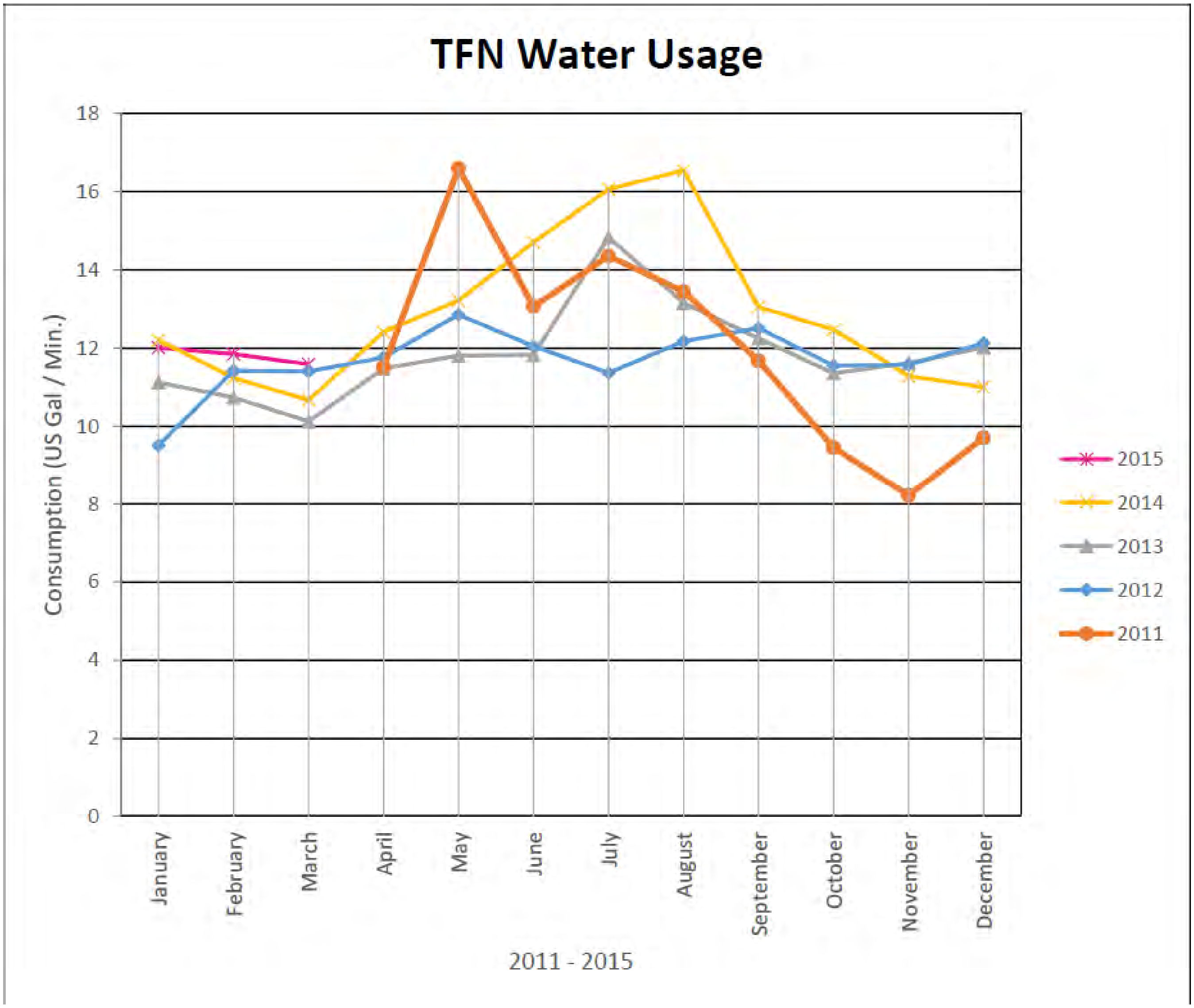
Dear Sirs:

As requested, we have prepared the following brief regarding the current status of the water supply system at the Long Beach Airport and a preliminary cost estimate to develop the well, treat the water and upgrade the pumphouse.

The water supply provides for airport tenants, the terminal, the golf course and for Tla-o-qui-aht First Nation (TFN) for the communities of Esowista and Ty-histanis. Historically, TFN has consumed 80% of the water.

Currently the water system has two operating wells. The first well (PW#1) was constructed in 1964. It was pump tested at that time and had a capacity of 28.5 Usgpm. Subsequent pump tests in 1999 yielded 13 Usgpm and in 2010 yielded 16 Usgpm. This well is not in use. It is not considered to be a viable water source at this time. A second well (PW#2) was installed in 2001 with a yield of 87 Usgpm at that time. Its yield was retested in 2010 and found to be 45 Usgpm. A third well (PW#3) was drilled and tested in 2014. Its yield is estimated at 60 Usgpm. PW#3 doesn't have a pump and has not been connected to the water system at this time. All wells have comparable water quality and require treatment for removal of iron and manganese. . The total water available from PW# 2 and PW#3 is in the order of 100 Usgpm, subject to confirmation of PW#2's yield. GW Solutions have provided the attached report on the capacity of PW#3.

We have assessed water usage by the TFN over the past 5 years based on monthly meter readings. A graph is provided below showing TFN water usage. The high flows identified in 2011 reflect the period when they were testing their new water system and filling their reservoir. The graph indicates a steady small increase in usage on an annual basis, with the exception of 2014 which had a more significant increase. Meter readings are taken more frequently at the system pump house by the wells at the airport. Peak daily water usage approached 30 usg/min/day. In 2009, the TFN requested a water supply of 50 Usgpm to meet their anticipated water requirement. This does not include an allowance for other users on the water system. The future requirements of both the TFN and other users exceeds the current capacity of PW-2. The increase in water usage is getting to a point where it needs to be addressed as further growth is anticipated by the TFN and other users.



The existing water treatment system needs replacement and an increase in capacity to treat the available water from PW# 2 and PW#3. A treatment system capable of handling both iron and manganese can be developed with filters for removal of the impurities. We have a proposal from a water treatment expert to initiate a review of this.

The existing pumphouse and treatment plant was constructed in 1965, is in poor repair, and is well beyond its useful life. A new pumphouse is required. It would incorporate the treatment system, chlorination works, and controls for the new well.

We have prepared an overall airport site plan (Figure 1, attached) and the proposed pump station site plan (Figure 2, attached) showing the proposed works required to continue the operation of the water system.

A preliminary Class D cost estimate has been prepared which indicates possible expenditures to complete the proposed works.

• Pump & control installation c/w piping	$100,000
• Geotechnical Engineering	$ 37,000
• Water treatment plant equipment & installation	$200,000
• Pumphouse construction	$ 50,000
• Power supply	$ 10,000
Sub-Total	$397,000
• Allowance for Contingencies 20%	$ 79,400
• Allowance for Engineering	$ 59,550
Total Estimated Cost	$535,950

A preliminary meeting should be held with the LBA water users to assess their water supply requirements in the short and long term, and interest in participating in this project.

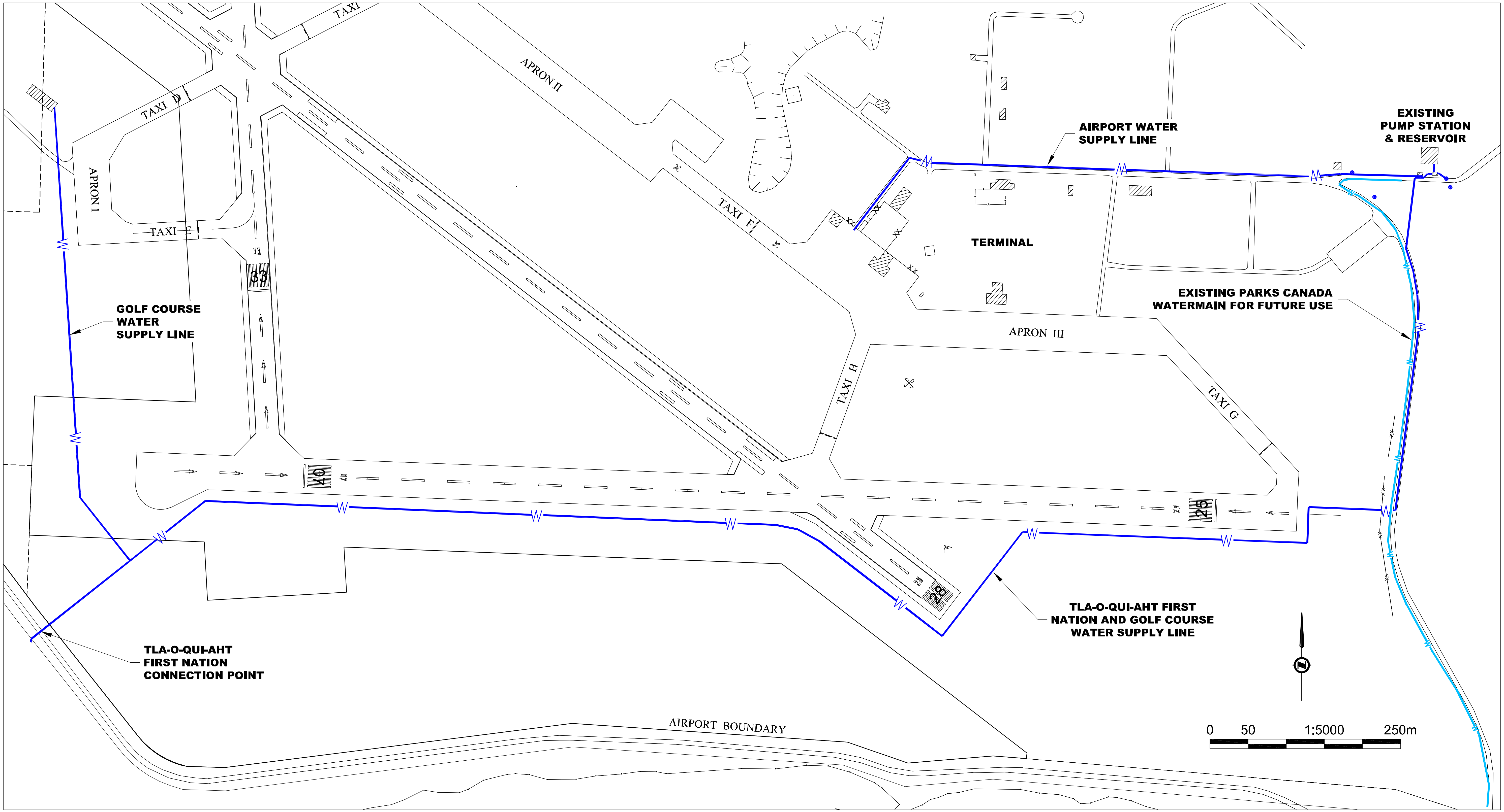
Should you wish to discuss this further, please contact us at your convenience.

Yours truly,

For **McGill & Associates Engineering Ltd.**

Alan J. McGill, P. Eng.

Encl. GW Solutions Report
Figure 1 – Site Plan
Figure 2 – Proposed Pump Station



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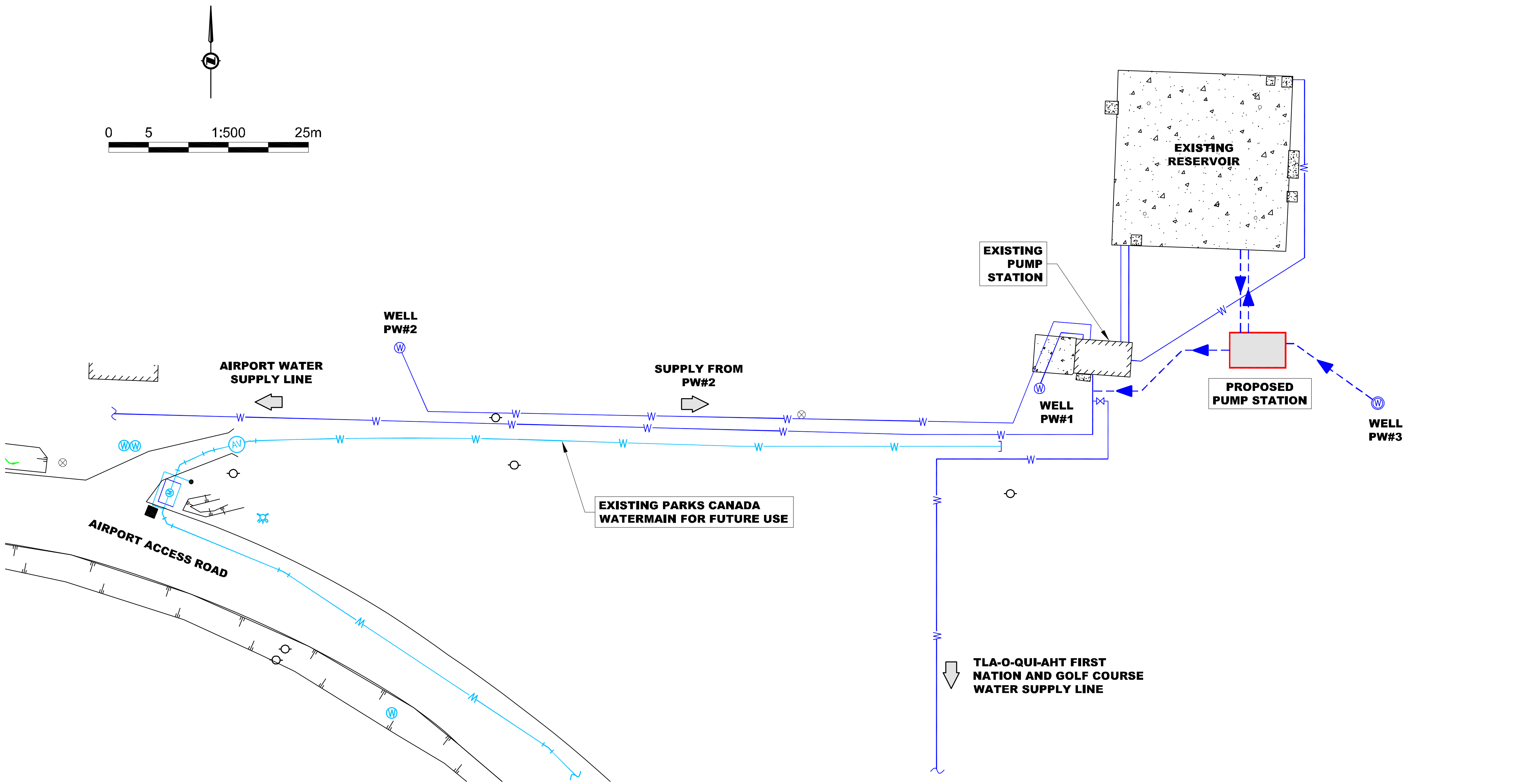
MARCH 2015

ALBERNI CLAYOQUOT REGIONAL DISTRICT
LONG BEACH AIRPORT WATER SYSTEM
OVERALL SITE PLAN

FIGURE 1



MARCH 2015

ALBERNI CLAYOQUOT REGIONAL DISTRICT
LONG BEACH AIRPORT WATER SYSTEM
PROPOSED PUMP STATION SITE PLAN

FIGURE 2

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January 19, 2015
11-13

McGill Associates Engineering Ltd.
4610 Elizabeth Street, Port Alberni, BC, V9Y 6L7

Attention: Alan McGill, P. Eng (Via email)

Re: Long Beach Airport – Design and completion of production well and monitoring wells

GW Solutions Inc. (GW Solutions) has been retained by McGill Associates to complete a 10 inch Stainless Steel Production Well and two groundwater monitoring wells. The following report summarizing work completed from August to November 2014, near Long Beach Airport (LBA, the site).

Background and Tasks completed

GW Solutions Inc. (GW Solutions) understands that the Alberni-Clayoquot Regional District (ACRD) needs to increase its water supply to meet the water demand for both the LBA facilities and part of the local Esowista First Nation. The current water system consists of two 6" wells, PW1 and PW2, which have seen the production rate decrease in recent years due to biofouling of the well screen, as described in GW Solutions report dated February 2013.

Work completed by GW Solutions follows recommendations made in February 2013 report which included the following:

- Design and completion of two monitoring wells that were drilled in 2012;
- Design, drilling and construction of a stainless steel production well;
- Development of the production well;
- Completion of an aquifer step test followed by a 24-hour constant rate pumping test;
- Rating of the new well;
- Testing of the water chemistry; and
- Reporting of the findings and recommendations.

Site Location

The site at Long Beach, where two monitoring wells and the new production well were completed, is located within Alberni Clayoquot Regional District at a distance of 110 km from Port Alberni and 16 km from Tofino (Figure 1).

Figure 2 shows in detail the groundwater exploration site. Wells denoted as PW1-LBA and PW2-LBA are part of the current water supply system for the airport. Monitoring wells drilled in 2012 and completed in 2014 are labeled as TW1-2012 LBA and TW2-2012 LBA. PW3-2014 refers to the new 10 inch stainless steel production well also completed in 2014.

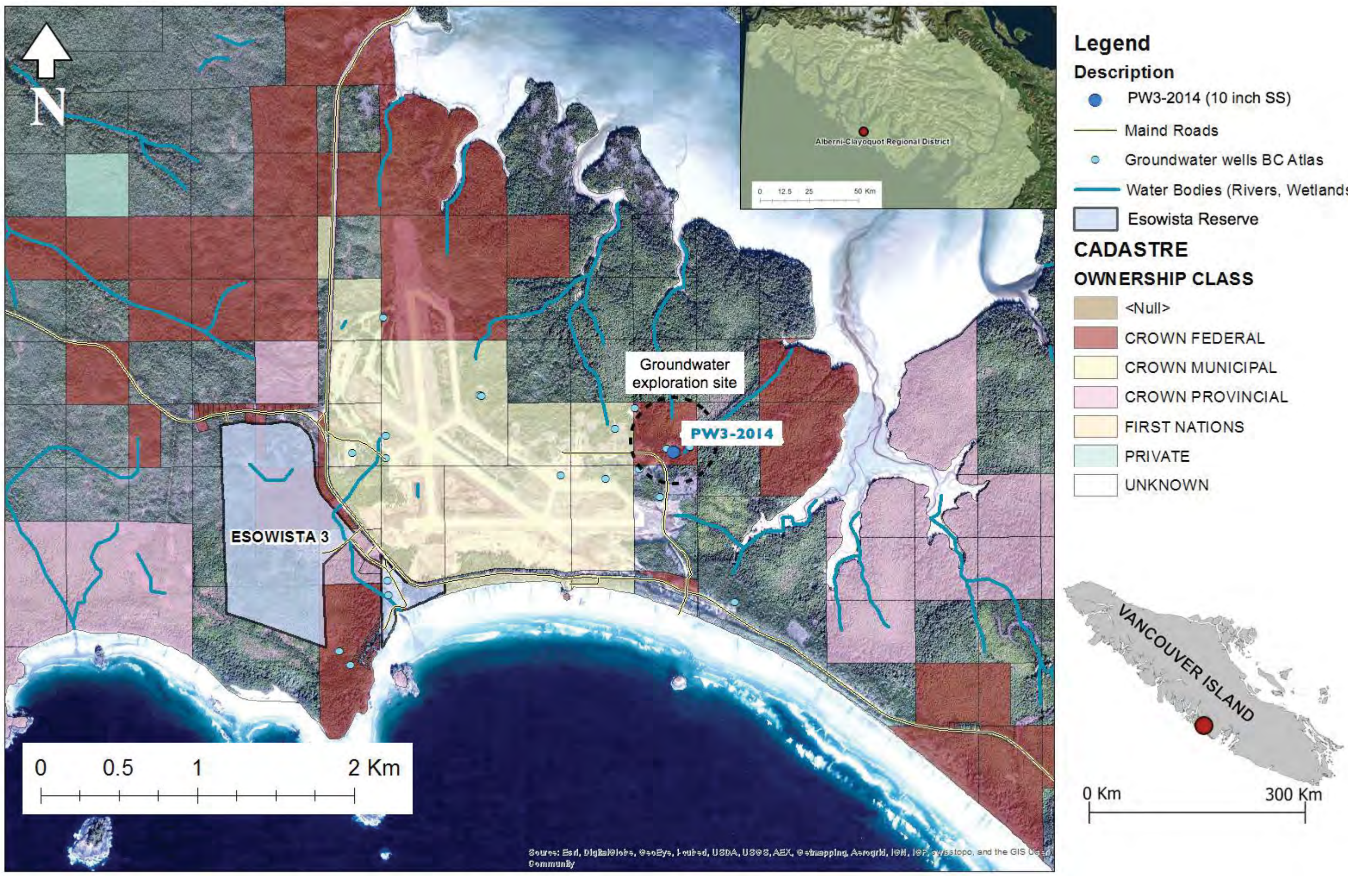


Figure 1: Site location

Figure 2: Locations of production and monitoring wells

Monitoring well completion

Screen design and assembly

Two test wells labeled as TW1-2012 LBA (ID Plate: 22593) and TW2-2012 LBA (ID Plate: 22592) were drilled in November-December 2012 by Fyfe's Well and Water Services (Fyfe) under GW Solutions Inc supervision. Soil samples were collected during drilling and selected samples were submitted to Levelton laboratory for grain size analyses. This information was used to select the most favourable location for the 10" production well, and to determine the optimum screen dimensions to be installed in the monitoring wells. Selected grain sizes (D_{40}, D_{50} and D_{60} passing) versus depth are shown in Figures 3 and 4.

Screen dimensions and designed flow rates are shown in Table 1. Both screens are 4 ft long, 6 inch diameter and they were designed for a flow rate of 70 USgpm without exceeding entrance velocity through screen of 3 cm/s.

Table 1: Screen dimensions and flow rates for both monitoring wells TW1-2012 LBA and TW2-2012 LBA

Selection of screen	
Screen diameter (inch)	6
Screen diameter (m)	0.1524
Screen Length (ft):	4
Screen Length (m):	1.2
Open Area (%):	30
Expected discharge (m^3/s)	0.0045
Expected discharge (USgpm)	71
Entrance Velocity (cm/s):	2.6
Upflow velocity (m/s):	0.25
Head loss (m):	0.000
Maximum discharge assuming entrance velocity of (cm/s	3
Discharge rate (m3/s)	0.005
Discharge rate (l/s)	5.3
Discharge rate (USgpm)	83.2

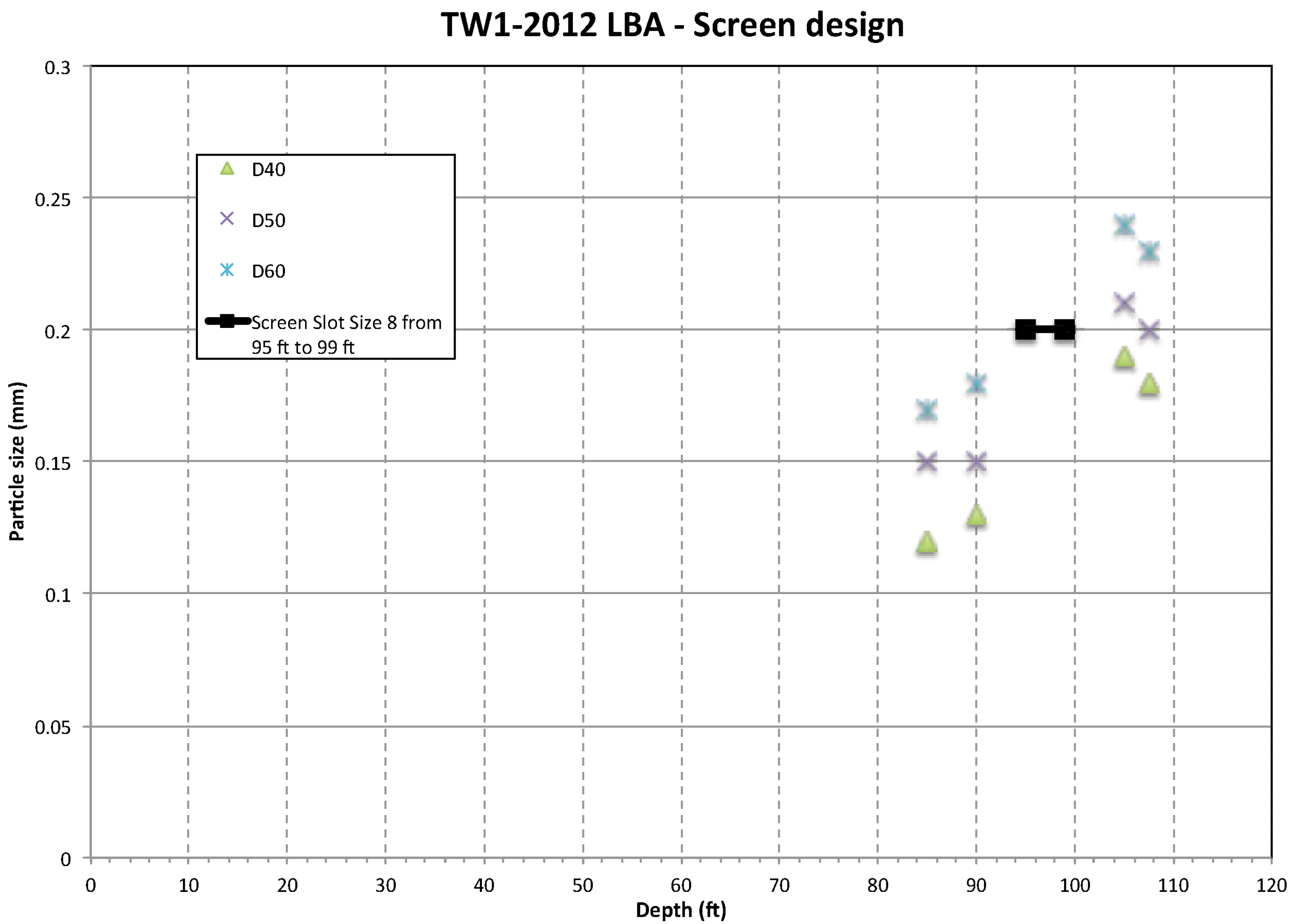


Figure 3: Screen design and representative D_{40}, D_{50} and D_{60} diameters for TW1-2012 LBA

Figure 4: Screen design and representative D_{40}, D_{50} and D_{60} diameters for TW2-2012 LBA

New production well completion

Drilling

Drilling and completion of PW3-2014 (10 inch SS ID Plate: 22571) was conducted in August-September 2014. The production well is located approximately 10 m from TW2-2012 LBA and 42 m from PW1. Both well screen and casing are made of stainless steel to minimize any future problem with corrosion and incrustation that could reduce well efficiency or compromise long-term water quality. The log of the well is presented in Figure 5 and also attached in Appendix 2.

During drilling eight soil samples were collected at depths ranging between 17.7 m (58 ft) and 32.6 m (107 ft). The samples were submitted to Levelton Consultants Ltd. (Levelton) laboratory for grain size analysis. The full report from Levelton is attached in Appendix 3.

Screen design and assembly

GW Solutions has completed the screen design based on the following criteria:

- The well screen must allow auto-filtration. Very small fines must be filtered by the natural filter pack adjacent to the well screen created by the initial well development.
- Minimize well losses during operation (minimize drawdown) so the well is energy-efficient. Entrance velocity should not exceed 3 cm/s to avoid turbulent flow and biofouling. Upward flow should not exceed 1.5 m/s to avoid excessive head loss.

The grain size curves and uniformity coefficient from the grain size analyses are shown in Figure 6. The curves indicate uniform, well sorted material for most of the layers (Cu < 3). The diameter of the grains are mainly between 0.15 mm and 0.4 mm suggesting very fine sand overall.

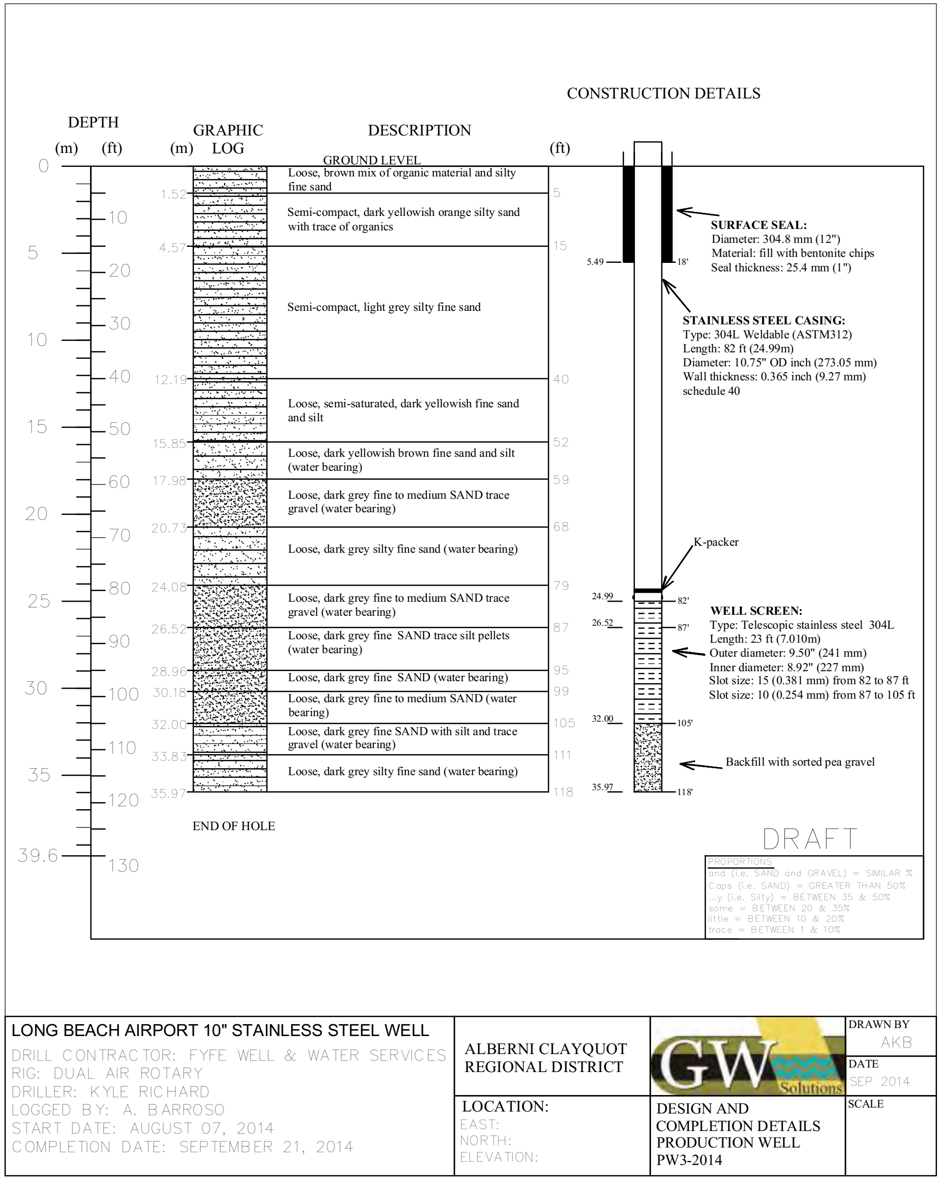
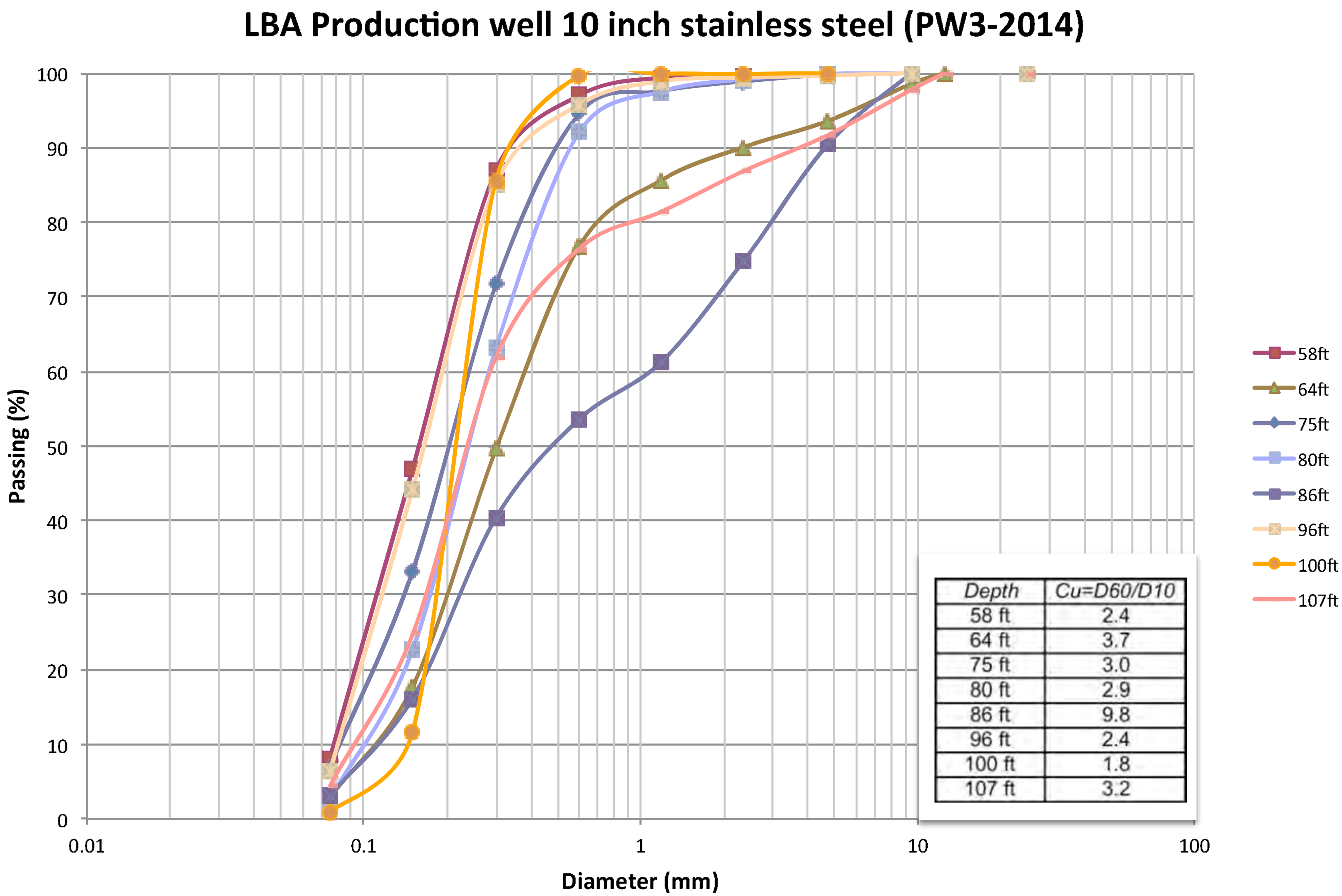


Figure 5: Log of production well PW3-2014



Depth	Cu=D60/D10
58 ft	2.4
64 ft	3.7
75 ft	3.0
80 ft	2.9
86 ft	9.8
96 ft	2.4
100 ft	1.8
107 ft	3.2

Figure 6: Grain size curves and uniformity coefficient (Cu)

Filtration and stability analyses were conducted to verify the internal stability of the aquifer material as a function of the opening of the screen, and to optimize the screen design to promote groundwater flow towards the well. The results are presented in Table 2.

Table 2: Filtration and stability analyses for soils at 80, 86, 96, 100, and 107 ft depths

Methodology			*86 filter - 80 retained*		*100 filter - 96 retained*		*100 filter - 107 retained*	
Author & year	***Standard/Crite***	***Type***	***Value***	***Test***	***Value***	***Test***	***Value***	***Test***
Terzaghi - 1922	D15/d85<4	Filtration	0.3	pass	0.5	pass	0.1	pass
Bertram - 1940	D15/d85 = 6	Filtration	0.3		0.5		0.1	
	D15/d15 = 9	Filtration	1.2		1.8		1.4	
USCE - 1948	D15/d85<5	Filtration	0.3	pass	0.5	pass	0.1	pass
	D50/d50<25	Filtration	2.1	pass	1.3	pass	0.9	pass
	D15/d15<20	Filtration	1.2	pass	1.8	pass	1.4	pass
Taylor - 1948	D50/d50<6.5	Filtration	2.1	pass	1.3	pass	0.9	pass
Sherman - 1953	D15/d15<20	Filtration	1.2	pass	1.8	pass	1.4	pass
	D15/d85<5	Filtration	0.3	pass	0.5	pass	0.1	pass
Leatherwood & Peterson - 1954	D50/d50<5.3	Filtration	2.1	pass	1.3	pass	0.9	pass
	D15/d85 <4.1	Filtration	0.3	pass	0.5	pass	0.1	pass
Karpoff - 1955	D50/d50<10	Filtration	2.1	pass	1.3	pass	0.9	pass

Zweck & Davidenkoff - 1957 : similar to Karpoff

Figure 7 shows calculated hydraulic conductivity based on the grain size analyses. The average aquifer hydraulic conductivity is 0.016 cm/s typical of fine conductive materials. The layers shallower than 86 ft contain sediments with a larger diameter (Figure 6). Figure 8 also corroborates previous observation where larger diameter particles are encountered above 86 ft. Based on the results, two slot sizes where chosen for the screen of the production well. Slot size 15 (0.381 mm) from 82 to 87 ft and slot size 10 (0.254 mm) from 87 to 105 ft as shown in the well log in Figure 5 and Appendix 2.

The well screen was designed for a maximum pumping rate of 208 USgpm as shown in Table 3. The optimum screen location was selected considering the permeability of the aquifer material as well as the maximum available drawdown when the well is in operation. Figure 8 displays the optimum location of the well screen including the representative diameter of analyzed soils.

Finally, soil stability analyses was carried out with the selected screen slot sizes to ensure filtration of fines will occur and the aquifer material will remain stable after development and during production. Table 4 presents the stability and filtration analyses considering the material retained by the two slot sizes (15 and 10) will act as a filter.

Table 3: Optimum screen design

Selection of screen	Slot size 15	Slot size 10
Screen diameter (inch)	10	10
Screen diameter (m)	0.254	0.254
Screen Length (ft):	5	18
Screen Length (m):	2	5
Open Area (%):	14	10
Expected discharge (m^3/s):	0.0051	0.0131
Expected discharge (USgpm):	81	208
Entrance Velocity (cm/s):	3.000	3.000
Upflow velocity (m/s):	0.10	0.26
Head loss (m):	0.000	0.001
maximum discharge assuming entrance velocity of (cm/s)	3	3
Discharge rate (m3/s)	0.0051	0.0131
Discharge rate (l/s)	5.1	13.1
Discharge rate (USgpm)	80.9	208.0

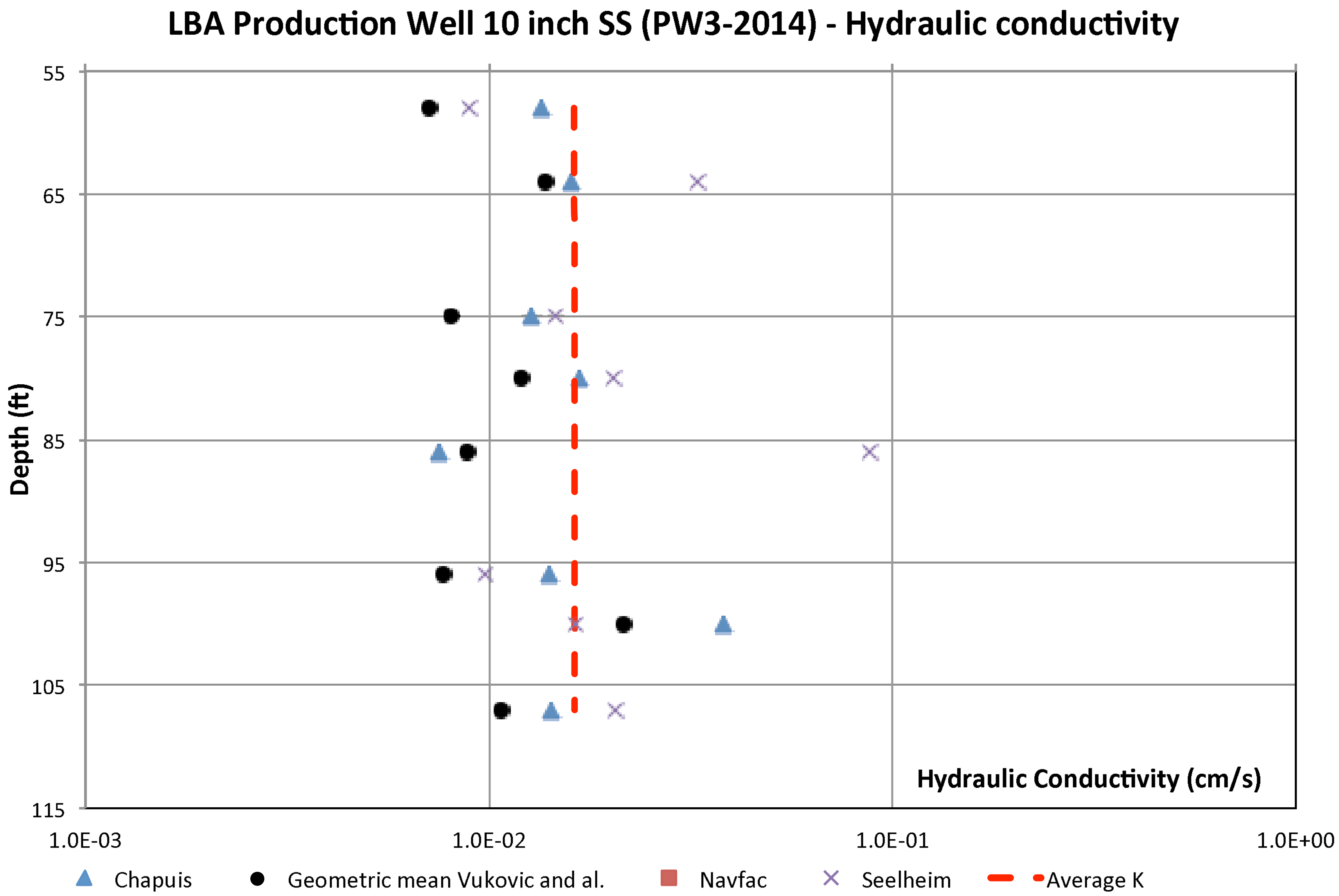


Figure 7: Calculated hydraulic conductivity of porous media from grain-size characteristics

Table 4: Stability and filtration analyses for the screen and aquifer material system

			Slot Size 15				Slot Size 10							
Methodology			*80 ft*		*86 ft*		*86 ft*		*96 ft*		*100 ft*		*107 ft*	
Author & year	***Standard/Crite.***	***Type***	***Value***	***Test***	***Value***	***Test***	***Value***	***Test***	***Value***	***Test***	***Value***	***Test***	***Value***	***Test***
Terzaghi - 1922	D15/d85<4	Filtration	0.8	pass	0.2	pass	0.1	pass	0.9	pass	0.9	pass	0.1	pass
Bertram - 1940	D15/d85 = 6	Filtration	0.8		0.2		0.1		0.9		0.9		0.1	
	D15/d15 = 9	Filtration	3.6		4.0		2.2		3.0		1.7		2.6	
USCE - 1948	D15/d85<5	Filtration	0.8	pass	0.2	pass	0.1	pass	0.9	pass	0.9	pass	0.1	pass
	D50/d50<25	Filtration	2.2	pass	4.1	pass	2.9	pass	1.8	pass	1.3	pass	2.2	pass
	D15/d15<20	Filtration	3.6	pass	4.0	pass	2.2	pass	3.0	pass	1.7	pass	2.6	pass
Taylor - 1948	D50/d50<6.5	Filtration	2.2	pass	4.1	pass	2.9	pass	1.8	pass	1.3	pass	2.2	pass
Sherman - 1953	D15/d15<20	Filtration	3.6	pass	4.0	pass	2.2	pass	3.0	pass	1.7	pass	2.6	pass
	D15/d85<5	Filtration	0.8	pass	0.2	pass	0.1	pass	0.9	pass	0.9	pass	0.1	pass
Leatherwood & Peterson - 1954	D50/d50<5.3	Filtration	2.2	pass	4.1	pass	2.9	pass	1.8	pass	1.3	pass	2.2	pass
	D15/d85 <4.1	Filtration	0.8	pass	0.2	pass	0.1	pass	0.9	pass	0.9	pass	0.1	pass
Karpoff - 1955	D50/d50<10	Filtration	2.2	pass	4.1	pass	2.9	pass	1.8	pass	1.3	pass	2.2	pass

Zweck & Davidenkoff - 1957 : similar to Karpoff

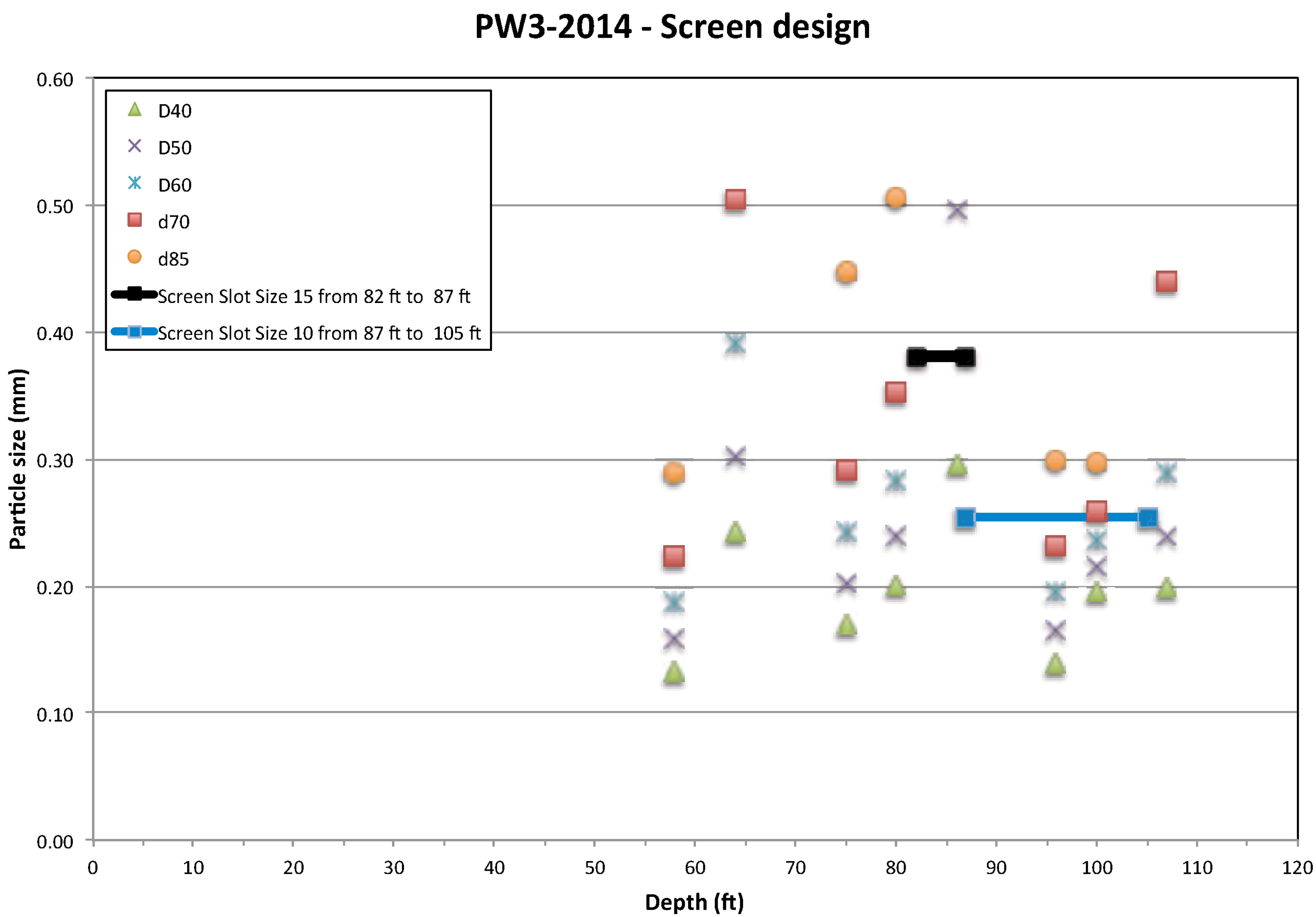


Figure 8: Final screen design and grain size diameters of aquifer (D_{40}, D_{50}, D_{70} and D_{85})

Well development

Well development was carried out after the screen was installed, from September 18 to 21, 2014. Different development methods were used in sequence. First, airlifting, followed by water jetting and finally development with both air and water jetting. Short pumping tests were also carried out between development stages in order to monitor development progress. Development was stopped when little to no fines were obtained and when no improvement in well efficiency was observed.

Well survey

The elevations of the wellheads were surveyed using an engineer level Meridian Model 8090 Level (David White Instruments, USA). This survey was important in the analysis of pumping test data and for the delineation of well capture zones. Although the starting ground elevation was assumed based on satellite maps (no geodetic benchmark was available close to the area), the relative elevation between wells was measured. The horizontal distances between points as shown in Table 5 are only approximations since the type of level used during the survey is mainly designed to determine differences in elevation between measured locations.

Table 5: Survey data

Name	Well ID Plate	Latitude	Longitude	Ground Elevation (masl)	Elevation TOC (masl)	Stick up (m)	Distance from 10 inch SS LBA (m)	Source
PW3-2014 10 inch SS LBA Tofino	*22571*	49.08006	-125.75820	23.035	24.325	1.290	0.0	Surveyed with Engineer level
TW1-2012 LBA Tofino	*22593*	49.07989	-125.75946	24.345	25.105	0.760	94.9	Surveyed with Engineer level
TW2-2012 LBA Tofino	*22552*	49.07998	-125.75815	23.085	23.905	0.820	10.1	Surveyed with Engineer level
PW1 - LBA Tofino	*13701*	49.08007	-125.75878	23.860	24.290	0.430	42.4	Surveyed with Engineer level
PW2 - LBA Tofino	*13705*	49.08011	-125.75982	24.268	24.988	0.720	118.5	Surveyed with Engineer level

TOC = Top of casing
masl = meters above sea level

Aquifer characterization

Step test and well efficiency

The water level in a well drops as the well is pumped, as a result of energy losses in the aquifer, adjacent to, and within the well screen. The interpretation of short pumping tests at different production rates provides the information necessary to estimate the hydraulic efficiency of a well screen. The step test in the PW3-2014 (10 inch SS) was carried out on September 30, 2014. It consisted of four steps each with 30 minutes duration and at rates ranging from 20 to 100 USgpm as shown in Figure 9.

Well efficiency can be determined as long as data is available for more than three steps. Coefficients for well losses and aquifer losses were calculated using Aquifer Test Pro V. 2014.1 (Appendix 4). From the step test data analysis, we conclude that PW3-2014 will operate with an efficiency higher than 97% when pumping at a rate lower than 100 USgpm as shown in Figure 10. The drawdown recorded in PW3-2014 is mainly due to aquifer material (aquifer losses) and a very small percentage (<3%) related to well construction/completion.

Constant rate pumping test

A 24-hour pumping test of PW3-2014 was completed from September 30 to October 01, 2014, at a rate of 75 USgpm. The drawdown measured by data loggers (and verified by periodic manual measurements) in the pumping wells and in the four monitoring wells is shown in Figure 11. The aquifer recovery was relatively fast, considering the aquifer material contains very fine sands, and the water level recovered by 90% within three hours following cessation of pumping.

No drawdown was recorded in monitored wells PW2 and TW1-2012 LBA. This indicates that PW3-2014 does not affect these wells when it is pumping at a rate of 75 USgpm or less.

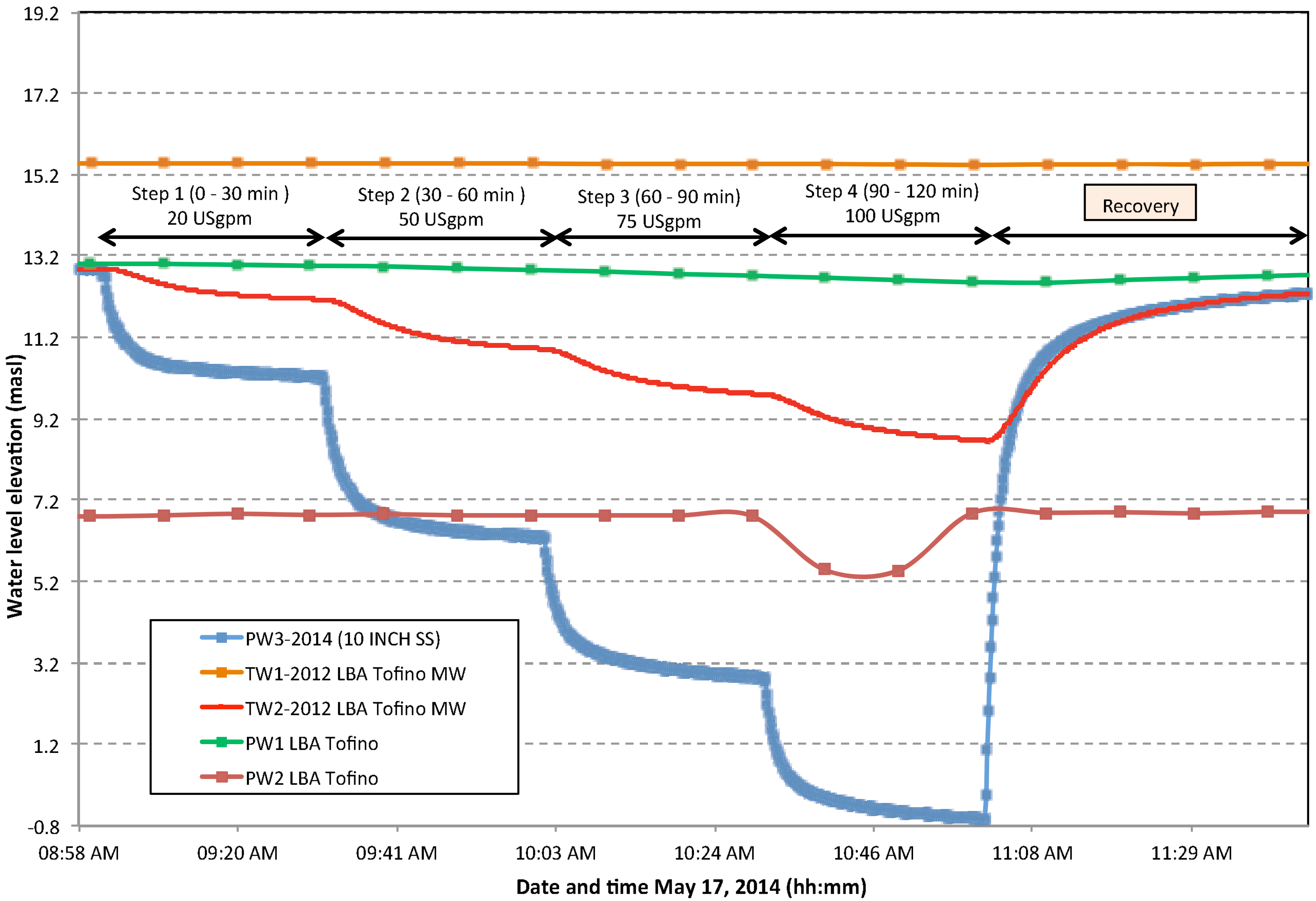


Figure 9: Step test in PW3-2014 showing also water level in test wells and production wells PW1 and PW2

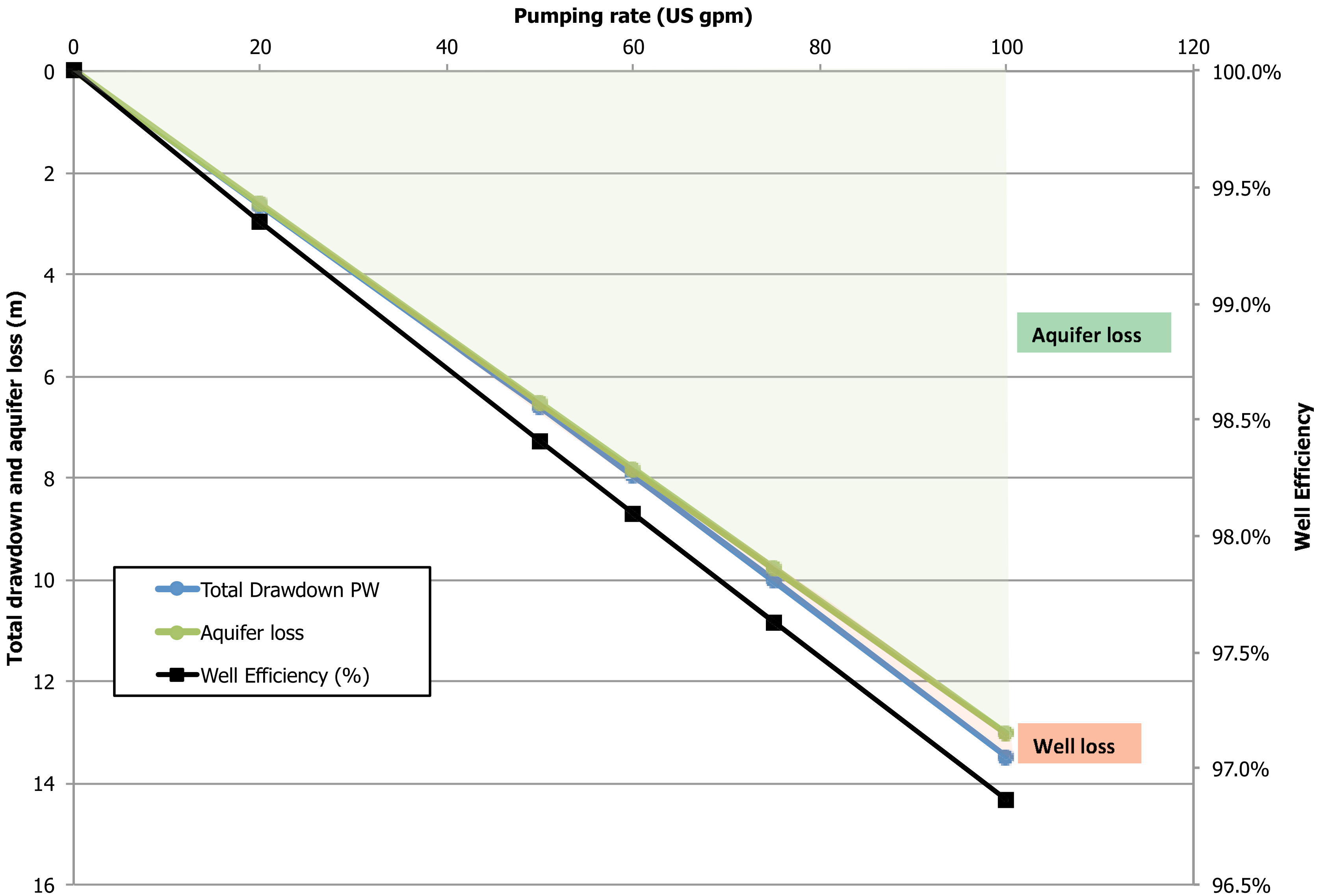


Figure 10: PW3–2014 - Well efficiency and aquifer and well losses

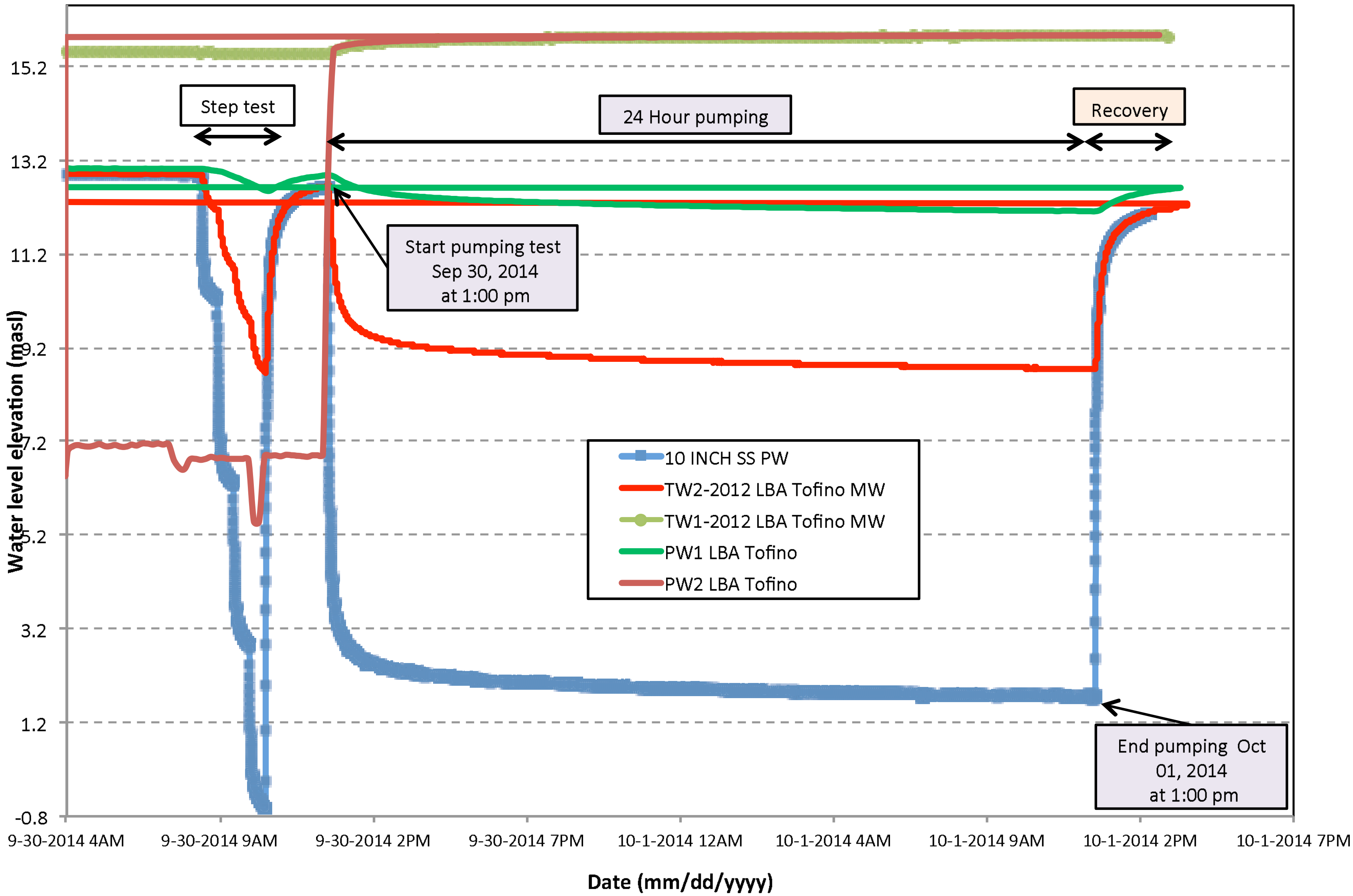


Figure 11: PW3-2014 - 24 hours pumping test including recovery period

Aquifer hydrogeological properties

Aquifer test Pro V2014.1 was used to estimate aquifer properties such as transmissivity and storativity. Results from the analyses are presented in Appendix 4. Table 6 summarizes aquifer properties estimated using different methodologies. The differences in transmissivity and storativity values for the different wells suggest there is spatial aquifer heterogeneity as well as a non-uniform aquifers thickness.

Table 6: Summary of aquifer hydrogeological properties

Observation Well	Method	Transmissivity (m^2/day)	Storage coeficient [-]	Radial Distance (m)
PW3-2014 (10 inch SS)	Theis (Step test+Pumping+Recovery)	70	2.91E-07	0.14
PW3-2014 (10 inch SS)	Theis+Agarwal Recovery	32	8.43E-03	0.14
PW3-2014 (10 inch SS)	Theis 24 hour Pumping	84	8.43E-03	0.14
TW2-2012 LBA	Theis (Step test+Pumping+Recovery)	80	5.47E-05	10.1
TW2-2012 LBA	Theis+Agarwal Recovery	47	6.08E-04	10.1
TW2-2012 LBA	Theis 24 hour Pumping	85	5.20E-06	10.1
PW1 - LBA Tofino	Theis (Step test+Pumping+Recovery)	173	1.73E-03	42.4
PW1 - LBA Tofino	Theis+Agarwal Recovery	125	1.47E-03	42.4
PW1 - LBA Tofino	Theis 24 hour Pumping	126	2.58E-03	42.4

Average values

PW3-2014 (10 inch SS)	77	5.62E-03
TW2-2012 LBA	83	2.23E-04
PW1 - LBA Tofino	150	1.93E-03

Well Yield Rating

The safe yield of the well was calculated using the presently applicable method in BC (Ground Water Reports and Well Tests in Support of a Certificate of Public Convenience and Necessity in Guidelines for Minimum Standards in Water Well Construction, Province of British Columbia (1982)). This method is based on the specific capacity calculated from the projected drawdown after 100 days of continuous pumping assuming no aquifer recharge during this period (the straight line 100-day approach) and using a 30% margin of safety (utilizing 70% of the available drawdown). The drawdown and recovery curves using the 100-day predicted drawdown are shown in Figure 12. The assumptions and the calculations are presented in Table 7. The safe yield of PW3-2014 is 3.8 L/s (60 USpgm)

Table 7: Calculated Safe Yield

Parameter	Unit	Key	PW3-2014 LBA 10" SS PW
Pumping rate	Usgpm		75
Drawdown (100 days)	m		12
Projected specific capacity (100 days)	Usgpm/m		6.3
Specific capacity	L/s/m	a	0.39
Depth to top of screen	mbg	b	25.0
Stickup	m	c	1.29
"Static" water level (Sep 29, 2014)	mbTOC	d	11.415
Seasonal impact	m	e	1
Safety factor (70%)		f	0.7
Available drawdown	m	g = b+c-d-e	13.87
Safe available drawdown	m	h = f x g	9.71
Safe available drawdown	ft		31.9
Safe estimated sustainable yield	L/s	I = a x h	3.8
Safe aquifer estimated sustainable yield	USgpm		60.7
Safe aquifer estimated sustainable yield	Igpm		50.5
Maximum recommended yield	**USgpm**		**60**
Maximum recommended yield	**Igpm**		**50**

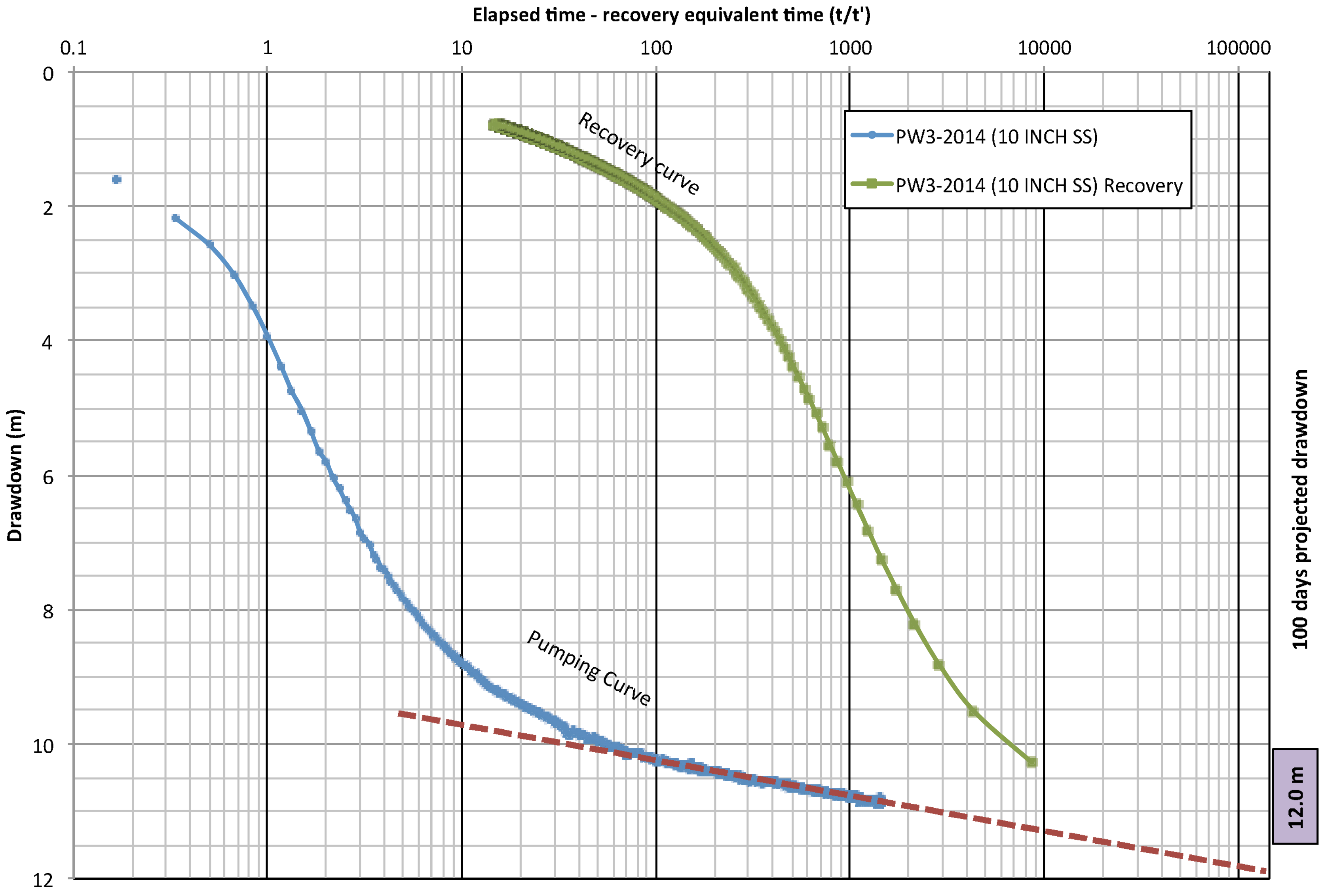


Figure 12: Extrapolated 100 days drawdown for a pumping rate of 75 USgpm (BC Well Rating Guidelines)

Assessment of long term safe yield in neighbouring wells

Another method of assessing a safe long-term pumping rate is through modelling. In order to evaluate how the groundwater withdrawal affects neighbouring wells, different scenarios were created using various pumping rates. From the pumping test (Figure 11), drawdown has been observed only within PW1 and TW2-2012 when PW3-2014 is in operation; therefore, modelling drawdown scenarios will include these wells as shown in Figure 13.

When PW3-2014 well pumps at a higher rate, greater drawdown will be expected in the neighbouring wells. For instance, when pumping at a rate of 100 USgpm from PW3-2014 for 100 days, 2.70 m of total drawdown will be expected in PW1 considerably reducing the available drawdown in PW1. If PW3 was pumped at a lower rate of 60 USgpm or 40 USgpm, drawdowns of 1.6 m or 1.0 m will be expected in PW1, respectively. This suggests that, if possible, PW1 should be used only as a monitoring well otherwise the pumping rate of PW1 should be lowered accordingly.

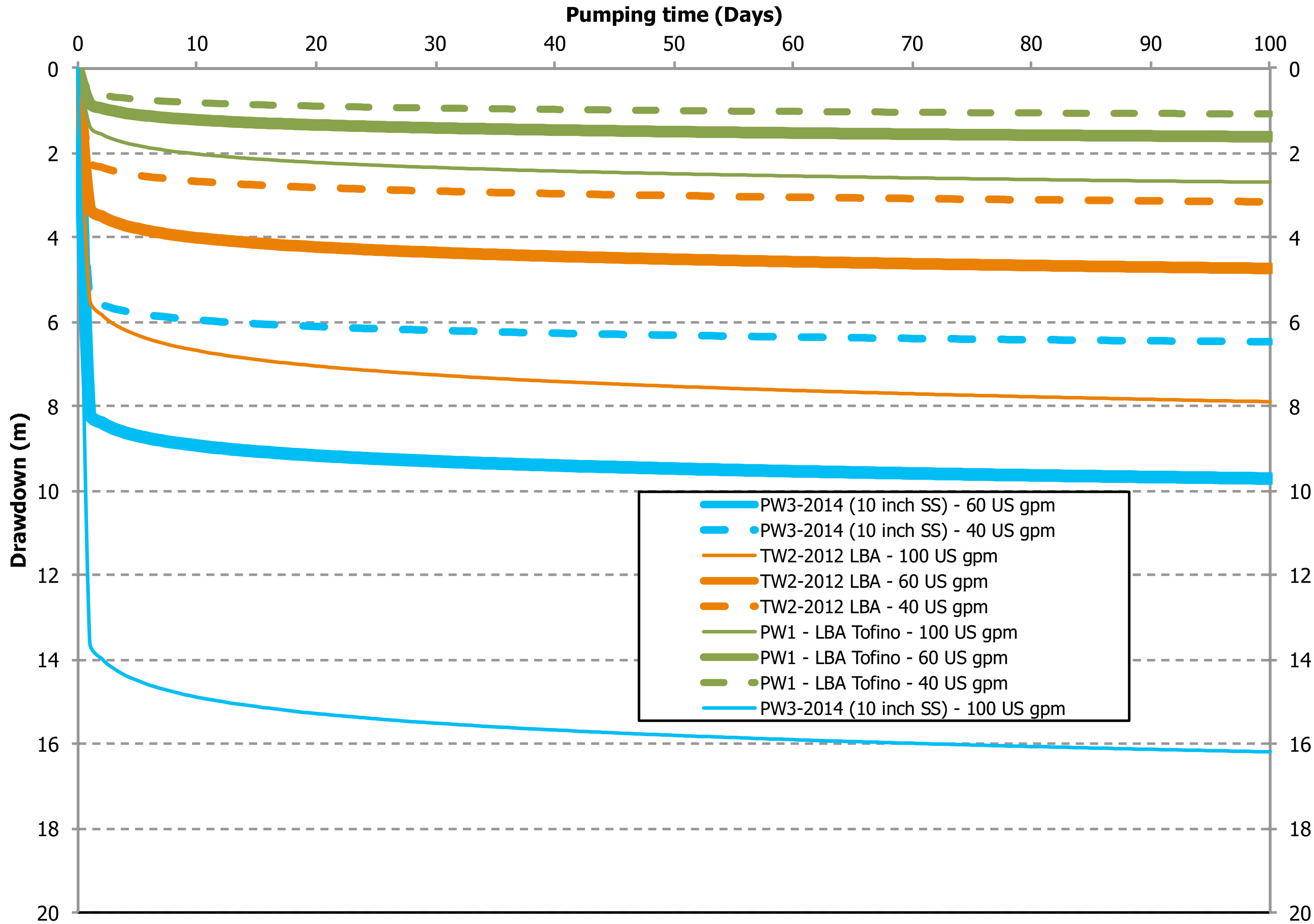


Figure 13: Modelled scenarios of drawdown behaviour when PW3-2014 is pumping continuously for 100 days

Groundwater Quality

Field parameters including conductivity, temperature, pH, oxido-reduction potential (ORP), dissolved oxygen, and salinity were monitored during the pumping test (Figure 14). In-situ monitoring helps identifying trends, if pumping has reached a boundary (river, creek, lake, no flow), or whether salt-water intrusion is occurring, which is a risk for wells in coastal areas. No substantial trends were noticed.

A water sample was collected at the end of the constant rate pumping test and submitted to Maxxam Analytics for chemical analyses. All the parameters meet the applicable Guidelines for Canadian Drinking Water Quality (GCDWQ), except for iron (0.689 mg/L compared to the guideline of 0.3 mg/L), manganese (0.366 mg/L compared to the guideline of 0.050 mg/L), and turbidity (7.6 NTU - guideline 0.1 NTU).

Both iron and manganese guidelines are aesthetic based (AO – Aesthetic Objective), and turbidity is a maximum acceptable concentrations (MAC) related to the efficacy of water treatment technology. GW Solutions expects that turbidity will drop with time when the well is put in production. Both iron and manganese concentrations are also expected to decrease as a result of aquifer development. Therefore, we recommend that the well should be pumped for several days (or even weeks) and water disposed of or used for non-potable purposes. Turbidity should be monitored during that period of time to establish what the turbidity under long-term pumping conditions, (and associated iron and manganese concentrations) will be. The design of any filtering or treatment system, should it be required, would be based on the quality of the water following this “clean-up” process.

A summary table of water quality results is presented in Table 8 and the lab report is attached in Appendix 5.

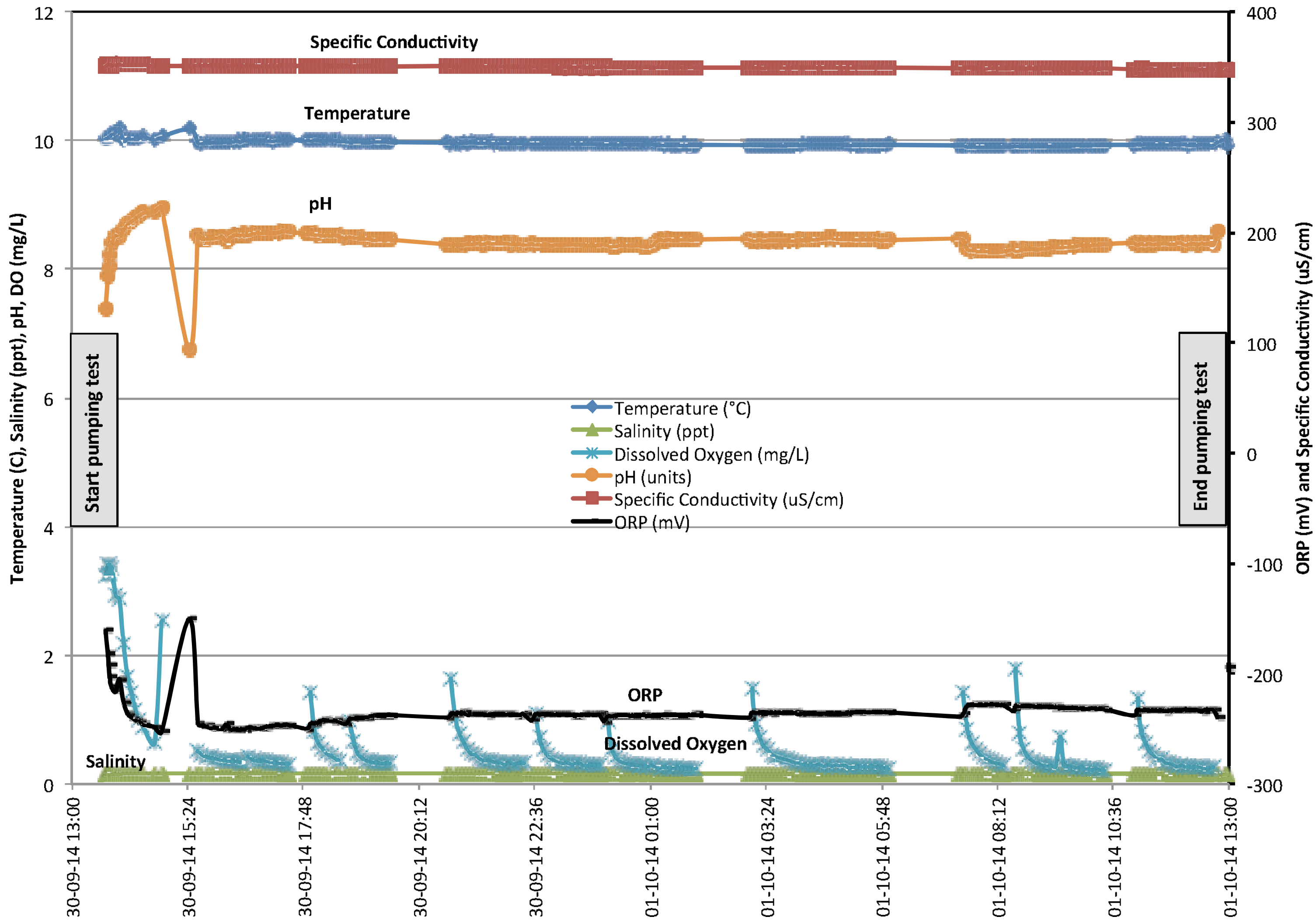


Figure 14: Field parameters monitored in PW3-2014 during the pumping test

Table 8: Water quality summary PW3-2014 (10 inch SS LBA well)

PARAMETERS	Units	10 SS LBA WELL	RDL	PARAMETERS	Units	10 SS LBA WELL	RDL
CONVENTIONALS				**Total Metals by ICPMS**			
Dissolved Nitrate (N)	mg/L	<0.010	0.010	Total Aluminum (Al)	ug/L	28.9	3.0
Dissolved Nitrite (N)	mg/L	0.045	0.010	Total Antimony (Sb)	ug/L	<0.50	0.50
Misc. Inorganics				Total Arsenic (As)	ug/L	0.81	0.10
Dissolved Chloride (Cl)	mg/L	14.9	0.50	Total Barium (Ba)	ug/L	8.8	1.0
Dissolved Fluoride (F)	mg/L	0.105	0.010	Total Beryllium (Be)	ug/L	<0.10	0.10
Dissolved Sulphate (SO4)	mg/L	23.5	0.50	Total Bismuth (Bi)	ug/L	<1.0	1.0
Misc. Inorganics				Total Boron (B)	ug/L	<50	50
Dissolved Hardness (CaCO3)	mg/L	142	0.50	Total Cadmium (Cd)	ug/L	<0.010	0.010
Alkalinity (Total as CaCO3)	mg/L	135	0.5	Total Chromium (Cr)	ug/L	<1.0	1.0
Total Organic Carbon (C)	mg/L	0.58	0.50	Total Cobalt (Co)	ug/L	<0.50	0.50
Alkalinity (PP as CaCO3)	mg/L	<0.5	0.5	Total Copper (Cu)	ug/L	<0.20	0.20
Bicarbonate (HCO3)	mg/L	164	0.5	Total Iron (Fe)	ug/L	688	5.0
Carbonate (CO3)	mg/L	<0.5	0.5	Total Lead (Pb)	ug/L	<0.20	0.20
Hydroxide (OH)	mg/L	<0.5	0.5	Total Manganese (Mn)	ug/L	366	1.0
MISCELLANEOUS				Total Molybdenum (Mo)	ug/L	<1.0	1.0
True Colour	Col. Unit	5	5	Total Nickel (Ni)	ug/L	<1.0	1.0
Sulphide	mg/L	0.0059	0.0050	Total Selenium (Se)	ug/L	<0.10	0.10
Nutrients				Total Silicon (Si)	ug/L	14600	100
Total Ammonia (N)	mg/L	0.15	0.0050	Total Silver (Ag)	ug/L	<0.020	0.020
Total Organic Nitrogen (N)	mg/L	<0.020	0.020	Total Strontium (Sr)	ug/L	144	1.0
Nitrate plus Nitrite (N)	mg/L	0.04	0.01	Total Thallium (Tl)	ug/L	<0.050	0.050
Total Nitrogen (N)	mg/L	0.204	0.020	Total Tin (Sn)	ug/L	<5.0	5.0
Physical Properties				Total Titanium (Ti)	ug/L	<5.0	5.0
Conductivity	uS/cm	346	1	Total Uranium (U)	ug/L	<0.10	0.10
pH	pH	7.9	N/A	Total Vanadium (V)	ug/L	<5.0	5.0
Total Dissolved Solids	mg/L	242	10	Total Zinc (Zn)	ug/L	6.9	5.0
Turbidity	NTU	7.6	0.1	Total Zirconium (Zr)	ug/L	<0.50	0.50
Elements				Total Calcium (Ca)	mg/L	40.3	0.050
Total Mercury (Hg)	ug/L	<0.010	0.010	Total Magnesium (Mg)	mg/L	9.04	0.050
Microbiological Param.				Total Potassium (K)	mg/L	2.16	0.050
Heterotrophic Plate Count	CFU/mL	54 (1)	1	Total Sodium (Na)	mg/L	11.4	0.050
Parameter				Total Sulphur (S)	mg/L	7.6	3.0
Sulphate reducing bacteria	CFU/mL	<200	200	RDL = Reportable Detection Limit			
Microbiological Param.				N/A = Not Applicable			
Total Coliforms	CFU/100mL	<1	1		Exceeds GCDWQ Standard		
E. coli	CFU/100mL	<1	1				

Preliminary aquifer protection plan

The delineation of the production well (PW3-2014) capture zone was estimated based on the static levels measured in both the monitoring and the pumping wells, the characteristics of the aquifer, and the proposed pumping rate (60 USgpm). The comet shape capture zone is shown in Figure 15. Groundwater flows from west to east at an average linear horizontal groundwater velocity of 30 cm/day (approximately 100 m/year).

There are no known or reported sources of contamination within the estimated capture zone, therefore GW Solutions does not expect any degradation of the water quality as a result of contaminants introduced at the land surface.

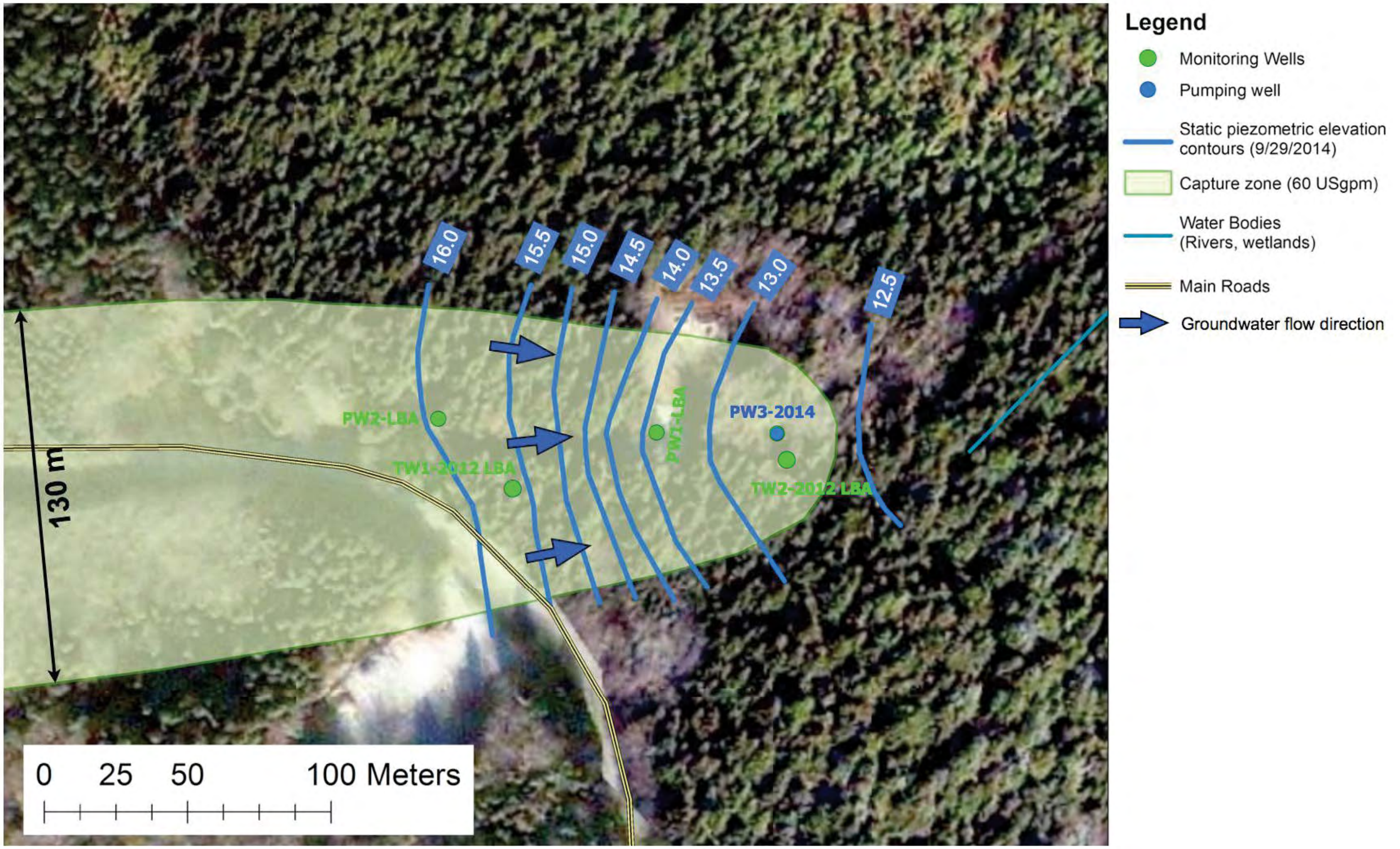


Figure 15: PW3-2014 production well capture zone delineation and piezometric contour map

Monitoring water quality and water level in aquifer

GW Solutions has been monitoring water levels in both test wells and production wells at the LBA site since August 2014 (Figure 16). No changes or trends on water levels have been observed at the LBA site over this short time period. However, it is recommended to continue monitoring water level at the LBA site in order to better assess water level behaviour. There are in total one barologger and five leveloggers installed in PW1, PW2, TW1-2012 LBA, TW2-2012 LBA and PW3-2014 wells. Water level data should be collected with dataloggers at an interval of 1 to 5 hours. Water level fluctuations should be reviewed on a yearly basis.

GW Solutions downloaded water level data from the dataloggers on January 05, 2015. At the same time devices were reprogramed to read water level every 2 hours.

Regarding water quality, once water from well is flushed and it is in operation, water samples should be collected and summited for full potability analysis on a regular basis (i.e., once a year).

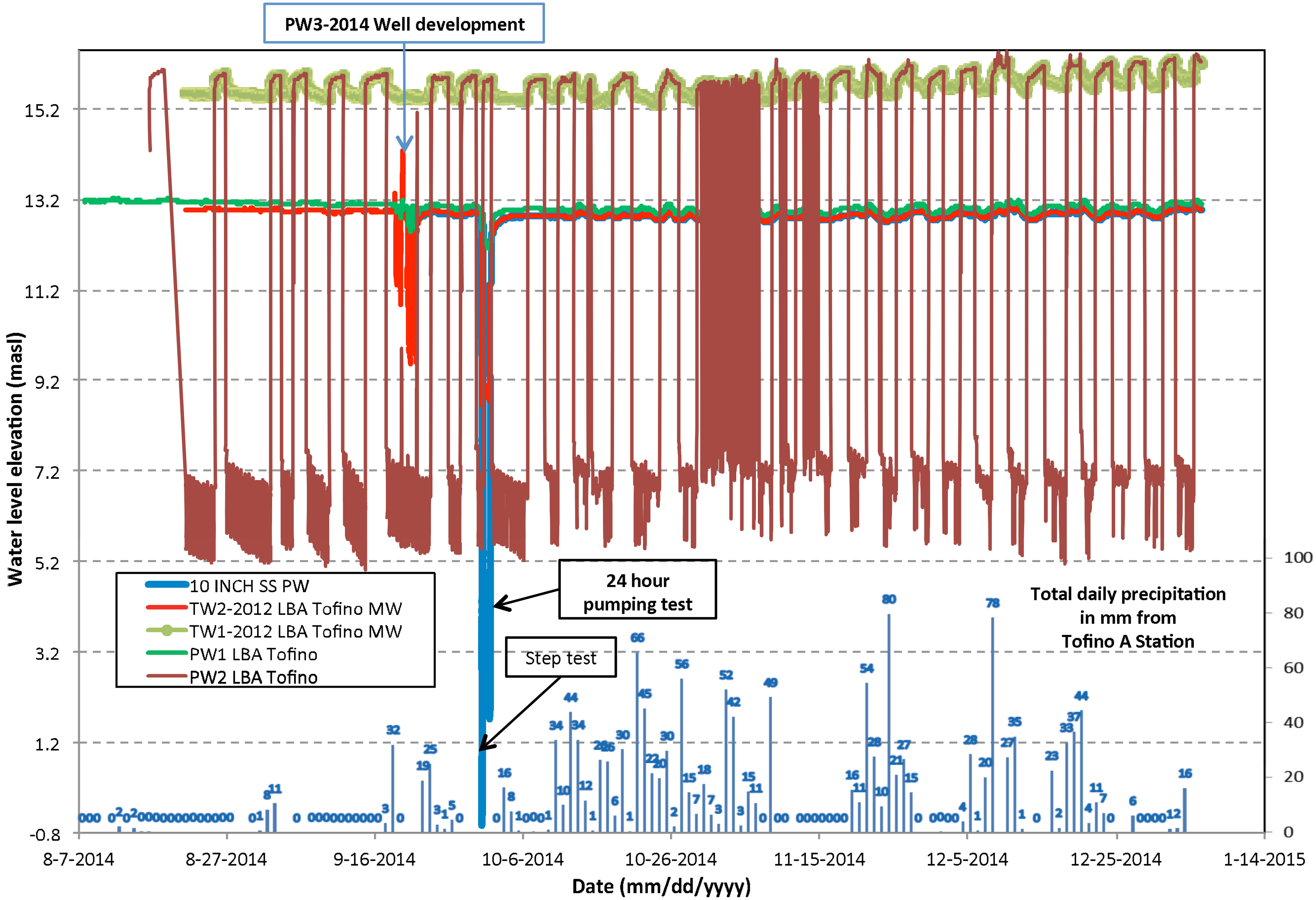


Figure 16: Long-term groundwater level monitoring at the LBA site

Conclusions

Based on the completed work and the data compiled and analysed, the following conclusions are made:

1. PW3-2014 (10" SS LBA well) is rated to be pumped at a safe yield of 3.8 L/s (60 USgpm).

2. The water from PW3-2014, sampled on October 1, 2014 is potable and meets the CDWQG, except for iron (0.689 mg/L – standard at 0.3 mg/L), manganese (0.366 mg/L – standard at 0.050 mg/L), and turbidity (7.6 NTU – standard at 0.1 NTU). The design of any filtering or treatment system, should it be required, should be based on the quality of the water following several days/weeks of pumping, because it is expected that turbidity, iron and manganese concentrations will drop considerably when the well is put into production.

Recommendations

GW Solutions makes the following recommendations:

1. The fluctuation of the water levels in PW3-2014, as well as in the monitoring wells TW1 2012 LBA, TW2 -2012 LBA, and PW1 and PW2 should be recorded using data loggers programed to collect data every 2 hours. The data should be reviewed by a hydrogeologist every year.

2. The quality of the water pumped from PW3-2014 should be analyzed according to the requirement specified by Island Health. It should include a full potability analysis on a yearly basis.

3. The well has to be maintained/rehabilated using airlifting and jetting methods every year. Light chemical and bactericide treatment may be part of the rehabilitation work. Every two years, at the end of a rehabilitation process, a 24 hour pumping test should be carried out again in order to assess aquifer yield

4. A gated and fenced area should be built to control access to the well and its recharge zone.

Closure

Conclusions and recommendations presented herein are based on available information at the time of the study. The work has been carried out in accordance with generally accepted engineering practice. No other warranty is made, either expressed or implied. Engineering judgement has been applied in producing this letter-report.

This report was prepared by personnel with professional experience in the fields covered. Reference should be made to the General Conditions and Limitations attached in Appendix 1.

GW Solutions was pleased to produce this document. If you have any questions, please contact me.

Yours truly,

GW Solutions Inc.

Gilles Wendling, Ph.D., P.Eng.
President

List of Appendices

Appendix 1: GW Solutions Inc. General Conditions and Limitations

Appendix 2: Well completion Logs

- TW1-2012
- TW2-2012
- PW3-2014 (10 inch SS LBA)

Appendix 3: Sieve analyses

- TW1-2012
- TW2-2012
- 10 inch SS LBA production well

Appendix 4: Aquifer test results

- Well losses and specific capacity analysis
- Step, 24 hour pumping and recovery test analysis
- Recovery data analysis after 24 hour pumping test
- 24 hour pumping period test analysis

Appendix 5: Water chemistry

- 10 inch SS LBA well

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

3008 Fifth Avenue, Port Alberni, B.C. CANADA V9Y 2E3 Telephone (250) 720-2700 FAX: (250) 723-1327

REQUEST FOR DECISION

To: West Coast Committee

From: Wendy Thomson, Manager of Administrative Services

Meeting Date: May 14, 2015

Subject: **West Coast Committee Draft New Terms of Reference**

Recommendation:

That the West Coast Committee recommend that the Alberni-Clayoquot Regional District Board of Directors approve the Terms of Reference for the West Coast Committee as presented.

Desired Outcome:

To approve a new terms of reference for the West Coast Committee.

Background:

The ACRD Board of Directors has instructed staff to update and or develop terms of references for all Regional District committees.

Regional District's may establish various committees to assist the Board in decision-making processes. There are three types of committees: standing, select and advisory.

Standing Committees are permanent bodies primarily made up of Directors that are established by the Chairperson to provide regular, ongoing advice to the Board on different areas of business, activities and services.

Select Committees are temporary, time-limited bodies that are established by the Board to provide advice on a particular issue or initiative that arises. Once the issue is dealt with, the select committee is dissolved.

Advisory Committees are made up primarily of community volunteers and assist with the delivery of regional district services, providing input on community interests related to a specific service.

The West Coast Committee is a "standing committee" of the ACRD. Attached for consideration of the West Coast Committee is a "draft" new terms of reference with the following amendments:

a. Scheduled quarterly meetings
b. Meeting schedule approved and circulated each January
c. Chair and Vice-Chair of the Committee elected annually

Time Requirements – Staff & Elected Officials:

Some staff time required to update and or develop terms of references for the Regional District's 17 Committees.

Policy or Legislation:

The *Local Government Act, Community Charter* and ACRD Procedures Bylaw A1075 apply.

Submitted by: ______________________________
Wendy Thomson, Manager of Administrative Services

Approved by: ______________________________
Russell Dyson, Chief Administrative Officer

Alberni-Clayoquot Regional District

Terms of Reference
West Coast Committee

1. Purpose

1.1 The West Coast Committee has been established to consider issues and to make recommendations to the ACRD Board pertaining to services paid for by one or more of the following areas within the region: District of Tofino, District of Ucluelet, Long Beach and Yuułuʔiłʔatḥ Government.

2. Duties/Mandate

2.1 The West Coast Committee is a standing committee of the Board that will assist the Board with decision making including budget, policy, infrastructure needs and any other issues relating to the following services:

- West Coast Waste Management
- Long Beach Airport
- Long Beach Emergency Planning
- Long Beach Bike Path

2.2 The Committee will explore, consider and make recommendations to the Board on possible future services within the areas defined in section 1.1.

2.3 The Committee will provide the Board with regular, ongoing advice on different activities and services with the areas defined in section 1.1

3. Membership

3.1 Membership on the Committee is as follows:

- Director for Electoral Area "C" Long Beach, or his/her alternate
- One (1) Director appointed to the Board from the District of Tofino, or his/her alternate
- One (1) Director appointed to the Board from the District of Ucluelet, or his/her alternate

- One (1) Director appointed to the Board from the Yuułuʔiłʔatḥ Government, or his/her alternate
- One (1) non-voting ex-officio Member representing Pacific Rim National Park

4. Appointment and Term

4.1 The appointment and term of Committee Members coincides with the Directors appointment or elected term on the ACRD Board of Directors.

4.2 Committee appointments are confirmed by the Chair of the Board at the Regular ACRD Board of Directors Meeting in January of each year.

4.3 The Chair of the Board may appoint persons who are not Directors of the ACRD Board to the Committee as ex-officio non-voting Members. These Members sit without remuneration. The ACRD Board may consider reimbursement for travel expenses for ex-officio non-voting Members upon recommendation from the Committee. The Chair will confirm appointments of non-voting ex-officio Members in January of each year.

5. Committee Chair

5.1 The Committee will elect a Chair and Vice-Chair from amongst its Members at the first meeting of each year.

6. Meeting Procedures

6.1 Meetings of the Committee shall be held quarterly or at the call of the Committee Chairperson. The yearly Committee meeting schedule will be developed and approved by the Board at the first Board meeting in January of each year.

6.2 A quorum for a meeting of the Committee shall be the majority of the Members of the Committee.

6.3 Meetings of the Committee shall be conducted and held in accordance with the Regional District's Procedure Bylaw.

7. Reporting to the Board

7.1 The Committee Chair will report to the ACRD Board on the activities of the Committee.

7.2 Recommendations from the Committee to the Board must be adopted by the Committee prior to presentation to the ACRD Board.

8. Resources

8.1 On behalf of the Committee, the CAO or his/her designate will provide advice and professional assistance to the Committee including writing letters, preparing reports to the ACRD Board.

8.2 ACRD Administrative staff will provide support to the Committee including preparing agendas, recording the minutes of meetings and ensuring Committee agenda's, minutes etc. are circulated electronically to all Members.

Approved by the ACRD Board:	
Revised by the Board:	