

# ASR Project Development

Englishman River Water Service

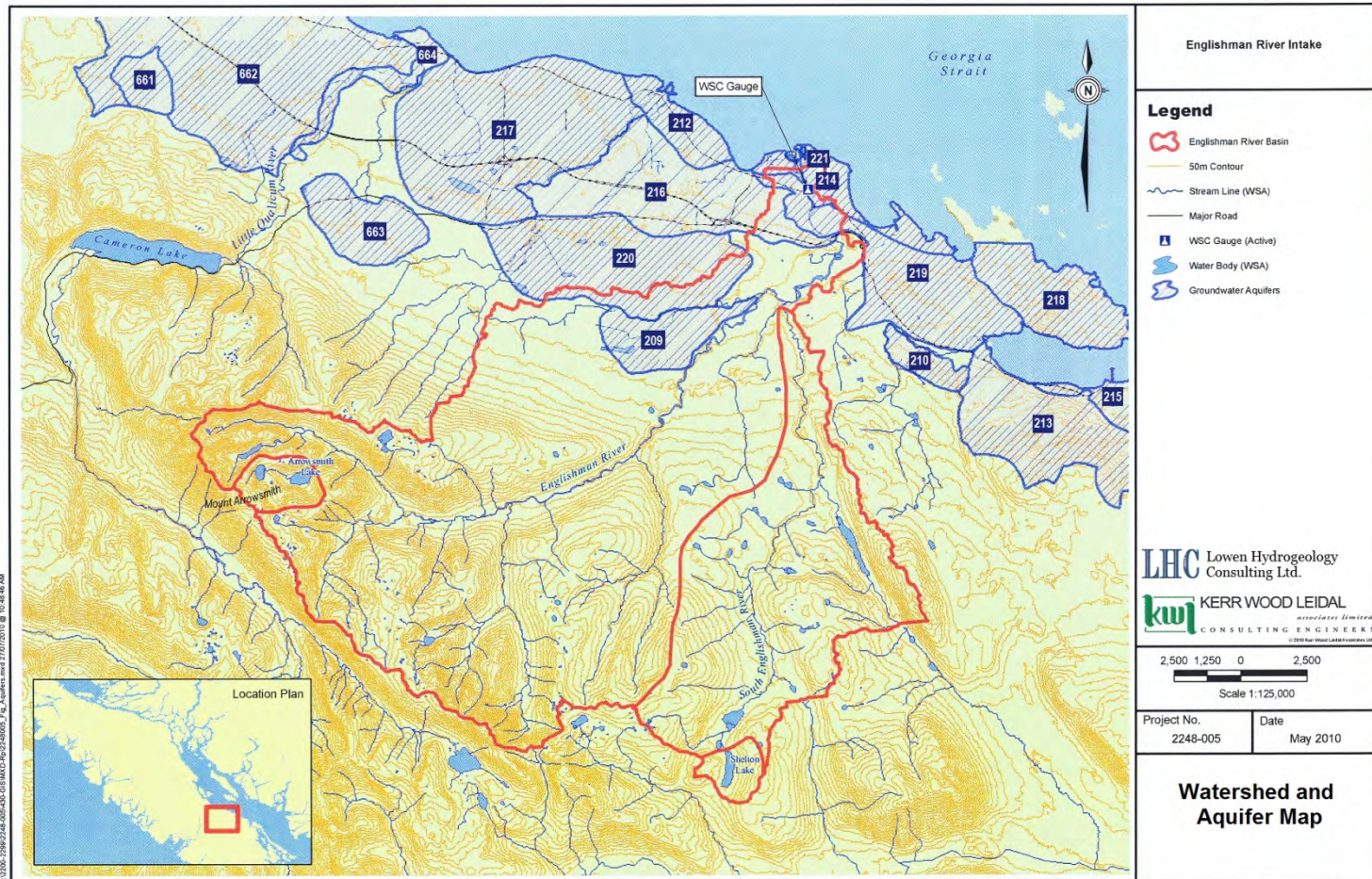
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Dennis Lowen  
David Pyne

*February 2012*

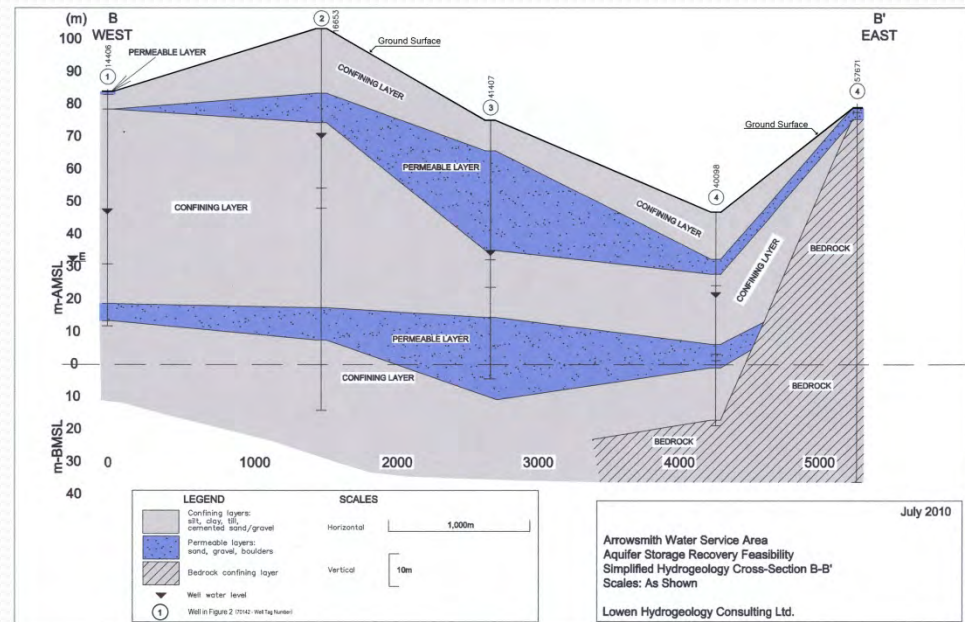
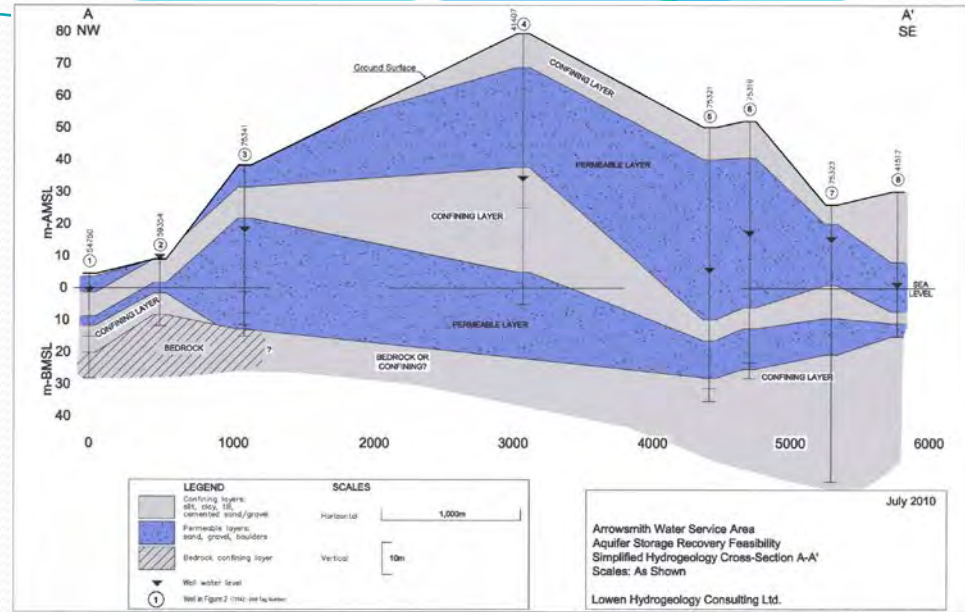
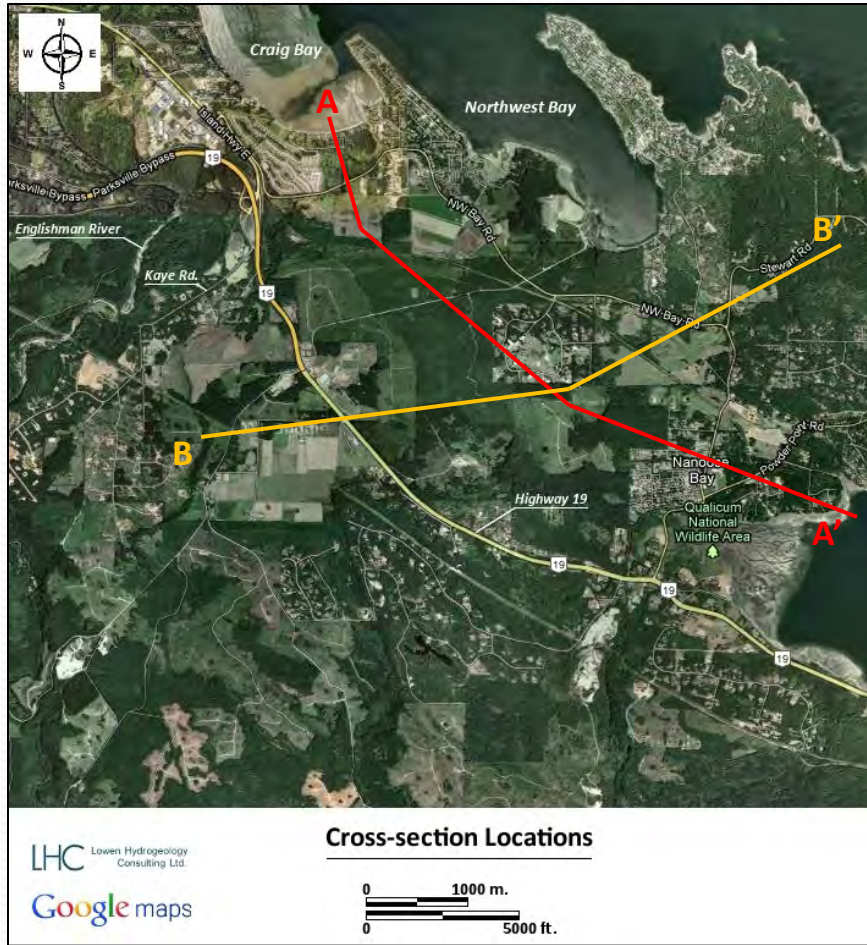
**LHC** Lowen Hydrogeology  
Consulting Ltd.

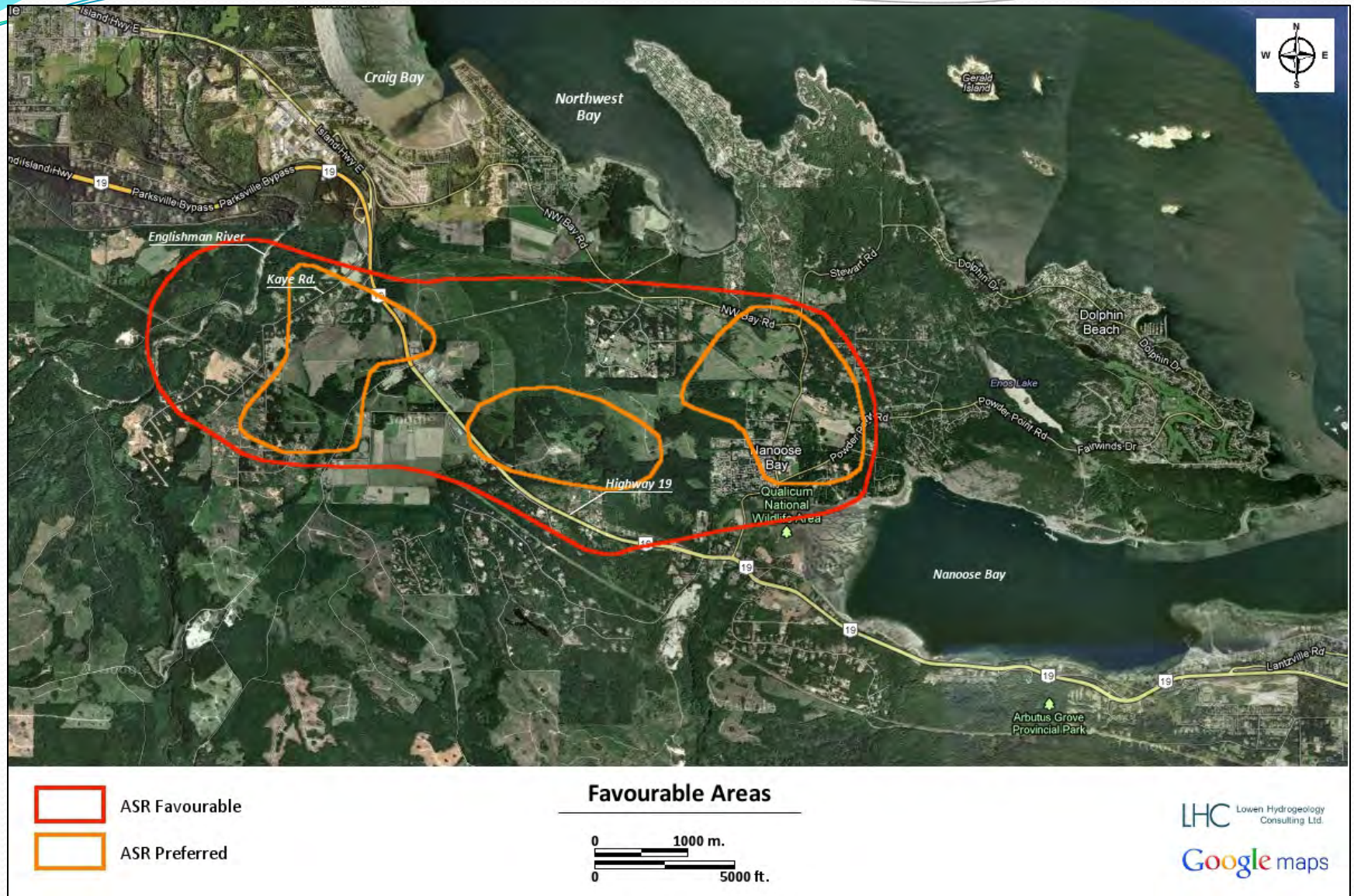
# Phase 1: Conceptual Planning



Aquifer Number	Aquifer Location / Name	Confinment	Water Quality	Depth	Hydraulic Gradient	Depth to Water	Transmissivity	Storage	Multi-layer	WTP* Large Pipes Distance	End of System Location	Development	Total Scores
664	Little Qualicum River	0	10	0	5	0	10	0	0	0	10	5	40
663	Upper Whiskey Creek	0	5	0	5	0	5	0	0	0	5	10	30
217	Qualicum	5	5	5	10	5	10	5	0	0	10	10	65
212	Parksville	10	10	5	5	5	0	0	0	5	0	5	45
216	Parksville	5	5	5	5	5	5	5	0	10	0	5	50
220	Errington	10	5	10	5	0	0	0	0	5	0	0	35
209	Errington	10	10	0	5	0	0	0	0	0	0	10	35
<b>219</b>	<b>Nanoose Creek</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>10</b>	<b>5</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>100</b>
221	Parksville	5	10	0	10	0	5	0	0	5	0	10	45
214	Madrona Point	5	5	5	10	0	0	0	0	10	5	10	50
218	Nanoose Hill	5	10	10	5	0	0	0	0	0	10	10	50
210	Nanoose Bay	5	10	10	5	0	0	0	0	0	10	0	40
213	Lantzville	5	0	10	0	5	0	5	0	0	10	10	45

\* WTP = Water Treatment Plant

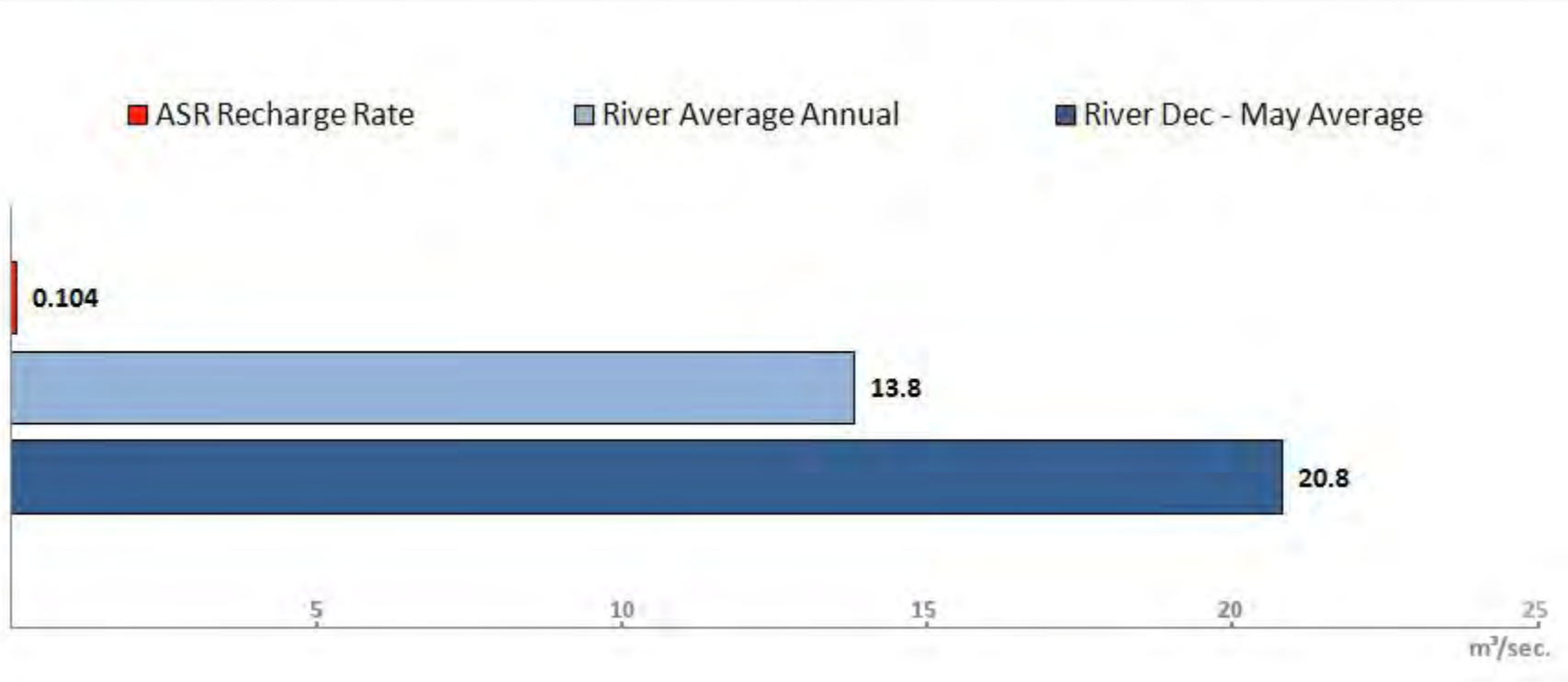




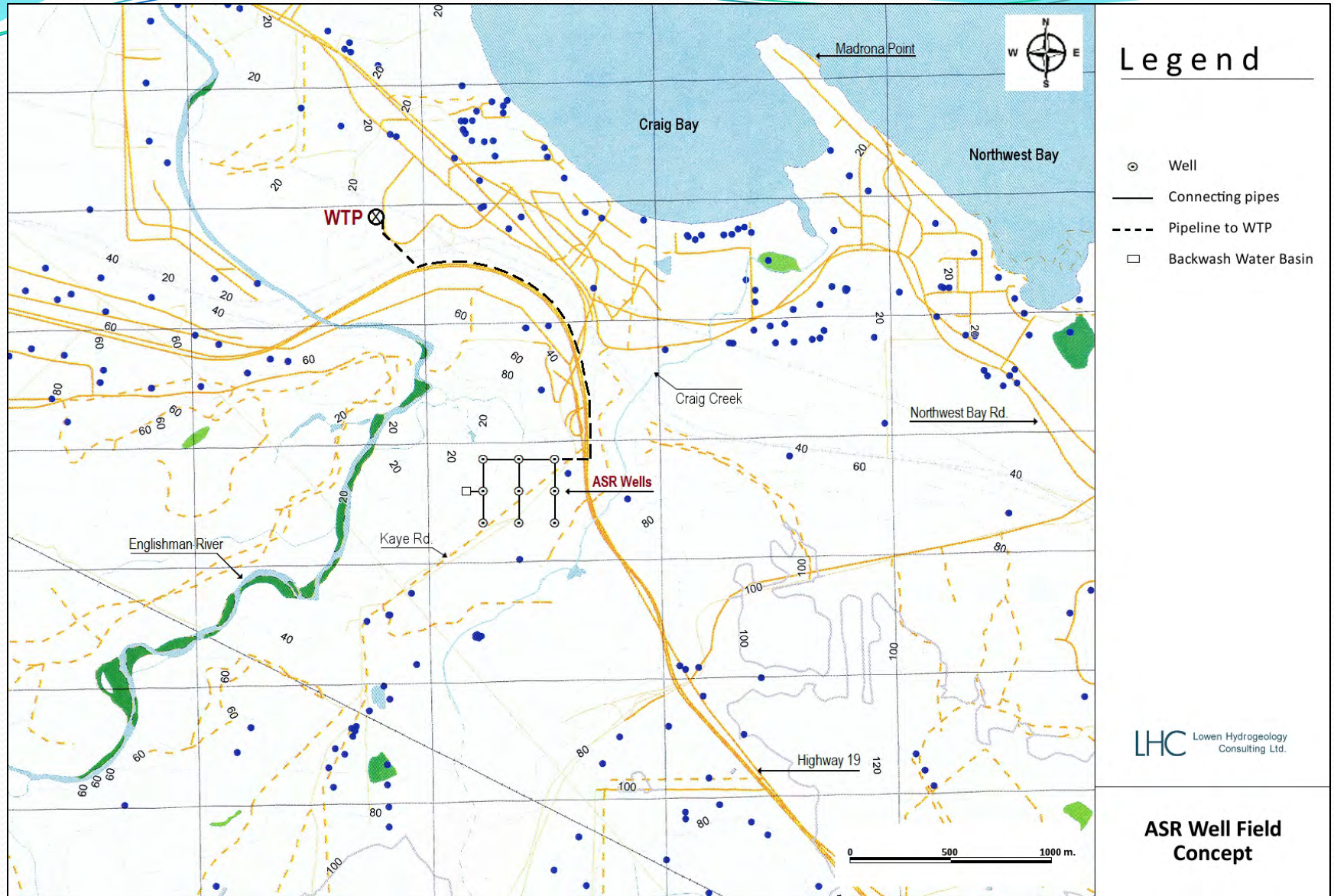
## ASR Program Recharge Objectives:

- To provide seasonal storage of water to help meet peak demands
- Water demand modelling shows a maximum 15 ML/d (3.3 M gallons/d) needed
- ASR wells can be recharged from December to May (6 months)
- ASR wells to be pumped June to September (3.5 months)
- Total annual stored water volume required is then 1000 ML (220 M gal.)
- An estimated buffer zone water volume of 300 ML (66 M gal.)
- Total first time recharge volume 1,300 ML (286 M gal.)

## ASR Recharge Flow Rate vs. Englishman River Flow Rate (in m<sup>3</sup>/sec.)



ASR Recharge Flow = 0.5 % of average River Flow Rate.



## Legend

- ⊙ Well
- Connecting pipes
- - - Pipeline to WTP
- Backwash Water Basin

LHC Lowen Hydrogeology Consulting Ltd.

## ASR Well Field Concept



## Capital and Operating Costs:

ASR Capital Costs:    **\$140 - \$570** CDN per m<sup>3</sup>/d of recovery capacity

Subject ASR well field:

Well Field Capacity	15 ML/d or 15,000 m <sup>3</sup> /d
Least cost	15,000 x 140 = \$ 2,100,000
Maximum cost	15,000 x 570 = \$ 8,550,000

After site review, first-cut estimate of capital cost:

- \$330 CDN per m<sup>3</sup>/d capacity;
- or, 15,000 x 330 = \$4,950,000.

*Includes ASR Test Program, does not include permanent pipeline connection cost and cost of well field land.*

Estimation of ASR field annual operating cost:

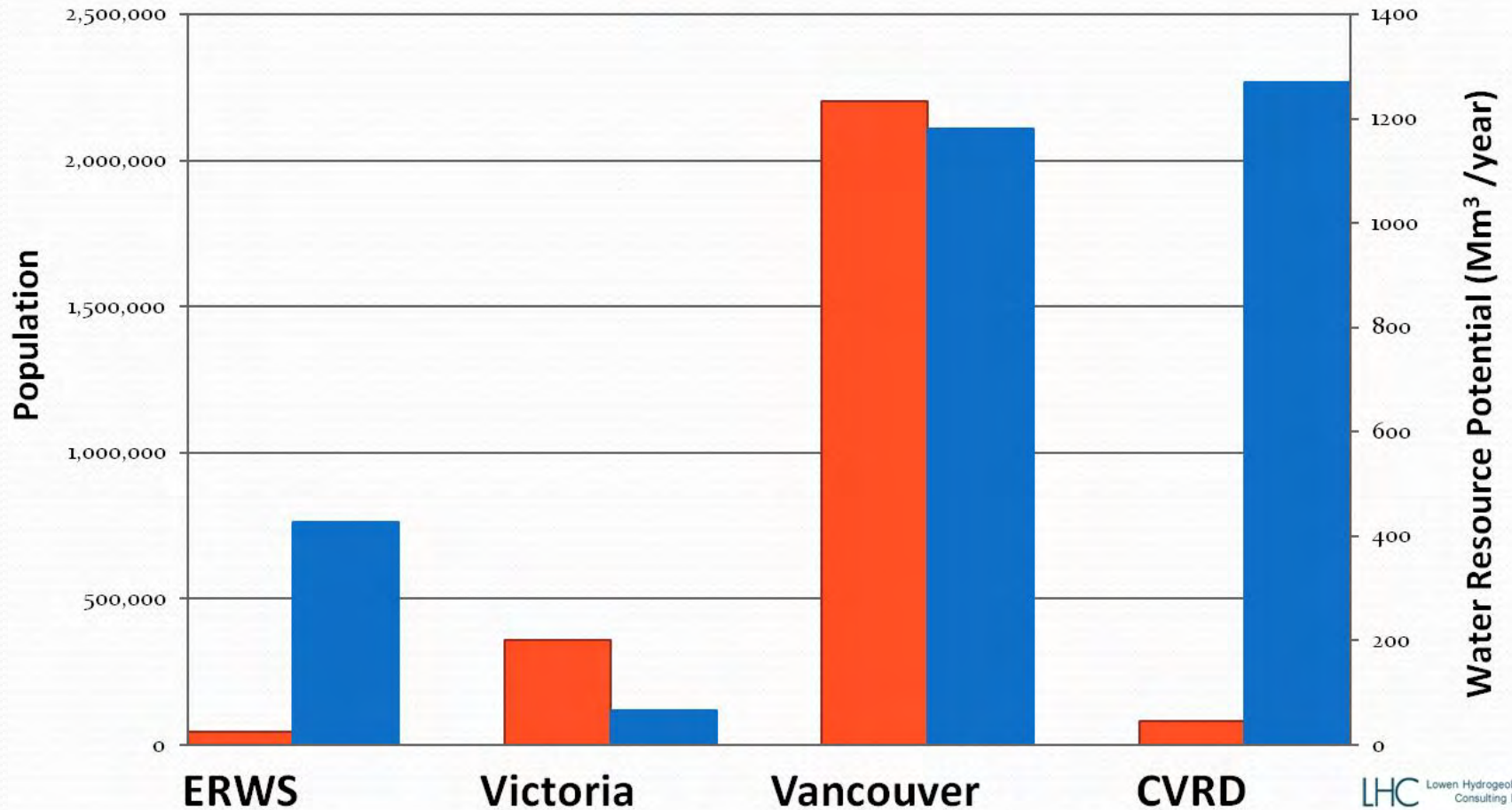
- \$4.25 CDN per m<sup>3</sup>/d recovery capacity;
- or, 4.25 x 15,000 = \$64,000

Over 100 successful ASR projects in North America:

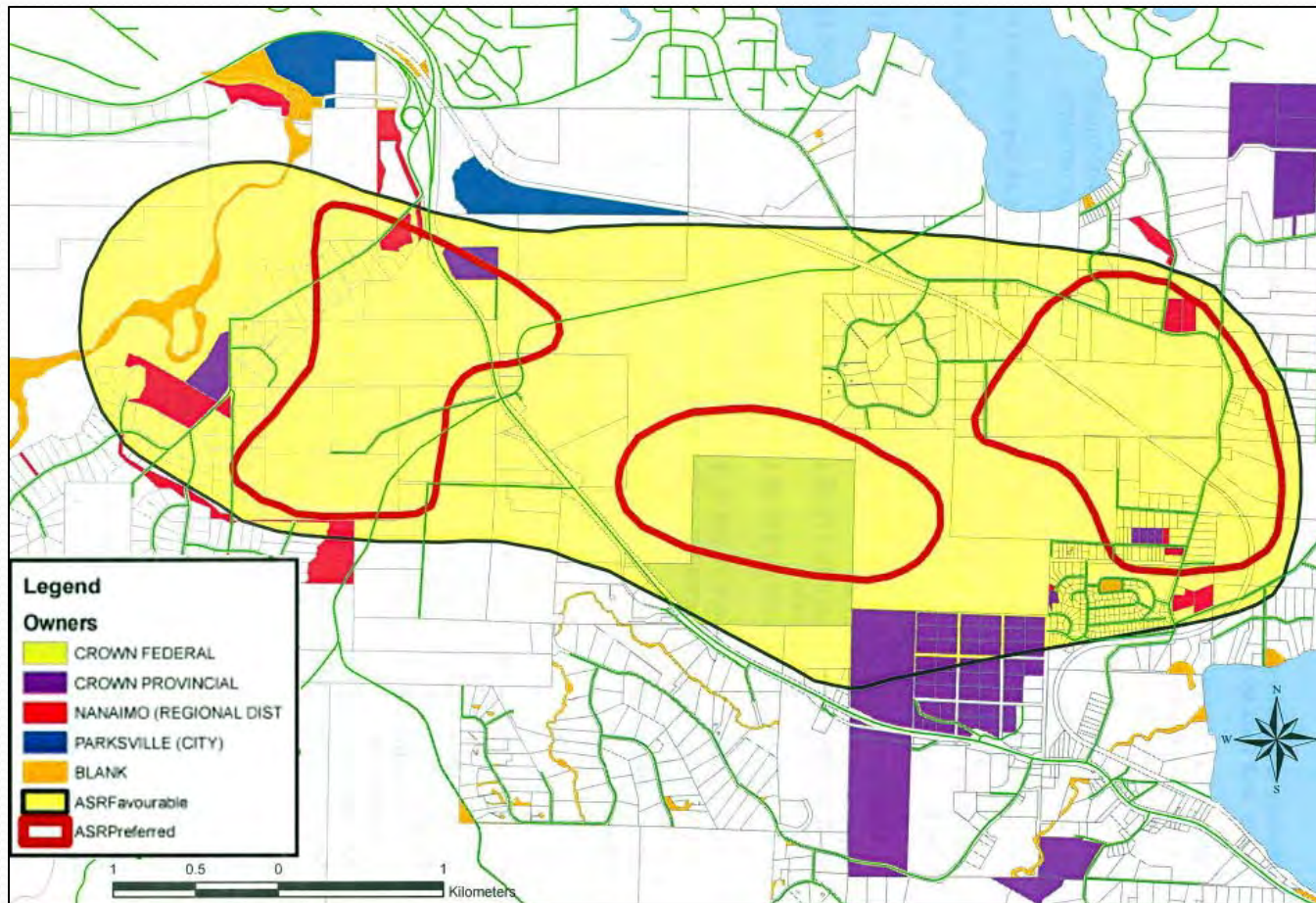
Water System expansion with ASR vs. WS expansion without ASR ⇒ Cost saving: **57 to 90%**

## Water Resource Management Opportunities

■ Population  
■ Water Potential



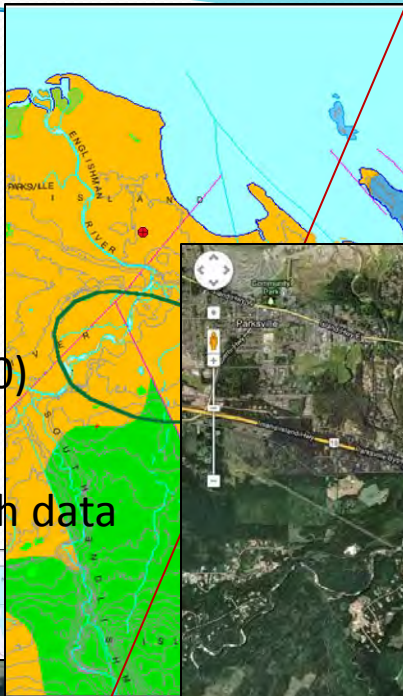
# Phase 2: ASR Feasibility Program



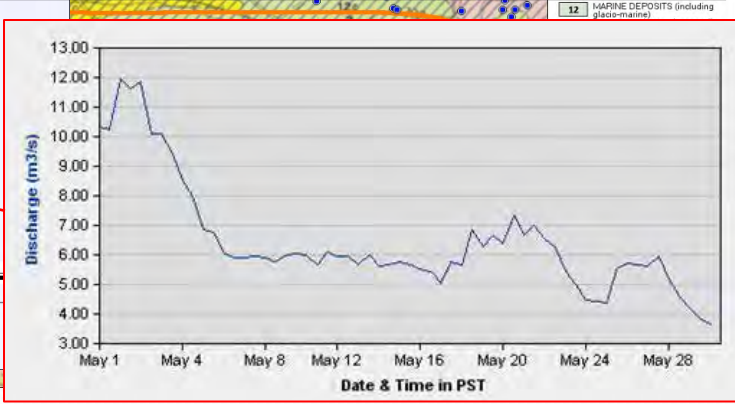
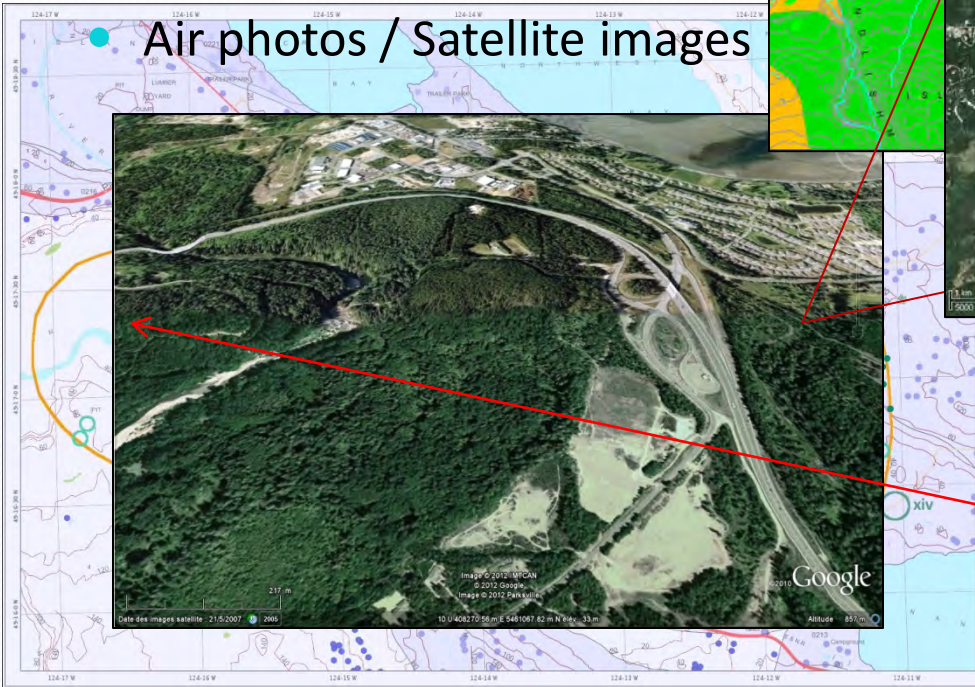
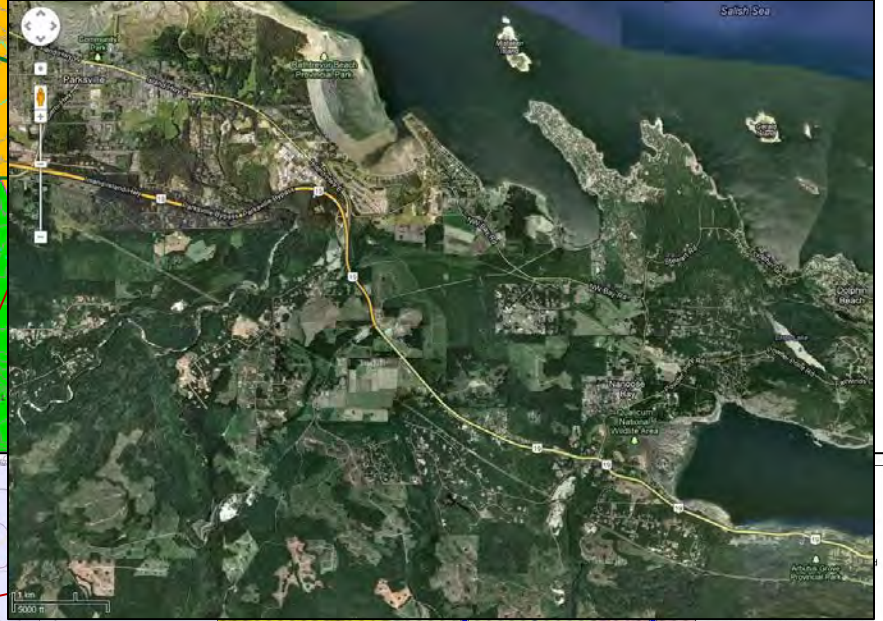
# Site Selection:

- Geology
- Hydrogeology / hydrology
  - Existing well reports (>1000)
  - Previous reports
  - Monitoring well hydrograph data

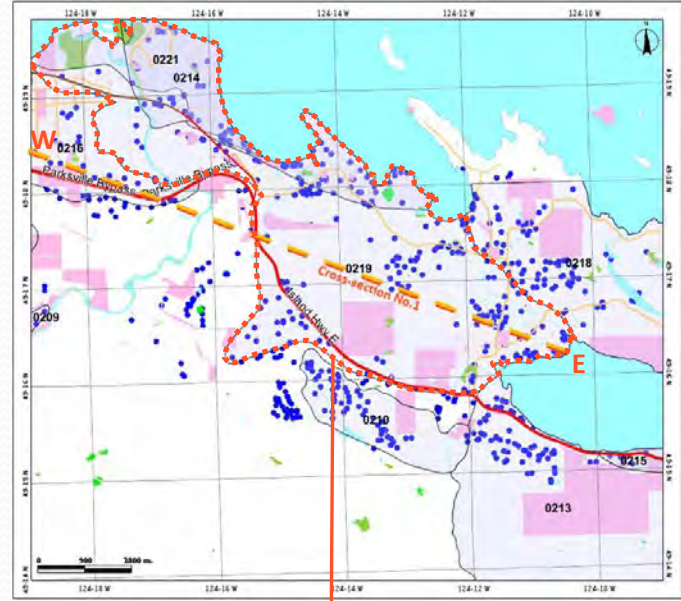
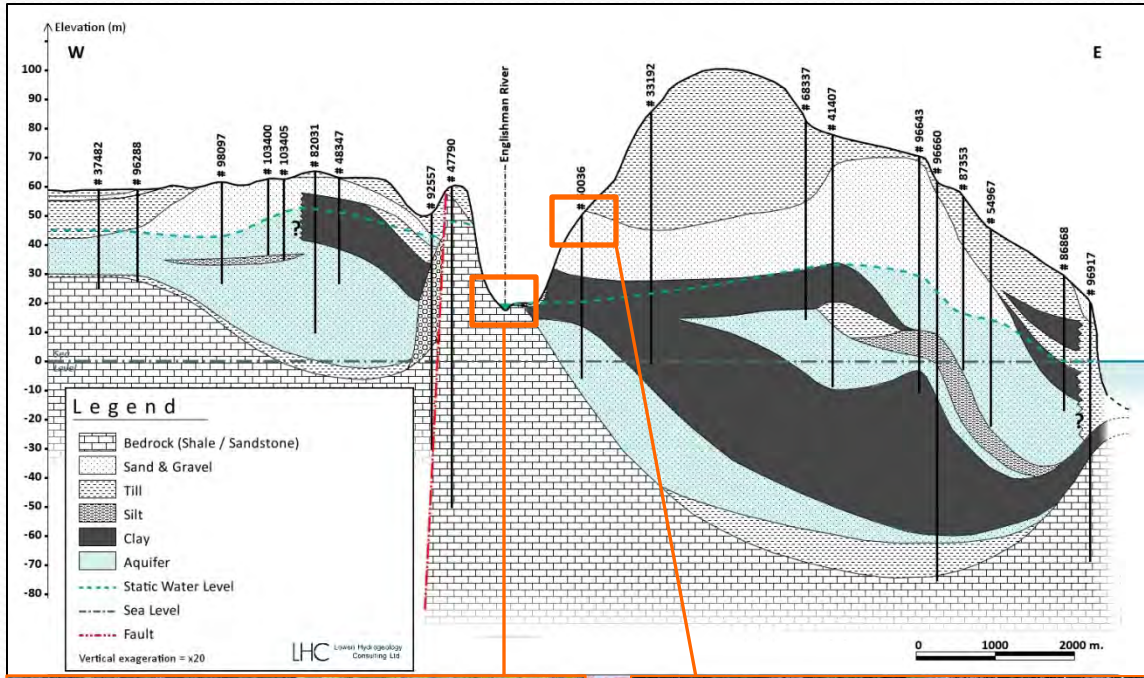
- Air photos / Satellite images



Report 1 - Detailed Well Record	
Well Tag Number: 40098	Construction Date: 1978-07-14 00:00:00.0
Owner: NANAIMO REGIONAL DIS	Driller: Dogwood Drilling
Address: 2550 NORTHWEST BAY ROAD	Well Identification Plate Number:
Area: NANOOSE PENINSULA	Plate Attached By:
	Where Plate Attached:
PRODUCTION DATA AT TIME OF DRILLING:	
WELL LOCATION:	Well Yield: 205 (Driller's Estimate) U.S. Gallons per Minute
NANOOSE Land District	Development Method:
District Lot: 62 Plan: 694R Lot:	Pump Test Info Flag: N
Township: Section: Range:	Artesian Flow:
Indian Reserve: Meridian: Block:	Artesian Pressure (fc):
Quarter:	Static Level: 93 feet



# Cross-sections design: large scale cross-section

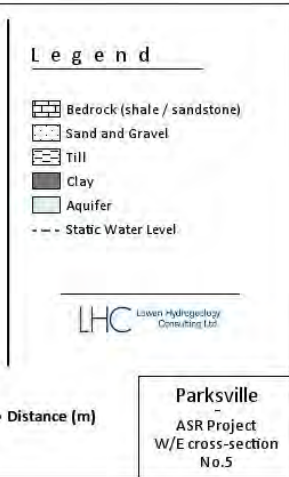
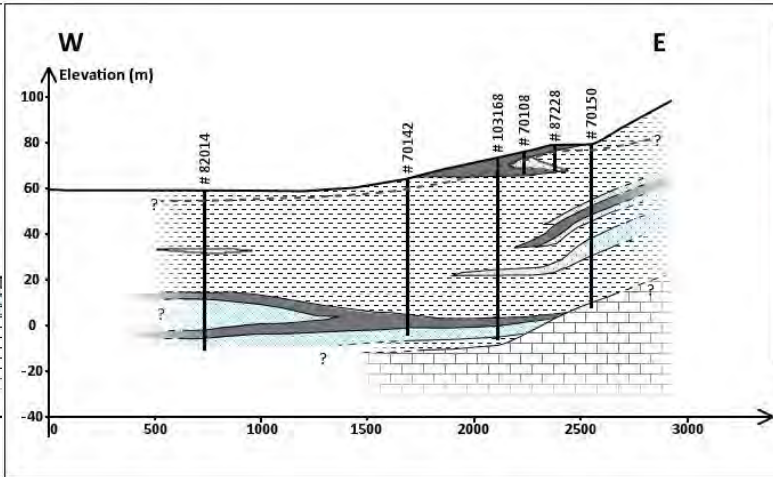
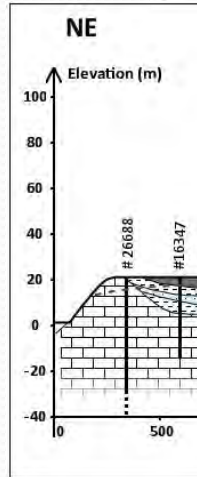
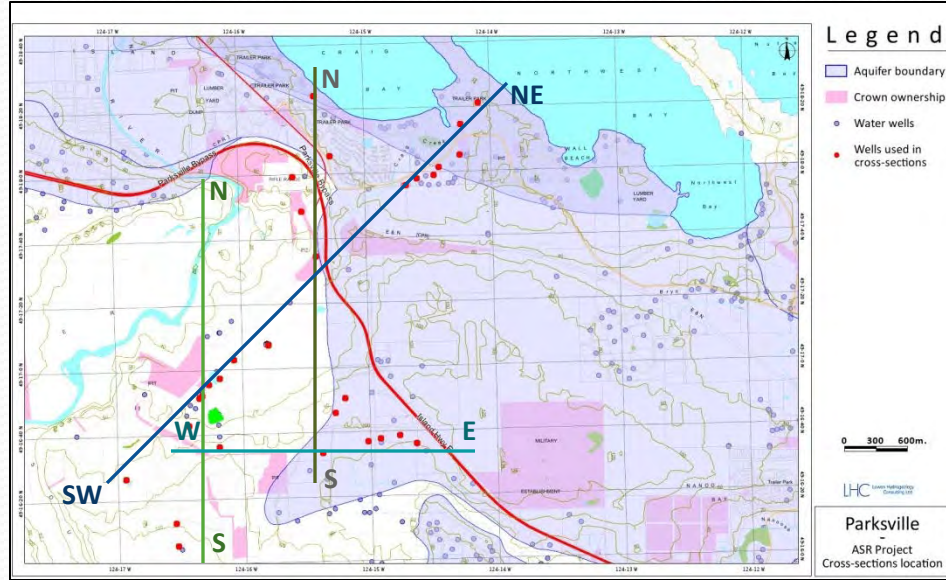


Aquifer #219 = 27 km<sup>2</sup>



Well log records  
Combined with field studies...

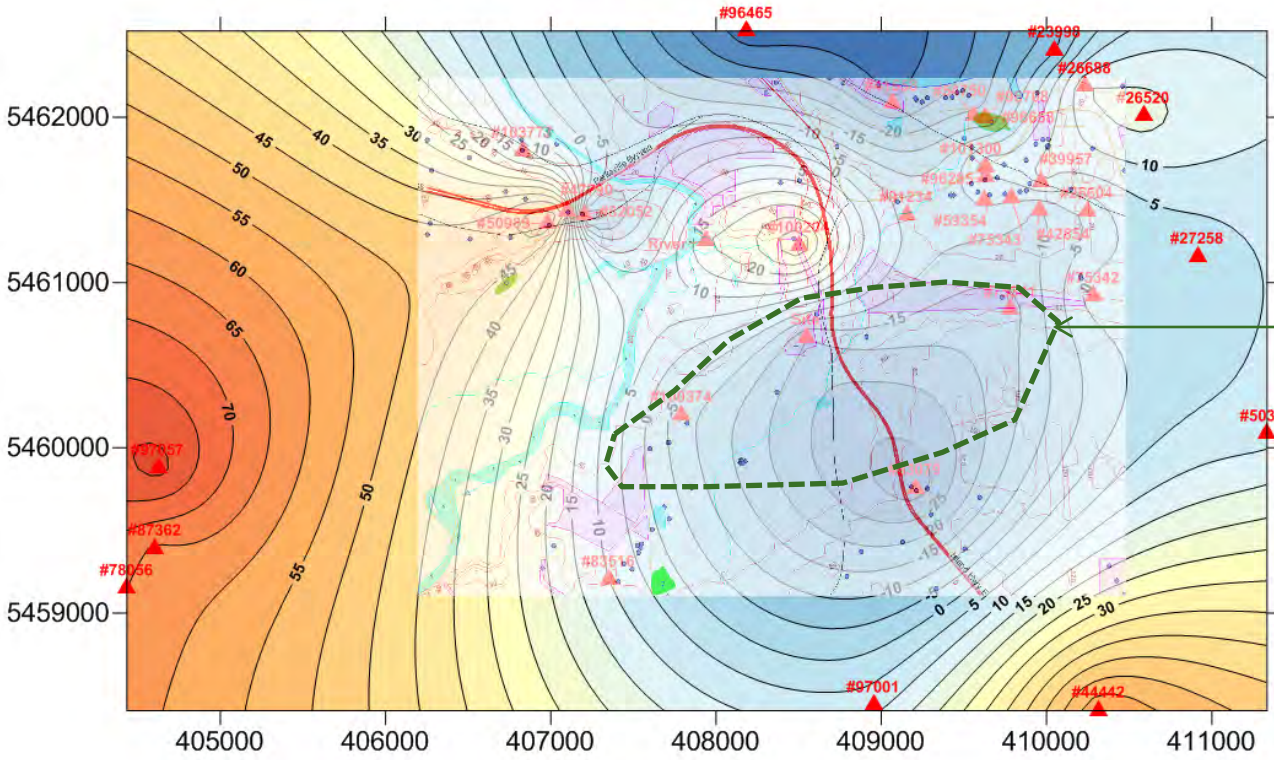
# Cross-sections design: small scale cross-sections



# Bedrock map design:

- Deepest bedrock location / thickest unconsolidated layer
- Bedrock surface gradient

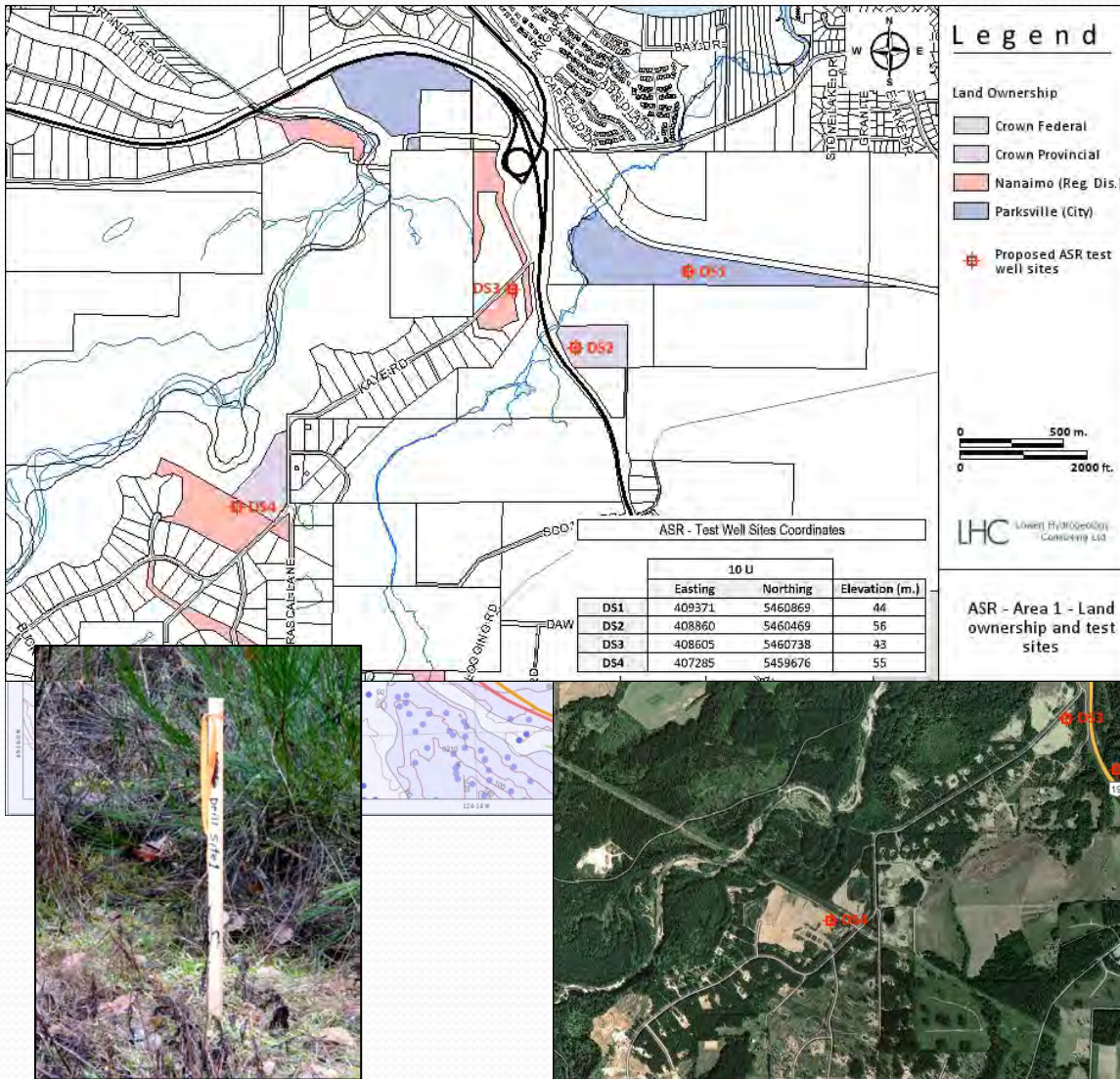
BEDROCK DEPTH (in m. ASL)



- Area of interest:
- Deep bedrock
  - Reasonable gradient
  - Good sand and gravel aquifer overlying



# Test well sites selection: 4 test sites selected



## Large scale selection:

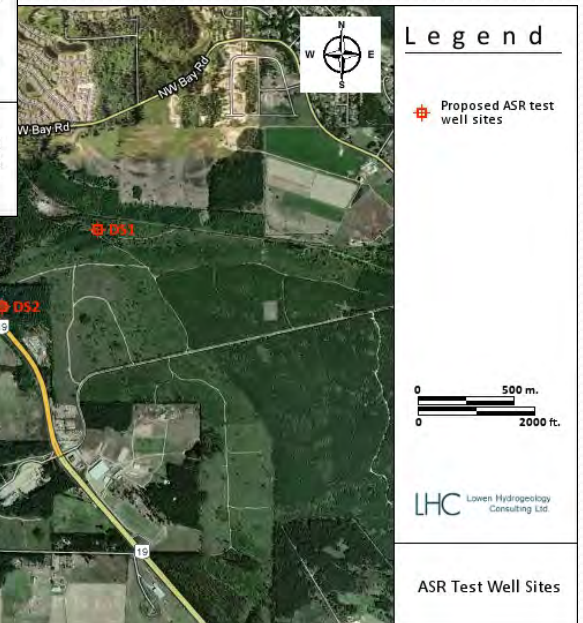
- ➔ General geology, hydrogeology, site settings

## Medium scale selection:

- ➔ Detailed cross-sections, well log records, field studies

## Small scale selection:

- ➔ Land ownership, site inspections





## Phase 2, Work Remaining:

- Obtain permission for test drilling
- Drill 3 or 4 test wells
- Conduct pumping tests on the most promising wells
- Construct an ASR test well at the best site
- Service the ASR test site; power, water and discharge facilities
- Cycle test the ASR well (6 months)
- Prepare a plan to address regulatory issues (20 acts and regulations)
- Environmental considerations
- Refine capital and operating costs

# Schedule:

2011															
No.	TASK DESCRIPTION	START DATE	COMP. DATE	January 2011	February 2011	March 2011	April 2011	May 2011	June 2011	July 2011	August 2011	September 2011	October 2011	November 2011	December 2011
1	Organize work and assign tasks	7-Nov-11	14-Nov-11												
2	Geology / Hydrogeology field work	16-Nov-11	17-Feb-12												
3	Geology cross-sections (sand/gravel)	7-Nov-11	5-Dec-11												
4	Bedrock geology review	21-Nov-11	29-Feb-12												
5	Test well site selection	21-Nov-11	29-Feb-12												

2012															
No.	TASK DESCRIPTION	START DATE	COMP. DATE	January 2012	February 2012	March 2012	April 2012	May 2012	June 2012	July 2012	August 2012	September 2012	October 2012	November 2012	December 2012
2	Geology / Hydrogeology field work	16-Nov-11	17-Feb-12												
4	Bedrock geology review	21-Nov-11	29-Feb-12												
5	Test well site selection	21-Nov-11	29-Feb-12												
6	GPS elevation surveys key wells	29-Feb-12	9-Mar-12												
7	ASR design considerations / analog study	23-Jan-12	9-Mar-12												
8	Identify environmental considerations	9-Jan-12	9-Mar-12												
9	ERWS site approval / permission to drill	1-Mar-12	30-Mar-12												
10	Plan/Protocol for water quality assurance (MOH) Plan/Protocol for aquifer protection (MOE)	9-Jan-12	30-Mar-12												
11	Capital, operating and maintenance cost estimates	9-Jan-12	31-May-12												
12	Test well construction tendering / drilling (3 wells - Area 1)	1-Mar-12	30-Apr-12												
13	Pumping tests and water quality sampling	16-Apr-12	18-May-12												
14	Drilling and pumping data analysis, impact assessment (Report results to AE + ERWS)	21-May-12	11-Jun-12												
15	Select ASR test well site with ERWS input	11-Jun-12	18-Jun-12												
16	ASR well tendering and construction	25-Jun-12	6-Aug-12												
17	ASR well initial pumping test and analysis	27-Aug-12	7-Sep-12												
18	Temporary water connection - ASR well	14-Aug-12	17-Sep-12												
19	RIB basin construction for back flushing	14-Aug-12	24-Aug-12												
20	Monitoring well set-up and elevation surveys	14-Aug-12	7-Sep-12												
21	ASR well equipment design, ASR program design	10-Sep-12	8-Oct-12												
22	ASR well head power connection	10-Sep-12	8-Oct-12												
23	ASR well cycle testing	15-Oct-12	15-Apr-13												

2013															
No.	TASK DESCRIPTION	START DATE	COMP. DATE	January 2013	February 2013	March 2013	April 2013	May 2013	June 2013	July 2013	August 2013	September 2013	October 2013	November 2013	December 2013
23	ASR well cycle testing	15-Oct-12	15-Apr-13												
24	Draft ASR Phase 2 Report	15-Apr-13	15-May-13												
25	Final ASR Phase 2 Report	30-May-13	15-Jun-13												



Questions ?

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