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REGIONAL WATER SUPPLY COMMISSION
Notice of Meeting on **Wednesday, June 17, 2015 @ 12:30 pm**
Board Room, 6th Floor, 625 Fisgard Street, Victoria, BC

M. Lougher-Goodey (Chair)	G. Orr (Vice-Chair)	G. Baird
C. Coleman	V. Derman	B. Gramigna
F. Haynes	M. Hicks	B. Isitt
R. Kasper	Z. King	G. Logan
J. Loveday	T. Morrison	D. Murdock
J. Rogers	V. Sanders	W. Sifert
L. Szpak	L. Wergeland	G. Young
E. Zhelka		

AGENDA

To ensure a quorum, advise Margaret at 250.474.9606 if you or your alternate cannot attend.

1720917

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MINUTES OF A MEETING OF THE REGIONAL WATER SUPPLY COMMISSION
Held Wednesday, May 20, 2015 in the 6th Floor Boardroom, 625 Fisgard Street

PRESENT: **Commissioners**: M. Lougher-Goodey (Chair), Z. King, G. Logan, T. Morrison, G. Baird, M. Hicks, B. Gramigna, G. Orr, E. Zhelka, F. Haynes, S. Brice (for L. Wergeland), D. Murdock, V. Derman, V. Sanders, R. Kasper, C. Coleman, J. Loveday, B. Isitt, G. Young, J. Rogers
Staff: T. Robbins, P. Sparanese, A. Constabel, J. van Niekerk, G. Harris, H. Dale, M. Montague (Recorder)
ABSENT: L. Szpak, W. Sifert

The meeting was called to order at 12:30 pm. The Chair noted that additional speakers had submitted requests to address Item 16.

MOVED by Commissioner Derman and **SECONDED** by Commissioner Haynes,
That the additional speakers be added to the Presentations/Delegations under Item 4.

CARRIED

1. **APPROVAL OF THE AGENDA**

MOVED by Commissioner Derman and **SECONDED** by Commissioner Haynes,
that the Regional Water Supply Commission approve the agenda as amended.

CARRIED

2. **ADOPTION OF THE MINUTES OF FEBRUARY 18, 2015**

MOVED by Commissioner Rogers and **SECONDED** by Commissioner Coleman,
that the Regional Water Supply Commission adopt the minutes of the meeting held February 18, 2015.

CARRIED

3. **CHAIR'S REMARKS**

The Chair reminded members of the 100th anniversary celebration on Thursday, May 28.

4. **PRESENTATIONS/DELEGATIONS**

1) Georgia Collins, 2730 Heald Road, Shawnigan Lake, BC expressed concerns with the South Island Aggregate site located within the Shawnigan Lake watershed.

2) Kerry Davis, 696 Frayne Road, Mill Bay, BC expressed concerns with the location of the South Island Aggregate hazardous waste dump and noted that a petition asking that the operation not be allowed was submitted to the Legislature last week containing approximately 15,000 signatures.

3) Laurel Collins, Michigan Street, Victoria, BC expressed concerns with the South Island Aggregate site located within the Shawnigan Lake watershed.

5. **WATER ADVISORY COMMITTEE – VERBAL REPORT FROM THE CHAIR**

R. Mersereau provided a verbal report on the status of the Water Advisory Committee and provided an update on current initiatives.

MOVED by Commissioner Isitt and **SECONDED** by Commissioner Haynes,
That the Regional Water Supply Commission direct staff to engage First Nations with a view to fill the current vacancy on the Water Advisory Committee as soon as possible.

CARRIED

MOVED by Commissioner Baird and **SECONDED** by Commissioner Morrison,
That the Regional Water Supply Commission receive the verbal report from the Chair of the Water Advisory Committee for information.

CARRIED

6. SUMMARY OF RECOMMENDATIONS FROM OTHER WATER COMMISSIONS

MOVED by Commissioner Derman and **SECONDED** by Commissioner Logan,
That the Regional Water Supply Commission receive the report for information.

CARRIED

7. CORRESPONDENCE

MOVED by Commissioner Rogers and **SECONDED** by Commissioner Zhelka,
That the Regional Water Supply Commission receive the correspondence from Robin P. Lowry, regarding the South Island Aggregates Ltd. site, Shawnigan Lake, for information.

CARRIED

8. CENTENNIAL ANNIVERSARY EVENT – MAY 28, 2015

T. Robbins provided an update on the Centennial Anniversary Event scheduled for May 28, 2015. He asked that Commission members email M. Montague if they will be attending the event. The invitation will be resent to members as a reminder.

9. DRAFT REGIONAL SUSTAINABILITY STRATEGY - WATER ADVISORY COMMITTEE INPUT

MOVED by Commissioner King and **SECONDED** by Commissioner Haynes,
That the Regional Water Supply Commission support, in principle, the submission from the Water Advisory Committee on the draft Regional Sustainability Strategy.

CARRIED

10. PROPOSED PUBLIC SAFETY IMPROVEMENTS, SMITH HILL RESERVOIR

MOVED by Commissioner Isitt and **SECONDED** by Commissioner Young,
That the Regional Water Supply Commission:

1. a) Approve a new 2015 capital project, Phase 1 - Smith Hill Reservoir Public Safety Improvements, related to public safety and the environment, at an estimated total cost of $107,200 with funding from the existing 2015 capital budget.
   b) Reduce the budget for the existing capital project Main #14 – rectify Low Pressure from $500,000 to $392,800.
   c) Include Phase 2 – Smith Hill Reservoir Public Safety Improvements in the 2016 capital budget at an estimated cost of $104,000.

CARRIED

11. T'SOU-KE FIRST NATION TRADITIONAL USE STUDY – LEECH WATER SUPPLY AREA

MOVED by Commissioner Kasper and **SECONDED** by Commissioner Morrison,
That the Regional Water Supply Commission recommend to the CRD Board to enter into a Contribution Agreement with T'Sou-ke First Nation to conduct a Traditional Use Study of the Leech Water Supply Area, and utilize approved 2010/2015 Leech Water Supply Area Restoration capital funds in the amount of $42,000 to fund the agreement.

CARRIED

12. SPRING 2015 ALGAE BLOOM IN SOOKE LAKE RESERVOIR

MOVED by Commissioner Kasper and **SECONDED** by Commissioner Morrison,
That the Regional Water Supply Commission receive the staff report for information.

CARRIED
CARRIED

13. WATER QUALITY REPORT FOR SOOKE LAKE RESERVOIR JANUARY – APRIL 2015

MOVED by Commissioner Kasper and **SECONDED** by Commissioner Morrison,
That the Regional Water Supply Commission direct staff to post the Sooke Lake Reservoir monitoring results for January 2015 through April 2015 for public release.

CARRIED

14. UPDATE ON THE LEECH OPEN HOUSES (VERBAL REPORT)

T. Robbins provided a verbal update on the Leech Open Houses.

MOVED by Commissioner Kasper and **SECONDED** by Commissioner Morrison,
That the Regional Water Supply Commission receive the report for information.

CARRIED

15. WATER WATCH

MOVED by Commissioner King, and **SECONDED** by Commissioner Baird,
That the Regional Water Supply Commission receive the report for information.

CARRIED

16. MOTION WITH NOTICE

MOVED by Commissioner Isitt and **SECONDED** by Commissioner King,
That staff be directed to report on the potential impact of the South Island Aggregates facility on the Sooke Lake water supply in light of new information considered during the BC Environmental Assessment Board process.

CARRIED

17. NEW BUSINESS

Peninsula Farm Tour – Commissioner Orr noted that the Peninsula and Area Agricultural Commission is hosting a farm tour on June 13. The invitation will be forward to the Commission members by email.

18. ADJOURNMENT

MOVED by Commissioner Derman and **SECONDED** by Commissioner King,
That the Regional Water Supply Commission meeting be adjourned at 1:55 pm.

CARRIED

Chair

Secretary

JUAN DE FUCA WATER DISTRIBUTION COMMISSION

**SUMMARY OF RECOMMENDATIONS MADE
AT A MEETING HELD JUNE 2, 2015**

Full reports can be viewed at https://www.crd.bc.ca/about/document-library/documents/committeedocuments/juandefucawaterdistributioncommission/20150602

1. **Sooke Road Water Main Crossing of Ayum Creek – Award of Construction Contract 2015-889**

   That the Juan de Fuca Water Distribution Commission award the contract for the Sooke Road Crossing of Ayum Creek (Tender No. 2015-889) to York Excavating Ltd. in the amount of $126,940.80, including tax.

   CARRIED

2. **Sooke Road Watermain Upgrade – Glen Lake to Jacklin Road – Award of Construction Contract 2015-971**

   That the Juan de Fuca Water Distribution Commission award the contract for the Sooke Road Watermain Upgrade - Glen Lake to Jacklin Road Project (Tender No. 2015-971) to CHEW Excavating for the amount of $1,465,446.15 including tax.

   CARRIED

3. **Rectify Low Pressure Section of Main No. 14 – Pressure Increase to Millstream Village Area**

   That the Juan de Fuca Water Distribution Commission receive the staff report for information.

   CARRIED

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Agenda Item #8
REPORT #RWSC 2015-10

REPORT TO REGIONAL WATER SUPPLY COMMISSION
MEETING OF WEDNESDAY JUNE 17, 2015

SUBJECT **POTENTIAL IMPACT OF SOUTH ISLAND AGGREGATES CONTAMINATED SOILS LANDFILL ON GREATER VICTORIA DRINKING WATER – REVIEW OF NEW INFORMATION**

ISSUE

The Regional Water Supply Commission directed staff to report on the potential impact of the South Island Aggregates (SIA) facility on the water supply in Sooke Lake Reservoir in light of new information considered during the BC Environmental Appeal Board process.

BACKGROUND

The BC Ministry of Environment issued a waste discharge permit to South Island Aggregates in August 2013 to accept and store contaminated soil at an existing quarry/landfill site at 460 Stebbings Road in the Goldstream Heights area of the Cowichan Valley Regional District. The landfill site is located within the catchment of Shawnigan Lake and is approximately 5.5 km east of Sooke Lake Reservoir and 2 km east of the Goldstream Water Supply System (Butchart Lake Reservoir) in the Greater Victoria Water Supply Area.

CRD staff have been monitoring this file since early 2013 as information on the landfill application, assessments and reports became available. The CRD Board issued a letter to the Ministry of Environment in April of 2013 (Attachment 2) requesting the SIA Waste Discharge Permit application be denied in light of the inadequate 3 week time period for public input and conflicting hydrogeological and technical opinions, and that the contaminated site regulations be amended to provide for thorough and appropriate consideration of local government input and land use regulations in the contaminated soils permitting process. The CRD Board also directed staff to conduct an internal analysis of the potential impact of the proposed landfill on the Capital Region's water supply at Sooke Lake.

A staff report was presented to the CRD Board for information in May of 2013 (IWS 2013-01) (Attachment 3) and was accepted. Based on a review of the proposal, critiques of the proposal, available technical reports and information, CRD staff concluded that the landfill site would have no impact on the quality of drinking water received by Greater Victoria consumers.

Four appellants appealed the Ministry of Environment decision to issue the waste discharge permit, and a lengthy Environmental Appeal Board (EAB) review took place from March to July 2014. The EAB accepted and heard 4 new technical reports and testimony from several witnesses during their review. A final EAB decision was reached on March 20, 2015, which stayed all four appeals and provided for continuance of the permit for the storage and remediation of contaminated soils.

At its May 2015 meeting, the Regional Water Supply Commission directed staff to review the new reports considered during the Environmental Appeal Board hearings to assess whether there was increased risk or uncertainty to Greater Victoria drinking water in light of the new information.

CRD staff reviewed new reports and related witness testimony presented during the Environmental Appeal Board hearings from Ingimundson, Kohut and Lowen. In addition, CRD staff reviewed information that was not available during preparation of the previous staff report from Hancock, Mortensen, Barroso and Lapcevic, Morin and the EAB decisions.

The results of the staff review are contained in the attached technical report (Attachment 1): Potential Impact of the South Island Aggregates Contaminated Soils Landfill Site on Greater Victoria Drinking Water Quality – Supplementary Report in Light of New Information Considered During the 2014 Environmental Appeal Board Process. Technical Report File # SS2015005.

CONCLUSIONS

1. **Potential for Contamination via Surface Water Flow**
   There is no potential for contamination from the SIA landfill site to Sooke Lake Reservoir or the Goldstream reservoirs via surface water flow. Surface water leaving the site flows into streams that feed Shawnigan Lake. Heights of land restrict water from flowing into the Sooke and Goldstream watersheds.

2. **Potential for Contamination Spreading from Soil Containment System**
   Assessment of the application and approved permit indicate an extensive engineered design to ensure that contaminants do not leak or move from the site. Multiple layers of protection would need to fail simultaneously for contaminants to escape the site. EAB direction to prohibit re-use of liners and blasting during installation of liners serve to further protect the containment measures. Based on the permit requirements and site plans, staff conclude there is no evidence to suggest contaminants will not be held by the system as designed.

3. **Potential for Contaminated Site Surface Water to Enter Groundwater**
   Expert opinion regarding the size, extent and connectivity of bedrock fracturing beneath the SIA site, as well as the permeability of the upper bedrock layer is conflicting. Although isolated pockets of limestone are found in the area, there is no evidence of limestone at the SIA site, nor for more extensive deposits of limestone in the wider area.

   Evidence from wells at the SIA site indicates an upwelling of water, which further restricts surface water from entering the groundwater.

   CRD staff find there is insufficient evidence to conclude that the bedrock is fractured, connected, and permeable to the extent that surface water from the site is conducted into groundwater.

4. **Groundwater Connection and Direction of Flow**
   Based on limited well information, the groundwater in the area flows to the north and northwest in the direction of Shawnigan Lake, rather than west to Sooke Lake Reservoir or southwest to the Goldstream system reservoirs. The estimated groundwater travel time for the distance to Shawnigan Lake from the SIA site given a groundwater connection is 100 to 6,000 years based on evidence heard at the EAB hearings.

   Groundwater/aquifer mapping is incomplete. To date there is no evidence that groundwater near the SIA site is connected to groundwater serving Sooke Lake Reservoir or the Goldstream reservoirs.

   CRD staff conclude that, based on the known information, groundwater is not moving from beneath the SIA site to Sooke Lake Reservoir or the Goldstream reservoirs.

5. **Drinking Water Guidelines**
   Despite evidence to the contrary, if contaminated soils were to escape engineered protections, leach contaminants into surface water at the SIA site, move down through upwelling water at the site, permeate down through the bedrock, enter groundwater and travel several kilometers intact into Sooke Lake Reservoir or the Goldstream reservoirs, the amount of contaminants reaching the reservoirs would need to be in high enough quantity to breach acceptable Canadian drinking water guidelines. Accepted testimony from Dr. Mortensen at the hearings stated that a plume of contaminants would be unlikely to travel more than 500 m, well short of Shawnigan Lake, Sooke Lake and Goldstream reservoirs before being diluted, degraded, entranced or diffused.

   Any contaminants reaching the north end of Sooke Lake Reservoir would be diluted by 160 million cubic metres of water before reaching the water intake at the south end of the Reservoir. The Goldstream water supply system is located to the west and southwest of the SIA site. Contaminants entering this system are diluted by 10 million cubic metres of water in 4 reservoirs prior to the intake approximately 10 km south of the SIA site.

   CRD staff conclude that small amounts of contamination received at the north end of the Sooke Lake Reservoir or the Goldstream reservoirs, whether from the SIA site or elsewhere, would be diluted to undetectable levels and have no impact on drinking water quality for Greater Victoria residents. In addition, all source water must pass through a treatment process that provides further opportunity to reduce contamination risks.

Summary
In order for contaminants to impact water quality in Sooke Lake and Goldstream reservoirs, conclusions 2 through 5 above must all occur and have an impact in succession, i.e. the contaminant containment system must fail, the contaminants must leach from the surface into the groundwater in significant quantity, and there must be a groundwater connection that carries a high enough contaminant load a sufficient distance in the direction of Sooke Lake Reservoir or the Goldstream reservoirs. While there is some uncertainty regarding a groundwater connection between the SIA site and Sooke Lake or Goldstream reservoirs, given the known information of the other necessary factors to complete such a pathway, staff conclude that the level of risk to water quality is very low, resulting in no impact to Greater Victoria drinking water supply.

ALTERNATIVES

1. That the Regional Water Supply Commission receive the staff report for information.

2. That the Regional Water Supply Commission direct staff to provide additional information.

RECOMMENDATION

That the Regional Water Supply Commission receive the staff report for information.

A Constabel

Annette Constabel, RPF, MSc
Senior Manager, Watershed Protection

Ted Robbins, B.Sc., C.Tech.
General Manager, Integrated Water Services
Concurrence

AC:mm

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Attachments:

1. Potential Impact of the South Island Aggregates Contaminated Soils Landfill Site on Greater Victoria Drinking Water Quality – Supplementary Report in Light of New Information Considered During the 2014 Environmental Appeal Board Process. Technical Report File #SS2015005.

2. Letter from CRD Board to Hon. Terry Lake, Minister of the Environment, dated April 12, 2013.

3. Potential Impact of South Island Aggregates Proposed Contaminated Soils Landfill on Greater Victoria Drinking Water Quality. CRD Board Staff Report IWS 2013-01 May 8, 2013. *NOTE: The Technical Report attached to this report has been appended to the supplementary report above.*

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Potential Impact of South Island Aggregates Contaminated Soils Landfill Site on Greater Victoria Drinking Water Quality

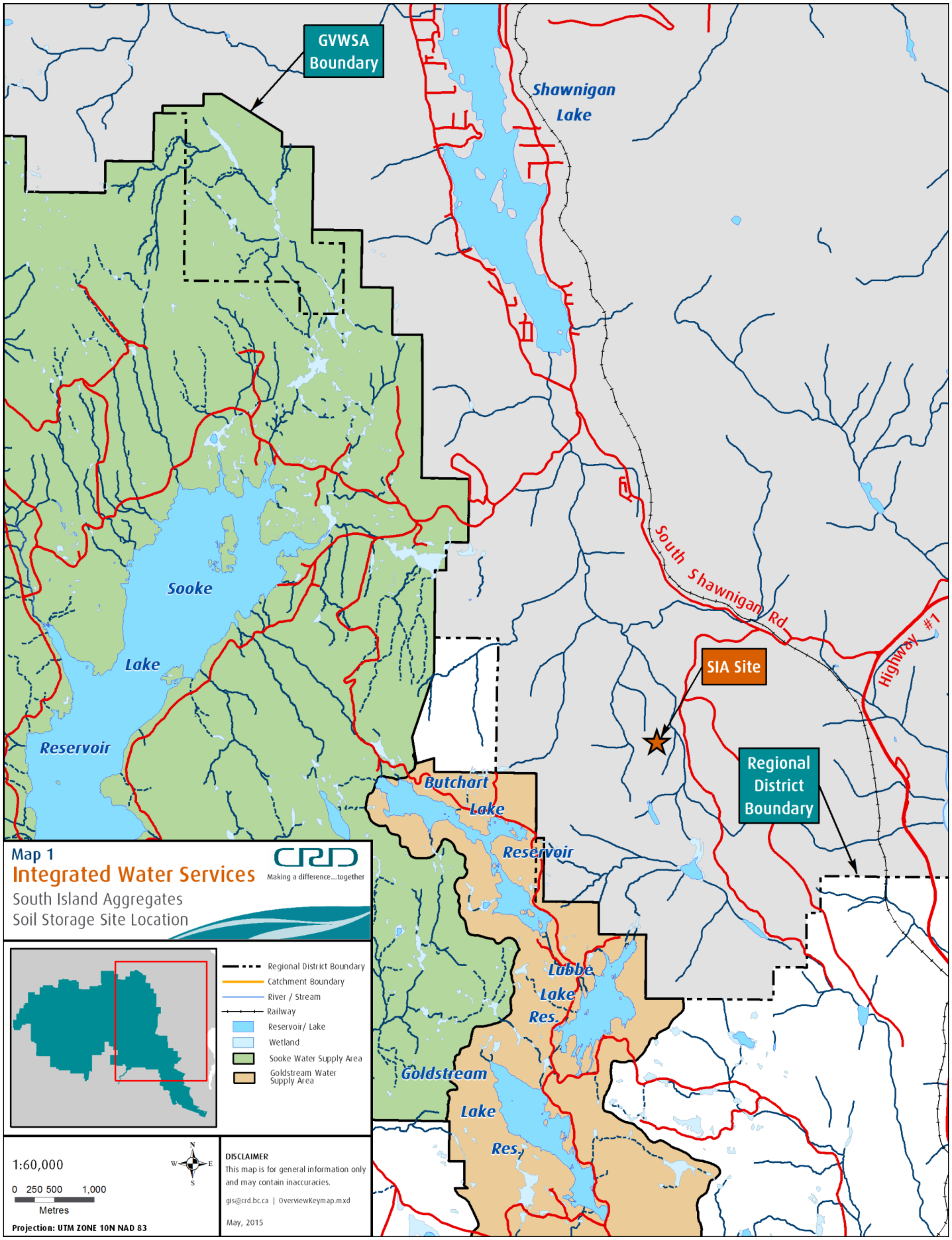
Supplementary Report In Light of New Information Considered During the 2014 Environmental Appeal Board Process

Technical Report File # SS2015005

Sharon Scott, M.Sc. P. Geo, Eng. L.
Senior Geoscientist
Watershed Protection Division
Integrated Water Services

May 29, 2015

INTEGRATED WATER SERVICES
CAPITAL REGIONAL DISTRICT
479 Island Highway
Victoria, BC
V9B 1H7


GVWSA Boundary
Shawnigan Lake
Sooke Lake Reservoir
South Shawnigan Rd
Highway #1
SIA Site
Regional District Boundary
Butchart Lake Reservoir
Lubbe Lake Res.
Goldstream Lake Res.
Map 1
Integrated Water Services
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South Island Aggregates
Soil Storage Site Location
Regional District Boundary
Catchment Boundary
River / Stream
Railway
Reservoir/ Lake
Wetland
Sooke Water Supply Area
Goldstream Water Supply Area
1:60,000
0 250 500 1,000
Metres
Projection: UTM ZONE 10N NAD 83
DISCLAIMER
This map is for general information only and may contain inaccuracies.
gis@crd.bc.ca | OverviewKeymap.mxd
May, 2015

Executive Summary

Further to the Scott and Irwin 2013 report, this report has reviewed the potential impact of the South Island Aggregates contaminated soil remediation/storage and landfill site on the Greater Victoria Drinking Water Reservoirs in light of new evidence presented at the 2014 Environmental Appeal Board (EAB) hearings. Based on the current scientific and technical reports combined with expert testimony during the 2014 EAB hearings CRD staff can state the following:

- There is an aquifer beneath the SIA site.
- Bedrock underneath the SIA site is Wark Gneiss. All evidence to date has not located limestone at the site.
- There is a shallow weathered bedrock layer immediately beneath the site but experts disagree on its permeability.
- All available data at the site indicates that groundwater wells upward into the floor of the SIA site. Additionally, groundwater trends northwest laterally next to the SIA site but regionally trends northwards to Shawnigan Lake.
- There is no consensus amongst the experts as to the requirement for further investigation, nor if required how much work would be required to characterize the site.

CRD staff examined potential impact to Greater Victoria Drinking Water Reservoirs considering the source-pathway-receptor pollution linkage. The presence and linkages of the 3 factors (source, pathway and receptor) is what constitutes potential risk. There is no question that sources and receptors exist. However based on this review we can state the following:

- Pathways from the site include both surface and groundwater flow, as well as engineered containment and mitigative measures.
  - Available evidence indicates that all surface water flow from the site is into Shawnigan Lake. There is no likelihood that surface water flow could impact Sooke Lake Reservoir. Additionally, groundwater wells upward at the SIA site into the floor of the site. Regionally the current understanding of groundwater flow is northwards towards Shawnigan Lake.
  - The containment measures required by the MOE eliminate migration and thus exposure to potential contaminates.

In order for contaminants to reach Greater Victoria Drinking Water Reservoirs, they would first have to breach the containment and mitigative measures, move through upwelling groundwater at the SIA site, enter deeper groundwater and this groundwater would have to travel towards Greater Victoria Drinking Water Reservoirs (all current evidence indicates flow is towards Shawnigan Lake).

The EAB (2015) determined that ultimately based on the balance of probabilities, the geology and hydrogeology of the site combined with the facility design and the permit conditions will provide the required protections to nearby domestic wells and drinking water in Shawnigan Lake. Based on the data presented there is no potential impact from the SIA contaminated soil storage and landfill site on the Greater Victoria Drinking Water Reservoirs.

Table of Contents

1 Introduction

At the May 20, 2015 meeting of the Regional Water Supply Commission, staff was directed to complete a report "on the potential impact of the South Island Aggregates facility on the Greater Victoria Drinking Water Reservoirs in light of new information considered during the BC Environmental Appeal Board process".

In April 2013, the Capital Regional District (CRD) Board directed staff to assess the potential impacts of the proposed South Island Aggregates (SIA) contaminated soil storage site in the Shawnigan Lake watershed on drinking water quality in Sooke Lake Reservoir (see Appendix 1). The SIA site is located in the Goldstream Heights area of the Cowichan Valley Regional District approximately 5.5 kilometers from Sooke Lake Reservoir, the primary water supply for Greater Victoria (see **Map 1**).

The technical report "Potential Impact of South Island Aggregates Proposed Contaminated Soils Landfill on Greater Victoria Drinking Water Quality" (Technical report file #SS2013004 by Scott and Irwin 2013) was presented to the CRD Board at their meeting of May 8, 2013. Based on their review of the information relating to the SIA site at the time, Scott and Irwin (2013) concluded that "there would be no potential impact on the quality of drinking water received by Greater Victoria consumers" from the storage of contaminated soil at the SIA site.

Since the 2013 technical report by CRD staff was prepared, four new technical studies relating to the SIA facility have been produced, the province has granted SIA a permit to operate the site, and provincial Environmental Appeal Board (EAB) hearings have been held to hear four appeals filed against the decision of the MOE delegate to issue the permit. The EAB hearings extended over 31 days between March and July 2014. The hearings reviewed all of the technical information relating to the SIA site, including the four new reports and incorporated a cross examination of the technical experts who produced reports on the site. The EAB produced a report summarizing the results of their review and the rationale for upholding the decision to grant a permit to SIA to operate the site. The EAB decision was released on March 25, 2015.

To prepare this report, staff from Integrated Water Services and Parks and Environmental Services has reviewed the 2015 EAB report and any associated technical reports referred to in that document. This report is further to the Scott and Irwin (2013) report. To put the review of new information into context, this report reviews the factors relevant to the containment of contaminated soil at the SIA site and the factors relating to the geology and hydrology of the area that would influence the potential for any escaped contaminants to move toward Greater Victoria drinking water reservoirs. This report also reviews the potential pathways that could allow these contaminants to reach the reservoirs. The conclusions of the EAB are used as a basis for the conclusions relating to the potential impact of the SIA site on the Greater Victoria Drinking Water Reservoirs.

1.1 Location of SIA Contaminated Soil Treatment Facility and Landfill

The South Island Aggregates (SIA) contaminated soil treatment facility and landfill is located at 640 Stebbings Road in the South Shawnigan Lake Area (of the Cowichan Valley Regional District) which is legally described at Lot 23 within the Shawnigan Lake catchment (**Map 1**). The site is 340 m above sea level (asl) and approximately 5 km southeast of the south end of Shawnigan Lake which is at an elevation of 120 m asl. Sooke Lake Reservoir is located 5.5 km west of the SIA site at an elevation of 187 m asl. Although terrain drops in elevation westward from the SIA site towards Sooke Lake Reservoir, there is a height of land surface drainage divide which separates the Sooke Lake and Shawnigan Lake catchments. Terrain rises to the south of the SIA site to a height of 640 m asl before dropping down in elevation to the north end of Butchart Lake Reservoir in the Goldstream water supply area, which is located approximately 2 km south of the SIA site at an elevation of 550 m asl.

2 Reports and Data

This report presents a review and summary of technical reports submitted as new evidence in the EAB (2015) decision and also evidence presented at the hearings from technical reports not available for review during the earlier Scott and Irwin (2013) technical report. As such, this report is limited in that the author has not completed their own technical field assessments and is simply reviewing and summarizing the data provided by other professionals. Thus conclusions reached are based purely on the available scientific data at this time. See the reference list for the complete list of technical reports reviewed in preparation of this report.

2.1 Reports Reviewed in 2013

The Scott and Irwin (2013) report reviewed and summarized data from the following reports on the SIA site:

- *Froude, C. and Froude, R. (2013). Letter in The Citizen dated January 9, 2013.*
- *Hancock, K. (2012). Bedrock Geology of the South Island Aggregates Stebbings Road Quarry. BC Geological Survey-Energy, Mines and Natural Gas Province of British Columbia. 13 pp.*
- *Lowen, D. (2012). Letter to the Shawnigan Residents Association titled "Proposed SIA Contaminated Soils Landfill, Stebbings Road, Malahat Land District, BC". 11 pp.*
- *Lowen, D. (2013). Letter to B.C. Ministry of Environment, titled "South Island Aggregates (SIA) Contaminated Soils Landfill – Stebbings Road near Shawnigan Lake, B.C. 4 pp.*
- *Lucey, P. and Barraclough, C. L. (2013). Letter to Shawnigan Residents Association with attachments titled, "Technical Concerns Regarding Draft Permit PR-105809 Issued to Cobble Hill Holdings Ltd. 12 pp.*
- *Ministry of Environment. (2013). Letter and Draft permit 105809 issued from the Environmental Protection Division Nanaimo office. 23 pp.*
- *Pye, M. and Kneale, D. (2012). Technical Assessment for Authorization to Discharge Waste by Active Earth Engineering Ltd. 361 pp.*

These reports were the documents available to CRD staff at the time of writing the 2013 report. Staff was aware of, but unable to obtain, copies of other technical assessment reports at that time. However, subsequent to writing the original report, these technical reports have been accumulated.

2.2 New Evidence References

Four reports were deemed to be new evidence in the EAB hearings in 2014. These included:

- *Ingimundson, B.I., Bean, S.M. and Petersmeyer, C.W. 2014. Hydrogeological review SIA Permit PR-1058098 to Discharge Waste, report to Young Anderson from Thurber Engineering Ltd., file # 17-971-19 dated February 11, 2014.*
- *Kohut, A.P. 2014. Shawnigan Residents Association v. South Island Aggregates and Others-opinion for use in an Environmental Appeal Board Hearing. Report to Farris, Vaughn. Wills and Murphy LLP by Hy-Geo Consulting file # 1312182 dated February 9, 2014.*

- *Lowen, D.A., 2014 (a). Assessment of Groundwater and Surface Water Contamination Risks associated with the South Island Aggregates Contaminated Soil Landfill Proposal (EAB Hearing Subdivision) – Stebbings Road, CVRD, BC. Report to Farris, Vaughan, Wills and Murphy LLP by Lowen Hydrogeology Consulting Ltd. dated February 11, 2014.*

- *Lowen, D.A. 2014 (b). SIA Contaminated Soil Landfill Proposal Site Visit Report and Update on Geology/hydrogeology Features. Project File Number 1329 dated February 11, 2014.*

The 2014 EAB hearings also heard testimony from two witnesses who did not write technical reports on the site. These two witnesses were a blaster with Western Grater, Mr. Anthony Miller, and Mr. M. Block (one of the owners of Cobble Hill Holdings). As their testimony relates to the other new technical reports reviewed by the appeal board, it was also reviewed for this report.

In addition, this report includes a review of several other technical reports on the site relevant to the 2014 EAB proceedings which were not reviewed in the original Scott and Irwin (2013) report. These documents are relevant as they were referred to in the final EAB (2015) decision. These reports include:

- *Hancock, K. (2013). Addendum to the "Bedrock Geology of the South Island Aggregates Stebbings Road Quarry". BC Geological Survey-Energy, Mines and Natural Gas Province of British Columbia. 7 pp.*

- *Mortensen, A. 2013. Review of "Technical Assessment for Authorization to Discharge Waste", South Island Aggregates Ltd. Ministry of Environment dated July 24, 2013.*

- *Barroso, S. and Lapcevic, P. 2012. South Island Aggregates, Stebbings Rd. – Review of Application for an Authorization to Discharge Waster. Ministry of Forests, Lands and Natural Resource Operations, Water Protection Division, Watershed Protection File # 38050-40 Dunc South Island Aggregates dated September 14, 2012.*

- *Morin, K.A. 2014. South Island Aggregates Ltd., Stebbings Road Quarry – Expert Hydrgeologic Review by Dr. Kevin Morin prepared for Cox and Taylor dated February 25, 2014.*

Finally, staff reviewed the EAB March 2015 decision as that document contains relevant information obtained during witness cross examination pertinent to the contaminated soil landfill site.

- *Environmental Appeal Board, 2015. Decision Nos. 2013-EMW-015(c), 019(d), 020(b) and 021(b) in the matter of four appeals under section 100 of the Environmental Management Act, S.B.C. 2003, C.53. dated March 25, 2015.*

2.3 New Evidence Presentation, Discussion and EAB Conclusions

The new evidence presented to the EAB during hearings in 2014 consisted of four subject areas related to the question on whether the SIA site is suitable for this type of facility including:

- Presence of an aquifer under the site
- Bedrock: type and fractures; and presence or not of a 75 m thick low permeability upper bedrock layer
- Groundwater/hydrogeology analysis
- Additional investigations to help characterize the site

The data relevant to the above items is presented in the following sections.

2.3.1 Aquifer Beneath the SIA Site

In the original Pye and Kneale (2012) technical report on the site, it was reported that there was no aquifer beneath the SIA site. That conclusion was based on water well and aquifer mapping available at the time of their assessment work. However, as was reported in Scott and Irwin (2013), data available subsequent to that initial report indicates an aquifer is located underneath the site. This was confirmed at the EAB hearings by expert testimony from Kenneth Ronneseth as well as was the opinion of S. Barroso and P. Lapcevic (2012). As the MOE delegate reviewing the application for permit for the site assumed there was an aquifer beneath the SIA site when making his decision, the EAB Board indicated that the presence of an aquifer beneath the site is not in question (EAB, 2015).

2.3.2 Bedrock

The new evidence cited in the EAB 2015 decision with regards to bedrock is essentially threefold including:

- Bedrock type (Wark Gneiss versus limestone);
- Bedrock fracturing (more extensive and thus more of an issue in possibly transporting water)
- The identification of a new weathered bedrock layer bringing into question the presence of a 75 m thick low permeability upper bedrock layer beneath the site.

2.3.2.1 Bedrock Type

Hancock (2012 and 2013) has indicated that at the SIA site the bedrock type is Wark Gneiss diorite intrusion. Based on his field assessment he has stated that there is no carbonate rock (limestone) at the site. Hancock testified at the EAB 2014 hearings that he specifically was looking for limestone at the site as one of the early drill well logs had indicated 300 feet of limestone in the drill log. He went on to further state that likely this drill log record indication of limestone (named but with no description) must be incorrect.

The drill well record also identified granite (named but not described) at the site and had indicated the “limestone and granite” had the same drilling properties, which is unlikely. Errors in drill well logs are not uncommon as reported in research by Greenwood and Mihalynuk (2009) on the reliability of driller logs for the purposes of geology. In his 2013 work Hancock also assessed a quarry (Butler Quarry) to the north of the SIA site which had been mined for limestone. Hancock found that there is a structurally bound block of marble in the Butler Quarry but that it was the result of a contained zone of carbonate caught up in a shear zone. There is no similar evidence at the SIA site.

At the EAB hearings, Mr. Block testified that rock in the SIA quarry is unique in that it is very hard. He also stated that rock from this quarry is certified by the US Army Corp of Engineers, meaning that the rock must be fracture free, have no bore holes or cracks. Mr. Block also indicated that rock at the quarry is difficult to blast; it takes longer to blast the rock and rock crushers wear out quicker than at other mine sites. Mr. Miller also testified at the hearings that the rock at the site is some of the hardest he has seen in his 39 year career on southern Vancouver Island. Mr. Miller also indicated that his crews used a blasting powder at the site that would not have worked if wet.

As part of testimony at the EAB 2014 hearings related to the new evidence, Kohut (2014) indicated he agreed with Hancock's lithological and petrographic descriptions of the SIA site, meaning that he agreed the rock at the site is dioritic gneiss. Lowen (2012) had stated that rock at the site was identified as limestone based on the onsite well record data. He used this to argue that limestone, being a soluble rock, is susceptible to solution weathering from acidic landfill leachate. However, in the Lowen (2014a) report he indicates there has been a lot of discussion about local rock types and whether limestone is present beneath the site but the rock type is not germane to the issue of hydraulic conductivity of the local rock. During the EAB 2014 hearings Lowen abandoned his position that there was evidence of limestone at the site. Ingimundson, B.I., Bean, S.M. and Petersmeyer, C.W. (2014) (the Thurber experts) indicate that although no limestone was positively identified at the SIA site, it was reported in the early drill well log and in their experience the Wark Gneiss does contain limestone in lenses or blobs either within the gneiss or adjacent to it. At the 2014 EAB hearings these Thurber experts agreed with Hancock in that the driller misidentified limestone in the onsite well log records. However, the Thurber engineers also felt that additional investigations could provide increased confidence that limestone was not present.

The EAB (2015) decision indicates that the Appeal Board accepted that the SIA site is located in a geologic area described as Wark Gneiss (a heterogeneous, complex and hard rock). The fact that limestone is present in the Butler Quarry north of the SIA site is not in dispute. However the EAB also state that although isolated pockets of limestone cannot be completely ruled out at the SIA site, all available evidence to date has not located any limestone at the site.

2.3.2.2 Bedrock Fracturing

As reported in Scott and Irwin (2013), Hancock (2012) identified three rock types at the SIA site including: medium to coarse grained dark green gabbro; medium to fine grained, medium to dark green diorite; and pale green, fine grained diorite. His examination of fractures in the exposed rock at the quarry site indicated that there were three types: tight (1-3 mm), filled (>2 mm) and veins. Hancock did report areas of blocky weathering which likely resulted from the effects of exposure to elements over time. However, he noted it took considerable effort to break open this weathered rock but once open he could see that the fractures in the rock were filled a few centimeters below the weathered surface. Hancock also reported finding a shear zone in the quarry that was 30-50 cm wide and took 96 structural measurements which did not yield any preferred orientation of the fractures, nor was water observed in any of the fractures. He also noted that igneous and metamorphic rocks commonly consist of crystals that typically transmit fluids poorly, and the rocks at the quarry site did not have a well-developed network of interconnected closely spaced fractures. He concluded the rocks underneath the SIA site were unlikely to transmit water well. As a result Hancock concluded that the rocks at the quarry site appeared to have minimal permeability or porosity.

Lowen (2014b) reports on fractures in rock near the SIA site. He disagrees with Hancock's description of fractures on site and says that open fractures up to 10 mm across occur every 1-1.5 m on the surface of the quarry. In his opinion these fractures would facilitate higher groundwater flow volumes and velocities (up to 3 orders of magnitude greater than originally estimated by

Pye and Kneale, 2013). Kohut (2014) also disagrees with Hancock's description on the nature and type of bedrock fractures. Kohut is of the opinion that many of the fractures are interconnected, open to weathering and not filled. He also disagrees that there is no discernible preferred direction to the fractures orientation and suggests that there are significant large scale fractures in the area that could be open to or control groundwater movement. However, under cross examination at the 2014 EAB hearings and reported in EAB (2015), Kohut acknowledged that he only observed 1 open fracture at the SIA site. Given his opinion on fracturing in the rock, Kohut feels that groundwater flow into the quarry bottom could be 2 orders of magnitude higher than the value calculated by Pye and Kneale (2012).

The assessment of fractures at the site by the Thurber engineers (Ingimundson, B.I., Bean, S.M. and Petersmeyer, C.W., 2014) concluded that the site is complex and although many discontinuities at the site were tight and filled there were some open fractures. Thurber had concern over active blasting at the quarry site while it was being used as a contaminated soil storage and treatment facility. More specifically they state in their 2014 report that a large blast at the site could increase the risk of leakage due to opening of local fractures. In the 2014 hearings and, as reported in EAB (2015) decision, the Thurber engineers agreed that it was possible to blast in one section of the quarry and have no impact on fracture in another area of the Site. Thurber went on to state that in order determine whether blasting at the site during operations caused any of the fractures identified to date, they would require site-specific data.

The EAB (2015) decision indicates that the evidence clearly establishes there are fractures at the quarry site. However the experts' observations and opinions differ on the size of the fractures and the degree of interconnectedness.

2.3.2.3 New Weathered Bedrock Layer Questions Presence of 75 m of Low Permeability Rock

The original technical report by Pye and Kneale (2012) indicated that there was an upper, very low permeability (hydraulic conductivity (k) $=7.6\text{x}10^{-10}$ m/s) bedrock from 0-75 m with negligible groundwater flow and a deeper more porous ($k=1.6\text{x}10^{-7}$ m/s) bedrock layer below 75 m with minor groundwater flow. However, new evidence from the two new groundwater monitoring wells that were drilled in 2013 revealed a new shallower layer referred to as weathered bedrock.

This shallower layer of weathered rock consists of a mixture of filled and unfilled fractures as a result of exposure to air, water, freeze/thaw and other factors that have begun to break down the original structure. The data from the wells confirm the assertion by Barroso and Lapcevic (2012) that the original technical report did not contain enough evidence to validate the claim of a 75 m upper very low permeability layer of bedrock beneath the site. However Barroso and Lapcevic did state that data from the new wells provide some support for the theory that there are low permeability layers beneath the site.

Mortensen (2013) felt that the upper bedrock will provide some protection to the deeper bedrock. In her opinion the hydraulic conductivity of the site (piezometric pressure) indicated that all pressures were above the quarry floor confirming very few active fractures and that the area has very low permeability. The 2014 report on the site by Morin, which included a review of data from the two new wells, suggested that the bedrock has mixed zones of lower and higher conductivity. In Morin's opinion the vertical gradient of groundwater becomes more important in this instance.

Lowen states in his 2014b report that the 10^{-7} k values in the weathered bedrock indicates the rock is significantly more permeable than originally thought. Kohut (2014) stated that the weathered bedrock identified in the new cores extends across the SIA site and that this layer is not an effective confining layer.

The EAB (2015) decision accepts the evidence that there is not a 75 m low permeability layer beneath the SIA site as originally stated. There is a shallower weathered bedrock layer immediately beneath the site but the experts disagree on the exact permeability of that layer.

2.3.3 Groundwater/Hydrogeology

Groundwater/hydrogeology at the site has been extensively reviewed by a number of experts. Morin (2014) indicated that groundwater levels measured at the site show that groundwater would move upward into the quarry floor. Based on an analysis of well data in the area, Lowen (2012) and Morin (2014) concluded that the data indicates groundwater moves laterally near the quarry in a northwest direction but regionally northward to Shawnigan Lake.

There is additional evidence for the upwelling of groundwater at the SIA site. Lowen (2014a) concluded that there is an upward flow of groundwater at the site into the pit. Based on the piezometric elevations, Kohut (2014) acknowledges that groundwater at the site flows upwards into the pit bottom at all times of the year.

Thurber (2014) suggests that there is insufficient evidence to understand groundwater flow at the site and believe that more work is needed. However, under cross examination at the EAB hearings, the Thurber experts agreed that based on available data from the wells from 2011-2014, the static elevation piezometric readings are above the pit floor and water flows upward into the quarry in every case.

The EAB (2015) decision reports that all the experts agree that understanding the hydraulic gradients is important to evaluating the site. The evidence available to date indicates that there is a vertical gradient upward such that groundwater will flow upward into the pit bottom rather than down. Uncertainty regarding groundwater gradient led the MOE Delegate to require ongoing vertical gradient monitoring as a Permit condition.

2.3.4 Additional works to help better characterize the site

The new evidence put before the EAB hearings in 2014, included statements that additional works should be required to help characterize the site. More specifically, Lowen (2014a) indicated the need for additional rock core drilling, packer tests, surveying, water quality sampling, pumping tests, stream flow monitoring to help better characterize the site. At the EAB 2014 hearings he also indicated that 12 additional drilled test wells spread over the area would provide sufficient data to characterize the site. Kohut (2014) recommended drilling an additional 5 wells while the Thurber experts suggested 8-10 more bore holes distributed across the SIA site to specifically target fractures would help characterize the site.

Barroso and Lapcevic had suggested in 2012 that additional wells should be drilled to help determine groundwater flows. Dr. Mortensen (2013) indicated that in her opinion the two new wells proposed for monitoring should provide sufficient evidence to determine the uniformity of the confining layer. Hancock indicated at the hearings that although he would prefer to have data from additional wells he felt he had sufficient data from the 5 previous wells and the two new monitoring wells (drilled in 2013) to characterize the site. Morin (2014) states that no amount of investigation will provide complete certainty regarding the site.

The EAB (2015) decision concludes that there is no consensus amongst the experts as to whether any further investigation is required, nor if required, what may be needed to adequately characterize the site. The data presented suggests that all of the experts agree that no amount of investigation will allow site characterization with absolute certainty. Ultimately, the EAB decided there is currently sufficient evidence indicating that the bedrock does provide some added secondary protection to the site. Since the highly engineered containment measures at the site include multiple layers of constructed protection as the primary mechanism for preventing the escape of contaminants, the EAB ruled that the geology of the site is just one of many measures to help protect groundwater and as such there was sufficient evidence to find the rock does provide some added protection for that purpose.

3 Potential Threat to Drinking Water in Greater Victoria Drinking Water Reservoirs

An assessment of the threat of contaminants to identified values typically involves a review of three factors:

1. sources of the potential contamination

2. pathways by which contaminants may travel

3. receptor(s), such as humans or the environment that could be harmed

The presence and linkages of these three factors (sources, pathways and receptors) constitute risk or potential risk. If all three risk components exist risk exists. In most cases, risk assessments seek to identify whether all of these risk components are present concurrently or whether one of the components is absent and whether the conditions will continue. If the risk is unacceptable, then mitigation should be evaluated and/or implemented. The following section seeks to identify the SIA specific potential sources, pathways and receptors which may contribute to risk and any assumptions regarding those components including permit mitigation requirements which block pathways at the SIA site.

Any threat to the quality of drinking water in Greater Victoria Drinking Water Reservoirs from the SIA facility would require:

- A source of contamination
- Pathway(s) - the free movement of contaminants from the SIA site to the Greater Victoria Drinking Water Reservoirs (escape of harmful contaminants from the SIA site at concentrations that exceed water quality guidelines at the reservoirs).
- Receptor(s) – humans or the environment

The technical information available for the SIA site, and the EAB review and findings, have been used to evaluate the potential threat posed by each of these factors.

3.1 Source - SIA Contaminated Soil Treatment Facility and Landfill Processes

The SIA site is authorized by permit to process contaminated soil in two ways: bioremediation and landfilling. SIA is authorized to take in up to 100,000 tonnes of contaminated soil every year for up to 50 years. As such, there is a potential source of contaminants at the site.

3.2 Pathways – Potential Transport of Chemicals to Greater Victoria Drinking Water Reservoirs

There are several mechanisms by which contaminants can travel including by air in the form of dust and/or vapor and in water. The main pathway related concern with the proposed permitted activities at the SIA site is that contaminated water (both surface water and groundwater) may migrate away from the site.

The permit requires monitoring and/or mitigation for each of the transport mechanisms. This section intends to illustrate potentially available contaminant migration pathways from the available documents and limits to those pathways. Two types of pathways are discussed herein: 1) natural site conditions and 2) engineered containment.

3.2.1 Natural Site Conditions – Pathway Analysis

The natural site pathways include surface water flow and groundwater flow.

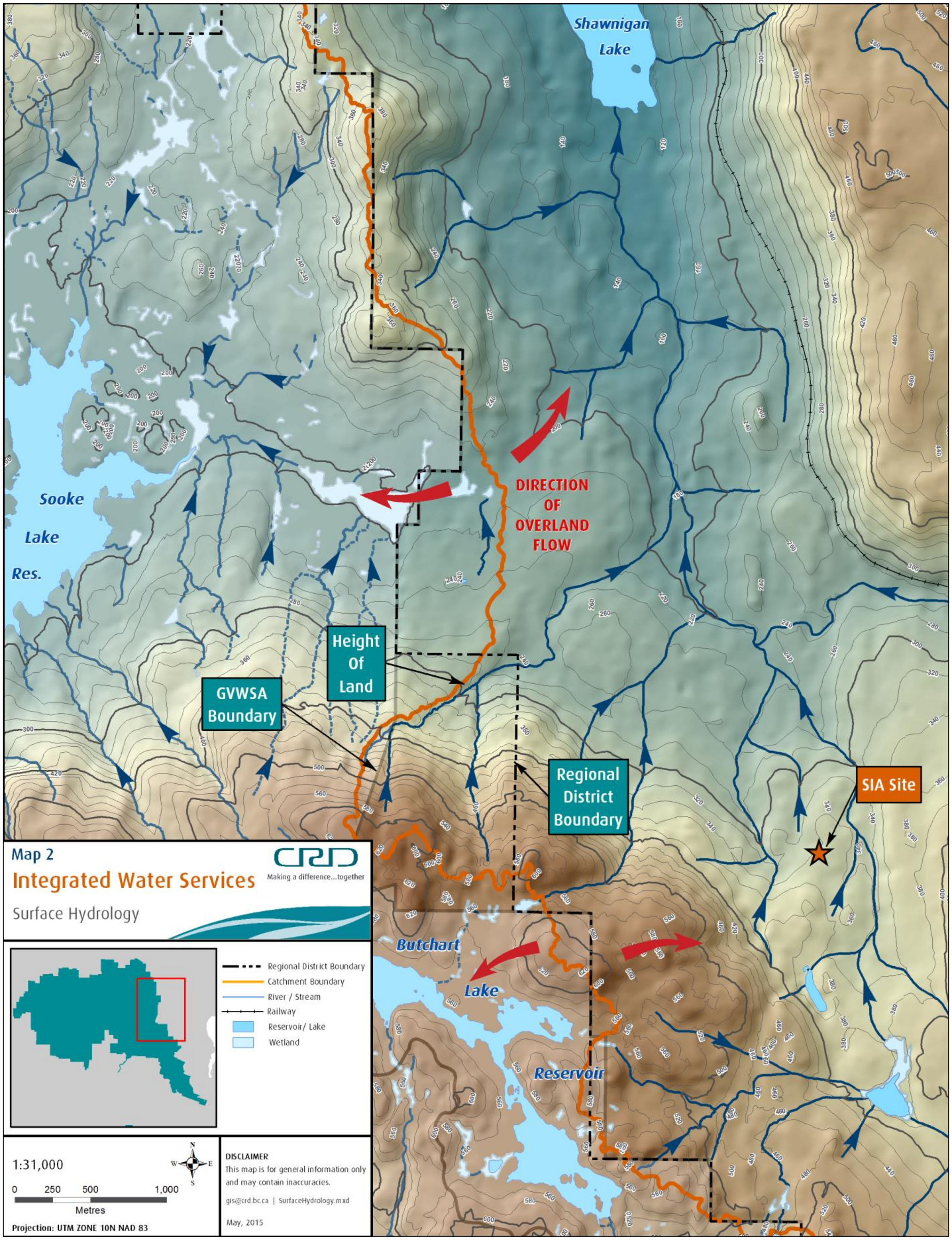
3.2.1.1 Hydrology (Surface Water)

The SIA site is within the Shawnigan Lake watershed. **Map 2** shows the location of the SIA site, Shawnigan Lake, Sooke Lake Reservoir, Goldstream System Reservoirs and the general topography and surface water flow direction. The map illustrates all surface water flow near the SIA site is to the north, north-northwest and northeast but ultimately north towards Shawnigan Lake. The orange line on the map depicts the height of land watershed divide separating the Sooke and Shawnigan catchment areas and depicts a generalized direction of overland flow from that divide

As noted in Scott and Irwin (2013), a review of the available mapping of terrain and streams in the area indicates that surface water flows into streams that in turn flow into Shawnigan Lake (see **Map 2**). A height of land or watershed divide (shown in orange on **Map 2**) prevents surface water in the Shawnigan Lake watershed from flowing into the area that supplies Greater Victoria Drinking Water Reservoirs.

Under the 2013 MOE permit, all the surface water from the SIA site is required to be contained and treated and then released into Shawnigan Creek which flows into Shawnigan Lake.

As stated in the Scott and Irwin (2013) report, should untreated water escape from the SIA site and enter the surface water, there is no likelihood that surface water would reach Greater Victoria Drinking Water Reservoirs.


Shawnigan Lake
Sooke Lake Res.
DIRECTION OF OVERLAND FLOW
Height Of Land
GVWSA Boundary
Regional District Boundary
SIA Site
Butchart Lake Reservoir
Map 2
Integrated Water Services
Making a difference...together
Surface Hydrology
Regional District Boundary
Catchment Boundary
River / Stream
Railway
Reservoir/ Lake
Wetland
1:31,000
0 250 500 1,000
Metres
Projection: UTM ZONE 10N NAD 83
DISCLAIMER
This map is for general information only and may contain inaccuracies.
gis@crd.bc.ca | SurfaceHydrology.mxd
May, 2015

3.2.1.1 Hydrogeology (Groundwater)

Groundwater has been identified as the most viable pathway for groundwater contaminants to migrate toward Greater Victoria Drinking Water Reservoirs.

As reported in Scott and Irwin (2013), the original hydrogeology analysis of the SIA site was based on five monitoring wells installed to determine groundwater conditions beneath the site as well as well logs obtained from the MOE database. Subsequent to the issue of the draft MOE permit in 2013, the SIA owners were directed to drill two new monitoring wells which were completed in 2013.

Lowen (2012) and Morin (2014) reports that the data available from these wells indicate lateral groundwater flow near the SIA site is to the northwest but on a regional scale to the north. This flow direction is toward Shawnigan Lake, not Greater Victoria Drinking Water Reservoirs.

At the 2014 EAB hearing all the experts with the exception of Thurber, agreed that the evidence (the piezometric pressures) at the site indicates there is a vertical gradient upwards upward into the floor of the SIA site. Under cross examination at the hearings, Thurber suggested more work was needed to understand groundwater flow and that based on currently available data the evidence does indicate water flows upward into the quarry bottom at the site. Morin (2014) purported that this upward gradient minimizes the potential for any contaminated water to move down into the deeper groundwater system. This upward gradient presents a barrier to downward contaminant migration toward Greater Victoria Drinking Water Reservoirs.

Even if contaminants did enter the groundwater in the bedrock below the SIA site, there was no consensus amongst the technical experts on how quickly these contaminants could move. Original calculations by Pye and Kneale (2012) indicated 100,000 to 3 million years for any contaminant in groundwater to reach Shawnigan Lake. Lowen (2014 a and b) indicates that it would only take 1.8 years for contaminated groundwater to reach Shawnigan lake but that was revised to between 1.4 and 2.7 at the EAB 2014 hearings. Under cross examination Lowen testified his calculations were based on a single fracture 0.147 mm wide running to the lake but he admitted that fractures do not typically travel in a straight line. Lowen also acknowledges that in his calculation he used a porosity calculation that was 2-3 orders of magnitude larger that the bedrock porosity at the site. Further to this subject of contaminated groundwater travel, Lowen testified that even with his calculations the amount of water ultimately reaching Shawnigan Lake would be about 7 ml (1.5 teaspoons) and if one assumed 100 fractures to transport water that would equate to about 150 teaspoons of contaminated water reaching the lake. As Shawnigan Lake contains an estimated 64 million liters of fresh water then the dilution factor would be 4.2 billion times. In contrast, at full capacity Sooke Lake Reservoir contains just over 16 million cubic metres of water. As was presented at the 2014 EAB hearings, Barroso and Lapcevic postulated that using a single fracture scenario the travel time for groundwater to reach Shawnigan Lake would take 100-250 years. Dr. Mortensen provided her opinion of the time to travel as being 6000 years. At the hearings she testified that the more likely travel time would be between 100-6000 years. At the EAB hearings some of the faster timelines (1.4 years) were somewhat discounted on cross examination due to inappropriate assumptions.

At the EAB hearings, Dr. Mortensen raised the issue how a plume of contaminants from the site may behave in the groundwater. Some contaminants travel faster than others. Some will be diluted, some will degrade, and some can be entrained and diffused into fractures in the rock. She stated at the hearings that a plume of contaminants in the groundwater beneath the SIA site is unlikely to exceed 500 m (i.e., would not reach Shawnigan Lake). She testified that in order for a plume of contaminants to travel more than a few kilometers it would have to be dense non-aqueous phase liquids (DNAPL) in high concentration. However, the prohibition of hazardous wastes under the permit suggests that no DNAPL's are permitted at the SIA site.

3.2.2 Engineered Containment – Pathway Analysis

In order for contaminants to escape from the site, there would have to be a substantive breach in the proposed containment of soil storage and water management at the site. Currently there are extensive engineering designs planned for the facility to ensure contaminants do not migrate from the site.

3.2.3 Bioremediation Area

Under the permit issued by the Ministry of Environment (MOE) in 2013, the SIA site is permitted to bioremediate soils contaminated with Benzene, Toluene, Ethylbenzene Xylene (BTEX), Styrene, Methyl Tertiary Butyl Ether (MTBE), Volatile Petroleum Hydrocarbons (VHP's), Light and Heavy Extractable Petroleum Hydrocarbons (LEPHs/HEPHs), Polycyclic Aromatic Hydrocarbons (PAHs) Chlorinated Hydrocarbons, Phenolic Substances, Chloride, Sodium and Glycols as defined in Schedules 4 and 5 of the BC Contaminated Sites Regulation (CSR). Many of these chemicals are soluble in water and therefore require special containment measures.

Based on the 2013 MOE permit, the authorized bioremediation works consist of:

- a lined asphalt paved soil management and bioremediation treatment area approximately 1800 m^2 in size,
- a temporary soil holding area,
- biocell, berm, primary and secondary containment detection and inspection sumps, and associated cleanout ports,
- catch basins,
- groundwater monitoring wells,
- management works and related appurtenances (e.g., piping, venting).

At the sites where stockpiled soil would be undergoing classification or remediation, the typical cross section for containment measures was described by Pye and Kneale (2012) and clarified in the EAB (2015) decision. These measures consist of:

- native bedrock with a permeability of 10^{-10} and 10^{-7} m/sec
- a layer of 300 mm clear crush rock over the bedrock with a network of PVC piping wrapped in filter cloth for leak detection

- synthetic membrane liner over the clear crush rock material protected from puncture by non-woven geotextile
- a layer of compacted 50 mm road base over the liner
- asphalt surfacing (HMAC)
- soil material being classified or undergoing bioremediation placed on the asphalt
- tarp over the soil to prevent water infiltration and to reduce dust
- roof built over the site to reduce to reduce the potential for leachate

3.2.4 Landfilling Area

Under the permit issued by the Ministry of Environment (MOE) in 2013, the types of soil that can be stored at the landfill facility are soils and associated ash that are better than Hazardous Waste as defined in the HWR Schedule 1. 1.1. 3. And 4 (Part 3, table 1 Leachate Quality Standards) of the Hazardous Waste Regulation and contain contaminants limited to metals, Dioxins, Furans, BTEX, MTBE, Phenolic Substances, Chloride, Sodium and Glycols as defined in Schedules 4 and 5 of the BC CSR.

Under the 2013 MOE Permit, the authorized landfill facility at the SIA site consists of:

- engineered lined landfill cells,
- perimeter ditches,
- erosion and sedimentation control infrastructure,
- primary and secondary containment detection and inspection sumps and associated cleanout ports,
- catch basins,
- groundwater monitoring wells,
- management works and related appurtenances.

At the sites where contaminated soil would be landfilled, the typical cross section for containment measures was described by Pye and Kneale (2012) and clarified in the EAB (2015) decision.

- Native bedrock with a permeability of 10^{-10} and 10^{-7} m/sec
- 2 m thick blast rock and crush rock seepage blanket over the bedrock
- 1 m thick compacted clay till layer with permeability of less than $1x10^{-8}$ m/sec over the seepage blanket
- 300 mm clear crush rock with network of PVC piping wrapped in filter cloth for leak detection
- 40 mm synthetic membrane liner (LLDPE) protected from puncture by non-woven geotextile and sand layers
- 300 mm thick sand leachate collection blanket

- Contaminated soil (compacted to a 6 m depth)
- Geofabric layer
- 30 mm LLDPE liner
- Sand leachate collection blanket
- Next layer of contaminated soil, geotextile fabric, liner and sand leachate and repeated once again+
- Capped with a 1 m thick relatively impermeable (k< or equal to $1X10^{-7}$m/s) material
- Capped with 1 m thick growing medium

As a result of the finding that groundwater was upwelling at the site, the 2 m thick blast rock and crush rock seepage blanket was added to the required containment measures per the EAB findings. The seepage blanket allows for a passive drainage pathway for any groundwater seepage that may occur at the base of the pit.

There are also a series of drains to take any water to a water treatment area comprised of holding tanks, water treatment system, a settling pond and a water discharge location. All surface water as well as shallow seepage and potential leachate would be managed within the site, treated, tested and discharged at the ground surface near the western boundary of the site.

3.2.5 Effectiveness of Containment

The EAB (2015) found that the containment and water treatment plans for the site would be effective in protecting the environment and human health. Under the permit, water treatment and discharge is performance based, meaning that the water has to meet standards set out in the permit and if it does not, then the water cannot be discharged. In order to reduce risk further, the EAB panel directed that the Environmental Procedures Manual prohibit re-use of the liners, that blasting be prohibited while liners are being installed in the containment cells and that a roof be built over the soil management site to further reduce potential for leachate.

3.3 Receptor

As defined previously, receptors in this instance are humans and the environment. There is no dispute that humans inhabit the terrain outside of the SIA site and as such the site has the potential to impact both human health and the environment should the containment measures fail.

3.4 Summary of sources, pathways and receptors

Respecting SIA site activities, there is no question that sources and receptors exist. At question is the presence of pathways and whether the pathways are open or closed. Where pathways are present, they should be closed to eliminate exposure and risk.

At the SIA site, the containment measures required by the MOE eliminate migration and thus exposure. These Permit requirements include soil acceptance plans, remediation and permanent containment design, soil treatment, weather protection and control of water discharge. Based on the evaluation of the SIA site as reported in the EAB (2015) decision, the appeal board indicated that containment and treatment measures at the site will protect the environment and human health.

With respect to the issue of contaminants entering Greater Victoria Drinking Water Reservoirs, this was reviewed by Scott and Irwin (2013). It was assumed that even in the unlikely event that contaminants were able to enter the Sooke Lake Reservoir; they would enter in the North Basin which is approximately 7.5 kilometers away from the Sooke Lake water supply intake. Given the large volume, and associated dilution factor, of the reservoir, it was determined that any potential contaminants reaching Greater Victoria drinking water consumers would be so low in concentration as to be virtually undectable. Hence there would be no potential impact on the quality of drinking water received by Greater Victoria Drinking Water consumers.

4 Conclusions

Further to the Scott and Irwin 2013 report, this report has reviewed the potential impact of the SIA site on the Greater Victoria Drinking Water Reservoirs in light of new evidence presented at the 2014 EAB hearings. The 2014 EAB hearings on four appeals against the MOE delegate who issued the permit for the SIA site extended for 31 days between March and June 2014. The EAB (2015) decision indicated that the primary focus of the appeals was a concern that allowing the site as permitted, in this particular location, is too risky given the values at stake. The panel reviewed the permit as well as considered all evidence (documentary and oral) that was put before it. The EAB determined that ultimately based on the balance of probabilities, the geology and hydrogeology of the site combined with the facility design and the permit conditions will provide the required protections to nearby domestic wells and drinking water in Shawnigan Lake.

4.1 New Evidence

Based on the current scientific and technical reports combined with expert testimony during the 2014 EAB hearings CRD staff can state the following regarding the new evidence presented:

- There is an aquifer beneath the SIA site.
- Bedrock underneath the SIA site is Wark Gneiss. All evidence to date has not located limestone at the site.
- There is a shallow weathered bedrock layer immediately beneath the site but experts disagree on its permeability.
- All available data at the site indicates that groundwater wells upward into the floor of the SIA site. Additionally groundwater trends northwest laterally next to the SIA site but regionally trends northwards to Shawnigan Lake.
- There is no consensus amongst the experts as to the requirement for further investigation, nor if required how much work would be required to characterize the site.

4.2 Potential Impact to Greater Victoria Drinking Water Reservoirs

CRD staff examined the potential impact to Greater Victoria Drinking Water Reservoirs considering the source-pathway-receptor pollution linkage in light of the new evidence presented at the 2014 EAB hearings. The presence and linkages of the 3 factors is what constitutes potential risk. Based on this review staff can state the following:

- There is no question that a source and receptors are present
- There are two potential pathways including surface and groundwater as well as engineered containment and mitigative measures
  - Available evidence indicates that all surface water flow from the site is into Shawnigan Lake. Additionally, groundwater wells upward at the SIA site into the floor of the site, which would likely prevent any escaped contaminates from entering deeper groundwater. Regionally the current understanding of groundwater flow is northwards towards Shawnigan Lake.
  - The containment measures required by the MOE permit for the site eliminate mitigation risk and exposure.

For potential contaminants from the site to reach Sooke Lake Reservoir:

- Many (if not all) of the engineered containment and mitigation measures would have to fail
- Contaminants would have to migrate through the upwelling groundwater at the site and enter deeper groundwater flow
- The deeper groundwater flow would have to travel towards Sooke Lake Reservoir (available evidence indicates groundwater moves towards Shawnigan Lake)

Evidence presented at the 2014 EAB hearings indicated the best estimated travel time for groundwater to reach Shawnigan Lake from the SIA site, would be between 100-6000 years. The EAB (2015) hearings found that if contaminated groundwater reaches Shawnigan Lake it would consist of the equivalent of 1.5 teaspoons for water (7 milliliters) and it would be diluted by a factor of 4.2 billion times (Shawnigan Lake contains 64 million liters of water). It is also expected that if a contaminated plume of groundwater was released at the SIA site it would only travel 500 m before the contaminants were diluted, degraded, entranced or diffused. And even if contaminated water reached the lake it would be so diluted it would unlikely exceed water quality standards (hence not be considered contaminated). In contrast, at full capacity Sooke Lake Reservoir contains just over 16 million cubic metres of water.

Based on the available evidence staff concludes that there is no potential impact from the SIA contaminated soil storage and landfill site on the Greater Victoria Drinking Water Reservoirs.

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6 Signature

I trust that the information included in this report answers the question posed by the CRD Regional Water Supply Commission. Please do not hesitate to contact the author for any clarification.

Sincerely,

05/29/15

Professional Geoscientist — Province of British Columbia — S. SCOTT

Association of Professional Engineers and Geoscientists of the Province of British Columbia — S. SCOTT — ENGINEERING LICENSEE — Limited Licence 123085

Sharon Scott

Sharon Scott, M.Sc., P. Geo, Eng. L
Senior Geoscientist
Watershed Protection

7 Limitations

This report provides a review and summary of the available technical documents (to the best of our knowledge at this time) relating to the SIA proposed contaminated landfill site for information purposes only. It is not a hydrogeological or contaminated site data peer review of the technical documents reviewed. The Senior Geoscientist authoring the report is neither a hydrogeologist nor a contaminated sites specialist. However, Section 3 was written with input and advice from Korene Torney Supervisor Geo-Environmental Programs of CRD Parks and Environmental Services.

Making a difference...together

Potential Impact of South Island Aggregates Proposed Contaminated Soils Landfill Site on Greater Victoria Drinking Water Quality

Technical Report File # SS2013004

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April 29, 2013

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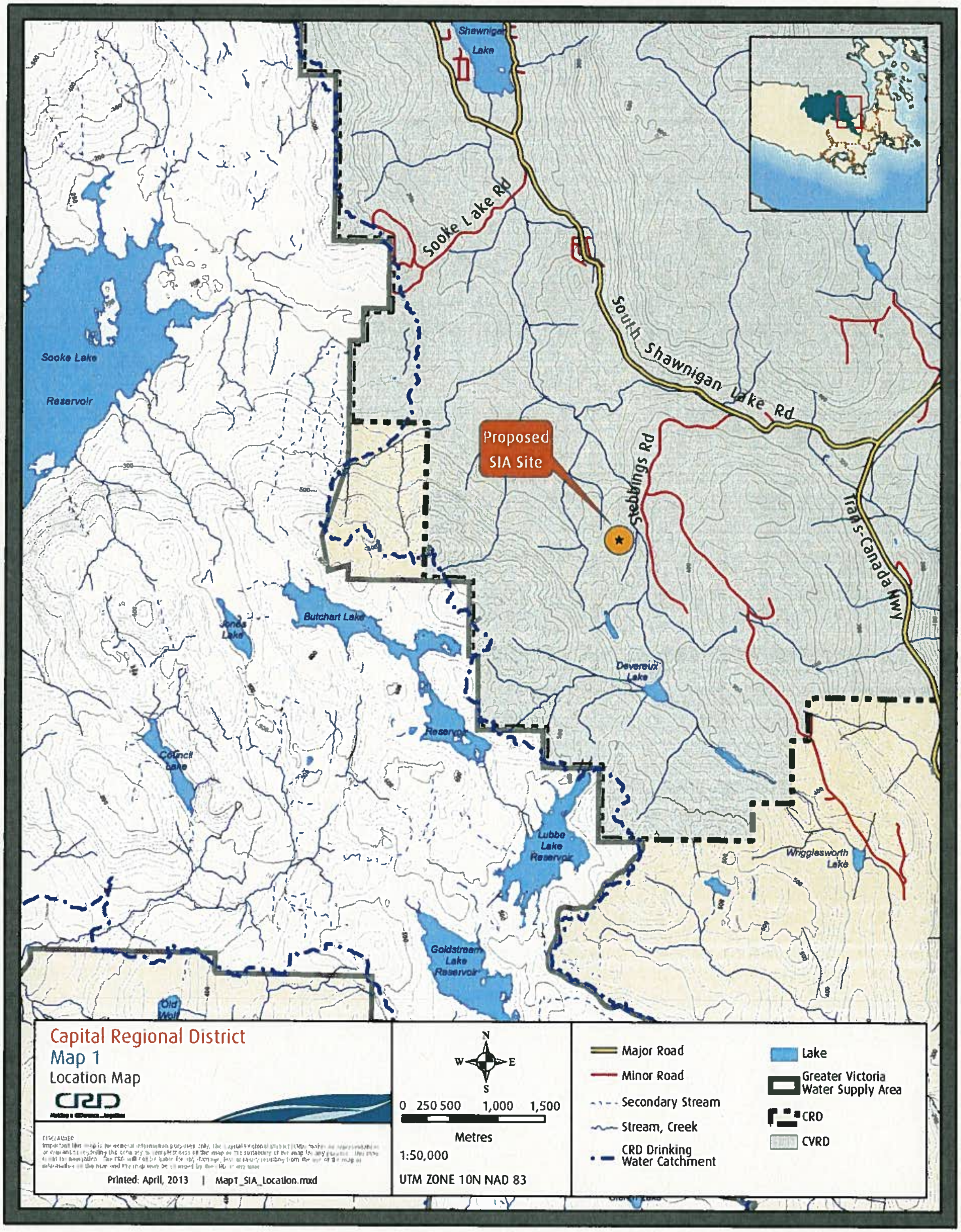
MAP 1. Location Map



Executive Summary

This report is a brief review of information from the available technical reports that address the South Island Aggregates (SIA) proposed contaminated soils landfill site. The site is located (**Map 1**) within the Shawnigan Lake catchment at 340 m above sea level (asl) and approximately 5 km southeast of the south end of Shawnigan Lake which is at an elevation of 120 m asl. Sooke Lake Reservoir is located 5.5 km west of the site at an elevation of 187 m asl.

Two bedrock aquifers have been identified in the vicinity of the SIA site and Greater Victoria Water Supply Area (**Map 2**). These aquifers include the Shawnigan Lake/Cobble Hill bedrock aquifer and the Spectacle Lake /Malahat bedrock aquifer. Groundwater has been determined to be flowing to the northwest from the proposed site. Regionally, the proposed site of the SIA landfill for contaminated soil is underlain by Lower Paleozoic (295-384 million years) aged rocks of the Wark Gneiss complex that are comprised of massive to well foliated gabbro and diorite and contains slivers and pods of limestone that occurs within the gneiss or between major faults (**Map 3**).

The proposed SIA site is to only accept contaminated soil that is non-leachable and some industrial waste. Several levels of protection are proposed ranging from a soil acceptance plan, soil discharge including permanent containment design, soil treatment, weather protection and control of water discharge. To fully appreciate if the above measures will function as predicted, a proper assessment would need to be undertaken by a contaminated soils specialist to determine if they meet government standards. Such a study is beyond the scope of this report.

The threat posed to the quality of water in Greater Victoria's source reservoirs from potential contaminants in the proposed SIA landfill was evaluated using a risk management approach: the probability of an event occurring and the potential consequence of such an event.

The contaminants at the site have the potential to impact drinking water quality if they are present in sufficient quantity. However, for that to occur there would have to be a substantive breach in the proposed containment of soil storage and water management at the site. Should water escape and enter the surface water, there is no likelihood that surface water would reach Sooke Lake Reservoir. In the case of contaminants entering the groundwater, as currently reported, it would take 100,000 years for water to transport through a 65-75 m thick impermeable bedrock layer before arriving at the bedrock aquifer. Unfortunately, the paucity of well sites within the Greater Victoria Water Supply Area and on the terrain east of Sooke Lake Reservoir over to the SIA site, means that there is insufficient data to define whether or not an aquifer lies under the CRD land base and further, its direction and velocity of groundwater flow.

If contaminated water from the site actually reached Sooke Lake Reservoir, it would most likely enter the reservoir at the extreme north end. At full pool, Sooke Lake Reservoir contains approx. 16,000,000,000 cubic metres of water and has an average detention (passage of water through the reservoir) of more than two years. Thus, during this two year passage to reach the intake tower (located some 7.5 km away) at the extreme south end of the reservoir, the contaminants would undoubtedly mix with the water in the reservoir (the water in the reservoir mixes vertically each spring) and could potentially be diluted by up to a billion times.

Finally, to reach Greater Victoria drinking water consumers, the diluted contaminants would need to pass unscathed through a water treatment process that many years in the future may bear little resemblance to current water treatment technology.

Any potential contaminants reaching Greater Victoria drinking water consumers would be so low in concentration as to be virtually undetectable. Hence, there would be <u>no</u> potential impact on the quality of drinking water received by Greater Victoria consumers.

Table of Contents

1 Introduction

This report reviews and summarizes information from available technical reports and data sources that relate to the landfill for contaminated soils proposed by South Island Aggregates (SIA) at its quarry the Goldstream Heights area of the Cowichan Valley Regional District (See **Map 1**).

At its April 10, 2013 meeting, the Capital Regional District (CRD) Board requested staff "to provide all available information and an internal analysis on potential impacts of this proposed facility on the Capital Region's water supply at Sooke Lake".

1.1 Location of Proposed Contaminated Site to Greater Victoria Water Supply Area

The SIA proposed landfill site for contaminated soils is located at 640 Stebbings Road South Shawnigan Lake Area (in the Cowichan Valley Regional District) within the Shawnigan Lake catchment (**Map 1**). The site is 340 m above sea level (asl) and approximately 5 km southeast of the south end of Shawnigan Lake which is at an elevation of 120 m asl. Sooke Lake Reservoir is located 5.5 km west of the site at an elevation of 187 m asl. Terrain rises to the south of the SIA site to a height of 640 m asl and the north end of Butchart Lake Reservoir is located approximately 2 km south of the SIA site at an elevation of 550 m asl.

1.2 Groundwater and Aquifers Terminology

Some basic terminology is required to help in understanding groundwater and aquifers. Groundwater is water that occurs in the ground that can discharge into lakes, streams or the ocean. An aquifer is a saturated geologic unit that is permeable, yields water in useable quantity and can be comprised of sand and gravel (referred to 'unconsolidated') or bedrock (consolidated) (Berarinucci and Ronneseth, 2002). Conceptually, groundwater flow is similar to surface watersheds in that water flows from high elevations (divides) to low elevations (outlets or discharge areas). However, groundwater is subjected to the hydraulic properties of the aquifers, input to (recharge) and outflow (discharge) as well as geological factors.

In bedrock aquifers, the porosity and permeability of the rock controls the amount of water yielded. Porosity is the ratio of the volume of openings (voids) to the total volume of the material and represents the storage capacity of the geologic material. Fractures in rock (which can include, faults, joints and bedding plans) increase the porosity of bedrock. Permeability is the rate of flow of liquid through a porous medium.

To delineate the boundary of an aquifer, sufficient information must be available to indicate it actually exists. Information needed is either hydrological in nature (discharge from springs) or of geological nature (existence of a permeable formation) (Berarinucci and Ronneseth, 2002). Sources of information include:

- Data interpreted from water wells
- Hydrogeological studies and cross sections
- Mapped boundaries of surficial materials and bedrock geology formations
- Mapped lakes or rivers
- Topographic boundaries

The absence of mapped aquifers in an area does not mean an aquifer does not exist - just that there are no records available to delineate and classify one at that location.

Once an aquifer has been defined, the groundwater flow rate and direction can be determined provided data from a minimum of three well sites is available. To calculate the flow rate, the hydraulic conductivity of the material the aquifer is located within must be determined as well as the associated hydraulic gradients.

2 Available Reports and Data

The review and summary of available technical reports and data sources information is provided in the following four sections:

1. Aquifers Near the Greater Victoria Water Supply Area
2. Bedrock Geology
3. Summary of SIA Technical Assessment for Authorization to Discharge Waste Report
4. Letters from Environmental Professionals

2.1 Aquifers Near the Greater Victoria Water Supply Area

Two bedrock aquifers have been identified in the vicinity of the SIA site and Greater Victoria Water Supply Area (**Map 2**). These aquifers include the Shawnigan Lake/Cobble Hill bedrock aquifer (203) and the Spectacle Lake /Malahat bedrock aquifer (209). Both these aquifers are depicted on the BC Water Resources Atlas online map and are classed as IIA. Both aquifers are moderately developed (i.e. demand is moderate relative to water availability and any additional development of these aquifers should be given careful consideration) (Berarinucci and Ronneseth, 2002). In addition, both aquifers have:

- a high vulnerability rating (i.e., they have a high vulnerability to contamination from surface sources)

- little natural protection against contamination introduced at the ground surface

- existing land use or future developments should initiate measures to protect against introducing contaminates

- these aquifers should be given first priority for the implementation of quality protection measures (Berarinucci and Ronneseth, 2002)

Note that the vulnerability rating is based on hydrogeology alone and is not an assessment of risk of contamination (Berarinucci and Ronneseth, 2002).

Ligget *et al.* (2011), present intrinsic vulnerability mapping using the DRASTIC methodology for the South Cowichan area of Vancouver Island as an example. Intrinsic aquifer vulnerability is used to describe the relative degree of natural protection of groundwater from contamination due to physical characteristics of the land and subsurface (Ligget *et al.* 2011). This type of mapping assumes a regional scale, applies only to the uppermost aquifer, only assumes contamination from the surface, doesn't show specific recharge areas and assumes only downward movement of contaminant. It is also only one part of a complete assessment of risk to groundwater. Potential hazards at the land surface also need to be assessed. In stating this, the Ligget *et al.* (2011) work indicates that both the Shawnigan Lake/Cobble Hill aquifer (203) and the Spectacle Lake/Malahat aquifer have a low to moderate vulnerability while the BC Aquifer Classification System indicates that they have high vulnerability. Ligget *et al.* (2011) indicate that a conservative approach could be to use the most limiting classification. However, they state that the more rigorous methodology used to map vulnerability with DRASTIC should be assumed to provide a more defensible determination of groundwater vulnerability.

The BC Aquifer Classification System also has a ranking component used to assess the aquifer with respect to seven hydrogeological and water use criteria (productivity, vulnerability; aquifer area; demand for water; type of water use; quality concerns and quantity concerns) in order to determine aquifer priority (Berarinucci and Ronneseth, 2002). Point values in the ranking range from 0-3 for each criterion and each criterion is given equal weight. The lowest possible ranking is 5 and the highest is 21. Both the Shawnigan Lake Cobble Hill and Spectacle Lake Malahat bedrock aquifers have rankings of 12, which means that in general the aquifers rank in the middle in terms of prioritizing management.

Although the CRD has a report by Kenny (2004) on aquifers of the Capital Regional District, the aquifer mapping was only completed on lands within municipalities, not the unincorporated lands that make up the Greater Victoria Water Supply Area (Leech, Sooke and Goldstream Water Supply Areas).

A 1994 report by Axys Environmental Consulting Ltd., for the CRD commented on groundwater in the Greater Victoria Water Supply Area in relation to raising the dam and flooding the Sooke Lake Reservoir shoreline. The report indicates that groundwater in the area is contributed by subsurface flow from higher elevations or percolating rainfall. The surficial geology and topography affect the groundwater flow and fluctuation. This report made no mention of bedrock aquifers.

2.2 Bedrock Geology

2.2.1 SIA Site

Regionally, the proposed site of the SIA landfill for contaminated soil is underlain by Lower Paleozoic (295-384 million years) aged rocks of the Wark Gneiss complex (Muller, 1980 and Hancock, 2012). Rocks in this complex are comprised of massive to well foliated gabbro and diorite (**Map 3**). This complex has slivers and pods of limestone that occurs within the gneiss or between major faults (Muller, 1983 and Hancock, 2012).

At the SIA site, Hancock (2012) identified three rock types including: medium to coarse grained dark green gabbro; medium to fine grained, medium to dark green diorite; and pale green, fine grained diorite. An examination of fractures in the exposed rock at the quarry site noted that there were three types: tight, filled and veins. The rock was noted to be hard to break and does so in an irregular pattern.

Hancock (2012) noted that although igneous and metamorphic rocks commonly consist of crystals that typically transmit fluids poorly, the rocks at the quarry site did not have a well-developed network of interconnected, closely spaced fractures. Water was not observed in the fractures and thus the rocks were unlikely to transmit well. As a result Hancock concluded that the rocks at the quarry site appeared to have minimal permeability or porosity.

Hancock also indicated that no limestone was located at the quarry site. One well located at the site had limestone indicated in the lithology report, but Hancock speculated that it was misidentified.

No faults are mapped beneath the site (Hancock, 2012; and Pye and Kneale 2012). However, on a regional scale, the nearest fault is located 3 km southwest of the site and the Shawnigan Lake fault is located 6 km northwest of the site (Muller, 1983; Hancock, 2012; and Pye and Kneale 2012).

2.2.2 Greater Victoria Water Supply Area Lands

The Greater Victoria Water Supply Area lands are underlain by the same Lower Paleozoic rock complex reported to underlie the SIA site (Muller, 1977; 1983 and Drown 1994; 2001) (**Map 3**). Bedrock geology mappers identified light colored meta gabbro and meta diorite of the Wark Gneiss complex as well as quartz-feldspar gneiss of the Colquitz gneiss complex.

Drown (1994 and 2001) identified two isolated pockets of limestone located along a secondary fault line that trends in a northwest to southeast orientation east of Rithet Creek and one pocket north of the headwaters of Judge Creek. This matches the small isolated pockets that Muller (1983) shows on his map. Several faults separate the Wark and Colquitz bedrock types in the area.

A cursory regional search of the available well lithology information from the BC wells database, for an area extending from the northeast side of Sooke Lake Reservoir to approximately 100 m east of the SIA site and northwards to the South end of Shawnigan Lake, indicate that there are 639 records of lithology in wells. Limestone was identified in 17 of those 639 records (<2%) with the majority of the limestone reports being multiple identifications in wells located along or near Cougar Ridge which is near the southwest edge and at the height of land of the Shawnigan Lake catchment. This information fits well with the mapped geology of the area which identifies isolated pockets and lenses of limestone as present in the bedrock type.

2.3 Summary of SIA Technical Assessment for Authorization to Discharge Waste Report

2.3.1 General Summary

SIA hired Active Earth Engineering Ltd. to conduct a technical assessment for authorization to discharge waste at the proposed site. These consultants are experienced hydrogeologists and contaminated site specialists on the roster of approved professionals by the BC Ministry of Environment Director of Waste Management. According to the Active Earth Engineering Ltd. report by authors Pye and Kneale (2012), the proposed SIA site is to only accept:

- Contaminated soil that is non-leachable, and
- Some industrial waste

Soils accepted will not exceed the standards set out for hazardous waste in the Hazardous Waste Regulation. Soils that exceed residential, commercial and industrial land using standards as defined by the BC Contaminated Sites Regulation would also be accepted.

The report indicates that the soils will be placed in engineered cells with appropriate liners, covers, drainage systems and leachate detection/collection systems. Soils are to be managed on 30 m^3 cells and stockpiles are not to exceed 150 m^3. They also indicate there will be surface water management and drainage works.

The contaminants of concern with the potential to be in soil accepted at the site may include one or more of the contaminants listed in Schedules 4, 5, 7 and 10 of the Contaminated Sites Regulation (Pye and Kneale, 2012). The report lists the following broad categories of contaminants:

- Inorganic substances
- Petroleum hydrocarbons
- Polycyclic aromatic hydrocarbons
- Chlorinated hydrocarbons
- Phenolic substances
- Glycols
- Waste from industrial processes

Pye and Kneale (2012) identify several levels of protection to eliminate the potential for leachate to enter the subsurface environment and this includes:

- Native bedrock with a permeability of $8x10^{-10}$ m/sec
- Compacted till layer with permeability of less than $1x10^{-8}$ m/sec
- 300 mm clear crush with network of PVC piping wrapped in filter cloth for leak detection
- Synthetic membrane liner protected from puncture by non-woven geotextile and sand layers
- Compacted 50 mm road base
- Asphalt surfacing

The 2012 Pye and Kneale report indicates the groundwater quality is to meet the standards for the protection of aquatic life within the Contaminated Site Regulations. The technical assessment indicates that as there is very low permeable bedrock at the ground surface and since no drinking water wells are within 150 m of the site then the drinking water standards in the Contaminated Site Regulation are not applicable to the site.

2.3.2 Surface Hydrology Summary

Pye and Kneale (2012) indicated the proposed contaminated landfill site is located in the upper reach of the Shawnigan Lake catchment and that surface water bodies in the vicinity include Shawnigan Creek and its tributaries. The report indicates that all surface water as well as shallow seepage and potential leachate would be managed within the site, treated, tested and discharged at the ground surface near the western boundary of the site.

A review of the available topographic mapping of the area indicates that surface groundwater flow is to the northwest, north and northeast and due to the height of land in the area, none of the surface water flow would impact the Greater Victoria Water Supply Area lands.

2.3.3 Hydrogeology (groundwater) Summary

The hydrogeology analysis of the SIA proposed contaminated landfill site was based on five monitoring wells installed to determine groundwater conditions beneath the site as well as well logs obtained from the MOE database.

Pye and Kneale (2012) indicated that although the MOE has identified two bedrock aquifers in the area (the Spectacle Lake/Malahat and Shawnigan Lake/Cobble Hill bedrock aquifers, located 1 km east and 2 km north of the site, respectively), no aquifer was mapped beneath the site as all existing well data indicated the bedrock was not productive (rate of flow and abundance of water) enough to be considered a groundwater resource. However, there is potential to intersect deep water bearing fractures that have the capacity to service single family residences (Pye and Kneale 2012). Pye and Kneale (2012) also indicate that due to the limited overburden soils in the area, generally they are not sufficient for the development of overburden aquifers at the site.

Based on the data from the well sites at the SIA site, Pye and Kneale (2012) indicated that it may be possible to identify two bedrock types:

- An upper bedrock that extends from 0-75 m depth that has a hydraulic connectivity of 7.6×10^{-10} m/s; a hydraulic gradient of 0.7%; groundwater flow velocity of 0.001 m/year; and a rate of 3 million years for recharge water from the site to reach Shawnigan Lake; the vertical travel time from this bedrock to the deeper bedrock is >100,000 years; and

- A deeper bedrock (>75 m or 250 ft) that has a hydraulic connectivity of 1.6×10^{-10} m/s and a hydraulic gradient of 5%; groundwater flow velocity of 1.7 m/year; and a rate of 103,000 years for recharge water from the site to reach Shawnigan Lake. The horizontal groundwater travel time to Shawnigan Lake is approx. 3000 years.

They concluded that the upper bedrock at the site will provide a 65-75 m confining layer of lower permeability rock that will act to help protect the deep bedrock aquifer.

Pye and Kneale (2012) also commented on the site with respect to the mapped aquifers. They estimated it would take 1000 years of flow in the deep bedrock before water reached the Shawnigan Lake/Cobble Hill aquifer (plus the 100,000 years of vertical flow through the upper bedrock). And as the Spectacle Lake/Malahat aquifer is located within a different catchment, there would be no hydraulic connection between the deep bedrock aquifer identified beneath the site. This report also indicated that the groundwater flow is towards the northwest.

2.4 Letters from Environmental Professionals

2.4.1 Summary of Letters from Lowen in 2012 and 2013

A letter from Lowen (2012) was written to address five specific concerns the author had with the Pye and Kneale (2012) report as well as to provide some alternate scientific analysis of available data. The author is a registered professional engineer and geoscientist in BC who specializes in hydrogeology. His main points were:

- The Pye and Kneale (2012) report states that the BC MOE had two aquifers mapped near the site but none directly below. However, that mapping was based on available well data at the time. Now the available data indicates an aquifer is located below the site.

- The report describes the demand and productivity rating of the identified aquifers but not the vulnerability rank. Both are ranked high vulnerability.

- Lowen refuted the assertion that the rock below the site has extremely low permeability and suggested that it should be 1000 times higher than as reported. His test indicated that the permeability value at one well was at 6.9×10^{-7} m/s. He also indicated that fractured limestone was reported in one well. This is the same limestone that Hancock (2012) indicated may possibly have been misidentified.

- Lowen refuted the assertion that it will take surface water 100,000 years to migrate down to the aquifer. He believes it will be much quicker than that.

- Lowen suggested that an environmental impact study should be completed before the site is approved.

- Lowen confirmed that, from his analysis of the available data, the groundwater flow direction is to the northwest.

A second letter by Lowen (2013) presented additional comments:

- The proposed site is located on fractured bedrock (as shown in well records);

- The estimated travel time to the aquifer was an erroneous conclusion based on inadequate testing;

- Five drinking water wells are within 500 m of the site;

- The site provides no natural protection for established drinking water sources in the region.

2.4.2 Summary of Letter from Lucey and Barraclough in 2013

Lucey and Barraclough (2013) submitted a letter to the MOE outlining several key items of concern with respect to the issuance of the draft permit 105809. Both of these authors are registered professional biologists in BC. Their two main issues relate to the geology information in the Pye and Kneale (2012) and Hancock (2012) reports as well as water quality issues as it relates to the draft permit. The concerns outlined were:

Geology

- There was inadequate information on the gross structural properties so conclusions on porosity cannot be made;

- Information on fractures at the site do not contribute useful information to the determination of groundwater availability;

- An air photo lineament analyses has not been completed;

- An evaluation of the regional or local tectonic settings has not been completed.

Water Quality

- The authors suggest that the BC and Canadian drinking water guidelines should be referenced and the most stringent guidelines pertaining to the permit applied;
- A clear itemized list of parameters and standards for effective compliance monitoring should be created
- The permit should state that the BC approved water quality guidelines referred to are for drinking water
- The guidelines listed in the permit should be treated as legally enforceable standards
- The dioxin toxic equivalent to be applied was for discharges to the environment or to storm sewers. This is an inappropriate standard as it should apply to a drinking water supply.
- The receiving environment monitoring is inadequate to confirm if the proposed facility could impact the Shawnigan Lake water supply
- Surface water sampling plans of twice a year are inconsistent with the risks associated with this type of facility
- Baseline data must be gathered at a frequency and duration suitable to fully characterize background water quality prior to any discharge from the site;
- If monitoring detects a trend of increasing contamination in the receiving environment the draft permit does not provide a procedure the proponent must follow to correct the situation.

3 Discussion

3.1 Technical Reports

After reviewing the available reports and data that relate to the proposed contaminated landfill site several things are apparent.

1. The location of the proposed site has generated a significant response to the draft permit the MOE released in March 2013.
2. There is conflicting information about whether or not the proposed site is located above an aquifer. At the time of the initial technical assessment, data about aquifers in the area indicated that two bedrock aquifers are located in the area but the site was not located above an aquifer. Subsequent data from wells allowed the aquifer expanse to be enlarged and now the site is located above a mapped aquifer as shown on the BC Water Resource Atlas online map.
3. There are conflicting reports about whether or not there is a confining bedrock layer over a deeper bedrock aquifer at the site. There are also conflicting predictions on the groundwater flow and the time it would take for the water in the ground to enter Shawnigan Lake. Some claims have been made that limestone deposits in the area are more extensive than mapped but no evidence has been produced to support this supposition.

4. The application for the permit for the landfill site indicated that groundwater quality is to meet the standards for the protection of aquatic life in the Contaminated Site Regulations. Other concerned proponents refute this and indicate that any approved BC water quality guidelines referred to in the permit should be for drinking water.

3.2 Risk

Some years ago, CRD Integrated Water Services adopted a risk management approach for dealing with potential threats to the quality of water in the Greater Victoria Water Supply Area. Thus, the threat posed to the quality of water in the source reservoirs from potential contaminants in the proposed SIA landfill was evaluated using this risk management approach.

Risk is a combination of the probability of something occurring coupled with its potential consequence. In this case, we need to look at the probability of an event occurring and the potential consequence of such an event.

3.2.1 Probability

Currently, the SIA site has a number of measures proposed to be put in place to prevent the potential escape of any contaminants. These measures include soil acceptance plans, soil discharge including permanent containment design, soil treatment, weather protection and control of water discharge.

To fully appreciate if the above measures will function as predicted, a proper assessment would need to be undertaken by a contaminated soils specialist to determine if they meet government standards. Such a study is beyond the scope of this report.

Nevertheless, we need to examine the further probability that:

- Contaminated soils brought to the site contain chemicals that have the potential to adversely impact drinking water quality
- Contaminated water would escape from the site and become part of the surface flows
- Contaminated water would enter the groundwater, and
- Contaminated groundwater would reach Sooke Lake Reservoir
- Contaminants would enter the Sooke intake tower
- Contaminants would pass through the water treatment plant

In the case of the first bulleted item, we know that the potential contaminants at the site have the potential to impact drinking water quality if they are present in sufficient quantity.

However, in order for water to escape from the site, there would have to be a substantive breach in the proposed containment of soil storage and water management at the site. Should water escape and enter the <u>surface water</u>, given that the site is located within the surface water catchment area of Shawnigan Lake and not Sooke Lake Reservoir, there is no likelihood that surface water would reach Sooke Lake Reservoir.

In the case of contaminants entering the groundwater, it is reported that it would take 100,000 years for water to transport through a 65-75 m thick impermeable bedrock layer before arriving at the bedrock aquifer. Further, it is estimated that once in the deeper bedrock aquifer it would take an additional 3000 years to reach Shawnigan Lake. For argument sake, a similar timeline might apply to reaching Sooke Lake Reservoir.

In terms of the groundwater reaching Sooke Lake Reservoir, the current groundwater flow direction in the bedrock aquifer is to the northwest. However, Sooke Lake Reservoir is located west northwest. Unfortunately, the paucity of well sites on CRD lands and on the terrain east of Sooke Lake Reservoir over to the SIA site, means that we simply do not have data available to define either the presence or absence of an aquifer under the CRD land base, nor the direction of groundwater flow or its velocity.

If all of the above conditions perfectly lined up and contaminated water from the site actually reached Sooke Lake Reservoir, it would most likely enter the reservoir at the extreme north end (see **Map 1**). At full pool, Sooke Lake Reservoir contains 16,032,000,000 cubic metres of water and has an average detention (passage of water through the reservoir) of more than two years. Thus, during this two year passage to reach the intake tower (located some 7.5 km away) at the extreme south end of the reservoir, the contaminants would undoubtedly mix with the water in the reservoir (the water in the reservoir mixes vertically each spring) and could potentially be diluted by up to a billion times.

Finally, to reach Greater Victoria drinking water consumers, the diluted contaminants would need to pass unscathed through a water treatment process that many years in the future may bear little resemblance to current water treatment technology.

3.2.2 Consequences

The consequence of contaminants from the SIA site reaching Greater Victoria drinking water consumers is dependent upon:

- The type and concentration of contaminants in the groundwater
- The effect of these contaminants on the aquatic environment
- The effects of these chemicals on drinking water quality

Given that the concentration of any contaminants delivered to Greater Victoria consumers would be so dilute, it is unlikely that analytical methods could even detect them, let alone exceed any of the environmental or drinking water regulatory limits.

4 Conclusions

Based on a review of the available reports and maps we can conclude the following:

- A review of current topographic maps and known surface water flow suggest that there is no danger that surface water flow from the proposed site would reach any of the drinking water source reservoirs that lie within the current Greater Victoria Water Supply Area.

- The SIA report indicates that no shallow overburden aquifers have developed in the area primarily due to the limited thickness and type of overburden soils.

- The SIA report indicates that based on data from MOE well sites near the site and five monitoring wells drilled at the site, bedrock beneath the SIA site is stratified into two layers:

    - Upper bedrock 0-75 m (0-250 ft) thick which has negligible groundwater flow; and
    - Deep bedrock below 75 m (250 ft) which has minor groundwater flow

  However, the presence of an upper confining bedrock layer with negligible flow, as well as the permeability of the rock and the length of time of would take groundwater to travel to Shawnigan Lake is refuted by several proponents.

- Available well data extending from the SIA site to Shawnigan Lake indicate that the groundwater is flowing to the northwest.

- Statements made that suggest the presence of limestone deposits in the area as being more extensive and therefore could possibly provide a conduit for groundwater flow, have been made but are not backed up by data from available geological mapping of the area. Currently available data do not support this supposition.

- Due to the lack of well sites within Greater Victoria Water Supply Area lands and on the terrain east of Sooke Lake Reservoir over to the SIA site, a definitive statement cannot be made with regards to either the presence or absence of an aquifer under the CRD land base, nor the direction of groundwater flow or its velocity.

- Any potential contaminants reaching Greater Victoria drinking water consumers would be so low in concentration as to be virtually undetectable. Hence, there would be no potential impact on the quality of drinking water received by Greater Victoria consumers.

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6 Signatures

We trust that the information included in this report answers the question posed by the CRD Board. Please do not hesitate to contact the authors for any clarification.

Sincerely,

PROFESSIONAL PROVINCE OF S. SCOTT BRITISH COLUMBIA SCIENTIST

Association of Professional Engineers and Geoscientists of the Province of British Columbia S. SCOTT ENGINEERING LICENSEE Limited Licence 123085

29/04/13

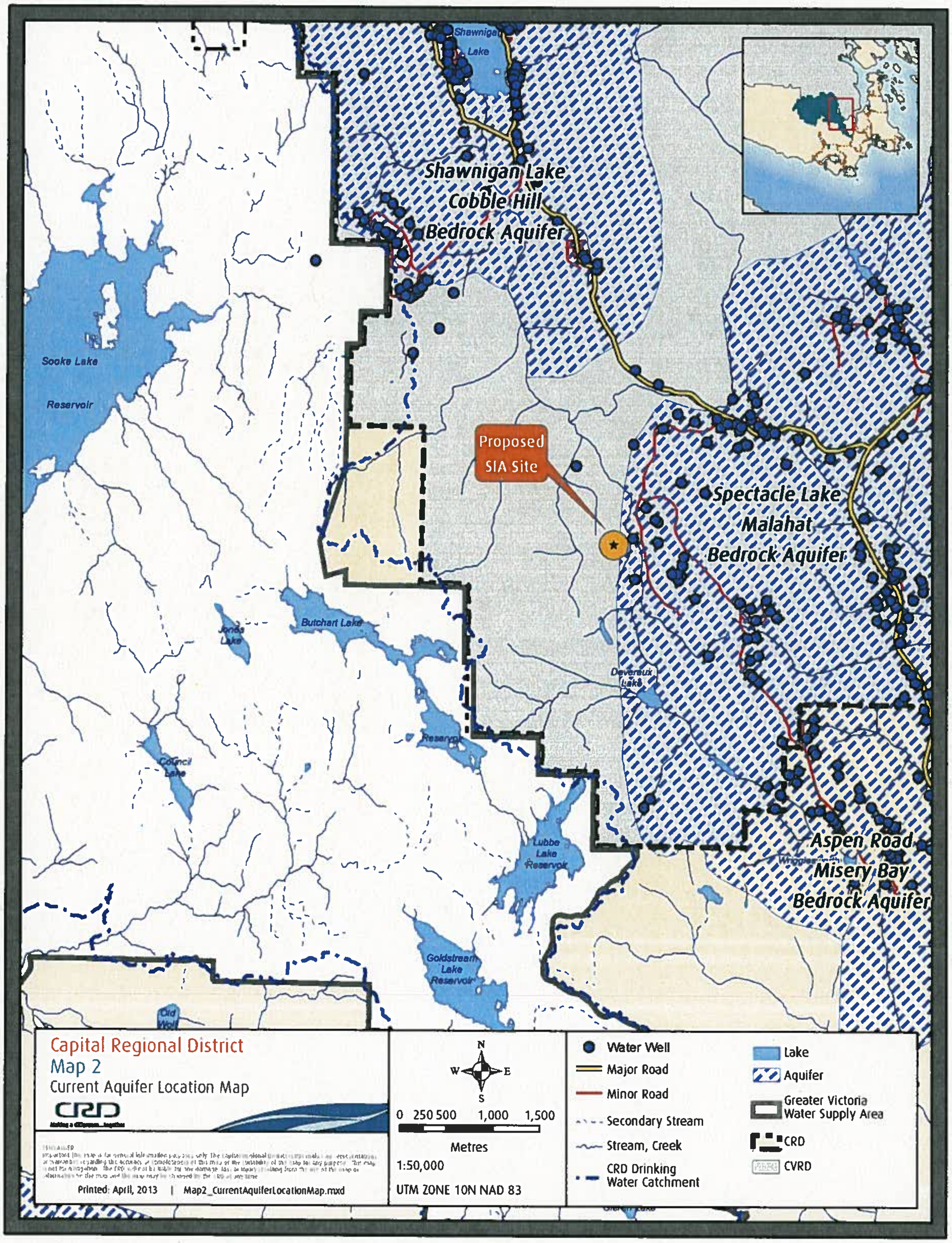
Sharon Scott, M.Sc., P. Geo, Eng. L
Senior Geoscientist
Watershed Protection

Stewart Irwin, M.Sc.
Senior Manager
Water Quality

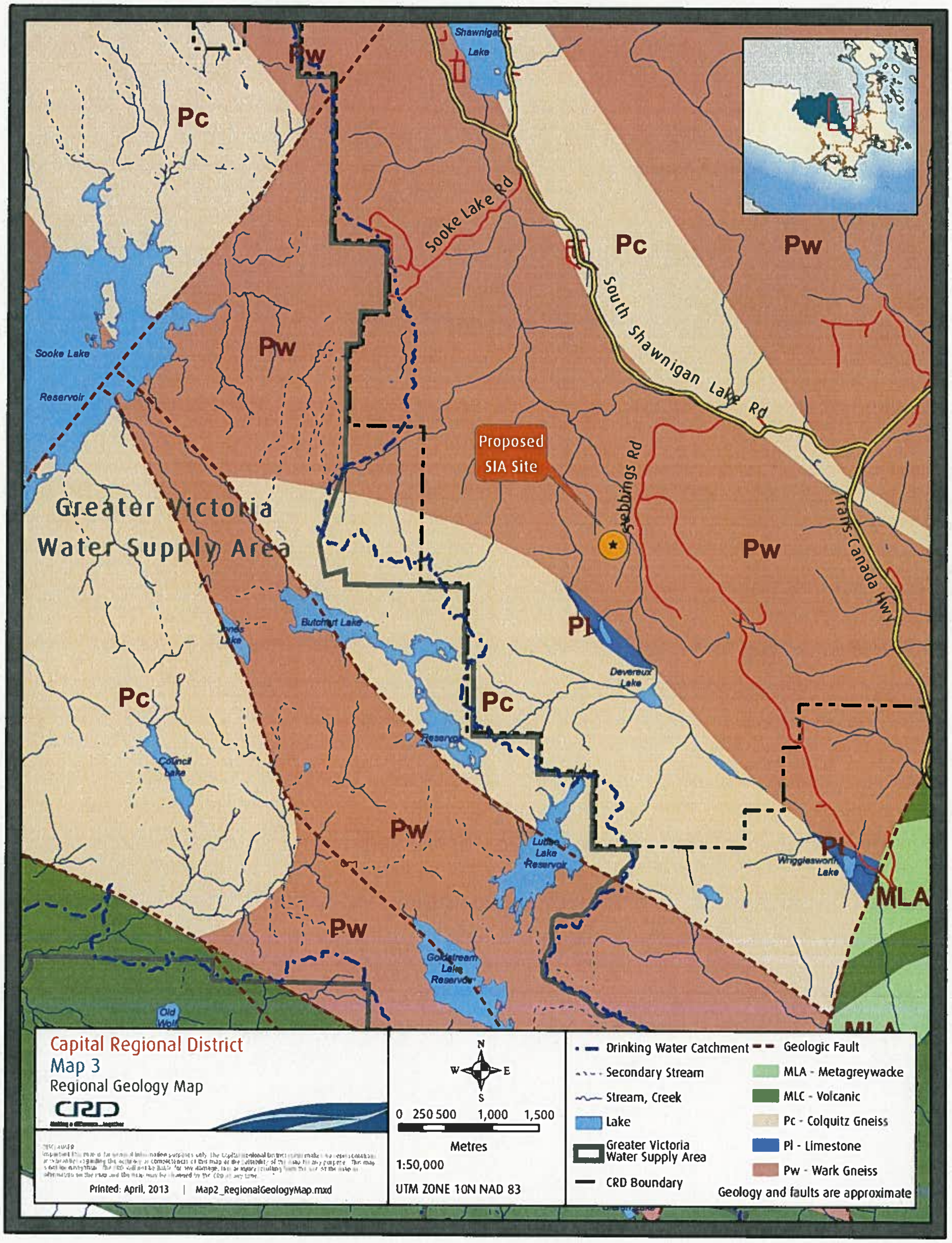
7 Limitations

This report provides a review and summary of the available technical documents (to the best of our knowledge at this time) relating to the SIA proposed contaminated landfill site for information purposes only. It is not a hydrogeological or contaminated site data peer review of the technical documents reviewed. The Senior Geoscientist co-authoring the report is neither a hydrogeologist nor a contaminated sites specialist.

Map 2. Current Aquifer Location Map



Map 3. Regional Geology Map. Based on mapping by Muller (1983).



ATTACHMENT 2

Making a difference...together

Capital Regional District
625 Fisgard Street, PO Box 1000
Victoria, BC, Canada V8W 2S6

T: 250.360.3000
F: 250.360.3234
www.crd.bc.ca

April 12, 2013

File: 0400-50

The Hon. Terry Lake, MLA
Minister of Environment
PO Box 9047, Stn. Prov. Govt.
Room 247, Parliament Buildings
Victoria, BC V8W 9E2

Dear Minister Lake:

CONTAMINATED SOIL FACILITY IN SHAWNIGAN LAKE WATERSHED

At its meeting held April 10, 2013, the Capital Regional District (CRD) Board of Directors considered a motion in relation to concerns expressed by the Cowichan Valley Regional District and residents in the vicinity of Shawnigan Lake over a proposed contaminated soil facility to be located in their drinking watershed. A number of delegations representing the area and a director of the Cowichan Valley Regional District Board appeared before the CRD Board to express their concern and request the CRD's support in calling on the Province to deny the Waste Discharge Permit Application for property at 460 Stebbings Road in Shawnigan Lake.

Subsequently, the following motion as adopted by the CRD Board:

> "**WHEREAS** the Province of British Columbia appears on the verge of approving a contaminated soils facility that would permit the dumping of five million tons of highly contaminated material near the headwaters of the Shawnigan Lake drinking water watershed;
>
> **AND WHEREAS** the citizens and Board of the Cowichan Valley Regional District have expressed their strong opposition to the proposed facility and the dumping of contaminated material in drinking water watersheds;
>
> **AND WHEREAS** there are significant conflicting hydrogeological and technical opinions about the risk the facility would pose to the environment and people's drinking water;
>
> **THEREFORE BE IT RESOLVED** that the Capital Regional District (CRD) Board supports the Cowichan Valley Regional District's recommendations and request that the Province of British Columbia deny the Waste Discharge Permit Application for property at 460 Stebbings Road in Shawnigan Lake, in light of the inadequate three-week time period for public input and conflicting hydrogeological and technical opinions;
>
> **AND BE IT FURTHER RESOLVED** that the CRD forward this resolution to the Province of British Columbia, requesting that contaminated site regulations be amended to provide for thorough and appropriate consideration of local government input and land use regulations in the contaminated soils permitting process;

AND BE IT FURTHER RESOLVED that the CRD Board direct staff to provide all available information and an internal analysis on potential impacts of this proposed facility on the Capital Region's water supply at Sooke Lake."

On behalf of the CRD Board of Directors and in support of the Cowichan Valley Regional District, we request the Province deny the Waste Discharge Permit Application for property at 460 Stebbings Road. Furthermore, we request that the Province amend the contaminated site regulations to provide for consideration of local government input and land use regulations in the contaminated soils permitting process If you have any questions regarding the above, please feel contact me at 250-360-3125.

Yours truly,

Alastair DA Bryson

Alastair Bryson, Chair
Capital Regional District Board of Directors

cc: CRD Board of Directors
Cowichan Valley Regional District Board of Directors
Warren Jones, CAO, Cowichan Valley Regional District

ITEM 6.7

Making a difference...together

Report IWS 2013-01

REPORT TO THE CAPITAL REGIONAL DISTRICT BOARD
MEETING OF WEDNESDAY, MAY 8, 2013

SUBJECT **POTENTIAL IMPACT OF SOUTH ISLAND AGGREGATES PROPOSED CONTAMINATED SOILS LANDFILL ON GREATER VICTORIA DRINKING WATER QUALITY**

ISSUE

The Capital Regional District (CRD) Board requested an internal assessment of the potential impact of a proposed landfill of contaminated soils in the Cowichan Valley Regional District on Greater Victoria drinking water quality.

BACKGROUND

South Island Aggregates (SIA) has submitted a proposal to the BC Ministry of Environment for a landfill to accept and store contaminated soil in the Goldstream Heights area of the Cowichan Valley Regional District. The proposed landfill site is located within the catchment of Shawnigan Lake and is approximately 5.5 kilometres (km) east of Sooke Lake Reservoir and 2 km northeast of Butchart Lake Reservoir in the Greater Victoria Water Supply Area.

CRD staff reviewed available hydrogeology technical reports about the site, existing information on the geology and aquifers in the area, critiques of the proposal, and the draft provincial permit. The results of this review are contained in the attached report:

> *Potential Impact of South Island Aggregates Proposed Contaminated Soils Landfill Site on Greater Victoria Drinking Water Quality.*

CONCLUSIONS

Based on a review of the available technical reports and data, the main conclusions and interpretations are provided below:

- There is no risk that surface water flow from the proposed site would reach any of the drinking water reservoirs that lie within the Greater Victoria Water Supply Area. Due to the profile of the land, the surface water flows in the other direction.

- No shallow aquifers are located under the SIA site. This is primarily due to the limited thickness and type of overburden soils.

- The bedrock beneath the SIA site is stratified into two layers:

  - Upper bedrock 0-75 m thick which has negligible groundwater flow; and
  - Deep bedrock below 75 m which has minor groundwater flow

  Note: Several proponents dispute the upper bedrock as potentially having greater groundwater flow than reported by SIA. SIA reported flow time of approx. 100,000 years to reach any lower lying aquifers. However, the proponents' conclusion is based on information from only one well site and the data/analysis is not available for review.

- The direction of groundwater flow is to the northwest - toward Shawnigan Lake, not toward Greater Victoria Water Supply reservoirs.

- Statements that suggest limestone deposits in the area are more extensive than reported, and therefore possibly a conduit for groundwater flow, are not backed up by data from available geological mapping of the area. Currently, available data do not support the statements made.

- A definitive statement cannot be made about the presence or absence of an aquifer under the Greater Victoria Water Supply Area lands because of a lack of data.

- In the unlikely event that any contaminants might reach the north end of Sooke Lake Reservoir, those contaminants would potentially be diluted by up to a billion times before entering the intake tower located some 7.5 km away at the south end of the reservoir. The reservoir contains approx. 16,000,000,000 cubic metres of water, which provides substantive opportunity to dilute the contaminants below detectable levels.

- Finally, because water from Sooke Lake Reservoir must also pass through a water treatment process that, many years in the future would use very different and improved technology, there would be <u>no</u> impact on the quality of drinking water received by Greater Victoria consumers.

RECOMMENDATION

That the CRD Board receive the staff report *Potential Impact of South Island Aggregates Proposed Contaminated Soils Landfill Site on Greater Victoria Drinking Water Quality* for information.

Ted Robbins, B.Sc., C. Tech
General Manager, Integrated Water Services

Robert Lapham, MCIP, RPP
Chief Administrative Officer
Concurrence

SI:SS:mm
Attachment: 1

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Agenda Item #9
REPORT #RWSC 2015-09

REPORT TO REGIONAL WATER SUPPLY COMMISSION
MEETING OF WEDNESDAY, JUNE 17, 2015

SUBJECT **JAPAN GULCH WATER DISINFECTION FACILITY UPGRADE – PROJECT STATUS REPORT**

ISSUE

Provide a project status update for the Japan Gulch Water Disinfection Facility Project (Project) to the Regional Water Supply Commission (Commission).

BACKGROUND

At its meeting held October 15, 2014, the Regional Water Supply Commission resolved:

That the Regional Water Supply Commission direct CRD staff to:
a) Proceed with the Design Build (DB) procurement strategy for this project;
b) Retain OPUS as the Owner's Representative, subject to finalizing the revised scope and effort for services, and revising the original contract accordingly; and
c) Approve the redistributed budget of $9.0M for the DB procurement strategy.

The following summarizes progress subsequent to that meeting, and next steps for the Project:

1. With the assistance of the Procurement Specialist and Owner's Representative, published a Request for Qualifications (RFQ) on January 18, 2015.

2. Developed a project Risk Register to identify and track key issues and mitigative strategies.

3. Created a project link on the CRD website to provide information on the project to the public.

4. The RFQ closed on February 20, 2015 and the following three proponents were selected to move forward to the Request for Proposal (RFP) stage:
   a. Bird Construction Inc. and Tetra Tech
   b. Knappett Projects Inc. and Associated Engineering
   c. TriTech Group Ltd. and Stantec Consulting

5. Ongoing coordination with requisite approving authorities and utilities including the City of Langford, the Island Health Authority (IHA), and BC Hydro.

6. Additional Archeological, Environmental and Geotechnical Site investigation to further define site constraints.

7. Preparation of the Project RFP. This package includes the contract, indicative design, background information, and evaluation criteria. The RFP will be released to the shortlisted proponents on June 29, 2015.

8. It is expected that the Project RFP and negotiation processes will conclude October 23, 2015 and a recommendation of award to the successful proponent will be submitted to the Commission at its meeting on November 18, 2015. If the review/negotiation process takes longer than anticipated, award will be rescheduled to the next available Commission meeting. This will be followed by the development of a final contract which is anticipated to be complete by the end of the year.

9. Construction is anticipated to commence in early 2016 and will likely be complete by the end of 2017. The construction schedule and duration may vary depending on the preferred proponent's proposal.

In considering the Project logistics further, it has been determined that replacement of the existing 36" and 48" bulk water supply meters at Japan Gulch concurrently with the Project and by the DB proponent, would provide a number of benefits. The meters were scheduled for replacement in 2016 and were identified in the Regional Water Supply Five Year Capital Plan in 2016 with a budget of $490,000. It was anticipated that the meters would be scheduled for installation in late 2016 through early 2017 (low flow period).

Including the meters in the Project RFP will benefit the Project by improving coordination between the metering, control, and treatment processes, and provide additional opportunity for Design Build innovation. Including the meters will also reduce risk to the Project by defining a single source of responsibility for plant operation, and avoiding the conflict that might be caused through separate contractors working within the same site. Therefore, it is recommended that the Project RFP should be expanded to include the replacement of the existing meters on the 36" and 48" mains that currently reside within the existing chloramination building. The meters and associated works will be itemized separately within the RFP for budgeting purposes. Since the expenditures for the meter replacements will occur in 2016 as planned, there would be no need to amend the capital plan.

ALTERNATIVES

That the Regional Water Supply Commission:

1. Direct staff to include the replacement of the 36" and 48" bulk water supply meters, identified in the 2016 capital budget for $490,000, into the 2015 Japan Gulch Water Disinfection Facility Upgrade Project RFP.

2. Direct staff to not include the replacement of the 36" and 48" main meters, identified in the 2016 capital budget for $490,000, into the Japan Gulch Water Disinfection Facility Upgrade Project RFP and undertake this work separate to the Project in 2016.

IMPLICATIONS

1. Including the meters in the Project RFP, rather than undertaking this work outside of the Project as originally planned, will benefit the Project by improving coordination between the metering, control, and treatment processes, and provide additional opportunity for design build innovation. Including the meters in the Project RFP will also reduce risk to the Project by defining a single source of responsibility for plant operation, and avoiding the conflict that might be caused through separate contractors working within the same site. Design, supply and installation of the meters will be competitively priced as part of the RFP process.

2. The meters are essential to control the project disinfection process. Not including the meters in the Project has the potential to add risk and cost to the Project, as it will require separation of the meters and the Project.

   a) This may result in the meters being installed under a separately tendered contract, and a separate contractor completing the works. This will generate challenges in coordination of two contractors working within the same treatment system and reduce clarity of definition of responsibility in the works.

   b) It may extend the Project schedule as there is a short duration in which the meters can be installed due to the flow regime at the Japan Gulch site. Installation of the meters must occur during the low flow period (November through February). It would be better to have the responsibility for Project schedule under the control of one entity.

CONCLUSION

The Project is progressing as planned and the RFP is scheduled for release early in July of 2015. The subsequent review, negotiation and agreement processes are anticipated to be complete by the end of this year. Construction will be initiated in early 2016 and the Project is scheduled to be completed and commissioned by the end of 2017. The final construction schedule and duration will be dependent on the option selected and final design details.

Including the meters with the Project RFP will reduce Project risks and provide opportunity for an improved treatment system and additional opportunity for DB innovation. The meters will be considered as part of the Project however, no funds for this work will be expended in 2015, only as planned in the 5 year capital plan.

RECOMMENDATION

That the Regional Water Supply Commission direct staff to include the replacement of the 36" and 48" bulk water supply meters, identified in the 2016 capital budget for $490,000, into the 2015 Japan Gulch Water Disinfection Facility Upgrade Project RFP.

Ian Sander, P.Eng.
Manager, Capital Projects

Peter Sparanese, P.Eng.
Senior Manager, Engineering and Operations
Concurrence

Ted Robbins, B.Sc., C.Tech.
General Manager, Integrated Water Services
Concurrence

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Agenda Item #10
REPORT #RWSC 2015-13

REPORT TO REGIONAL WATER SUPPLY COMMISSION
MEETING OF WEDNESDAY, JUNE 17, 2015

SUBJECT **INFORMATION UPDATE ON PROPOSED AMENDMENTS TO CRD CROSS CONNECTION CONTROL BYLAW NO. 3516**

ISSUE

Insufficient Cross Connection Control inspection staff to complete initial facility audits and undertake the five-year re-audit cycle set out in Capital Regional District (CRD) Cross Connection Control Bylaw No. 1, 2008 (Bylaw No. 3516).

BACKGROUND

The CRD's Cross Connection Control (CCC) Program protects public health by removing or isolating sources of contamination that may backflow into the Regional Water Supply (RWS). The program was established in response to an Order, issued by the Vancouver Island Health Authority Chief Medical Health Officer in November 2005, directing the water suppliers within the RWS to prepare and complete a coordinated hazard prevention plan for their water systems.

The CCC Program operates under the umbrella of CRD CCC Bylaw No. 3516, adopted in June 2008. The bylaw applies to the seven water suppliers (CRD, Central Saanich, North Saanich, Oak Bay, Saanich, Sidney and Victoria) within the RWS. The program provides one of eight critical "water quality barriers" in place within the RWS to prevent contamination of drinking water supplied to customers. The program is funded through the CRD Regional Water Supply operations budget and has the following main components: backflow prevention device (BPD) tracking and notification, maintenance of a certified testers list, auditing of facilities and enforcement.

There are two main challenges that the CCC program is currently facing with regard to facility audits. The first challenge is the estimated timeline for completion of the "first round" of facility audits being undertaken by CCC inspection staff. It is estimated that, at current inspection rates and with recent information on the numbers of facilities in the region, it will take an additional 16 years to complete the first round of audits – initiated in August 2009. The types of moderate hazard facilities remaining to be audited in accordance with bylaw requirements include: food services, convenience stores, office buildings, apartment buildings, mobile home parks, farms and a range of small commercial facilities.

No timeline is specified in the bylaw for completion of the first round of audits; however, more timely completion is highly desirable. Further information on the estimated time for completion of the first round of audits is presented in Appendix A.

The second challenge is associated with the current requirement in Bylaw No. 3516 for all facilities classified as a "severe or moderate hazard" to be re-audited every five years. With one full-time inspector, an estimated 9,000 moderate hazard facilities remaining in the first round of audits, and increasing numbers of new facilities requiring initial audits, the CCC program has been unable to meet the five-year re-audit cycle set out in Bylaw No. 3516. The "second round" of audits (re-audits) was due to start in August 2014.

Research conducted on CCC programs in other Canadian jurisdictions with medium to large water systems similar in size to the CRD indicated that none of the seven jurisdictions contacted had set timeline requirements for re-auditing severe or moderate facilities after initial (first round) audits were completed. In addition, none of the above seven jurisdictions conduct audits on residential facilities.

A request for additional financial resources for the CCC program to hire an inspector for a four-year term to expedite re-audits of severe hazards and to assist with initial audits of the remaining moderate hazard facilities will be submitted to the Budget Subcommittee for consideration in September 2015. Following their financial recommendation, draft bylaw amendments to change the audit frequency for severe hazard facilities (only) to once every seven years and to exclude requirements for audits of all residential premises will be submitted to the RWSC for consideration in October 2015.

ALTERNATIVES

Alternative 1

That the Regional Water Supply Commission receive this report for information and direct staff to prepare a financial submission to the Budget Subcommittee for consideration.

Alternative 2

That the Regional Water Supply Commission direct staff to undertake further analysis.

OPERATIONAL, ENVIRONMENTAL AND PUBLIC HEALTH IMPLICATIONS

With one full-time inspector, an estimated 8,913 moderate hazard facilities remaining in the first round of audits and increasing numbers of new facilities requiring initial audits, the CCC program has been unable to meet the five-year audit cycle set out in Bylaw No. 3516.

INTER-JURISDICTIONAL IMPLICATIONS

Recent discussions between CRD staff and representatives of the other six water suppliers have indicated that they all expect that the CRD's CCC re-audits will be carried out on a defined frequency, with the main goal of protecting the quality of the region's drinking water against the risk of backflow and potential contamination.

The CRD has also consulted with Island Health on the background to the program, progress to date, current challenges and the proposed amendments to the bylaw. Island Health staff have indicated that they are not opposed to amending the type and frequency of facility re-auditing and that they support CRD staff going forward to the RWSC with bylaw amendments.

LEGAL IMPLICATIONS

Legal counsel has determined there is significant potential for liability if the CRD fails to carry out the audits in a timely fashion pursuant to its own bylaws and policies, and public health is impacted as a result of this failure. Legal counsel has recommended that the CRD either change its bylaw and policy to make it clear that the CRD is not responsible for completing or enforcing the audits, or hire sufficient inspectors to carry out the audits in a timely fashion.

CONCLUSION

The CRD's Cross Connection Control (CCC) Program protects public health against the possibility of contamination by removing or isolating sources of contamination that may backflow into the RWS. The program operates under the umbrella of CRD CCC Bylaw No. 3516, adopted in June 2008. Bylaw No. 3516 currently requires all facilities classified as a "severe or moderate hazard" to be re-audited every five years. At current staffing and funding levels, the CRD is unable to fulfill the regulatory requirements as outlined under the bylaw for audits and re-audits.

RECOMMENDATION

That the Regional Water Supply Commission receive the report for information and direct staff to prepare a financial submission to the Budget Subcommittee for consideration.

Heidi Gibson, M.N.R.M.
Senior Manager, Environmental Partnerships

Acting for Larisa Hutcheson, P. Eng.
General Manager
Parks & Environmental Services
Concurrence

Ted Robbins, B.Sc., C.Tech.
General Manager, Integrated Water Services
Concurrence

TS:ce

Attachment: 1

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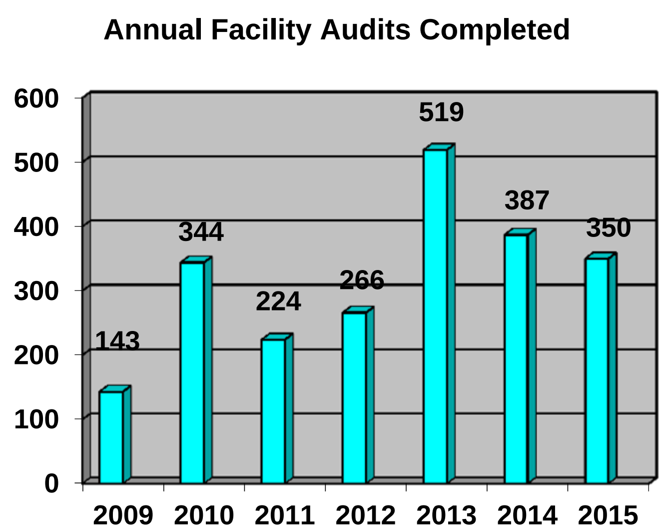
APPENDIX A

ESTIMATED TIME FOR COMPLETION OF THE FIRST ROUND OF AUDITS

The following graph shows the number of Cross Connection Control (CCC) audits completed every year since auditing began in August 2009. Audits of the majority of severe hazard facilities were undertaken within the first two-year period. Audit activity varied from year to year depending on a number of factors, including the hazard rating, the complexity of the facility category, the number of facilities within each category and CCC staffing changes during 2011-2012. Audits are currently focussed on the remaining moderate hazard facilities.



Based on the above information, the average number of audits completed per year by one CCC inspector is approximately 400. In addition, the program supervisor can carry out 100 audits per year.

There are an estimated total of 10,930 severe and moderate hazard facilities (industrial, commercial, institutional and residential) currently requiring audits within the CRD, with approximately 800 of these being severe hazard facilities. If residential properties are excluded from being audited, the total number of facilities requiring audits would drop to 5,946.

As of December 31, 2015 (if residential properties are excluded from being audited):

- An estimated **2,259** audits of both severe and moderate hazard facilities will have been completed.

- There will be an estimated **3,687** moderate hazard facilities remaining to be audited.

- **If an additional inspector is hired for a four year term**, and at the average audit rate per inspector, it will take approximately two years to complete the severe hazard re-audits and approximately **six** years to complete the first round of audits. There would be no scheduled re-audits of moderate hazard facilities.

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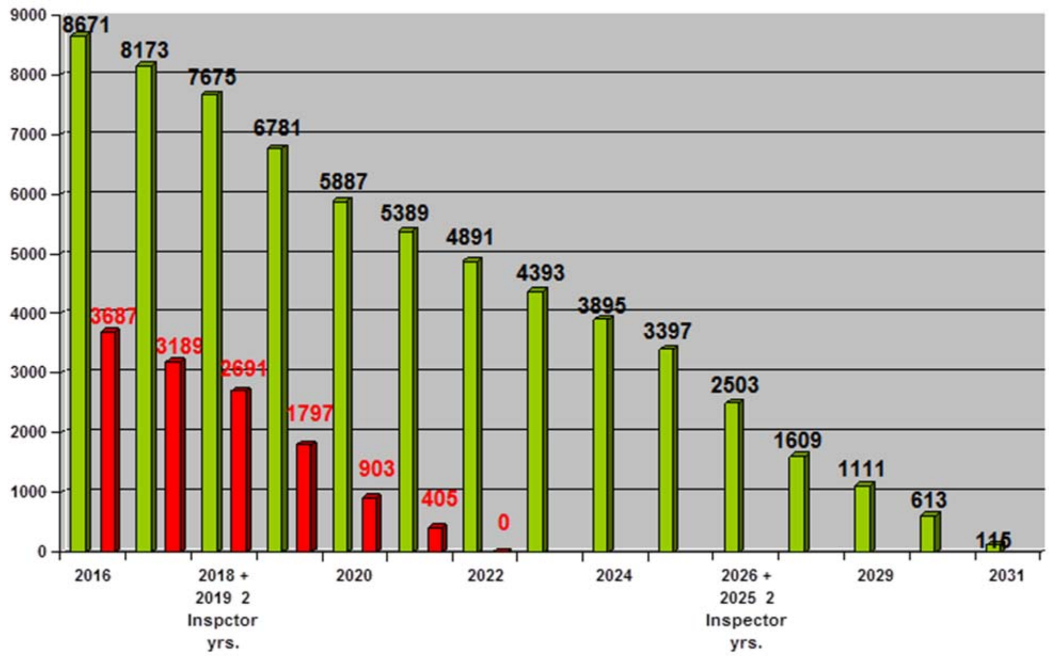
APPENDIX A
Page 2

Timeline for Completion of First Round of Audits with Exclusion of Residential Properties



Red: Residential Removed Green: Residential Included

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Agenda Item #11
REPORT #RWSC 2015-11

REPORT TO REGIONAL WATER SUPPLY COMMISSION
MEETING OF WEDNESDAY, JUNE 17, 2015

SUBJECT **SUMMARY OF THE 2015 PUBLIC TOURS OF THE GREATER VICTORIA WATER SUPPLY AREA AND WATER SUPPLY FACILITIES**

ISSUE

To provide a summary of the 2015 Public Tours of the Greater Victoria Water Supply Area and Water Supply Facilities.

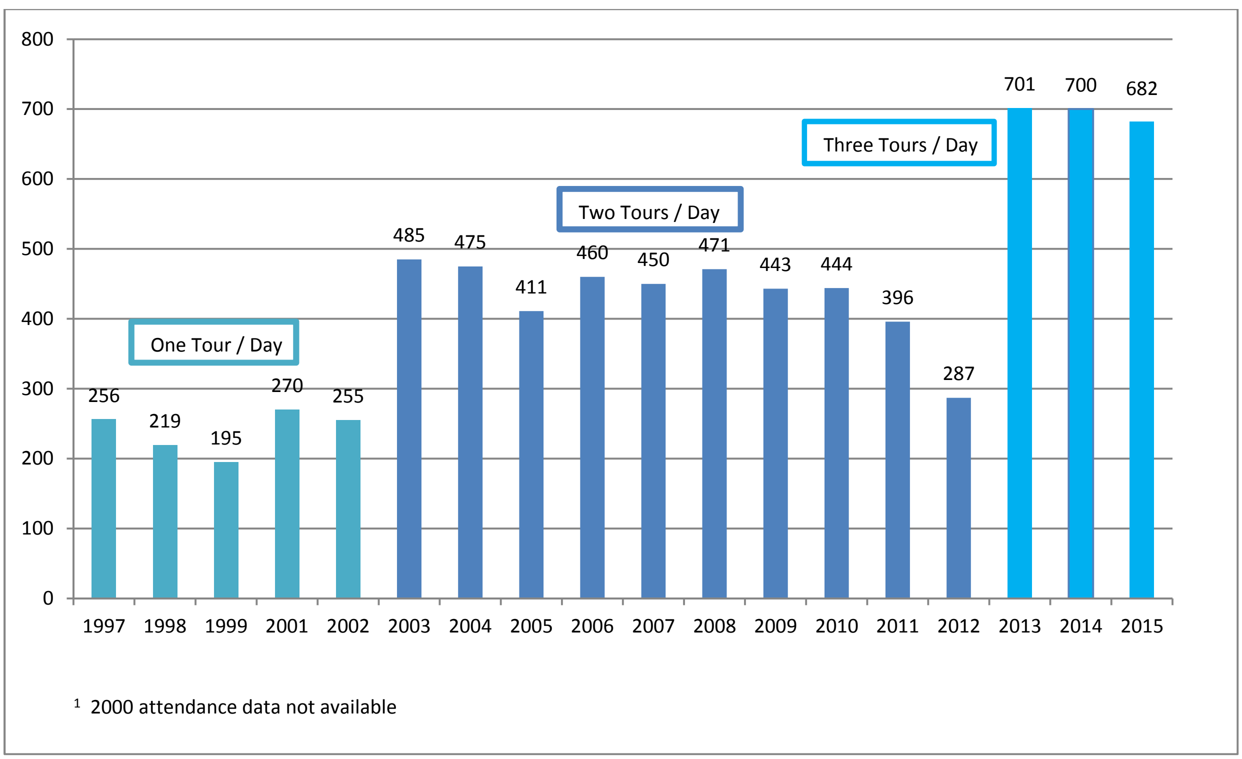
BACKGROUND

2015 marked the 26th year of CRD Integrated Water Services providing public tours of the Greater Victoria Water Supply Area (GVWSA) and Water Supply Facilities. The tours were held during National Drinking Water Week from Monday, May 4 through Saturday, May 9.

Participation

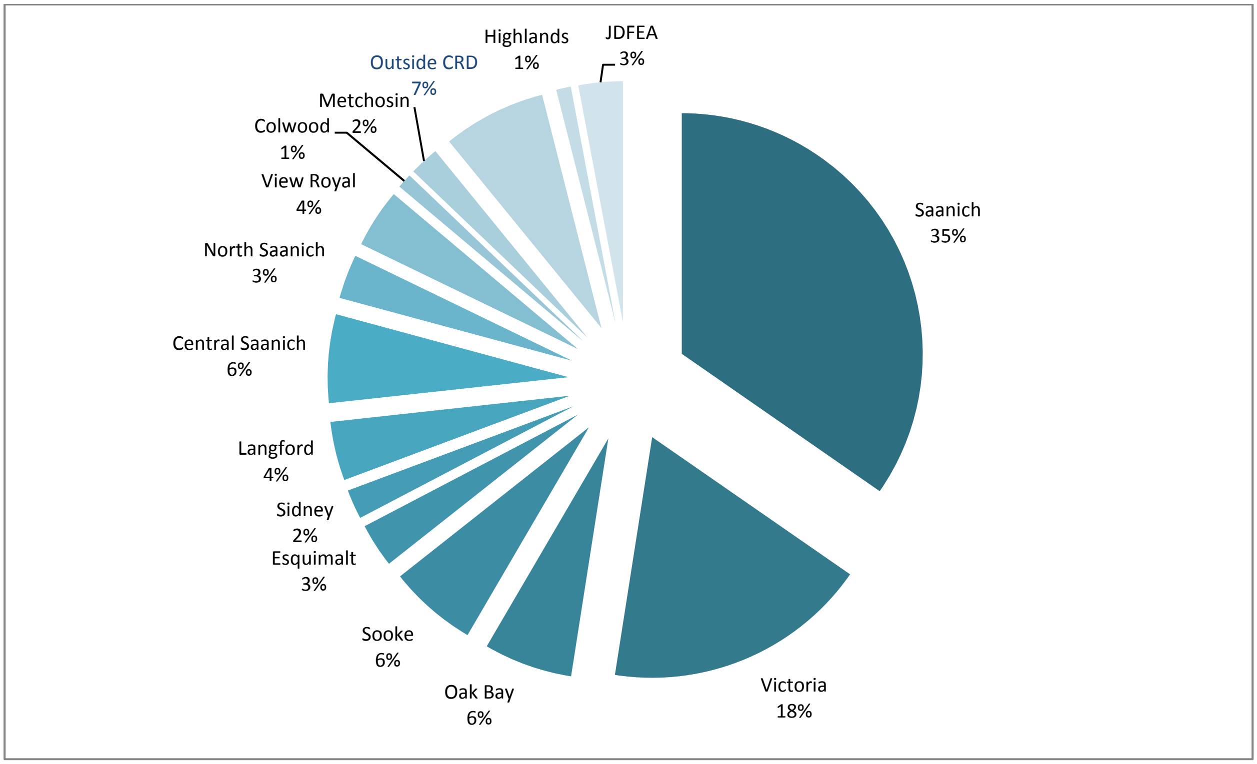
One long (5.5 hours) tour and two short (3 hours) tours were held each day visiting Sooke Lake Reservoir and Dam, Goldstream Reservoir and Dam, the Japan Gulch Disinfection Facility, and other points of interest. A total of 682 people participated in the tours. All public tours were fully booked and the slight decrease over 2013 and 2014 results from "no shows" at the time of departure. Figure 1 illustrates the increasing participation over time with increasing opportunities made available to the public. As in 2013 and 2014, one short tour each day was made available to school classes, resulting in a total of 165 students and staff from seven schools and a homeschool group touring the GVWSA. The low participation rate in 2012 is attributed to lesser advertising that year.

Figure 1. Public Tour Participation 1997 - 2015[1]



A tour questionnaire was completed by 32% of the general tour participants (not schools). Of those who responded, 72% were on a tour for the first time which is similar with previous years. Figure 2 outlines the home municipality of those participants who responded to the questionnaire. Relative to population size, residents of Saanich and Victoria had higher participation rates while residents of the Western Communities and Juan de Fuca Electoral Area had lower participation rates. There was an increase in the number of residents from the Juan de Fuca Electoral Area and from participants outside the CRD attending this year's tours.

Figure 2. Tour Participation by Municipality



Cost

The total cost of the public tours was $65,530 including staff wages to prepare, attend and escort the tours, and external costs for advertising, bus rental, tents, display materials, tour information package, signs, and refreshments. The tours are funded from the annual operating budget. With 682 total participants, the tours cost $96 per participant.

Feedback

As in previous years, the tours were well received with 92% of survey respondents rating the tours as "excellent" and the remaining 8% of respondents rating the tours as "good". Suggestions for improvement predominantly entailed more opportunity for longer tours and stops with additional facilities or sites visited.

Considerations for Future Years

Given the popularity of public tours and their positive impact in the Region, Integrated Water Services is considering whether a model of providing public tours not only one week of the year, but on a more regular basis over the course of the summer and early fall months could be accommodated with reasonable staffing and cost considerations. A question on the feedback form asked: "Would you support having tours offered on a regular schedule through the spring/summer, rather than only one week of the year?". Response to the question was: 116 (70%) yes, and 50 (30%) no. Although, in addition to the annual public tours, several tours are provided to post-secondary groups, other water utilities and research organizations on request throughout the year.

CONCLUSION

Public tours of the Greater Victoria Water Supply Area and Water Supply Facilities continue to play an important role in communicating the value of the Regional Water Supply resources to our customers, and establishing a better understanding of the service that is provided by the CRD in delivering safe and reliable drinking water to the Greater Victoria Area. Positive feedback from both the public and staff suggest tours should continue and staff should consider new opportunities that arise for the public and schools to attend a tour.

RECOMMENDATION

That the Regional Water Supply Commission receive the staff report for information.

A Constabel

Annette Constabel, RPF, PMP
Senior Manager, Watershed Protection

Ted Robbins, B.Sc., C.Tech.
General Manager, Integrated Water Services
Concurrence

AC:KH:mm

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Agenda Item #11
REPORT #RWSC 2015-12

REPORT TO REGIONAL WATER SUPPLY COMMISSION
MEETING OF WEDNESDAY, JUNE 17, 2015

SUBJECT **Greater Victoria Drinking Water Quality – 2014 Annual Report**

ISSUE

To present the 2014 annual report to the Regional Water Supply Commission.

BACKGROUND

The Capital Regional District (CRD) undertakes a comprehensive water quality monitoring program as part of its multi-barrier approach to providing a safe drinking water supply to the region. The Water Quality program reports water trends on a regular basis to the Commission along with a comprehensive annual report for each calendar year. The executive summary of the Greater Victoria Drinking Water Quality 2014 Annual Report is attached as Appendix A. The final report will be distributed to Island Health and posted on the CRD website.

ENVIRONMENTAL IMPLICATIONS

The report indicates there is very good overall water quality associated with the source water that supplies the regional system. The system is monitored for physical, chemical and biological water quality parameters. All trends are either stable or improving, and indicate excellent overall conditions. Treatment using ultraviolet radiation and a sequence of chlorination and ammonification remains effective in managing low risks associated with our unfiltered water supply.

Monitoring results indicate that the CRD continues to meet guidelines for maintaining an unfiltered source water supply. Further monitoring within the distribution systems also indicates a good balance between managing algal and bacterial growth, and ensuring good water quality with low residual disinfectant by-products.

ECONOMIC IMPLICATIONS

The reporting function is included within the overall budget for the Water Quality program. The reporting function is essential for ensuring there is adequate information to inform and work with Island Health officials, meet provincial and federal regulatory requirements, and ensure CRD staff have sufficient information to maintain proper oversight of the water supply system.

SOCIAL IMPLICATIONS

The full disclosure of water quality monitoring data maintains public confidence that the CRD is effectively managing the regional drinking water supply. The data and reports are available online through the CRD public website. The program also responds to direct customer concerns and questions. The Water Quality program also works with CRD operational staff, municipal staff, small system operators and Island Health officials to ensure good communication and support for the overall system.

CONCLUSIONS

The water quality monitoring program remains an important component in the delivery of a safe and abundant drinking water supply to the region. Monitoring results indicate excellent overall water quality and all parameters indicate stable general conditions. The low risks associated with the unfiltered source water are well managed by the multi-barrier approach by the CRD, and the monitoring of the distribution systems indicates a good balance between residual chorine, disinfection by-products and any taste and odour concerns.

Program staff continue to review and revise the monitoring program so that it remains effective, efficient and consistent with current science, best practices and regulatory expectations. Information is also shared with all stakeholders to ensure high public confidence in the water supply and strong management of the overall water supply system.

RECOMMENDATIONS

That the Regional Water Supply Commission:

1. Receive the Greater Victoria Drinking Water 2014 Annual Report for information and direct staff to forward the report to the CRD Board for information; and

2. That staff be directed to distribute the full annual report to the appropriate agencies and post it on the CRD website.

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GH:cam

Attachment: Appendix A – Executive Summary of Greater Victoria Drinking Water 2014 Annual Report

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Greater Victoria Drinking Water Quality
2014 Annual Report
Executive Summary

This report is the annual overview of water quality testing conducted in 2014 within the Greater Victoria Drinking Water System (GVDWS) (Map 1). The test results indicate that Greater Victoria's drinking water continues to be good quality and is safe to drink. With a few minor exceptions, all the results were within the limits of both the *Guidelines for Canadian Drinking Water Quality* and the *BC Drinking Water Protection Regulation.*

Samples and Tests. In 2014, the Water Quality Program collected 6,179 samples from the GVDWS and analyzed those samples for 29,852 individual tests. Approximately 300 different types of analyses were conducted on these samples. Data collected in 2014 are reported in the water quality data tables (see Appendix A, Tables 1, 2, and 3).

Physical-Chemical-Radiological. All physical, chemical and radiological parameters were well within the Canadian Drinking Water Guideline limits except for summer water temperatures (aesthetic limit of 15ºC). In 2014, the weekly and monthly average water temperatures were above the 15°C limit for a period of about 2½ months from early August to mid-October (Figures 2 and 3). This is a typical pattern since the Sooke Lake Reservoir expansion. Previously, the water temperature was above the 15°C limit for about four months of the year. This cooler water is one of the benefits of raising the water level in Sooke Lake Reservoir and the ability to draw from deeper and cooler strata. Sooke Lake Reservoir water was again characteristic for its low alkalinity and softness and a neutral median pH of 7.2.

Bacteria in Source Water. As in the past few years, the level of total coliform bacteria in the raw (untreated) source water entering the Japan Gulch Disinfection Plant continued to be higher during late summer and fall, peaking from mid-September to early October (Figure 3). An increase in total coliform counts was also observed when the Goldstream Reservoir System was used to supply water to the Japan Gulch Plant (December 1–5, 2014) during the Kapoor Tunnel shut down for the annual inspection. Nevertheless, the quality of the raw water entering the treatment plant continued to easily meet the *E. coli* limit of 20 colony forming units (CFU) per 100 mL at least 90% of the time, as stipulated in regulatory guidance and, therefore, continued to meet requirements to remain as an unfiltered surface water supply (Figure 3A).

Treatment. Ultraviolet (UV) disinfection is used to treat the raw source water entering the distribution system, followed by the addition of free chlorine and then ammonia (to produce chloramines). The total chlorine residuals in the distribution system fluctuated seasonally, as well as geographically, in typical patterns generally within an acceptable range. However, the far extremities of the distribution system frequently experience low residual levels especially during the warm weather season (Figure 4). The monthly median total chlorine residual concentration at the entry point to the distribution system ranged from 0.80 to 1.35 mg/L.

Bacteria at First Customer. Staff detected only one positive total coliform sample (in April 2014) from all samples collected at the first customer sampling location below the Japan Gulch Disinfection Plant during 2014 (Figure 4). The monthly total coliform-positive sample rate of 5% in April 2014 was still lower than the 10% limit as per Guidelines for Canadian Drinking Water Quality (Guidelines). No *E. coli* bacteria were found in any of the samples collected at the entry point to the distribution system. This fact provides assurance that Greater Victoria's primary disinfection process is working in a satisfactory manner.

Bacteria in Distribution System. When all of the results from the various municipal distribution systems are grouped together (Figure 5), the percentage of total coliform-positive samples in the Greater Victoria distribution system did not exceed the 10% Guidelines limit during any month in 2014 and was, therefore, in compliance with the *BC Drinking Water Protection Regulation*. Over the last 20 years, monitoring indicates a broad reduction in total coliform bacteria detection and an overall improvement in the bacteriological quality of the water. The relatively low level of total coliform-positive samples (0.8%) reflects the balance maintained between reasonable concentrations of total chlorine in the distribution system and acceptable levels of positive bacterial samples.

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Parasites. Monitoring results indicated low concentrations of *Giardia* cysts detected in three out of six samples in the raw water entering the Japan Gulch Disinfection Plant including one sample that contained viable Giardia cysts (Figure 6). None of the 2014 samples contained *Cryptosporidium* oocysts (Figure 7). The 10-year average concentrations were only 0.030 total *Giardia* cysts and 0.027 total *Cryptosporidium* oocysts per 100 L, respectively (Figures 6 and 7). While these are extremely low values for a surface water supply, the addition of UV disinfection provides assurance that no infective parasites can enter the GVDWS.

Inorganic and Organic Chemicals. All inorganic chemicals, including metals and non-metals, were within Guideline values at the entry point to the distribution system. There were no organic chemicals detected in the raw water entering the treatment plant with the exception of trace levels of phenol, which can be found naturally at trace levels in soil and water due to decomposing animal waste and vegetation.

Disinfection Byproducts. Total trihalomethanes (TTHM), byproducts of the chlorine disinfection process, were well below (range of 10.9–47.4 μg/L for TTHM) the Canadian Guideline limit of 100 μg/L in the chloraminated distribution system (Figure 8). Similarly, a second group of disinfection byproducts, haloacetic acids (referred to as HAA5 because the limit is based on the concentration of a group of five haloacetic acids), were low in the chloraminated distribution system (typical HAA5 range of 10.2–20.1 μg/L with one sample result of 62.1 μg/L) (Figure 9). The Canadian Guideline limit for HAA5 of 80 μg/L was introduced in 2008.

Sooke Reservoir Biological Activity. The overall level of algal activity in Sooke Lake Reservoir is measured using chlorophyll-a, a component of all algal cells (Figure 10). Since the reservoir level was raised in 2003, the chlorophyll-a concentration shows a slight but steady decline. In 2014, the chlorophyll-a concentration peaked in early 2014 and early winter for both the south and north basins as a result of the typical seasonal turn-over events (see inset Figure 10).

Phosphorus. The primary contributor to the higher levels of the chlorophyll-a observed in Sooke Lake Reservoir in 2004 through 2007 was higher levels of total phosphorus, a nutrient that is needed for the algae to grow. The median concentration of total phosphorus between 2003 and 2007 was approximately 70% higher than in the years before the inundation of the new shoreline in both the north and south basins of Sooke Lake Reservoir (Figure 11). However, the levels of total phosphorus are declining and the median concentration from 2008 through 2014 was only 12% higher than in the years before the inundation. The highest phosphorus levels coincided with the flooding of the newly cleared lands around the margin of Sooke Lake Reservoir when the reservoir was expanded. In 2014, the phosphorus levels were similar to the previous two years and at a comparable level to the pre-inundation era.

Algae. In Sooke Lake Reservoir, it is not uncommon for algal species to become dominant at different times of the year. This trend continued in 2014 with three main peaks of algae, all of which occurred in the first half of the year (Figure 12). An extended dominance of the diatom *Urosolenia eriensis* occurred from February through to June (Figure 13). This fragile alga is not of significance to drinking water quality. A short peak in the concentration of the golden-brown (Chrysophyte) alga *Uroglena spp.* occurred in late spring which resulted in a slight fishy odour on the raw lake water as noted by Water Quality laboratory staff but was of no consequence to end users (Figure 14). Also in late spring there was a slight increase in the concentration of the diatom *Asterionella formosa* (Figure 15). Overall algae concentrations in the reservoir in 2014 were similar to the previous five years.

Water Quality Complaints. The number and nature of water quality complaints received by CRD Water Quality staff was similar to what was experienced in previous years with no significant issues of concern. The majority of complaints were related to objectionable chlorine odour and/or taste and temporary water discolouration due to distribution maintenance activities.

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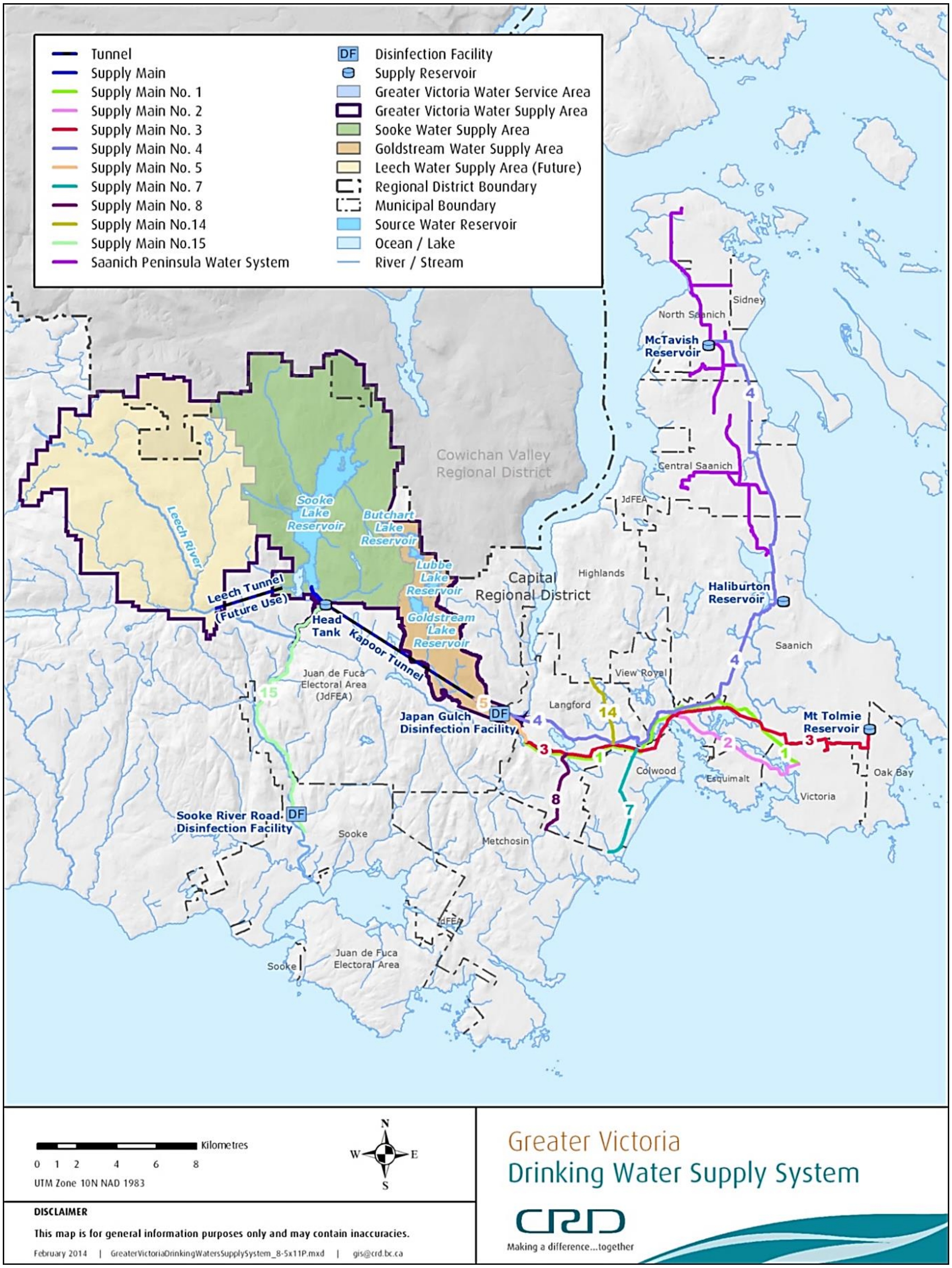
MAP 1. Greater Victoria Drinking Water Supply System



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CAPITAL REGIONAL DISTRICT - INTEGRATED WATER SERVICES

Water Watch

Issued: June 08, 2015

Water Supply System Summary:

1. Useable Volume in Storage:

Reservoir	June 30 5 Year Ave		June 30/14		June 7/15		% Existing Full Storage
	ML	MIG	ML	MIG	ML	MIG	
Sooke	86,243	18,974	84,959	18,691	85,319	18,770	92.0%
Goldstream	8,984	1,976	8,579	1,887	8,128	1,788	82.7%
Total	95,227	20,950	93,538	20,578	93,447	20,558	91.1%

2. Average Daily Demand:

For the month of June	186.6 ML	41.06 MIG
For week ending June 07, 2015	186.6 ML	41.05 MIG
Max. day June 2015, to date:	216.6 ML	47.65 MIG

3. Average 5 Year Daily Demand for June

Average (2010 - 2014)	167.0 MLD [1]	36.73 MIGD [2]

[1]MLD = Million Litres Per Day [2]MIGD = Million Imperial Gallons Per Day

4. Rainfall June:

Average (1914 - 2014):	35.9 mm
Actual Rainfall to Date	1.3 (4% of monthly average)

5. Rainfall: Sep 1 - Jun 7

Average (1914 - 2014):	1556.6 mm
2014 / 2015	1420.5 (91% of average)

6. Water Conservation Action Required:

Stage 1 water conservation bylaw is now in effect
Check our website at www.crd.bc.ca/water for more information.
If you require further information, please contact:

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General Manager, CRD - Integrated Water Services
or
Deborah Walker
Demand Management Coordinator

Capital Regional District Integrated Water Services
479 Island Highway
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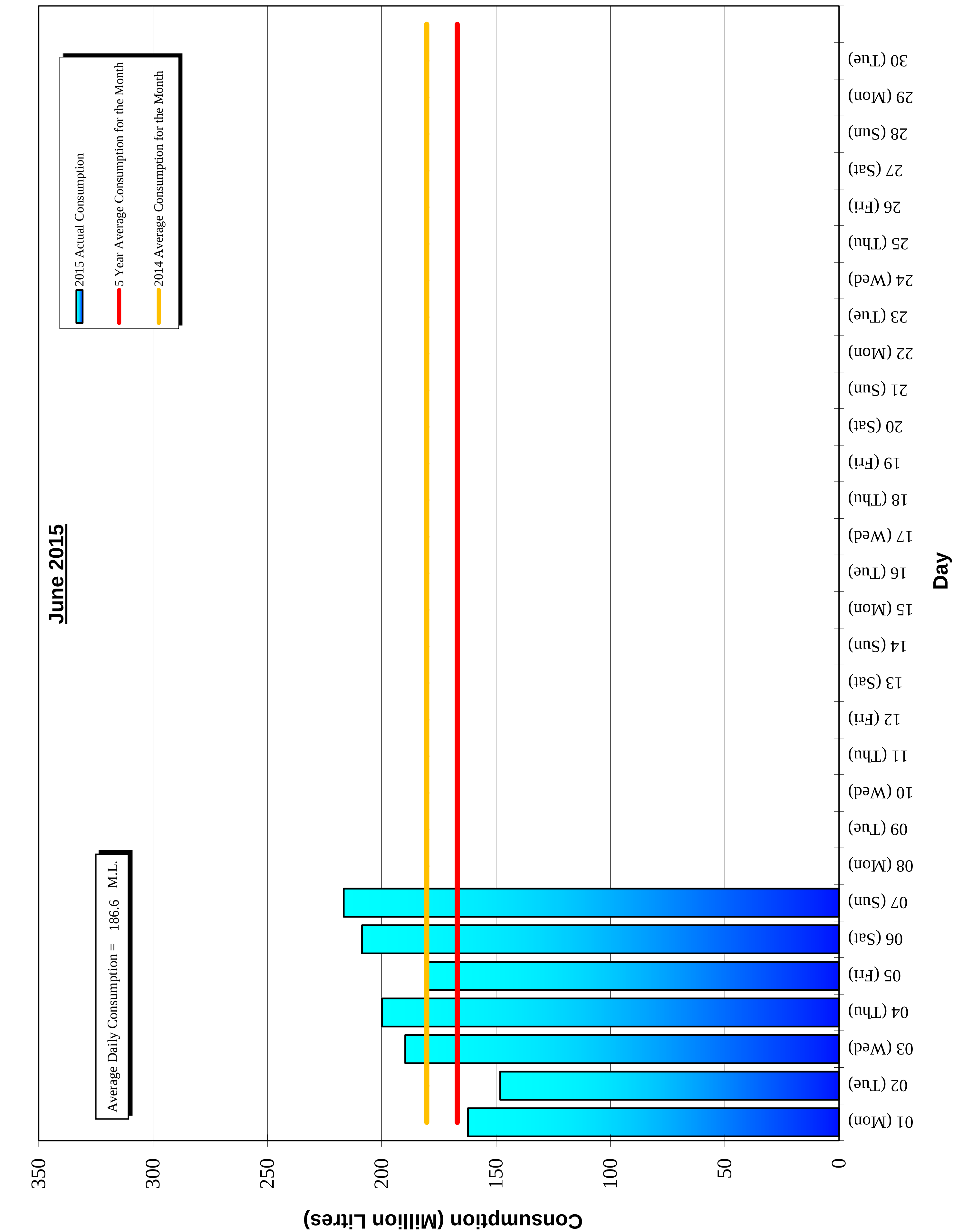

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Daily Consumptions: - June 2015

Date	Total Consumption (ML)		Total Consumption (MIG)	Air Temperature @ Japan Gulch High (°C)	Air Temperature @ Japan Gulch Low (°C)	Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am Rainfall (mm)	Snowfall (mm)	Total Precip.
01 (Mon)	162.3		35.70	21	12	Cloudy / P. Sunny / Showers	1.0	0.0	1.0
02 (Tue)	148.2	<=Min	32.60	17	12	Cloudy / Showers	0.3	0.0	0.3
03 (Wed)	189.7		41.74	18	12	Cloudy	0.0	0.0	0.0
04 (Thu)	199.9		43.98	21	9	Cloudy / P. Sunny	0.0	0.0	0.0
05 (Fri)	181.1		39.84	26	11	Sunny	0.0	0.0	0.0
06 (Sat)	208.6		45.90	26	13	Sunny	0.0	0.0	0.0
07 (Sun)	216.6	<=Max	47.65	29	14	Sunny	0.0	0.0	0.0
08 (Mon)									
09 (Tue)									
10 (Wed)									
11 (Thu)									
12 (Fri)									
13 (Sat)									
14 (Sun)									
15 (Mon)									
16 (Tue)									
17 (Wed)									
18 (Thu)									
19 (Fri)									
20 (Sat)									
21 (Sun)									
22 (Mon)									
23 (Tue)									
24 (Wed)									
25 (Thu)									
26 (Fri)									
27 (Sat)									
28 (Sun)									
29 (Mon)									
30 (Tue)									
TOTAL	1306.4 ML		287.41 MIG				1.3	0	1.3
MAX	216.6		47.65	29	14		1.0	0	1.0
AVE	186.6		41.06	22.6	11.9		0.2	0	0.2
MIN	148.2		32.60	17	9		0.0	0	0.0

ML = Million Litres MIG = Million Imperial Gallons

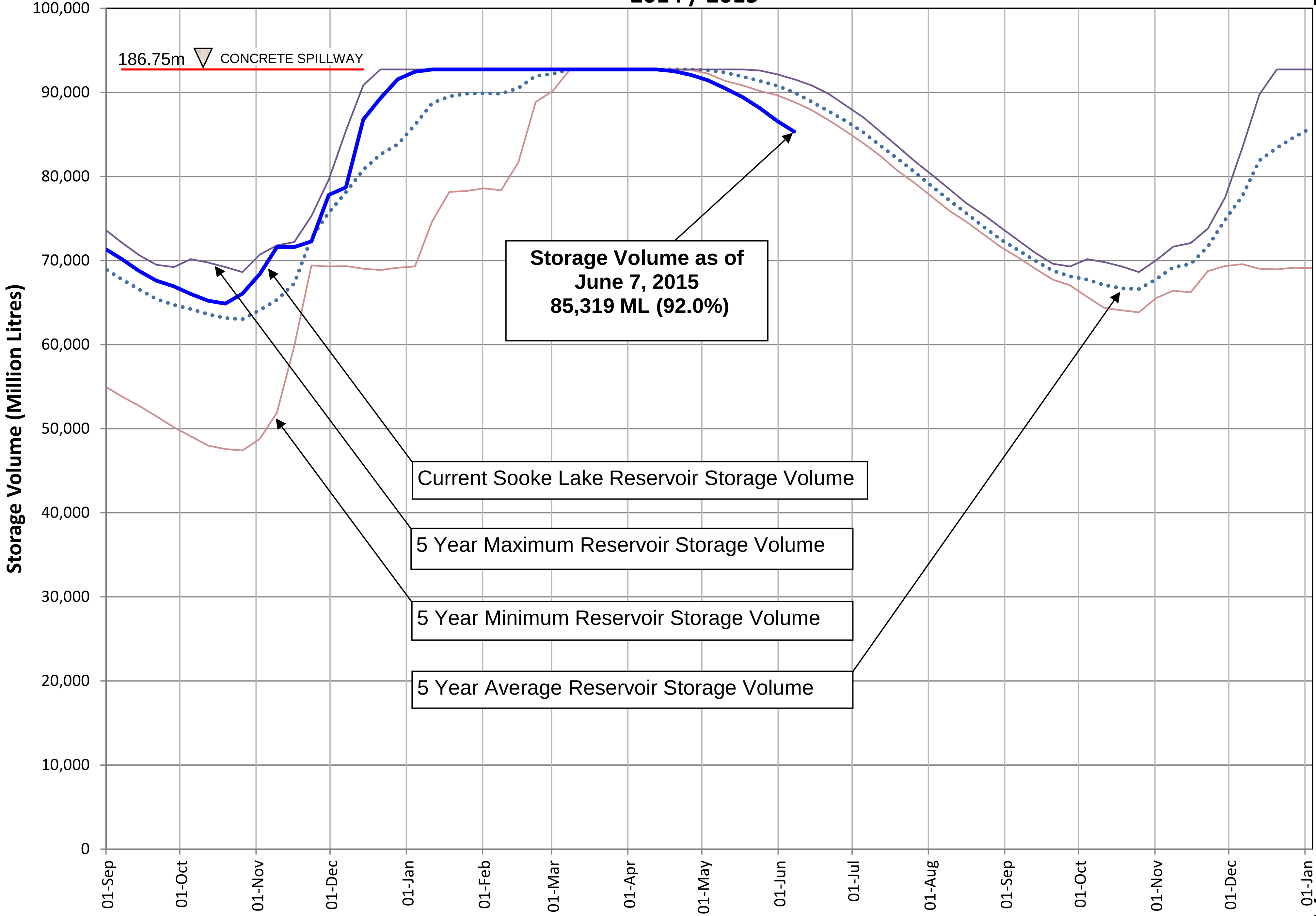
Average Rainfall for June (1914 - 2014)	35.9
Actual Rainfall: June	1.3
% of Average	4%
Average Rainfall (1914 - 2014): Sept 01 - Jun 07	1556.6
Actual Rainfall (2014 - 2015): Sept 01 - Jun 07	1420.5
% of Average	91%

Number days with precip. 0.2 or more
2

Note: 10% of Snow depth applied to rainfall figures for snow to water equivalent.

Water spilled at Sooke Reservoir to date = 6.51 Billion Imperial Gallons
= 29.60 Billion Litres

SOOKE LAKE RESERVOIR STORAGE SUMMARY
2014 / 2015



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