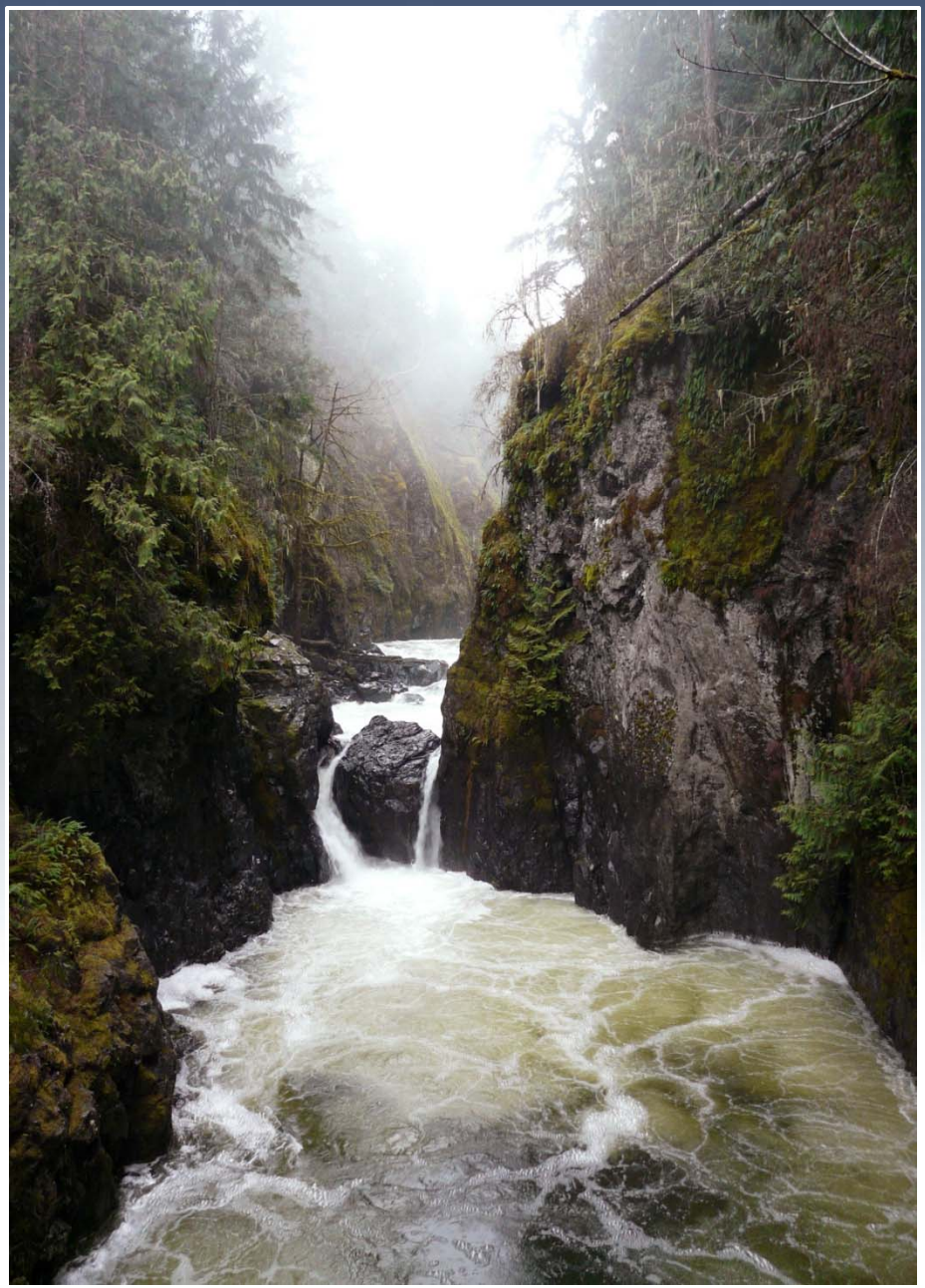


ASR Project Development

Progress Report

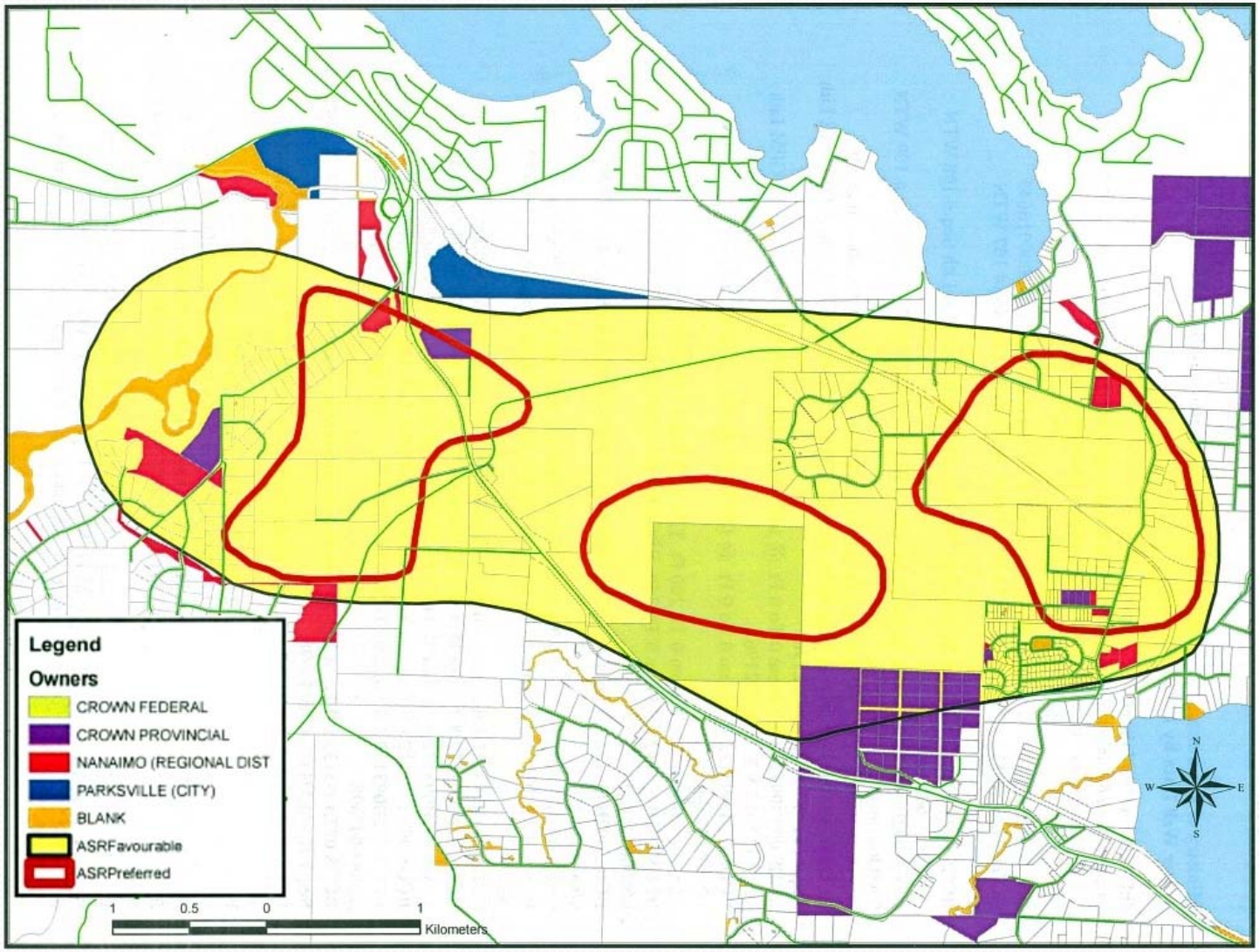
Englishman River Water Service

Dennis Lowen
B.Sc.G.E., P.Eng., P.Geo.

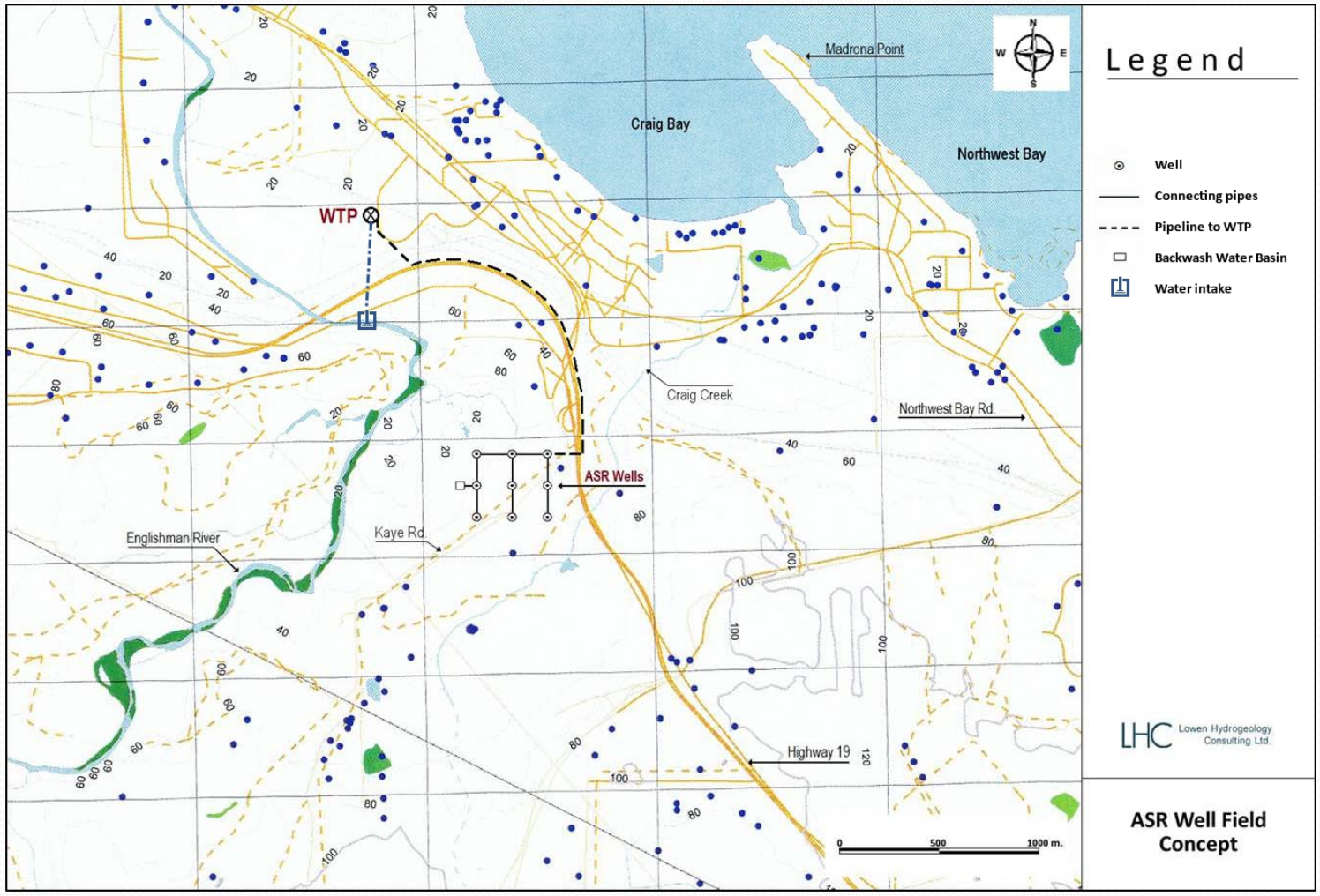
June 2013

LHC Lowen Hydrogeology Consulting Ltd.

ASR Feasibility Program (2011-12)



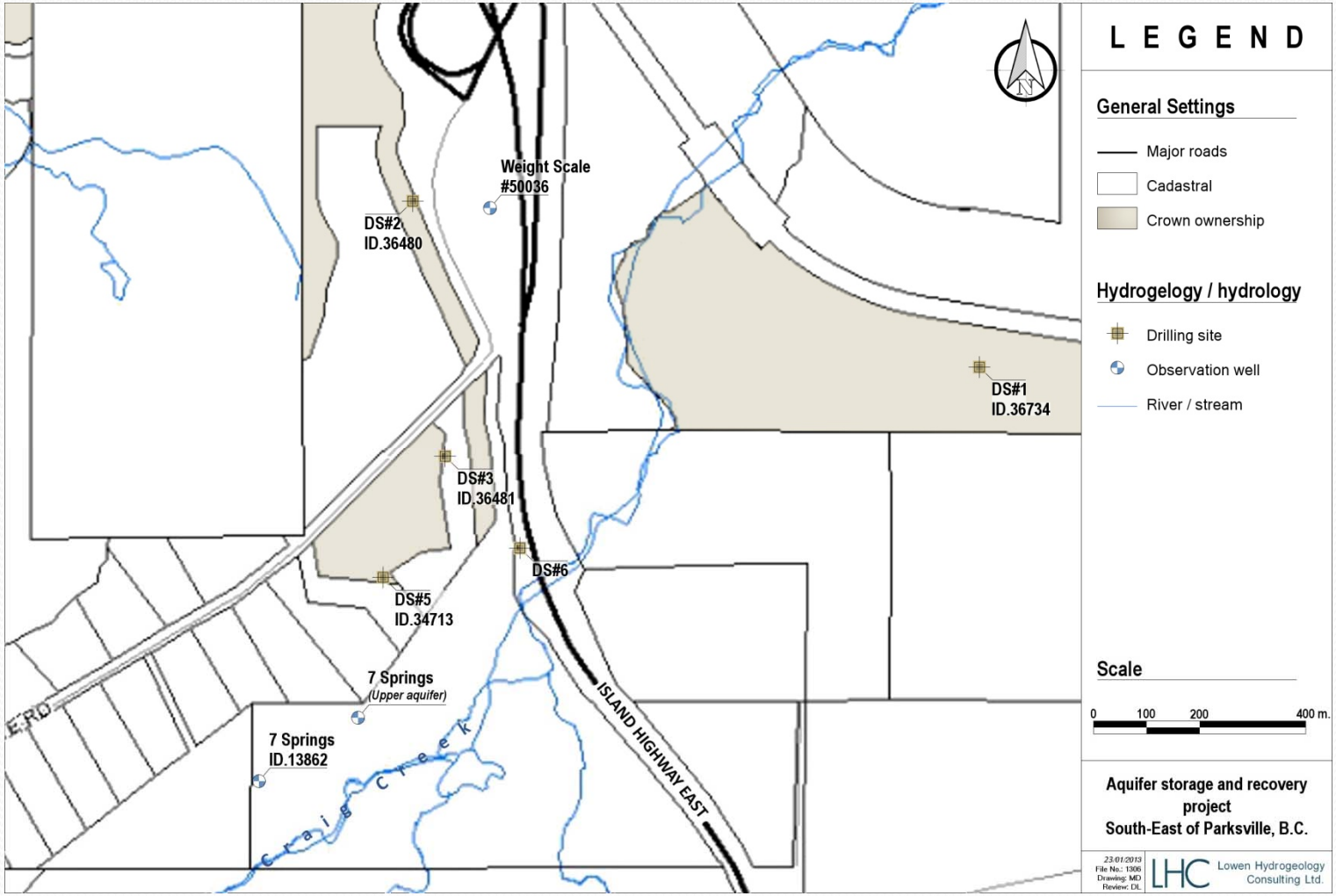
Original Conceptual Plan



Revised Project Water Storage Objectives

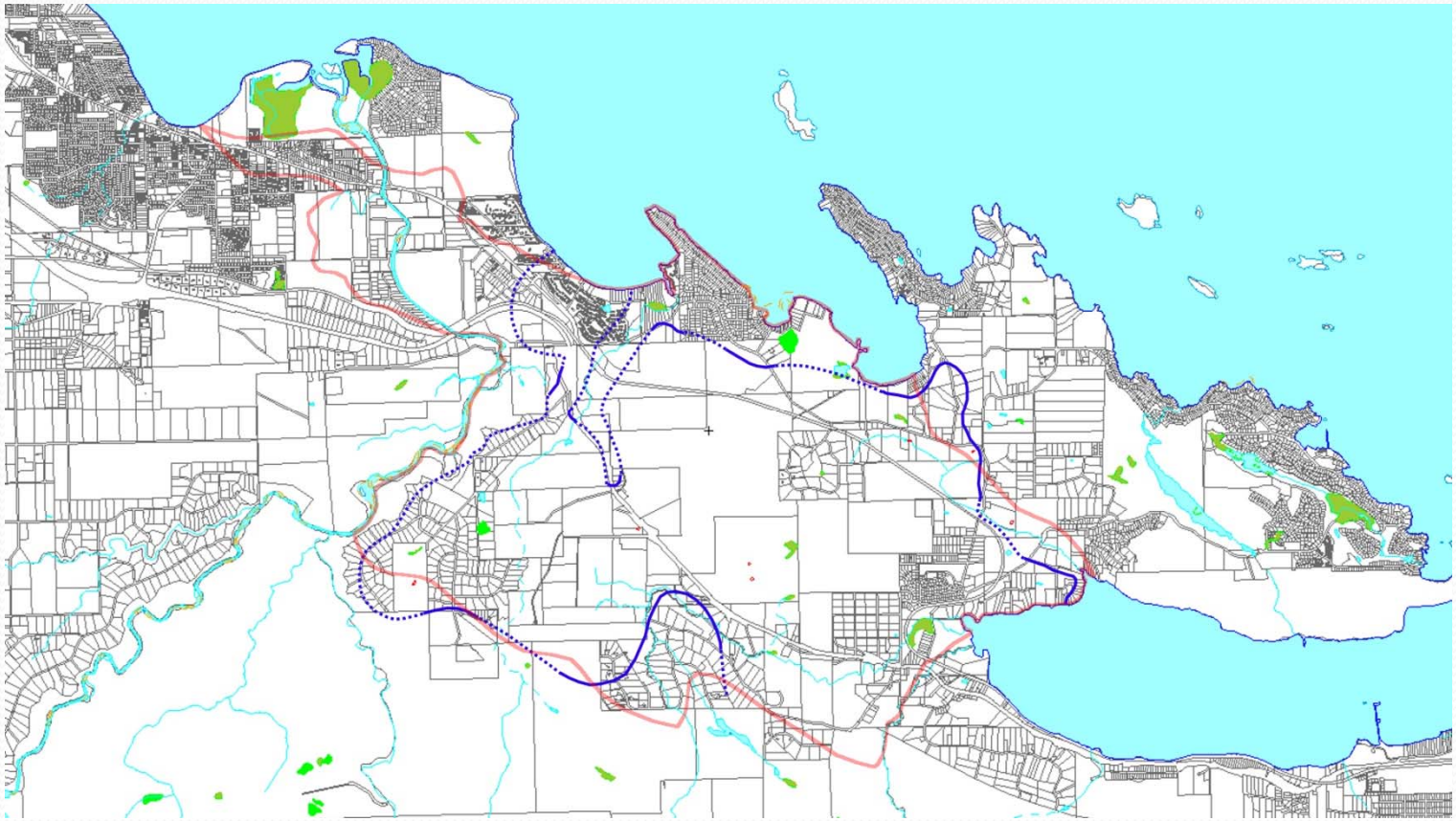
- ASR Wellfield capacity – 6 megaliters/day for 100 days or 69.5 L/s (24/7 pumping)
- Assumed ASR well average rating – 9 L/s capacity ; 69.5/9 = 8 wells required
- Total extraction required – 6 ML/d for 100 days = 600,000 m^3
- Target Storage Volume (TSV) = 600,000 + 30% = 780,000 m^3
- TSV per well = 780,000 / 8 = 97,500 m^3
- With average aquifer thickness of 5 m. storage bubble radius = 157 m.

Test and monitoring wells



Aquifer Boundary #219

- Aquifer boundary from March 2013 Water Resources Atlas well logs and drilling campaign.

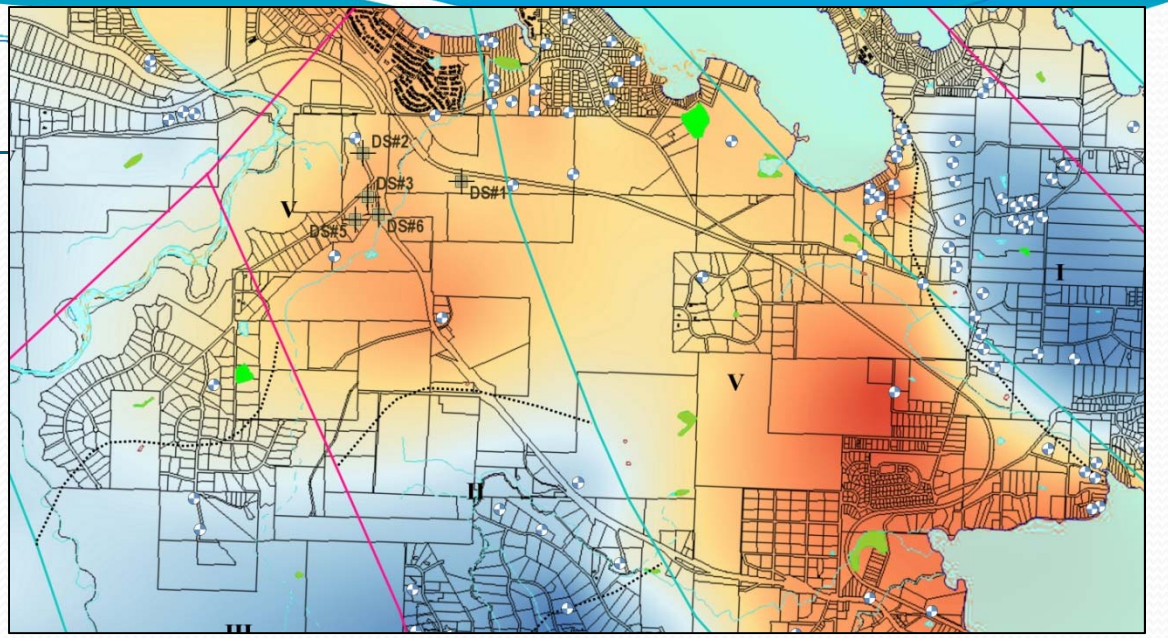


Maps

Bedrock elevation map:

Range: [-80 to +120 m.]

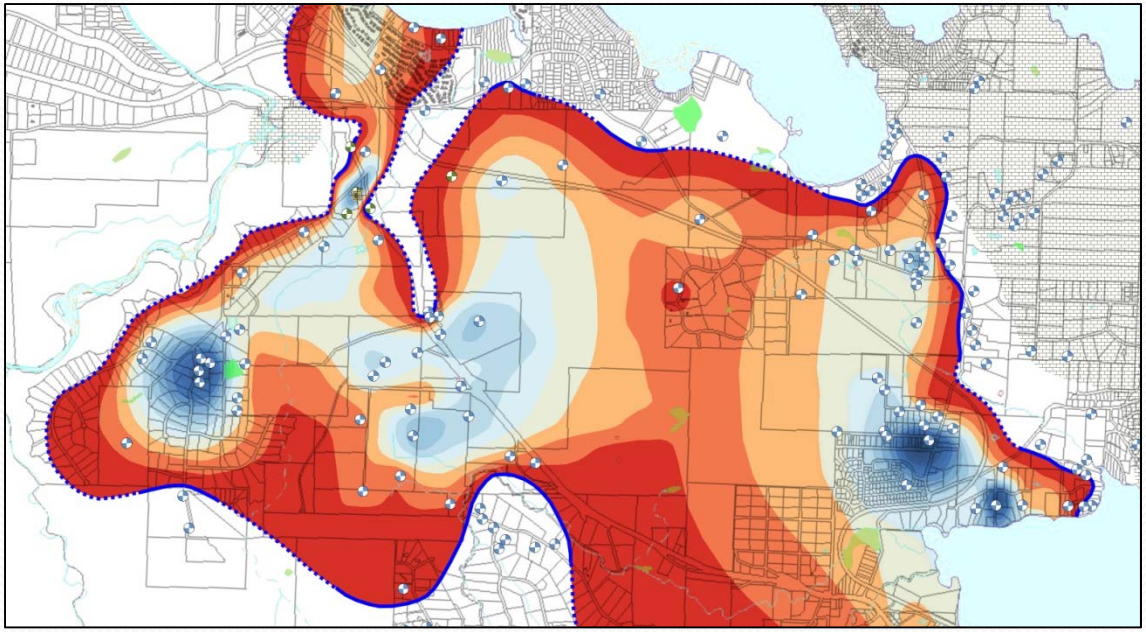
Red shades = low bedrock
Yellow shade = sea level
Blue shades = high bedrock



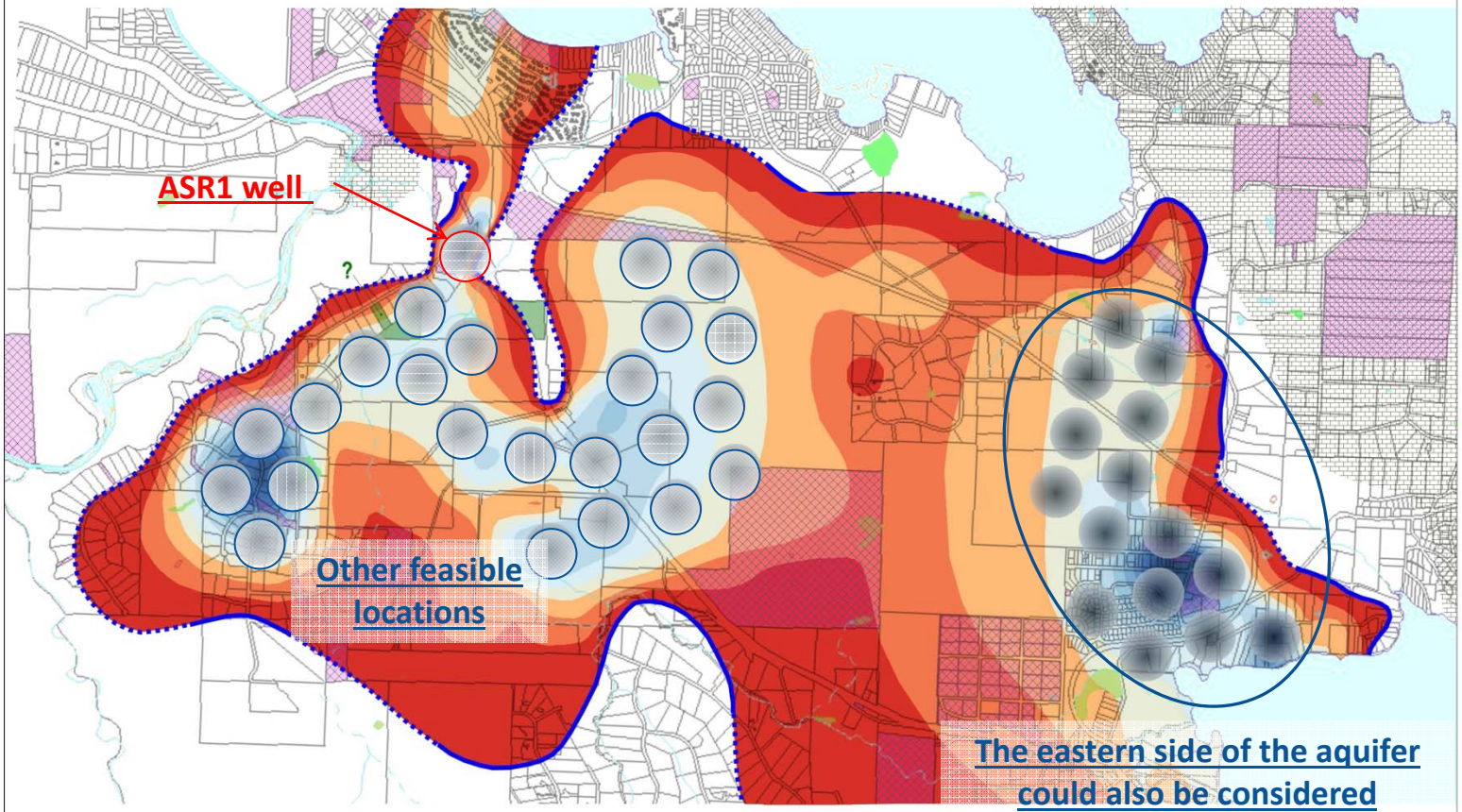
Aquifer thickness map:

Range: [0 to 18 m.]

Red shades = thin aquifer
Blue shades = thick aquifer



⇨ Theoretical “water bubbles” considering 300 m. of diameter.



LEGEND

Hydrogeology

Lower aquifer thickness (m.)

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

Targeted thicknesses or ASR project

- Aquifer boundary — *High degree of confidence*
- Aquifer boundary — *Low degree of confidence*
- Water well
- Test well
- ASR well
- Bedrock near surface
- Englishman River

Scale

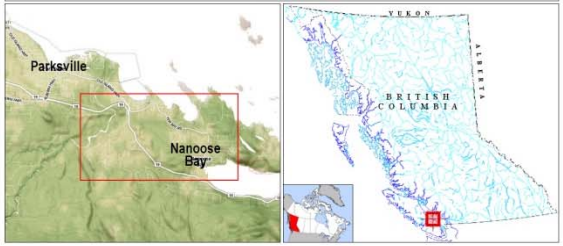
0 250 500 1000 1500 m.

NOTES

Kriging interpolation was used in this model.

Pink-shaded / green-dashed properties are crown land.
Green-shaded properties are properties where a drilling authorization has been granted.

KEY MAP

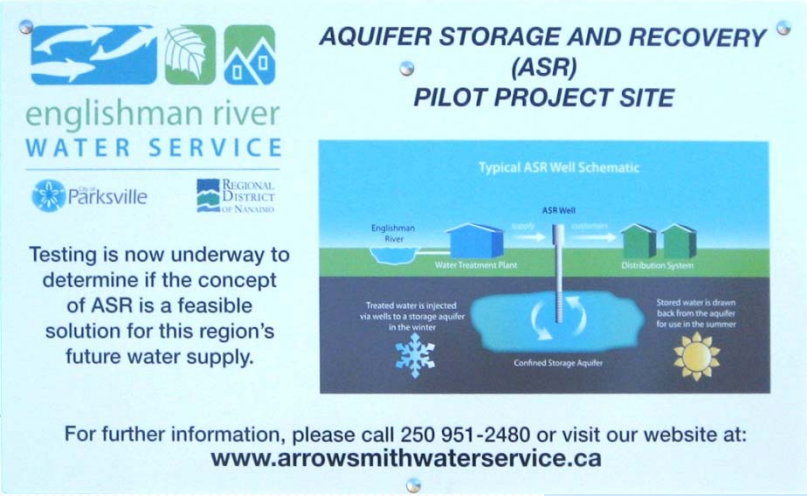


Aquifer Storage and Recovery Project
-
Electoral Area E / G
City of Parksville / Nanoose Bay, B.C.

27/05/2013
File: 1306
Drawing: MD
Review: DL

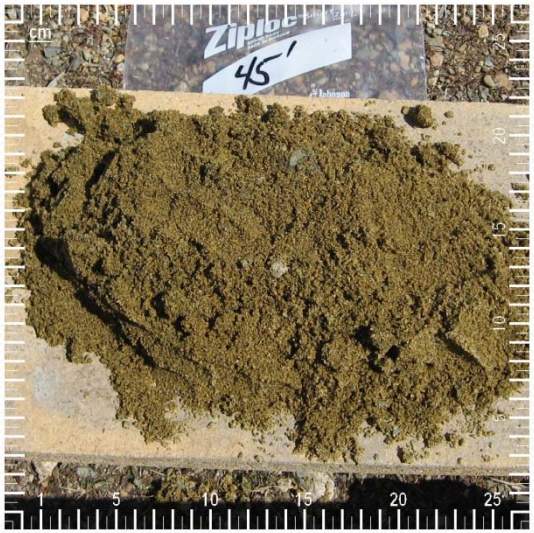
LHC Lowen Hydrogeology Consulting Ltd.

DRILLING OF THE WELL ASR 1 (at DS#3)



- Well: ASR1
- Method of drilling: Cable tool
- Completion depth: 165 ft
- Outside casing diameter: 20”
- Final casing diameter: 12”
- Method of sampling: Bailer
- Screen: 130’ to 150’

Sampling and logging of the well



UPPER AQUIFER :

Thickness: 26 ft ; [42 to 68']

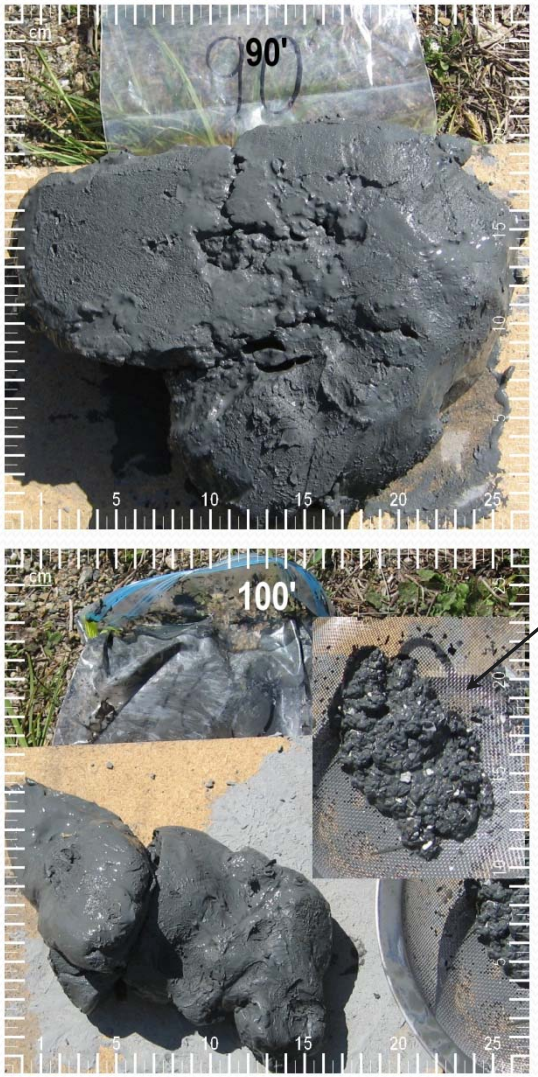
SAND (Quadra sand)

Fine to coarse, some fine gravel
Brown, Loose

Water @ 42'

Becomes grey at 59'

Sampling and logging of the well



CONFING LAYER:

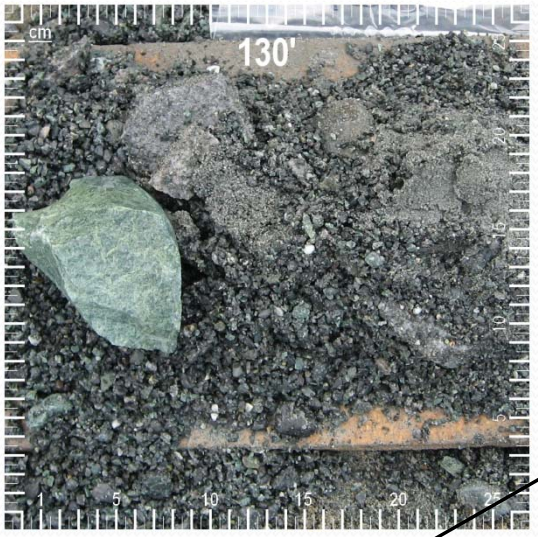
Thickness: 48 ft ; [68 to 116']

HEAVY CLAY, SILT AND GRAVEL (Till-like)

Very sticky and compact
Dark grey

Some wood and shells fragments

Sampling and logging of the well

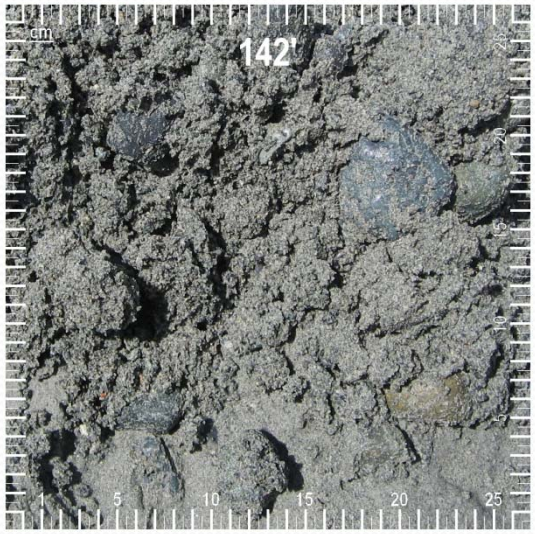


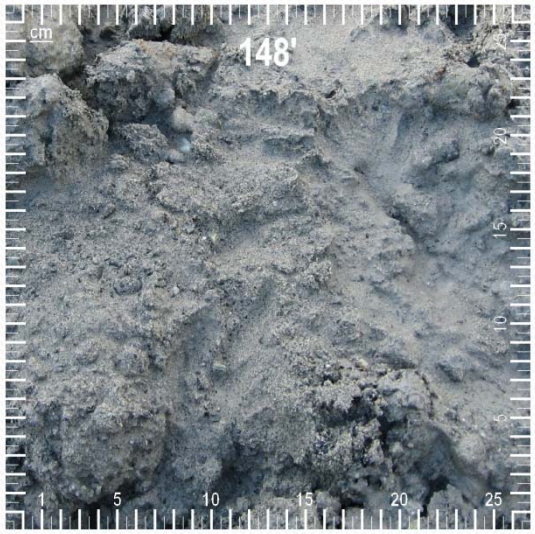
LOWER AQUIFER:

Thickness: 26ft ; [124 to 150']

SAND, GRAVEL, COBBLES and BOULDERS

Some silt and rare lumps of clay
Some wood fragments





Work Schedule

Englishman River Water Service

Schedule: ASR Well Completion and Cycle Testing

Last update: 05/06/2013 (12:54 PM)

2013

No.	TASK DESCRIPTION	START DATE	COMP. DATE	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013
1	ASR well drilling and completion	02/05	01/07												
2a	ASR cycle test - Injection	15/07	30/10												
2b	ASR cycle test - Production	30/10	01/02												

06/06/2013

2014

No.	TASK DESCRIPTION	START DATE	COMP. DATE	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	Jun 2014	Jul 2014	Aug 2014	Sep 2014	Oct 2014	Nov 2014	Dec 2014
2b	ASR cycle test - Production	30/10	01/02												
3	Final ASR Phase 2 Report	02/02	01/03												

Credits

- Barry, Jeff, M.Sc., P.Geo. – Hydrogeologist – *GSI Water Solutions Inc.*
- Dardare, Marion, M.Sc. – Hydrogeologist – *LHC Team*
- Geller, Douglas, M.Sc., P. Geo – Hydrogeologist – *Western Water Associates Ltd.*
- Green, Marta, B.Sc., P. Geo. – Hydrogeologist – *Summit Environmental Consultants Inc. (AE)*
- Hodge, Bill, P. Geo. – Hydrogeologist – *LHC Team*
- Kohut, Alan, M.Sc., P. Geo – Hydrogeologist – *LHC Team*
- Pyne, David, M.Sc. P.E. – *ASR Systems - LHC ASR Expert*
- Squire, Mike, AScT – Program Manager – *COP + AWS + ERWS*
- Wendling, Gilles, Ph.D., P. Eng. – Hydrogeologist – *GW Solutions Inc.*


Questions ?