Gambier Island Local Trust Committee
Special Meeting Addendum

Date: September 20, 2017
Time: 7:00 pm
Location: John Braithwaite Community Centre
145 West 1st Street
North Vancouver, BC

Pages

5. BUSINESS ITEMS 7:10 PM - 8:35 PM

5.1 GM-RZ-2004.1 (District Lot 696, Keats Island) - Staff Report

275 – 3001 Wayburne Drive
Burnaby, BC V5G 4W3 Canada
T: 604.874.1245 • www.exp.com

Memorandum

Date:	September 12, 2017	**Reference No.:**	VAN-00240303-A0
To:	Sonja Zupanec, RPP Island Planner, Islands Trust szupanec@islandstrust.bc.ca	**Total No. of Pages:**	3 + Attachments
From:	Matthew D. Munn, P.Eng. Jeff Johnson, BA, MBA	matthew.munn@exp.com jeff.johnson@exp.com	
Project:	**Hydrogeological Study (Phase 1) – Supplementary Information** **DL696, Keats Island, BC**		

1 INTRODUCTION

Exp Services Inc. (**exp**) was retained by the Convention of Baptist Churches of BC (the Convention) to complete a "Preliminary Hydrogeological Assessment" requested by Islands Trust for an on-going rezoning application for the Convention's above-referenced property on Keats Island, BC. Accordingly, **exp** prepared a "*Hydrogeological Study - Phase 1*" report and submitted it to Islands Trust on July 25, 2017. The primary objective of **exp's** Phase 1 Study was to complete a preliminary review and assessment of available property information and provide rezoning-stage confirmation that potable water needs for the Convention's proposed lots and intended uses could be satisfied from on-site groundwater sources and that neither the proposed groundwater extractions nor proposed community sewerage systems would have adverse impacts on local groundwater resources, groundwater users, and receiving waters. The Phase 1 Study was completed in agreement with **exp**'s Work Plan delivered to the Convention on May 17, 2017.

Aspects of the Phase 1 Study were discussed during a September 8, 2017 teleconference meeting attended by Islands Trust staff, Mr. Kevin Healy of CREUS Engineering Ltd. (CREUS) and Mr. Matthew Munn of **exp**. Based on feedback and comments provide by the Islands Trust attendees, this memorandum has been prepared to provide supplementary information as additional context for the Gambier Local Trust Committee's consideration of the Phase 1 Study report.

This memorandum and attached Table 1 Concordance Summary has been prepared by **exp** in consultation with CREUS. Use of this memorandum must include consideration of the Section 3 Limitations and the attached "Interpretation & Use of Study and Report" (Attachment #1).

2 SUPPLEMENTARY INFORMATION

2.1 Phase 1 Hydrogeological Study Scope

Scope for **exp's** Phase 1 (i.e., rezoning stage) study was developed in consultation with CREUS, assuming a separate Phase 2 study would be required at subdivision stage. The resulting Phase 1 "work plan" was reviewed by FLNRO on May 30, 2017 and the resulting review comments forwarded to Islands Trust on May 31. Although FLNRO is not specifically mandated to contribute to rezoning stage enquiries, they are the Statutory Decision Maker ultimately responsible for reviewing the Keats Camp groundwater licence application and assigning rights to withdraw groundwater, whether or not the project proceeds to

subdivision. CREUS separately contacted Vancouver Coastal Health (VCH) in May 2017 to likewise seek their review and comments regarding the proposed rezoning stage Hydrogeological Study, since both the Keats Camp water system and new communal sewage dispersal fields would ultimately be subject to VCH approvals, whether or not the project proceeds to subdivision.

2.2 Phase 1 Hydrogeological Study Scope

It is understood that the Rezoning phase is working in synchronisation with the Preliminary Layout Approval (PLA) process and subdivision of certain lands. The PLA requires rezoning to be well along its process, the rezoning requires the PLA prior to fourth reading and also requires subdivision of certain lands as a condition of terminating the Land Use Covenant and transferring certain lands to the regulatory authorities. Where certain commitments were made in the PLA, they were not necessarily repeated in this stage of reporting, as the Phase 1 Hydrogeological Study was not intended for the subdivision portion.

Specific elements referenced in the PLA are:

- That the Strata would be created with a starting capital fund to provide contingency for expanding the communal septic fields, if need arises prior to further building of the fund. The Strata would also be collecting both operating and capital replacement funds for the water system. Currently, capital repairs and capital replacement are done on an ad hoc basis. Current plans are to have adequate funds in place for a new well within 5 years.
- That the Strata would formalize and document a Water Conservation Policy for the lands, including the Camp lands. This would require bans on watering at certain times, use of low flow devices, water restrictions where required, rain barrels etc. This is expected to form part of the Bylaws. While the community has been reasonably able to manage water use, it is expected there are additional achievable reductions that could offset other demands.
- That as part of the backbone construction, portions of the current water system distribution would be replaced. The system is plagued with leaks and the subdivision would prompt replacement of a significant portions of the mains. Other portions of the system would be scheduled for replacement over time with the ongoing capital replacement funding. The current water system Operator has monitored usage and leakage and has repaired some leaks on an ad hoc basis. The Operator has recently had approval for additional automated flow monitoring equipment, which will further assist in identifying and eliminating system losses.
- As part of the subdivision process, the PLA recognizes that existing wells and any new wells will be necessarily registered and licenced under the new Water Sustainability Act. At the time of subdivision, a Well Head Protection Plan will also be prepared in consultation with VCH and an associated covenant registered.
- As part of the subdivision process, a Certificate of Public Convenience and Necessity (CPCN) will be obtained. This will require additional detailed hydrogeological assessment and reporting as a condition of PLA, and thus will be a condition of fourth reading. Accordingly, the intent is to review the current Phase 1 Report with FLNRO and VCH and Islands Trust to structure a program to achieve both CPCN and licencing of wells (i.e., water system).

2.3 Concordance Summary

The attached Concordance Summary (Attachment #2) lists the forty-two components (i.e., data, information or analyses) requested by Islands Trust's June 2, 2017 Terms of Reference (TOR) for a "Preliminary Hydrogeological Assessment" for DL696. The components are subdivided into two major categories, consistent with Island Trust's TOR layout, and further assembled into the prescribed TOR subgroups. The primary objective of the Concordance Summary is to identify Phase 1 Study report sections relevant to particular TOR components and to also provide supporting commentary (including rationale) for readers to understand **exp's** assessment approaches.

3 LIMITATIONS

This memorandum and attachments have been prepared by **exp** Services Inc. for the exclusive use and consideration of the Convention of Baptist Churches of BC, Islands Trust and Committees, and CREUS Engineering Ltd. Any use of this memorandum for purposes other than the purposes described in the preceding sections and/or by any other party must first be verified in writing by **exp** Services Inc. **Exp** does not accept any responsibility for damages resulting from other party's reliance on or use of the information, opinions, interpretations or conclusions contained in this memorandum. The attached "Interpretation & Use of Study and Report" is an integral part of this document and must be considered by readers and also included with any copies of this memorandum.

4 CLOSURE

We trust the content of this memorandum satisfies your current requirements. If you have any questions, please contact the undersigned.

Submitted by:

exp Services Inc.

Matthew D. Munn, P.Eng.
Senior Hydrogeologist

Reviewed by:

Jeff A. Johnson, BA (Econ), MBA
Senior Manager

Attachments: #1 – Interpretation & Use of Study and Report
#2 – Table 1. Concordance Summary

cc: Convention of Baptist Churches of BC, Ian Grant (iangrant890@gmail.com)
CREUS Engineering Ltd., Kevin Healey, P.Eng. (khealey@creus.ca)

MDM:jaj

L:\2017 (0237475-A0)\0240303-A0 MM Baptist Churches Hyd. Study Keats Island\deliverable\phase_500\mem_exp_final_20170912_240303.docx

ATTACHMENT #1

INTERPRETATION & USE OF STUDY AND REPORT

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental consulting unless specifically stated in the engineering report.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS “APPROVED USERS”. The contents of the Report remain our copyright property and we authorise only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorised use of the Report.

5. INTERPRETATION OF THE REPORT

a. Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b. Reliance on Provided information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

c. To avoid misunderstandings, **exp** Services Inc. (**exp**) should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by **exp**. Further, **exp** should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor’s work is being carried out in general conformity with **exp**’s recommendations. Any reduction from the level of services normally recommended will result in **exp** providing qualified opinions regarding adequacy of the work.

6.0 ALTERNATE REPORT FORMAT

When **exp** submits both electronic file and hard copies of reports, drawings and other documents and deliverables (**exp**’s instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by **exp** shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by **exp** shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of **exp**’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except **exp**. The Client warrants that **exp**’s instruments of professional service will be used only and exactly as submitted by **exp**.

The Client recognizes and agrees that electronic files submitted by **exp** have been prepared and submitted using specific software and hardware systems. **Exp** makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

TABLE 1. CONCORDANCE SUMMARY

"PRELIMINARY HYDROGEOLOGICAL ASSESSMENT" TERMS OF REFERENCE	REFERENCED? (YES/NO)	REPORT SECTION(S)	COMMENTS
"The LTC in consideration of Proposed Bylaws for this application, requires confirmation at the rezoning stage that the potable water needs of the proposed lots and intended uses can be met and the proposed wells and sewage disposal system(s) will have no adverse impacts on surrounding wells, groundwater resources and receiving waters"	**YES**	1 and 5	Section 5 of the **Hydrogeological Study (Phase 1)** provides the following "Statement of Opinion" from a Qualified Professional Hydrogeologist: ***"Projected potable water needs for the Convention's proposed 110 cottage lots and Keats Camp expansion can be satisfied from on site groundwater sources and neither the proposed groundwater extractions nor proposed new community sewerage systems will have adverse impacts on local groundwater resources, groundwater users, and receiving waters."***

CATEGORY	Tracking No.	SPECIFIED DATA, INFORMATION OR ANALYSES	REFERENCED? (YES/NO)	REPORT SECTION(S)	COMMENTS
Inventory and Analyze Available Information on the Ground Water Resource in the Area	**1**	Published Reports	**YES**	3.2	**-**
	2	Geological Maps	**YES**	3.2	**-**
	3	Publications	**YES**	3.2	**-**
	4	Well Record Data	**YES**	3.2	**-**
	5	Exploration Test Holes	**YES**	3.2	**-**
	6	Geophysical Data	***NO***	-	Geophysical surveys not completed on DL696 or adjacent properties. Such survey might be implemented (to be determined) to identify prefered drilling location for proposed new Keats Camp well.
	7	Aerial Photographs	**YES**	-	Keats Island orthophoto imagery was viewed during review of BC Water Resources Atlas. Development of DL696 generally reached current level of occupation and land use during the 1950's. Orthophoto imagery not a signifcant input to the overall assessment objectives.
	8	Well Users	**YES**	3.2	**-**
	9	Conduct Site Survey	**YES**	3.3	**-**
Prepare a Hydrogeological Assessment Report Outlining the Results of the Office and Field Investigation and Analysis of the Data	**10**	General Description of Physio/Geographic Setting	***NO***	-	Generalized physio/geographic setting is described in previous reports commissioned by the Applicant and submitted to Islands Trust.
	11	General Description of Topography	***NO***	-	CREUS Engineering Ltd. "Context Plan" issued to Islands Trust for PLA provides LIDAR survey topographic contours for DL696 and adjacent lands. This information provided to Islands Trust as Item #14 in email dated Sept. 9, 2017.
	12	General Description of Surface Water Drainage	***NO***	-	Although not specifically referenced in the Hydrogeological Assessment report, iMap was reviewed to confirm there are no mapped or classified water bodies ("streams") on DL696 or immediate adjacent properties. Roadside ditches and other shallow water management excavations on DL696 (Report Section 4.2) are not potential effluent breakout points for proposed new communal fields.
	13	General Description of Climate	***NO***	-	Climate is generally described in previous reports commissioned by the Applicant and submitted to Islands Trust.
	14	General Description of Geomorphological Conditions	***NO***	-	**-**
	15	General Description of Existing and Proposed New Road Network	***NO***	-	CREUS Engineering Ltd. "Context Plan" issued to Islands Trust for PLA provides surveyed locations/alignments of existing road network and design locations/alignments of proposed roadways and other access corridors. This information provided to Islands Trust as Item #14 in email dated Sept. 9, 2017.
	16	General Description of Existing and Proposed Water Supply Wells	**YES**	4.1	**-**
	17	General Description of Existing and Proposed Sewage Effluent Dispersal Field Areas	**YES**	4.2	**-**
	18	General Description of Geologic Setting	**YES**	4.1, 4.2	Description of actual subsurface profiles from numerous site-wide Test Pit excavations and local well logs.
	19	General Description of Bedrock Types	**YES**	4.2	Report references Keats Island Aquifer rock types cited in BC MOE Aquifer Classification Work Sheet. Also reviewed rock types reported in previous geotechnical investigation, BC MOE report and public bedrock maps.
	20	General Description of Surficial Geological Conditions	**YES**	4.1, 4.2	Description of actual subsurface profles from numerous site-wide Test Pit excavations and local well logs.
	21	Extent and Information on Aquifers	**YES**	4.1	Entire DL696 property and adjacent lands underlain by common bedrock aquifer.
	22	Information on Aquifer Hydrualic Gradients, Conductivity, Transmissivity and Storativity	**YES**	4.1	Long-duration monitoring in Keats Camp water system wells and Benson Well was completed by KICAS in general conformance with current CPCN testing/monitoring protocols. Results indicate prevalent shoreward flow through Keats Camp well field and through Benson property. These data provide confirmation of primary hydraulic traits (i.e., responses) required to estimate the productivity of Keats Camp wells and to develop recommendations for replacement of existing Well #1. Analysis of monitoring data not completed to estimate aquifer hydrualic properties (i.e., conductivity etc.) since original data not available, but also because graphed data was sufficient to quantify actual well hydraulic function and aquifer response under sustained withdrawal scenario.
	23	Extent of Ground Water Flow Systems	**YES**	4.1, 4.2	Entire DL696 property and adjacent lands are underlain by common bedrock aquifer that is overlain by a common sequence of granular surficial sediments with intermediate fine-textured silt/clay strata. The surficial sediment sequence hosts a shallow unconfined groundwater system and the underlying bedrock hosts the Keats Island Aquifer.
	24	Interpreted Flow Patterns	**YES**	4.1, 4.2	Shallow groundwater system flow patterns are interpreted to be congruent with local topographic trends, based on common presence and type of surficial soils reported in site-wide Test Pit excavations. Applicant has committed to monitoring and confirming actual shallow groundwater flow conditions within proposed Disposal Field Area E. Bedrock aquifer flow patterns in vicinity of existing Keats Camp Well #1 and Well #2 and proposed new Keats Camp well are interpeted to be southeastward (overall) toward marine foreshore. Aquifer flow patterns can be interpreted more generally as being radial from local upland areas and includes an approximate northeast-southwest aligned flow divide through the centre of DL696.

TABLE 1. CONCORDANCE SUMMARY

"PRELIMINARY HYDROGEOLOGICAL ASSESSMENT" TERMS OF REFERENCE			REFERENCED? (YES/NO)	REPORT SECTION(S)	COMMENTS
Prepare a Hydrogeological Assessment Report Outlining the Results of the Office and Field Investigation and Analysis of the Data (*continued*)	**25**	Surface Water-Ground Water Interrelationship	**YES**	4.1, 4.2	No designated surface water bodies ("streams") present on DL696 or immediate adjacent lands. Refer to Comment for Tracking Number 12.
	26	Existing and Long-Term Water Supply Volumes Required for Both Wet and Dry Seasons	**YES**	4.1, Figure 1	Peak period water demands were estimated based on a review of daily totalized (actual) pumping rates from the Keats Camp wells and actual daily treated water demand during the 8.5 year period of 2008-2017.
	27	Information on Existing Wells	**YES**	4.1	BC Ministry of Environment "Detailed Well Records" were obtained for the assessment.
	28	Information on Any Additional Wells Required to Meet Demands	**YES**	4.1	The Preliminary Hydrogeological Study recommends that Keats Camp Well #1 be replaced with a new well constructed at a location (to be determined) upslope of existing Keats Camp Well #2. Details for the new well and timing for construction would be necessarily confirmed for the Minstry of FLNRO licencing process and ovrall subdivision process. The Applicant has committed to decommissioning Keats Camp Well #1, constructing a new well, and maintaining Well #2 for supply redundancy purposes. The Applicant has further committed to study the use of shallow surface infiltation wells as part of subdivision process.
	29	Estimates of Aquifer Recharge Potential	**YES**	4.1, 4.2	Bedrock aquifer recharge occurs locally as direct infiltration of rainwater through bedrock fractures exposed in upland areas and more broadly as infiltration of water from the overlying shallow groundwater system hosted by surficial sediments. Aquifer recharge poential can be generally characterized as "low" due to presence of low-permeability sediments overlying the bedrock aquifer.
	30	Estimates of Effluent Field Discharges	**YES**	4.2	**-**
	31	Comparison of Well Abstraction Volumes After/Prior to New Water Supply System	**YES**	4.1	Post-development peak period water demands were estimated based on a review of daily totalized (actual) pumping rates from the Keats Camp wells and actual daily treated water demand during the 8.5 year period of 2008-2017.
	32	Assessment of Pontential for Saltwater Intrusion	**YES**	4.1	Consultations with Keats Camp water system Operator confirm that saltwater intrusion has not occurred historically and that the primary chemical indicators of saltwater intrusion (i.e., upward trending chloride and/or Electrical Conductivity and/or Total Dissolved Solids concentrations) have not been observed in either Well #1 or Well #2. Maintenance of an overall positive seaward gradient below the Keats Camp well field will addtionally ensure effective reduction and management of saltwater intrusion risk.
	33	Background Hydrochemical Information on Historical Ground Water Quality Trends	***YES***	-	Keats Camp water quality data not provided for Report assessment purposes. However, consultation with water system Operator and review of VCH reporting confirms the treated well water meets current CDWQ Guidleines and that raw aquifer water has natural elevated arsenic concentrations. No other untreated water chemistry traits, except intermittent Total Coliform detection, were referenced during Operator discussions.
	34	Hydrochemical Information on Anticipated Ground Water Quality Trends	***NO***	-	No post-development aquifer water quality projections were referenced in the Report. However, no post-development aquifer water quality variations are anticipated given the presence of protective sily/clay strata overlying the bedrock aquifer, coupled with the Applicant's committment to either decommission or install surface seals on existing wells, and given the renovative capacity of the surficial sediments within the proposed communal field areas.
	35	Identify Impacts of Development on Groundwater Resource Quantity and Quality and Interrelated Surface Water Resources	**YES**	4.1, 4.2	The primary finding of the Preliminary Hydrogeological Study is that "*Projected potable water needs for the Convention's proposed 110 cottage lots and Keats Camp expansion can be satisfied from on site groundwater sources and neither the proposed groundwater extractions nor proposed new community sewerage systems will have adverse impacts on local groundwater resources, groundwater users, and receiving waters* . "
	36	Assess Significance of Impacts in Terms of Human and Aquatic Habit Needs	**YES**	4.1, 4.2	Refer to Comment for Tracking Number 35.
	37	Assessment Should Include Changes in Rate of Surface Water Runoff and Aquifer Recharge Discharge Volumes	***NO***		The development is being designed in a manner to replicate pre-development runoff with post-developmnet runoff. Unbuilt lots have largely been precleared and more than 50% are on rock. All proposed pipeworks will be on existing dirt and gravel trails and not in paved roads. Clearing for the six proposed dispersal field will occur over several years. Stormwater calculations will be included with the subdivision submission. The increase in surface water runoff rate will be managed using conventional stormwater management features such as rain gardens and inflitation trenches. The area of full clearing is currently around 36,000 m^2 and is expected to increase by 12,000 m^2 with the majority of the newly cleared area being converted to vegetated fields. This is just over 1% of the property.
	38	Identify Measures to Mitigate any Significant Short and Long Term Potential Ground Water Resource Degradation	***NO***		Refer to Comment for Tracking Number 37.
	39	If Existing Wells are Deemed to Not Support Proposed Uses, Carryout Pump Testing in New Wells per CPCN	**PENDING**	4.1, Figure 1	During June/July 2016, when Keats Camp reported the highest demand on record (i.e., 22 USgpm averaged), the productivity of Well #2 was sufficient to meet demand. Post-development peak rates are estimated (projected) to be 6.4 USgpm higher than the 2016 value. Long-duration monitoring of water levels in Keats Camp water system wells indicates the yield of Well #2 has been adequate to satisfy the projected post-development peak demands. The Applicant is necessarily committed by the pending CPCN process and Minstry of FLNRO licencing requirements to verify the actual capacity of Well #2 and any proposed new well.
	40	Comments on Potential Impacts Resulting from Climate Change	***NO***	-	Anticipated climate change impacts will be related to the continued trend of hot/dry summer periods and warm/wet winter periods. Winter months are currently low demand for the Keats Camp water system and this will continue with the proposed camp expansion and build-out. Assessment of the long-term productivity of Keats Camp Well #2 was based on current Provincnial CPCN methodology, which conservatively assumed prolonged drought conditions of 100 days duration. Surface water infiltration wells have been proposed for the site and have been discussed with both VCH and the current water operators as a means to reduce demand on the Keats Camp wells. All existing and new water supply wells and proposed new communal dispersal field areas situated at elevations exceeding projected sea level rise.
	41	If Monitoring Wells are Proposed, Outline Details of Purpose, Locations, Design, Monitored Zones and Monitoring/Reporting Details	**PENDING**	-	Multiple monitoring wells are currently proposed and/or anticipated. VCH will require dedicated Observation Wells for each of the proposed new communal fields. The Applicant has also committed to installation of pre-construction monitoring wells in Fall 2017 within Dispersal Field Area E (Campfire Rock) to evaluate shallow groundwater conditions. As a condition for issuing an Existing Use Groundwater Licence, it is anticipated Ministry of FLNRO will require one or more aquifer monitoring wells be constructed between the Keats Camp wells and the marine foreshore to facilitate continuous evaluation and monitoring of saltwater intrusion potential.
	42	Comprehensive List of All References and Data Sources Used in the Hydrogeological Assessment Report	**YES**	3.2	As requested by Islands Trust, access (via ftp site) to information available from public sources listed in Section 3.2 of Report was provided on Sept. 9, 2017.

275 – 3001 Wayburne Drive
Burnaby, BC V5G 4W3 Canada
T: 604.874.1245 • www.exp.com

Memorandum

Date:	September 15, 2017	**Reference No.:**	VAN-00240303-A0
To:	Sonja Zupanec, RPP Island Planner, Islands Trust szupanec@islandstrust.bc.ca	**Total No. of Pages:**	4 + Attachment
From:	Matthew D. Munn, P.Eng. Jeff Johnson, BA, MBA	matthew.munn@exp.com jeff.johnson@exp.com	
Project:	**Hydrogeological Study (Phase 1) – Supplementary Information #2 DL696, Keats Island, BC**		

1 INTRODUCTION

Exp Services Inc. (**exp**) submitted a "*Hydrogeological Study - Phase 1*" report to Islands Trust on July 25, 2017, on behalf of the Convention of Baptist Churches of BC (the Convention), in support of a rezoning application for the above-referenced property on Keats Island, BC. Aspects of the Phase 1 Study were discussed during a September 8, 2017 teleconference meeting attended by Islands Trust staff, Mr. Kevin Healy of CREUS Engineering Ltd. (CREUS) and Mr. Matthew Munn of **exp**. Based on comments received from Islands Trust by email on September 8, 2017, **exp** submitted a "Supplementary Information" memorandum to Island Trust on September 12, 2107, as additional context for the Gambier Local Trust Committee's consideration of the Phase 1 Study report.

Exp's reliance on water use data provided by the DL696 water system Operator (i.e., Keats Island Construction & Service Ltd. [KICAS]) was specifically discussed during the September 12, 2017 teleconference. Islands Trust's post-meeting email further referenced this topic and requested that **exp** be prepared to further address the following:

> *"The rationale to use the DL696 water use data sets (despite being identified as having issues), and basing the statement of opinion that the proposal as presented can be supported by the aquifer, on the questionable data."*

Accordingly, this "Supplementary Information #2" memorandum has been prepared to provide additional comments and clarifications regarding use of KICAS's water system monitoring data. Use of this memorandum must include consideration of the Section 3 Limitations and the attached "Interpretation & Use of Study and Report".

2 SUPPLEMENTARY INFORMATION

2.1 Background

The "Groundwater Withdrawal and Consumption" section (page 5) of **exp's** Phase 1 Study report discusses data available from the DL696 water system Operator's monitoring program (ongoing), which includes a near-continuous record of daily water volumes, monthly water volumes and annual water volumes for the period of September 2008 to 2017 (8+ years). The Operator information included the following three water monitoring values:

1. Water withdrawal volumes from DL696 wells (designated "Well")
2. Water consumption volumes for Keats Camp (designated "Camp")
3. Water consumption volumes for Cottages (designated "Cottages")

As discussed in the Phase 1 Study report, **exp's** initial review of the Operator's data confirmed that annual consumption volumes were approximately 2% to more than 20% below than the annual water withdrawal volumes, which was interpreted to indicate flow meter calibration issues and/or water system leakage. During the September 8, 2017 teleconference meeting with Islands Trust, **exp's** use of KICAS' monitoring data was questioned, due to this confirmed imbalance between water withdrawals and consumption, and clarification was also sought regarding **exp's** related comment (Page 5 of Study) on this water volume imbalance:

> *"…… use of these data for the Phase 1 Study is considered valid given that the monitoring records are the lone available source for DL696 water use information, and provided that any assessment based on the monitoring records identifies all assumptions."*

Accordingly, **exp's** meeting attendee restated the purpose of the comment (above), which was to generally confirm the suitability and validity of the available data for the DL696 water supply assessment and to also reiterate **exp's** recognition of the water volume imbalance. However, Island Trust's email that followed the meeting indicates that further explanation is required.

2.2 Additional Explanation and Assessment

<u>Water Availability</u>

Exp's Phase 1 report concludes that the availability of water from DL696 Camp Well 2 is sufficient to satisfy the projected water demands for the proposed 110 lot build-out and expanded camp scenario. This conclusion is based on comparison of the estimated Well 2 yield of approximately 39 USgpm (US gallon per minute) to the estimated demand of 28.4 USgpm.

The sustainable yield of Well 2 was estimated through assessment of data acquired by the Operator during long-duration (21 days) pumping tests completed in 2013, and was not reliant on data from the Operator's separate water monitoring program established in 2008. The resulting Well 2 yield estimate of 39 USgpm is considered valid since both the 2013 data and **exp's** 2017 assessment method comply with current CPCN protocols. The 2013 data and resulting analysis results are also considered appropriate estimates for the 2017 well yield, in part, because July 2017 measurements of stabilized static (non-pumping) water levels in Well 2 were approximately 24 ft (7.2 m) below top of casing, which is nearly equivalent to the non-pumping aquifer water levels (i.e., 26 ft [7.9 m]) obtained from Well 2 at the time of construction in July 2004 and also generally confirms that operation of Well 2 has not depleted the source aquifer.

Water Consumption

Exp's Phase 1 report estimates DL696 peak period water demand to be approximately 28.4 USgpm based on our review of the Operator's 2008-2017 water use monitoring data. During **exp's** June 12, 2017 site visitation, and prior to receiving this Operator monitoring data, it was discussed and known that the water system was "leaky" and that differences between reported withdrawal volumes (Well) and consumption volumes (Camp + Cottages) would be apparent in data subsequently delivered to **exp**.

It is our understanding based on discussions with the Operator and CREUS Engineering Ltd. (CREUS) that water system leakage is primarily (if not exclusively) within the complex network of piping that delivers water from the treatment plant to the Camp and cottages, and not within the much simpler piping that leads from the DL696 wells to the treatment plant. Therefore, the Operator's "Well" data, which represents water volumes withdrawn from the aquifer, should be considered representative of actual DL696 water system demand.

The highest sustained (average) pumping rate on record for Well 2 is 22.0 USgpm, which was reported in July 2016 (see Figure 1 of Study). **Exp** accepted this rate as the baseline consumption value, prior to adjusting that value upward for the anticipated 50% growth in Camp consumption and the 31% growth in Cottages consumption. The highest sustained (average) pumping rates on record for both the Camp and the Cottages were also used to establish baseline values, prior to increasing by 50% and 31%, respectively. On this basis, **exp's** projected build-out water consumption rate of 28.4 USgpm is considered an acceptable estimate.

Alternative Consumption Assessment

For the purposes of this memorandum, **exp** has reexamined both the Camp and Cottages water consumption rates to evaluate the projected build-out water consumption using a modified approach that specifically considers the water volume variations reported in the Operators monitoring data. Reported water consumption volumes (cubic metres [m^3]) for the Camp and Cottages are summarized in Table 1 for years with complete data.

TABLE 1: CAMP AND COTTAGES CONSUMPTION

YEAR	CAMP (m^3)	COTTAGES (m^3)	TOTAL (m^3)	PROPORTION		PRORATED (22 USgpm)	
				CAMP	COTTAGES	CAMP	COTTAGES
2009	2,249	6,462	8,711	26%	74%	6	16
2010	2,763	6,475	9,238	30%	70%	7	15
2011	2,031	7,538	9,570	21%	79%	5	17
2012	3,951	6,159	10,110	39%	61%	9	13
2013	3,758	7,121	10,879	35%	65%	8	14
2014	3,381	8,841	12,222	28%	72%	6	16
2015	4,972	6,978	11,950	42%	58%	9	13
2016	4,356	8,012	12,368	35%	65%	8	14

The relative proportions of the Camp water volume and Cottages water volume, based on the annual reported combined volumes, range from 21% to 42% for the Camp and from 58% to 79% for the Cottages (Table 1), which indicates an overall ±20% variation in the proportional use between Camp and Cottages. Accepting 22 USgpm as the peak baseline demand value, the resulting prorated peak consumption rates range from 5 to 9 USgpm for the Camp and 13 to 17 USgpm for the Cottages (Table 1).

Applying build-out increases of 50% and 31% to the prorated consumption rates, respectively, results in projected Camp peak demands ranging from 7 to 14 USgpm and projected Cottages peak demands of 17 to 23 USgpm. Combining the range of Camp and Cottages peak demands produces an overall projected peak build-out demand of approximately 31 USgpm, which is a 41% increase in peak demand above the recorded high rate of 22 USgpm, and is quite similar to the previously estimated build-out value of 28.4 USgpm.

Based on the results of this alternative approach to considering and utilizing the available water consumption data, the estimated 39 USgpm sustainable yield for Well #2 is further verified to be adequate to satisfy the projected peak demand of 31 USgpm estimated for the 110 lot build-out and expanded camp.

3 LIMITATIONS

This memorandum and attachments have been prepared by **exp** Services Inc. for the exclusive use and consideration of the Convention of Baptist Churches of BC, Islands Trust and Committees, and CREUS Engineering Ltd. Any use of this memorandum for purposes other than the purposes described in the preceding sections and Phase 1 Report preamble and/or by any other party, must first be verified in writing by **exp** Services Inc. **Exp** does not accept any responsibility for damages resulting from other party's reliance on or use of the information, opinions, interpretations or conclusions contained in this memorandum. The attached "Interpretation & Use of Study and Report" is an integral part of this document and must be considered by readers and also included with any copies of this memorandum.

4 CLOSURE

We trust the content of this memorandum satisfies your current requirements. If you have any questions, please contact the undersigned.

Submitted by:

exp Services Inc.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
M. D. MUNN
#27072
Sept. 15/17

Matthew D. Munn, P.Eng.
Senior Hydrogeologist

Reviewed by:

Jeff A. Johnson, BA (Econ), MBA
Senior Manager

Attachment: Interpretation & Use of Study and Report

cc: Convention of Baptist Churches of BC, Ian Grant (iangrant890@gmail.com)
CREUS Engineering Ltd., Kevin Healey, P.Eng. (khealey@creus.ca)

MDM:jaj

L:\2017 (0237475-A0)\0240303-A0 MM Baptist Churches Hyd. Study Keats Island\deliverable\phase_500\mem_exp_final_20170915_240303.docx

INTERPRETATION & USE OF STUDY AND REPORT

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental consulting unless specifically stated in the engineering report.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS “APPROVED USERS”. The contents of the Report remain our copyright property and we authorise only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorised use of the Report.

5. INTERPRETATION OF THE REPORT

a. Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b. Reliance on Provided information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

c. To avoid misunderstandings, **exp** Services Inc. (**exp**) should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by **exp**. Further, **exp** should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor’s work is being carried out in general conformity with **exp**’s recommendations. Any reduction from the level of services normally recommended will result in **exp** providing qualified opinions regarding adequacy of the work.

6.0 ALTERNATE REPORT FORMAT

When **exp** submits both electronic file and hard copies of reports, drawings and other documents and deliverables (**exp**’s instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by **exp** shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by **exp** shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of **exp**’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except **exp**. The Client warrants that **exp**’s instruments of professional service will be used only and exactly as submitted by **exp**.

The Client recognizes and agrees that electronic files submitted by **exp** have been prepared and submitted using specific software and hardware systems. **Exp** makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.