AGENDA
COUNCIL MEETING
MUNICIPAL DISTRICT OF PINCHER CREEK NO. 9
October 24, 2023
6:00 pm
Council Chambers

A. ADOPTION OF AGENDA

B. DELEGATIONS

C. MINUTES/NOTES

1. Committee Meeting Minutes
   - October 10, 2023
2. Council Meeting Minutes
   - October 10, 2023
3. Special Council Meeting Minutes
   - October 12, 2023

D. UNFINISHED BUSINESS

E. BUSINESS ARISING FROM THE MINUTES

a) Evolugen - Sunrise Solar Project

F. COMMITTEE REPORTS / DIVISIONAL CONCERNS

1. Councillor Tony Bruder – Division 1
   - ORRSC Board Minutes June 2023
2. Reeve Rick Lemire – Division 2
3. Councillor Dave Cox– Division 3
4. Councillor Harold Hollingshead - Division 4
5. Councillor John MacGarva – Division 5

G. ADMINISTRATION REPORTS

1. Operations

a) Public Works Operations Report
   - Report from Public Works dated October 19, 2023
   - Public Works Call Log

b) Utilities & Infrastructure Report
   - Report from Public Works/Administration dated October 17, 2023

c) Terriault & Fish Lake Dam Studies
   - Report from Utilities & Infrastructure dated October 13, 2023

2. Finance

3. Planning and Community Services

a) Road Closure Bylaw 1339-22 2nd & 3rd Reading
   - Report from Development, dated October 18, 2023

4. Municipal

a) Chief Administrative Officer Report
   - Report from CAO, dated October 18, 2023

H. CORRESPONDENCE

1. For Action

a) Royal Canadian Legion Request
   - Letter of request dated October 5, 2023

2. For Information

a) CPR Holiday Train - MD of Pincher Creek

- December 12, 2023 10:45 to 11:15 am

b) Climate and Land Use Alliance (CALUA) Meeting
- MD Chambers Monday October 30, 2023 at 4:00 pm

c) Irrigators Warned to Plan for Shortages
- Article Regarding Oldman Dam Water Levels, Western Producer

I. NEW BUSINESS

J. CLOSED MEETING SESSION

K. ADJOURNMENT

MINUTES
REGULAR COUNCIL COMMITTEE MEETING
MUNICIPAL DISTRICT OF PINCHER CREEK NO. 9
Tuesday, October 10, 2023 2:00 pm
Council Chambers

Present: Reeve Rick Lemire, Deputy Reeve Tony Bruder, and Councillors Dave Cox, John MacGarva and Harold Hollingshead.

Staff: CAO Roland Milligan, Director of Finance Meghan Dobie, Utilities & Infrastructure Manager David Desabrais, Public Works Manager Patrick Gauvreau, Development Officer Laura McKinnon, Municipal Energy Project Lead Tristan Walker, Financial Manager Brendan Schlossberger and Executive Assistant Jessica McClelland.

Reeve Rick Lemire called the meeting to order, the time being 2:00 pm.

1. Approval of Agenda

Councillor Tony Bruder

Moved that the agenda for the October 10, 2023 Council Committee Meeting be approved as presented.

Carried

2. Delegations

a) Evolugen – Sunrise Solar Project Update

Mike Peters and Alexandre Pepin-Ross with Evolugen attended the meeting at this time to update Council on the progress since earlier engagement towards the Sunrise Solar Project.

The project is proposed to be located NW of Pincher Creek on 575 acres of privately owned land and is estimated to generate approximately 175 GWh of renewable electricity annually. Currently the AUC has a moratorium on new developments so Evolugen is unable to apply for a permit to move this project forward.

Evolugen continues to work with the feedback received from the open house as well as from the MD and Town. Mainly proximity to Town, viewscapes, location in urban fridge, loss of agricultural lands, reclamation plans and construction impacts.

Brett Wuth, Director of Disaster Emergency Management, attended the meeting at this time, the time being 2:25pm.

Mike Peters, Alexandre Pepin-Ross, Laura McKinnon, David Desabrais, and Tristan Walker left the meeting at this time, the time being 2:55 pm.

3. Closed Session

Councillor Dave Cox

Moved that Council move into closed session to discuss the following, the time being 2:58pm.

a) 2:30 pm to 3:00 pm - Draft PCREMO Budget – FOIP Sec. 23.1.a

Brett Wuth left the meeting at 3:33 pm.

b) Draft Policy – Procurement C-FIN-538 – FOIP 23.1.a

Councillor Tony Bruder

Moved that Council move out of closed session, the time being 4:35pm.

Carried

4. Asset Management Discussion

Financial Manager Brendan Schlossberger presented to Council Asset Management Costs and Funding.

Mainly:

- Outcomes
- Summary of Service Levels & Risk
- Understanding Costs & Funding
- Types of Costs & Funding
- Ensuring value for money
- Understanding Trade-offs
- Asset Management in our Community
- Current Status of Asset Management

Brendan Schlossberger left the meeting at this time, the time being 5:01 pm.

5. Water Situation Update

Utilities & Infrastructure Manager David Desabrais presented the updated water situation information.

6. Round Table

7. Adjournment

Councillor Dave Cox

Moved that the Committee Meeting adjourn, the time being 5:59 pm.

Carried

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REEVE

_____
CHIEF ADMINISTRATIVE OFFICER

MINUTES
MUNICIPAL DISTRICT OF PINCHER CREEK NO. 9
REGULAR COUNCIL MEETING
OCTOBER 10, 2023

The Regular Meeting of Council of the Municipal District of Pincher Creek No. 9 was held on Tuesday, October 10, 2023 at 6:00 pm, in the Council Chambers of the Municipal District Administration Building, Pincher Creek, Alberta.

PRESENT Reeve Rick Lemire, Deputy Reeve Tony Bruder, and Councillors Dave Cox, Harold Hollingshead and John MacGarva.

STAFF CAO Roland Milligan, Director of Finance Meghan Dobie, Utilities & Infrastructure Manager David Desabrais, Public Works Manager Patrick Gauvreau, Development Officer Laura McKinnon, and Executive Assistant Jessica McClelland.

Reeve Rick Lemire called the meeting to order at 6:00 pm.

A. ADOPTION OF AGENDA

Councillor Dave Cox 23/395

Moved that the Council Agenda for October 10, 2023 be amended to include:

Finance:

a) Policy C-FIN-538 Procurement

AND THAT the agenda be approved as amended.

Carried

B. DELEGATIONS

C. MINUTES

1) Council Committee Meeting Minutes - September 26, 2023

Councillor John MacGarva 23/396

Moved that the minutes of the Council Committee Meeting of September 26, 2023 be approved as presented.

Carried

2) Council Meeting Minutes - September 26, 2023

Councillor Tony Bruder 23/397

Moved that the minutes of the Council Meeting of September 26, 2023 be approved as presented.

Carried

D. UNFINISHED BUSINESS

E. BUSINESS ARISING FROM THE MINUTES

F. COMMITTEE REPORTS / DIVISIONAL CONCERNS

1. Councillor Tony Bruder – Division 1
   - ORRSC – Liquor and Land Use
   - Waterton Biosphere Newsletter September
2. Reeve Rick Lemire – Division 2
   - Alberta Southwest
3. Councillor Dave Cox– Division 3
   - Beaver Mines Community Association
4. Councillor Harold Hollingshead - Division 4
   - Concern regarding road North of Pincher Station

5. Councillor John MacGarva – Division 5
   - Concerns on water

Councillor Tony Bruder 23/398

Moved to accept the Committee Reports as information.

Carried

G. ADMINISTRATION REPORTS

1. Operations

a) Public Works Operations Report

Councillor Tony Bruder 23/399

Moved that Council receive the Public Works Operations Report, including the call log, for the period September 21, 2023 to October 4, 2023 as information.

Carried

b) Utilities & Infrastructure Report

Councillor Dave Cox 23/400

Moved that Council receive the Utilities & Infrastructure Report for the period September 20, 2023 to October 4, 2023 as information.

Carried

2. Finance

a) Asset Retirement Obligation

Councillor Tony Bruder 23/401

Moved that Council approve $30,000 from the tax rate stabilization reserve, to hire a consultant to be responsible for providing the appropriate Asset Retirement Obligation (ARO) estimates to be used at year-end.

Carried

b) Draft Policy – Procurement C-FIN-538

Councillor Dave Cox 23/402

Moved that Council approve policy C-FIN-538 Procurement, as amended,

AND THAT the policy be reviewed in October 2024.

Carried

David Desabrais left the meeting at this time, the time being 7:12 pm.

3. Development and Community Services

4. Municipal

a) Chief Administrative Officer Report

Councillor Dave Cox 23/403

Moved that Council receive for information, the Chief Administrative Officer's report for the period of September 22, 2023 to October 4, 2023.

Carried

H. CORRESPONDENCE

1. For Action

a) Regional District of East Kootenay/SW Alberta Elected Officials Meeting

Councillor Tony Bruder 23/404

Moved that any interested Councillor be authorized to attend the Regional District of East Kootenay/SW Alberta Elected Officials Meeting on October 25, 2023.

Carried

b) RMA Request for Meeting – RCMP

Direct administration to discuss current crime issues in the MD with the local detachment, as well to invite rural crime watch to the next Coffee with Council.

Patrick Gauvreau left the meeting at this time, the time being 7:26 pm.

2. For Information

Letter to AUC

Councillor Dave Cox 23/405

Moved that administration draft a letter to the AUC regarding a change in date for the November 8, 2023 meetings in Pincher Creek with the AUC Engagement for Electricity Development, stating that Council will be at RMA that week,

AND THAT should the dates not change for the meeting, Councillor Harold Hollingshead be authorized to attend.

Carried

I. NEW BUSINESS

J. CLOSED SESSION

Councillor John MacGarva 23/406

Moved that Council move into closed session to discuss the following, the time being 7:33 pm.

a) Eco Centre Funding – FOIP Sec. 16.1.a.ii
b) Upper Rock Creek Road Re-Alignment – FOIP Sec. 24.1.a

Meghan Dobie left the meeting at this time, the time being 7:51 pm.

Councillor Harold Hollingshead 23/407

Moved that Council move out of closed session, the time being 8:05 pm.

Carried

a) Eco Centre Funding

Councillor Dave Cox 23/408

Moved that Council approve a 2.5% increase for the 2024 budget year for the Pincher Creek and Crowsnest Landfill Association (Pincher Creek Eco Centre),

AND THAT this item be referred to the next Joint Council meeting with the Town of Pincher Creek for further discussion.

Carried

b) Upper Rock Creek Road Re-Alignment

Councillor Tony Bruder 23/409

Moved that Council direct administration to approach both landowners with potential offers, as discussed, and proceed with road allowance closure process for portion between NE 31-7-2 W5M and SE 6-8-2 W5M.

Carried

K. ADJOURNMENT

Councillor Harold Hollingshead 23/410

Moved that Council adjourn the meeting, the time being 8:06 pm.

Carried

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REEVE

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CHIEF ADMINISTRATIVE OFFICER

MINUTES
MUNICIPAL DISTRICT OF PINCHER CREEK NO. 9
SPECIAL COUNCIL MEETING
OCTOBER 12, 2023

The Special Meeting of Council of the Municipal District of Pincher Creek No. 9 was held on Thursday October 12, 2023 in the MD of Pincher Creek Council Chambers.

Notice of this Special Council Meeting was posted on the MD website and social media.

PRESENT Reeve Rick Lemire, Deputy Reeve Tony Bruder, and Councillors Dave Cox, Harold Hollingshead and John MacGarva.

STAFF CAO Roland Milligan, Director of Finance Meghan Dobie, and Finance Manager Brendan Schlossberger.

Reeve Rick Lemire called the meeting to order at 1:30 pm.

A. ADOPTION OF AGENDA

Councillor Dave Cox 23/411

Moved that the Council Agenda for October 12, 2023 be approved as presented.

Carried

B. CLOSED SESSION

Councillor John MacGarva 23/412

Moved that Council move into closed session to discuss the following, the time being 1:31 pm:

a) Draft Capital Budget – FOIP Sec. 24.1.a

Councillor Dave Cox 23/413

Moved that Council move out of closed session, the time being 5:00 pm.

Carried

C. ADJOURNMENT

Councillor Harold Hollingshead 23/414

Moved that Council adjourn the meeting, the time being 5:01 pm.

Carried

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REEVE

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CHIEF ADMINISTRATIVE OFFICER

OLDMAN RIVER REGIONAL SERVICES COMMISSION

BOARD OF DIRECTORS' MEETING MINUTES

Thursday, June 1, 2023 – 7:00 p.m.

ORRSC Conference Room (3105 - 16 Avenue North, Lethbridge) or ZOOM Virtual Meeting

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BOARD OF DIRECTORS:

Colin Bexte (Virtual).....Village of Arrowwood
Kent Bullock (Absent) ..... Village of Barnwell
Dan Doell (Absent)..... Village of Barons
Mike Wetzstein (In Person) ..... Town of Bassano
Ray Juska (In Person) ..... City of Brooks
Roger Houghton (In Person) ..... Cardston County
Allan Burton (In Person) .....Town of Cardston
Sue Dahl (In Person) ..... Village of Carmangay
James F. Smith (Absent) ..... Village of Champion
Brad Schlossberger (In Person)..... Town of Claresholm
Jesse Potrie (In Person) .....Town of Coalhurst
Tanya Smith (In Person)..... Village of Coutts
Dave Slingerland (Absent) .....Village of Cowley
Dave Filipuzzi (Virtual) ..... Mun. Crowsnest Pass
Dean Ward (Virtual)..... Mun. Crowsnest Pass
Stephen Dortch (Absent) ..... Village of Duchess
Gordon Wolstenholme (In Person)Town of Fort Macleod
Mark Peterson (In Person)..... Village of Glenwood
Suzanne French (Absent)..... Village of Hill Spring
Morris Zeinstra (Absent) .....Lethbridge County
Brad Koch (Absent) ..... Village of Lomond
Gerry Baril (In Person) ..... Town of Magrath
Peggy Losey (In Person) ..... Town of Milk River
Dean Melnyk (Virtual)..... Village of Milo
Victor Czop (Virtual)..... Town of Nanton
Marinus de Leeuw (Absent).....Town of Nobleford
Teresa Feist (In Person) .....Town of Picture Butte
Tony Bruder (In Person)..... M.D. of Pincher Creek
Don Anderberg (In Person)..... Town Pincher Creek
Ronald Davis (Absent)..... M.D. of Ranchland
Neil Sieben (In Person).....Town of Raymond
Don Norby (Absent) .....Town of Stavely
Matthew Foss (Absent)..... Village of Stirling
John DeGroot (In Person) ..... MD of Taber
Raymond Coad (Absent) ..... Town of Vauxhall
Christopher Northcott (In Person).....Vulcan County
Richard DeBolt (In Person) ..... Town of Vulcan
David Cody (In Person)..... County of Warner
Marty Kirby (Absent)..... Village of Warner
Evan Berger (Absent) ..... M.D. Willow Creek

STAFF:

Bonnie Brunner ..... Senior Planner
Mike Burla ..... Senior Planner
Ryan Dyck ..... Planner
Carlin Groves .....CAD/GIS Technologist
Steve Harty ..... Senior Planner
Diane Horvath ..... Senior Planner
Raeanne Keer .....Executive Assistant
Maxwell Kelly ..... Planner
Lenze Kuiper .....Chief Administrative Officer
Jennifer Maxwell ..... Subdivision Technician
Kattie Schlamp..... Planner
Tristan Scholten.....Intern Planner
Gavin Scott ..... Senior Planner
Jack Shipton..... Planner

Chair Gordon Wolstenholme called the meeting to order at 7:00 pm.

1. APPROVAL OF AGENDA

Moved by: Richard DeBolt

THAT the Board adopts the Agenda for June 1, 2023, as presented.

CARRIED

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2. APPROVAL OF MINUTES

Moved by: Peggy Losey

THAT the Board approves the meeting minutes of March 2, 2023, as presented.

CARRIED

3. BUSINESS ARISING FROM THE MINUTES

There was no business arising from the minutes.

4. PRESENTATION

a. 2022 Financial Statements & Auditor's Report – Derek Taylor, KMPG LLP

Derek Taylor, of KMPG LLP, presented the 2022 Financial Statements and Auditor's Report to the Board.

5. REPORTS

a. 2022 Annual Report

- **Financial Performance Presentation**

L. Kuiper, Chief Administrative Officer, presented the 2022 Annual Report and Financial Performance to the Board.

Moved by: Gerry Baril

THAT the Board of Directors have reviewed and ratified the Executive Committee Approval of the ORRSC Annual Report and Financial Statements for the Year ending December 31, 2022.

CARRIED

b. Executive Committee Report

Chair Wolstenholme presented the Executive Committee Report to the Board.

6. BUSINESS

a. Staffing Update

L. Kuiper introduced Jack Shipton, Planner, and Tristan Scholten, Intern Planner, to the Board as new staff to ORRSC.

L. Kuiper also noted that Kattie Schlamp and Maxwell Kelly have both been promoted from Assistant Planner to Planner.

b. Subdivision Activity
- **As of April 30, 2023**

L. Kuiper presented the Subdivision Activity statistics as of April 30, 2023 to the Board.

c. ORRSC Periodical – Temporary Uses

G. Scott, Senior Planner, presented information on the upcoming ORRSC Periodical topic, Temporary Uses.

7. ACCOUNTS

a. Balance Sheet and Comparative Income Statement
- **As of April 30, 2023**

L. Kuiper presented the Balance Sheet and Comparative Income Statements as of April 30, 2023.

Moved by: Roger Houghton

THAT the Board approves Balance Sheet and Comparative Income State, as of April 30, 2023, as presented.

CARRIED

8. NEXT MEETING – Thursday, September 7, 2023

9. ADJOURNMENT

With no further questions and nothing further to discuss, Chair Gordon Wolstenholme adjourned the meeting, the time being 7:40pm.

Gordon Wolstenholme, Chair

Lenze Kuiper, Chief Administrative Officer

Recommendation to Council

TITLE: PUBLIC WORK OPERATIONAL REPORT	
PREPARED BY: PATRICK GAUVREAU	DATE: OCTOBER 19, 2023
DEPARTMENT: PUBLIC WORKS	
Department Supervisor	October 19, 2023 (Date)
	ATTACHMENTS: 1. Call Log – Updated 10/19/23

APPROVALS:

Department Director	Date	CAO	Date
	October 19, 2023		

RECOMMENDATION:

THAT Council, accept the Public Works Operational report for the period of October 5, 2023 to October 19, 2023 as information.

BACKGROUND:

<u>PUBLIC WORKS OPERATIONS FROM OCTOBER 5, 2023 TO OCTOBER 19, 2023</u>:

FLEET/MECHANICS SHOP
Unit 430 (HVAC wiring repair and waiting on parts still)
Unit 501 (operator complaint of nasty smell) replaced blower motor and filter.
Unit 17 (CVIP) brake replacement and misc fixes
Unit 669 service and MRF module T/S
Unit 65 snow wing and Coolant heater install (wabasto)
Unit 04 (end of season inspection and winter ready up)
AES chute repairs

IN FIELD OPERATIONS
2 grader mowers running whenever possible (out a couple days a week)
Grader operators giving special attention to school bus routes
6 graders out on average
Snow Fencing Installation
Winterized Patton Irrigation System

Recommendation to Council

Other Misc:
Cattleguards for Bruce Mowat / Ed Kapala were installed on the Cabin Creek Rd. on October 18, 2023. Bruce and Ed are happy with the work.

FINANCIAL IMPLICATIONS:
None

REQUEST ID NUMBER	DIVISION	CONCERN/REQUEST	REQUEST DATE	ACTION TAKEN	FOLLOW UP	COMPLETION DATE
2023-157	Division 1	Would like the road graveled. West section of Mitchell Road. By Island lake. If gated is locked call-	July 13, 2023	Scheduled for later date	To be inspected	
2023-167		Access off highway road need to be graded to bottom of hill	July 31, 2023	To be actioned	Question on who owns road.	
2023-179	Division 3	Purchased gravel from us, and wasn't home when delivered. would like gravel leveled out , and spread around evenly.	August 15, 2023	To be actioned		
2023-180	Division 2	increased traffic from new arena and bus route, intersection is becoming dangerous and worried about collisions would like yield too a stop sign. PW already came to look at intersection last November and placed markers for signs. Resident under impression that the signs were getting switched?	August 15, 2023	Not actionable		October 18, 2023
2023-190	Division 3	spoke with someone last winter about getting bushes cut down as they are creating a large drift. And was told it would be done before next winter. And want to confirm snow fence on lynx creek road.	August 28, 2023	Completed	Brush Cut	October 17, 2023
2023-192	Division 3	Lundbreck Mobile park green space has lots of damage from MD's heavy equipment on the soft ground and now they are unable to mow the grass. Hoping to get it fixed, she will be sending the pictures to Patrick's email. You can contact her, or her husband 627-6778(Ken)	August 28, 2023	To be actioned	David - Contact Contractor	
2023-208	Division 3	Our grader hit his sign a while back so he called and ordered a sign from us 2-3 months ago. Wondering when it will be in.	September 7, 2023	Scheduled for later date	Sign is to be ordered by Development next round	
2023-214	Division 3	Grader broke 2 posts and a brace off last winter, and was told in June or July that it would be replaced, Just wondering when when it will be done. Cattle has been getting out. Right next to the bridge.	September 11, 2023	Completed	First Call in place - Temp Snow Fence Priority	October 12, 2023

REQUEST ID NUMBER	DIVISION	CONCERN/REQUEST	REQUEST DATE	ACTION TAKEN	FOLLOW UP	COMPLETION DATE
2023-220	Division 5	Monday someone came out to mow the roadside of the Villa Vega Acres subdivision but they forgot the lower part towards the river there are 5 houses on that part and they would greatly appreciate it if we could send someone out to finish it.	September 15, 2023	Completed	Mowing in Div 5 now	October 16, 2023
2023-221	Division 5	twp 7-2A would like Road graded and ditch mowed	September 18, 2023	Completed	Mowing in Div 5 now	October 16, 2023
2023-222	Division 5	PW was out and graded the road but forgot the bottom half (last 5 houses) wondering if they can come out an finish it.	September 19, 2023	Completed	Next time PW in Area - too dry last time	October 6, 2023
2023-225	Division 5	ditches got missed on willow valley road they only mowed tot the school house wondering if it will be finished? If not please give him a call as he'd like to know why.	September 19, 2023	Completed	Mowing in Div 5 now	October 11, 2023
2023-231	Division 5	Twp 8-0 Wondering if it will be getting mowed	September 22, 2023	Completed	Mowing in Div 5 now	October 11, 2023
2023-234	Division 5	would like MD ditches mowed near there property	September 27, 2023	Completed	Mowing in Div 5 now	October 11, 2023
2023-235	Division 5	Driveway Grading	September 27, 2023	To be actioned	PW to check	
2023-237	Division 3	Twp 6-5 would like Road Graded, first mile is bad second mile even worse	October 3, 2023	Completed	PW informed	October 18, 2023
2023-239	Division 2	Could we please get some gravel on the hill Grading like last time it was called in my another resident isn't enough. There is no gravel left and it's just a muddy rutted up road when we get moisture.	October 3, 2023	To be actioned	Week of 23rd	
2023-242	Division 2	No Thru Road sign missing	October 4, 2023	Completed		October 13, 2023
2023-243	Division 4	Wondering about grader and gravel in sub division	October 4, 2023	Completed	PW Informed - to Inspect	October 12, 2023
2023-244	Division 3	RR 6-5 on the 507 West would like road graded as its in rough condition.	October 6, 2023	Completed		October 18, 2023

REQUEST ID NUMBER	DIVISION	CONCERN/REQUEST	REQUEST DATE	ACTION TAKEN	FOLLOW UP	COMPLETION DATE
2023-245	Division 1	Driveway grading.	October 10, 2023	To be actioned		
2023-246	Division 3	The road failed after the resufacing, and with the winter coming, he is worried about what its going to be like once the snow hits. Has no gravel on it.	October 10, 2023	Not actionable	Concerns noted	
2023-247	Division 3	Was told by PW he was getting a snow fence this year but the MD came to do the neighbours about 3 weeks ago and he still hasn't gotten his.	October 10, 2023	Not actionable	Fence placed where operator deemed better. We don't do snowfence for private road	
2023-248	Division 5	North Burmis Road is dangerous, she went 45km, hit the washboard and almost went off the road	October 10, 2023	Completed	Being Actioned	October 17, 2023
2023-249	Division 5	North Burmis road is washboarded badly and needs to be attended too.	October 10, 2023	Completed	Being Actioned	October 17, 2023
2023-250	Division 4	Driveway grading, Sent in form a while back just following up, I informed them that the guys are getting road ready for winter and will get to them as they have a chance. RR 30-1	October 10, 2023	Completed	To be inspected	October 17, 2023
2023-251	Division 4	Driveway Grading	October 11, 2023	Completed		October 17, 2023
2023-252	Division 3	Road off 774 into castle forestry reserve, Goes down castle bring to catle falls camegroung overtop of the ohagen into moss ceek lynx creek. Road by the bridge is terrible. Wrecking the vehicles. Pot hole and washboarding is horrible.	October 11, 2023	Not actionable	Alberta Parks	October 17, 2023
2023-253	Division 3	past the airpot to old lundbreck highway, and landfill road washboard really bad. almost rolled her truck the otherday.	October 12, 2023	Completed		October 17, 2023
2023-254	Division 3	Ditch needs to be cut north of the landfill, new renters going in for novermber and kids will be on the bus worried about drifting.	October 12, 2023	To be actioned		
2023-255	Division 3	wondering if ditches will be cut at north of the landfill. Worried about drifting an deer hiding in the long grass	October 12, 2023	To be actioned		

REQUEST ID NUMBER	DIVISION	CONCERN/REQUEST	REQUEST DATE	ACTION TAKEN	FOLLOW UP	COMPLETION DATE
2023-256	Division 3	RR15 north of landfill, hoping to get graded as its really wasboarded, 70 going into town is nasty as well.	October 12, 2023	Completed		October 16, 2023
2023-257	Division 5	The North Burmis road is really bad, he hasn't seen a grader the whole year. He has never seen the roads in this horrible of condition before. TC Energy ruined the whole road and its nothing but mud and potholes now.	October 12, 2023	Completed	Being Actioned	October 17, 2023
2023-258	Division 3	Snowfence Needs Repair	October 13, 2023	To be actioned		
2023-259	Division 3	Washboard	October 13, 2023	Completed	PW aware	October 17, 2023
2023-260	Division 3	Driveway Grading	October 13, 2023	To be actioned	To be done when caught up	
2023-261	Division 3	Hoping to get driveway graded, been on the list a while as there was a mixup with his previous property	October 13, 2023	To be actioned	To be done when caught up	
2023-262	Division 3	Driveway grading	October 16, 2023	To be actioned	To be done when caught up	
2023-263	Division 3	twp 5-4 from highway 6, cemitary west hill by Sorge's is washboarded bad, Can we cut below the washboard.	October 16, 2023	To be actioned		
2023-264	Division 5	talked to someone last year regarding snow fence in Burmis Mountain Estates - by Hiawatha Campground. Just following up if someone could give him a call.	October 16, 2023	To be actioned		
2023-265	Division 4	785 they put a special treatment on road 4-5 years ago and its starting to break down and there is pretty bad holes that need to be filled. Going up the river hill. About 5 big holes	October 16, 2023	Not actionable	Alberta Transport?	
2023-266	Division 2	Driveway Grading	October 16, 2023	To be actioned	To be done when caught up	

REQUEST ID NUMBER	DIVISION	CONCERN/REQUEST	REQUEST DATE	ACTION TAKEN	FOLLOW UP	COMPLETION DATE
2023-267		MD ditch needs mowing before snowfall, or drifts will start.	October 17, 2023	To be actioned	Mowing in Div 5 now	
2023-268		top of the hill, grading is not cutting it, it also needs gravel, after the moisture it is a rutted out mess again	October 17, 2023	To be actioned		
2023-269	Division 3	Christie Mines road has turned to mush again with the bit or rain weve had, worried about the upcoming winter moisture.	October 17, 2023	To be actioned	To be gravelled and graded	
2023-270	Division 4	called back to give me correct road. RR 29-1 Near the summer view feedlot. they put a speacial tratment on road 4-5 years ago and its starting to break down and there is pretty bad holes that need to be filled. Going up the river hill. About 5 big holes	October 17, 2023	Scheduled for later date	Need to be addressed 2024	
2023-271		would like ditch mowed before winter (doesn't know exact road) the road to the pumphouse and the booster station for the water line that goes to beavermines.	October 17, 2023	To be actioned	Mowing in Div 5 now	
2023-272		Thank you for Grading the North Burmis Road	October 17, 2023	Completed		October 17, 2023
2023-273	Division 5	Need mowing at 36 VillaVega Twp7-2Turn left down the hill its still public road, 5 houses down at the bottom	October 18, 2023	Completed	Mowing in Div 5 now	
2023-274	Division 2	Alberta ranch road between mackenzies and Larsons, washboarded really bad on the top of the hill.	October 18, 2023	To be actioned		
2023-275		Pincher standpipe the upper water hose has 2 hooks, 1 is bent and has been for a while if we can get fix, as hose keeps falling off	October 18, 2023	To be actioned	Inspected	

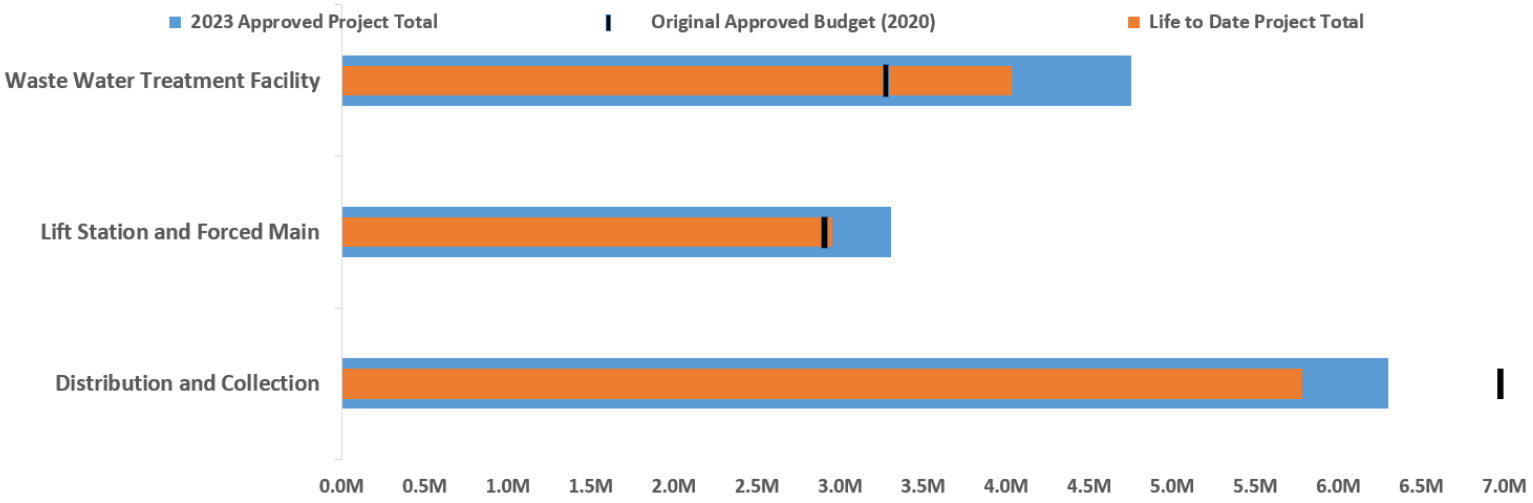
M.D. OF PINCHER CREEK NO. 9

UTILITIES & INFRASTRUCTURE REPORT

BEAVER MINES

Spend as of October 17th: $12,773,111 / $14,359,848 (89%)

October 17th (no change from previous):



- **Beaver Mines Water Distribution, Collection System**
  - Tender was awarded to BYZ on July 21, 2021.
    1. BYZ Enterprises Inc. **$5,468,977.50 (Budget $6,251,600)**
  - U/G Schedule A & B Completion May 31st, 2023 (excluding additional service work)
  - Final walkthrough completed August 1st, 2023. Total completion was requested based on a July 21st completion date, with minor deficiencies to be addressed under holdback
    - Completion date request under review
    - Awaiting formal sign off for total completion
  - Projecting final costs to be within current budget
  - Working to closeout contractual duties related to landowner ROW agreements and remaining related costs

- **Beaver Mines Waste Facility/System**
  - Tender was awarded to BYZ on May 31, 2022
    BYZ Enterprises **$2,338,309.00 (Original Budget $2,076,999)**
  - Lagoon cells base civil work complete, liner installed. Significant deficiencies related to liner installation have been noted, which is resulting in a delay of initial fill and commissioning of lagoon system
  - Site works 95% complete. Final site works continue. Groundwater monitoring well deficiencies remain
  - Collection system is now connected to wastewater site via lift station
    - Fencing and final civil/cleanup work ongoing
  - Anticipate substantial completion of construction end of October, 2023

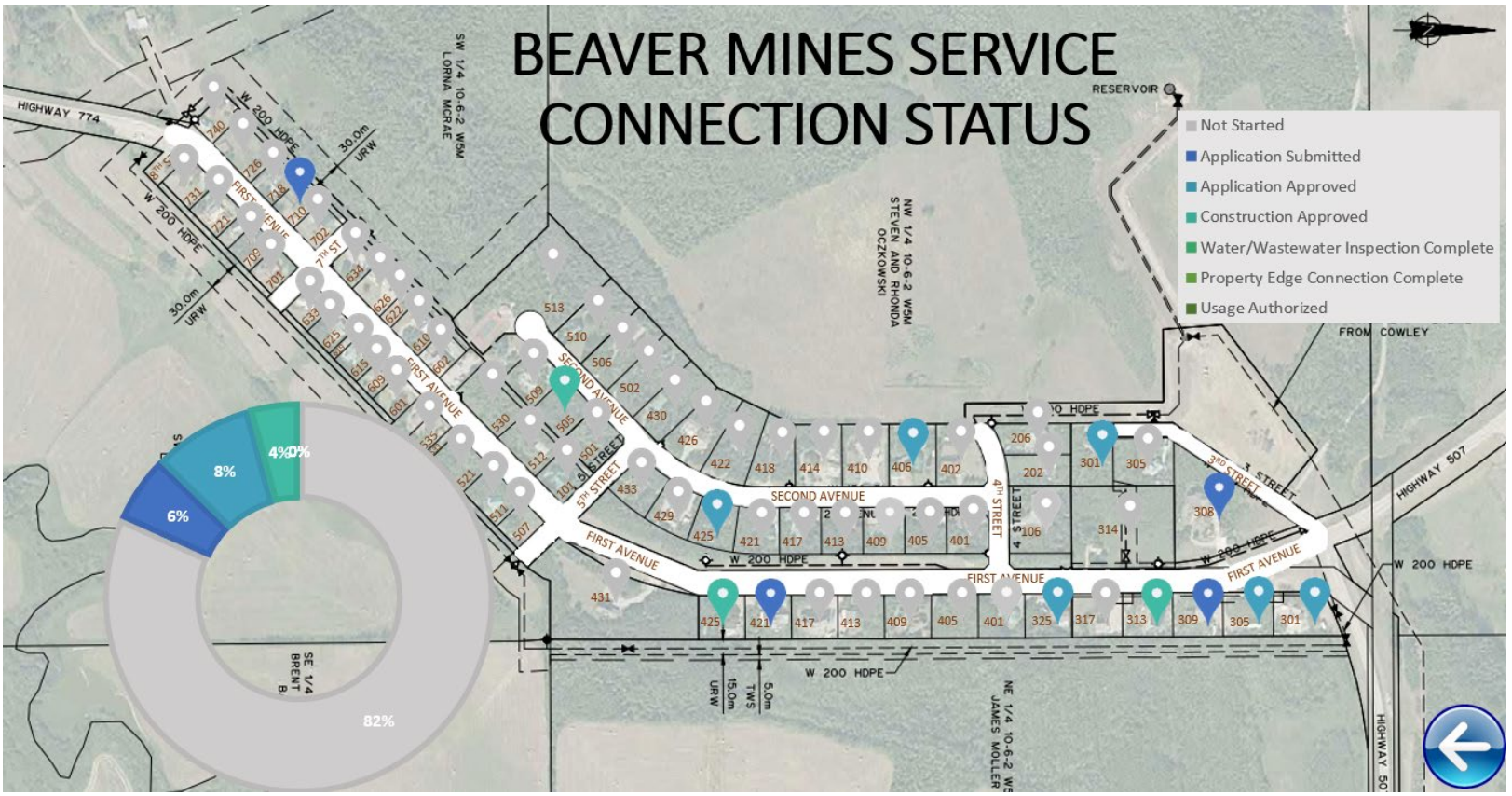
- **Beaver Mines Forcemain & Lift Station**
  - Tender was awarded to Parcon for Lift Station June 15th **$2,326,091 (Original Budget: $2,220,000)**
  - Construction awarded to low bidder for forcemain work:
    - TA Excavating: **$386,925 (Eng. Est. $600,000)**
  - Long lead generator and electrical control center identified as major point of supply chain delay that has potential for substantial delay. Working with contractor and engineering firm to mitigate this issue
    - Substantial completion is now June 30th, 2023 (up and running date), total completion (permanent MCC/generator installed) Nov. 30th, 2023
  - Forcemain complete
  - Site is conveying flow to wastewater site. Substantial completion excluding permanent MCC/generator installation complete

Appeal was dropped July 11th, 2023 and the file was officially closed by the Alberta Environmental Appeals Board July 14th, 2023.

Current Water Operations Activity

Ongoing Water Supply Issues

- **Issued a Stage 3 water restriction August 16th, 2023**
  - **Updates being sent weekly to Council regarding temporary and permanent solutions**
- Beaver Mines Lot Servicing Utility Services Guidelines released May 30th, 2023. 6 general and 2 plumbing contractor prequalified to date. Application process open to residents
  - 13 applications reviewed, 9 fully approved

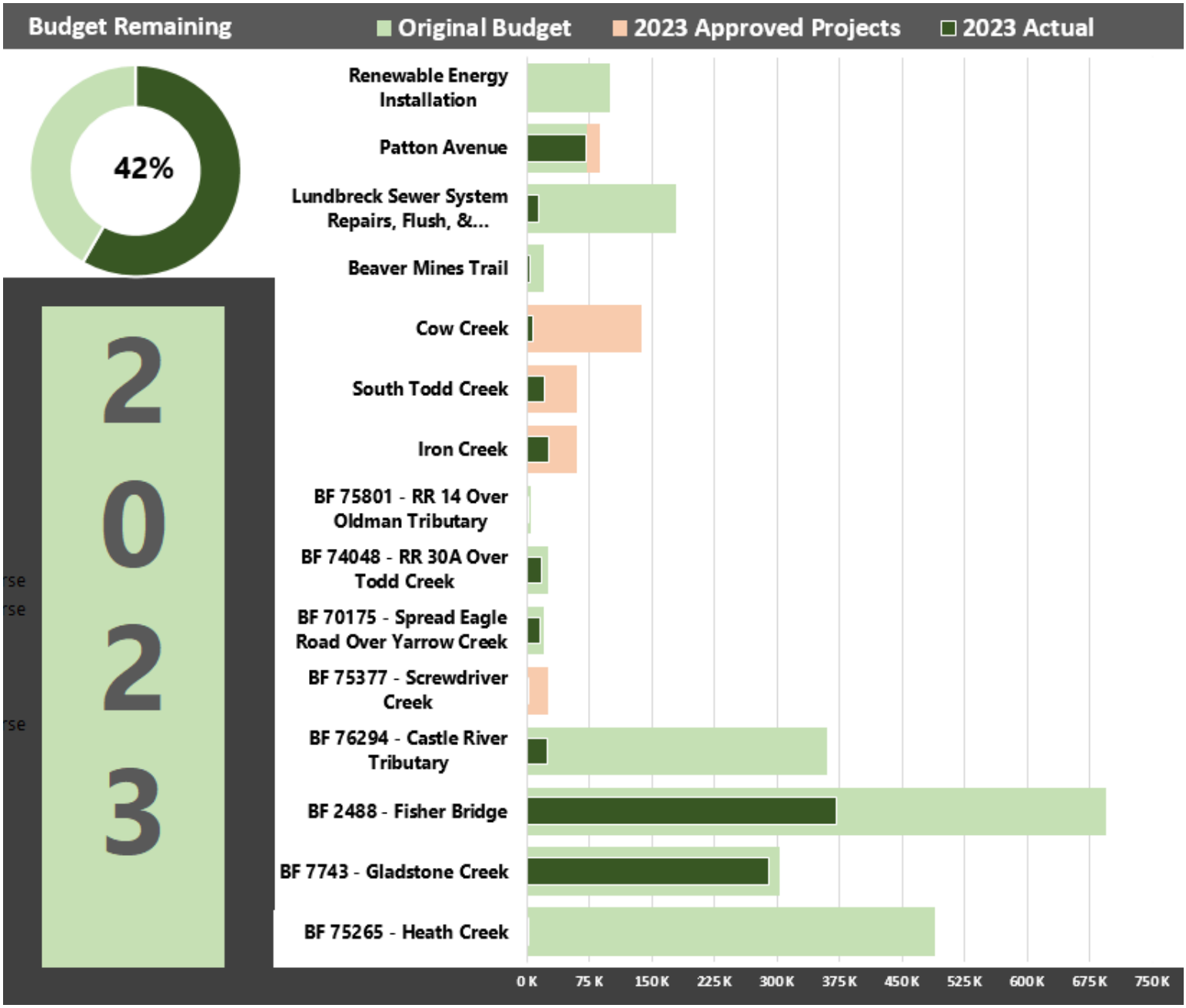


  - Official release to tie-in starting October 6th releases to residents with mandatory connection required by Jan 1, 2028
  - Anticipate first connections by Council meeting
- Hydrant flow testing in BM was completed by PCES and passed for fire flow. PCES is updating the Fire Underwriters Survey with the MD's assistance

- **Standpipes**
  - PC Standpipe coin acceptor sent for warranty replacement. BM coin acceptor moved to PC for time being. Fixed part received and installed July 26th, 2023. Spare ordered for coin acceptor
  - Last known issue: June 2023

Large Capital and Other Projects

Total Approved Budget: $3,559,000. Spend as of October 17th, 2023: $1,800,481



Airport Lighting – *Design 2022, Construction 2023*

Install Airport Airfield Lighting Replacement, with portion of funds from STIP

- Design-build contract awarded to Black & McDonald **(Cost: $979,600, Original Budget: $867,000). Revised Contract: $1,016,435 + line removal/paint**
- Generator installation will be completed after Aug 1, 2023 due to long lead delivery
- Deficiency walkthrough complete June 28th, 2023. Partial completion for entire scope excluding generator install has been executed
    - Request for substantial completion (excluding generator) officially received September 5th (June 30th completion). Granted
- Approached by an AI drone company to capture images of our new painting for free as part of their data gathering/algorithm improvement. Anticipate drone flight week of October 16th
- Anticipate completion by end of month

Lundbreck Sewer System Repairs – *Design/Construction 2023*

Repair of 3 sewer main locations within the Hamlet of Lundbreck

- Construction complete

Lundbreck Lagoon Resiliency Analysis & Regionalization – *Engineering 2023*

Review Lagoons ability to take on more flow (both regular and high strength). Review Cowley Lagoons ability to do the same, and options for regionalization

- ACP Grant submitted in 2022, will not hear back until March/April 2023. Notice of successful grant received March 21st, 2023. Expanding scope to include Cowley
- Kickoff meeting held March 6th, 2023. Anticipate starting analysis work and investigations throughout April
- Reached out to brewery April 4th to arrange sampling. Sampling complete May 11th at lagoon and brewery 2023.
    - Continued delays with metering device. Plan to draft report with assumed flows and update once flow monitoring device arrives
    - Draft report for Lundbreck phase of project received from MPE with assumed flows, initial review complete. Awaiting MPE response. Will not be able to confirm actual flows until Spring 2024
- Sampling results received and sent to brewery for reference

Beaver Mines Trail – *Design/Construction 2023*

Phase 1 design along HWY between 5th and 4th street and potential construction (if funds are available)

- Construction of pathway complete, with exception of signage and benched area

Therriault Dam – Geotechnical & Misc. Studies – *Engineering 2023*

Address high priority deficiencies for the Therriault Dam

- Agreement signed with SNC Lavalin for Geotechnical & Hydrotechnical Assessments for the damn Jan 11, 2023
- 2 of 2 finalized reports received
  - Therriault Dam has deficiencies that should be monitored and addressed

Energy Projects

MD Estimated Annual Energy Savings: ***$22,667***
MD Achieved Annual Savings:* ***$26,287***
MD Funding Secured (Total): ***$240,094***
**Based on utility bill review adjusted cost savings and the ICF agreement framework. This number is expected to rise as projects completed within the last year haven't seen a full year of savings.*

- **General Updates**
  - Change thermostats to winter schedule
  - Lebel mansion windows grant approved July 25, 2023
    - Project on hold until directive received from Town
  - Arena and MPF retrofit
    - Community Building Retrofit grant pre-application submitted for 25% of Arena upgrades March 3, 2023
    - Full application submitted August 28, 2023
  - Received confirmation of $22,080 for Electrical Tracking System at the Multipurpose facility
    - Installation scheduled for October 20, 2023
  - Grant received from Lethbridge Community Foundation for $5,000 to install offgrid equipment and remove the electrical service at the Lundbreck Welcome Sign
    - Annual savings projected to be $980-$1,100
    - Installation underway, expected completion October 25, 2023
  - QUEST net zero accelerator
    - Official kickoff Meeting September 28, 2023
  - Lebel solar project
    - To include a solar array and display inside to teach residents about the outputs of solar and the process for developing it
    - Received offer of $2,750 from Old Man 2 Wind Farm pending Council acceptance
    - $10,000 received from Lethbridge Community Foundation
    - $7,000 USD from Enel North America has been committed
      - Town has tabled project for review in August
      - Presented project update August 28, 2023 with education sample
      - Town has requested to revisit when grant funding news is received
  - Submitted expression of interest for Energy Futures Lab roadshow in 2024. Received letters of support from Matthew Halton high school, Fortis Alberta, Riteline Electric, Southwest Alberta Sustainable Communities Initiative, and Enel North America
    - Decision expected October 2023
    - Received acceptance, first planning meeting October 19, 2023

- MCCAC has indicated expected energy efficiency and solar funding is being reviewed at the Provincial level. High probability of efficiency funding, unsure on solar

- **EV Chargers**
  - All closeouts submitted September 18, expect payment March 2024 from Federal program
  - Castle and Town expected to send invoice to receive Enel funding distribution

- **Eco-centre Solar Installation**
  - Complete July 20, 2023, producing power into grid
    - 879 kw-hr produced to date

- **Climate Resiliency and Adaptation Plan**
  - Alberta Municipalities has submitted a proposal to present this project at the United Nations Conference of Parties in Abu Dhabi pending Town and MD council approval
  - PC-REMO to take lead on:
    - Firesmart and flooding legislation recommendations
    - Fuel management program
    - Heat and Smoke emergency response plans
    - Flood infrastructure development plans
  - Project brief developed for review by Climate Resilience Team
  - Team met August 30. 2023 to review project briefs. Directed as follows:
    - Request PARC to present wind study to next joint council to discuss seed funding and allow team to approach other stakeholders
    - Develop draft homeowner assessment toolkit and recommendations
    - Develop draft recommendations to be included in both Town and MD procurement policies based on examples from existing municipalities
    - Develop recommendations for deliverables in future Tourism master plan
    - Review progress on PC-REMO tasks on bi-monthly basis
  - Met with MITACS to investigate funding avenues for wind study
  - Reviewed homeowner assessment toolkits and adaptation guides
  - Conducted video interview with Green Energy Futures October 4, 2023
  - Presenting plan to Southern Alberta Council for Public Affairs October 19, 2023

- **Clean Energy Improvement Program**
  - Full application submitted June 29, 2023
  - Amendments made based on FCM feedback and resubmitted August 11, 2023
  - Expected launch pending grant approval in Q2 2024

- **Ford Lightning**
  - Tender received from Marlborough Ford with estimated ETA of September 2023
    - Tracking usage to compare vs gas equivalent
      - Distance: 693 km, Energy used: 307 kWh
      - Cost (energy only): $18.42, Cost (energy+T&D): $49.12
      - Cost of unit 504 to drive equivalent distance: $142.2
      - Total Savings: $93.08
    - Funding closeout submitted September 5, 2023

Capital Projects Update - Bridges

- **Bridge File 75265 – Local Road over Heath Creek, NE-11-10-01-W5M**
  - Tender awarded for engineering in 2021
    - Roseke Engineering at **$52,162.00** (Budget: $53,000.00)
  - Tender awarded for construction in 2023
    - Volker Stevin at **$367,000** (Estimate: $475,700)
    - Awarded bidder $124,000 lower than cancelled Tender May, 2022
  - Land is purchased and agreements are signed. Title registration may take a few months
  - Construction timeline and quality exceeding expectations
  - Final walkthrough and completion issued September 19th, 2023, noted minor deficiencies that must be addressed prior to release of holdback
    - All deficiencies addressed. Post-construction BIM to be complete prior to final closeout

- **Bridge File 7743 – Local Road over Gladstone Creek, SW-23-05-02-W5M**
  - Project complete

- **Bridge File 75377 – Local Road over Screwdriver Creek, NW-08-06-02-W5M**
  - Project complete

- **Bridge File 2488 – Fisher Bridge, NW-26-07-02-W5M**
  - ISL awarded Supply-Build Engineering contract
  - Design, Supply, & Fabrication of Prefabricated Bridge awarded to Algonquin Bridge **(Cost: $458,040. Eng. Est: $638,000).**
  - RFPQ (Request for Contractor Pre-Qualification) for Installation has been sent out and closed July 26th. Installation RFQ bids received September 14th, 2022. Awarded to low bidder **(Cost: $330,954. Eng. Est: $349,000)**
  - Existing abutments will have partial depth repairs complete, and cracks will be epoxy injected and sealed. Work falls under new DFO code of practice for clear span bridge
    - Scour identified under existing abutment. Costed plan to be discussed in 2024 budget
  - Signage and epoxy crack injection complete. Guardrail work complete, abutment repair work complete. Walkthrough required

- **Bridge File 74048 – Todd Creek Culvert, NW-36-009-03 W5M**
  - Preliminary engineering complete. Recommendation is to replace if STIP funding can be obtained, or install timber struts until funding can be obtained (to be discussed in 2024 budget planning)

- **Bridge File 70175 – Yarrow Creek Bridge Rehabilitation, NW-22-003-030 W4M**
  - Pricing Received for Preliminary Engineering & Design from multiple firms.
    - Awarded to Roseke Engineering at **$17,990 (Budget $20,000)**
  - Preliminary engineering report complete June 9th, 2023. Proceeding with design and permitting. Scope includes:
    - Perform a pile splice repair on two piles in the west abutment, replace the east pile cap, place fill and riprap at the west headslope, minor wheel guard repairs & repairs to east timber span, channel realignment, and west abutment riprap work

- **Bridge File 75801 – Oldman River Tributary Culvert, SW-09-010-01 W5M**
  - Preliminary engineering complete. Struts recommended, drawing complete

- **Bridge File 76294– 2nd Tributary to Castle River, SW 32-006-01 W5M**
  - Preliminary Engineering & Design awarded to Roseke July 14, 2022
  - Tender awarded for construction in 2023
    - East Butte at **$198,407** (Estimate: $253,500)
  - Recommendation is replacement with an upsized 1.6m diameter x 27m L single culvert (existing structure is 1.5m diameter x 18.3m L)
  - STIP funding confirmed April 17th, 2023
  - Anticipated completion by Nov. 30th, 2023
  - ECO Plan and Traffic plan submitted and sent back with comments. Contractor mobilizing October 16th
    - Revised traffic and Eco Plan received, and approved with minor comments

- **Watercourse Crossing Inspection & Remediation Project – 100% Grant funded**
  - **$150,000** in grant funding awarded for Year 1 of this program
  - **Fintegrate** awarded initial contract to assess all MD crossings, prioritize for remediation, & perform detailed regulatory authorizations
  - Work has begun on prioritization & initial assessment, 175+ crossings reviewed
  - Anticipate moving forward with design of 3 crossings. Proposals received for 3 eligible crossings, kicked off preliminary design January 20th, 2023
    - BF 7080 Dungarvan Creek Culvert Replacement, SW-17-003-29 W4M
    - Tapay (Carbondale) Road over Iron Creek Culvert Replacement, SW-15-006-03 W5M
    - TWN Rd. 31A (Chapel Rock) over South Todd Creek Culvert Replacement, SE-023-09-03 W5M
  - Anticipating regulatory Directives making dealing with SAR crossings mandatory
  - Y1 grant extension to November 30th, 2023 received
  - Funding agreement signed March 28th, 2023 for additional $1.55M to cover additional assessment, and engineering along with replacement of 2 crossings, to be complete by March 2025

- **WCR #1: Iron Creek under Tapay (Carbondale) Road, LSD SE-15-006-03 W5M**
  - Prelim. engineering complete. Design awarded to Roseke Engineering
  - 100% grant funded (excluding potential land costs)
  - Anticipated structure is a 4.7m x 2m corrugated steel box culvert
  - Anticipate 2024 construction

- **WCR #2: South Todd Creek Trib. under Chapel Rock Road, LSD SE-23-009-03 W5M**
  - Prelim. engineering complete. Design awarded to Roseke Engineering
  - 100% grant funded (excluding potential land costs)
  - Anticipated structure is a 1.6m open bottom CSP culvert
  - Anticipate 2024 construction

- **WCR #3: Cow Creek Trib. under North NU Road, LSD NE-35-008-03 W5M**
  - Design & QAES portion awarded to ISL Engineering
  - Engineering and design will be 100% grant funded (excluding potential land costs)
  - QAES report complete
  - Anticipate construction late Fall 2023 by PW
  - Received design brief from ISL September 1st. Design complete. Culvert ordered, awaiting delivery. Permitting work has begun, in discussion regarding feasibility this year (unanticipated permit delays)
  - Working to secure landowner agreement

Roads

- **Patton Avenue (Lundbreck) -** ***Engineering and construction 2023***
  - Project complete

Recommendation:

That the Utilities & Infrastructure report for the period October 5th – 17th is received as information.

Prepared by: Roland/David/Tristan Date: October 17th, 2023

Submitted to: Council Date: October 24th, 2023

Administration Guidance Request

TITLE: Therriault & Fish Lake Dam Studies			
PREPARED BY: David Desabrais		**DATE: October 13th, 2023**	
DEPARTMENT: Utilities & Infrastructure/Public Works			
David Desabrais		23/10/12	**ATTACHMENTS:** 1. **Therriault Dam Geotechnical Investigation Report** 2. **Therriault Dam Hydrotechnical Investigation Report** 3. **Fish Lake Culvert Assessment**
Department Supervisor		**Date**	

APPROVALS:

David Desabrais	23/10/12	**Roland Milligan**	2023/10/13
Department Director	**Date**	**CAO**	**Date**

RECOMMENDATION:

That Council receive the Therriault and Fish Lake Dam Studies for information.

BACKGROUND:

The MD completed a Dam Safety Review (DSR) of the Cridland, Therriault, Sandy Lake, Fish Lake, and Foothill Lake Dams.

Therriault Dam

Four (4) high priority deficiencies were identified in the study. In 2023 the MD proceeded with the studies recommendation to complete both geotechnical and hyrotechnical (spillway and freeboard assessment) studies for the Therriault Dam as the DSR indicated:

- Spillway structures are likely insufficient to pass Inflow Design Flood (IDF)
- The downstream end of dam may be inadequate for slope stability (with ongoing seepage)

These studies were completed and have been attached. It is recommended to review the Executive Summaries. Key findings:

- Hydrotechnical (spillway survey & freeboard assessment) Results
  - Elevation of dam and embankment is not consistent, there is a low point near the emergency spillway
  - Capacity of spillways found to be insufficient to pass IDF. Both the main dam and low spot would be expected to overtop

- Without accounting for wind/wave setup, the low point would be expected to overtop for events smaller than 1:100 year return storm
- During Full Supply Level (FSL), required freeboard at low section of embankment is not achieved
- Recommend completing a more detailed wind and wave setup analysis to help finalize the lowest cost solution to the above concerns. Potential solutions:
  - Increase spillway capacity
  - Raise embankment
  - Lower effect of wind/wave through various construction options
  - Lower FSL
  - Raise dam crest height
  - Construct secondary spillway

- Geotechnical Investigation Results
  - MDPC continue reviewing (new) instrument data and performing visual inspections
  - Slope stability "appears" stable. If not controlled, could cause issues over time. Recommend planning for filter-type toe berm to minimize risk of internal erosion
    - Not considered "urgent", but would be a prudent measure to assure long term dam safety

Fish Lake

MDPC Administration was made aware of the desire to lower the culvert between the West and East reservoir to increase useable volume for downstream users. A brief assessment was completed to assess feasibility. Key findings:

- Culvert can be lowered without negatively impacting flood conditions and hydraulic functionality of reservoirs
- Lowering (up to 1m) would increase amount of water accessible to users by 223 dam^3 from FSL

There is an active pipeline ROW between the reservoirs. It is unknown at this time if that ROW would impact how low a culvert could be lowered.

FINANCIAL IMPLICATIONS:

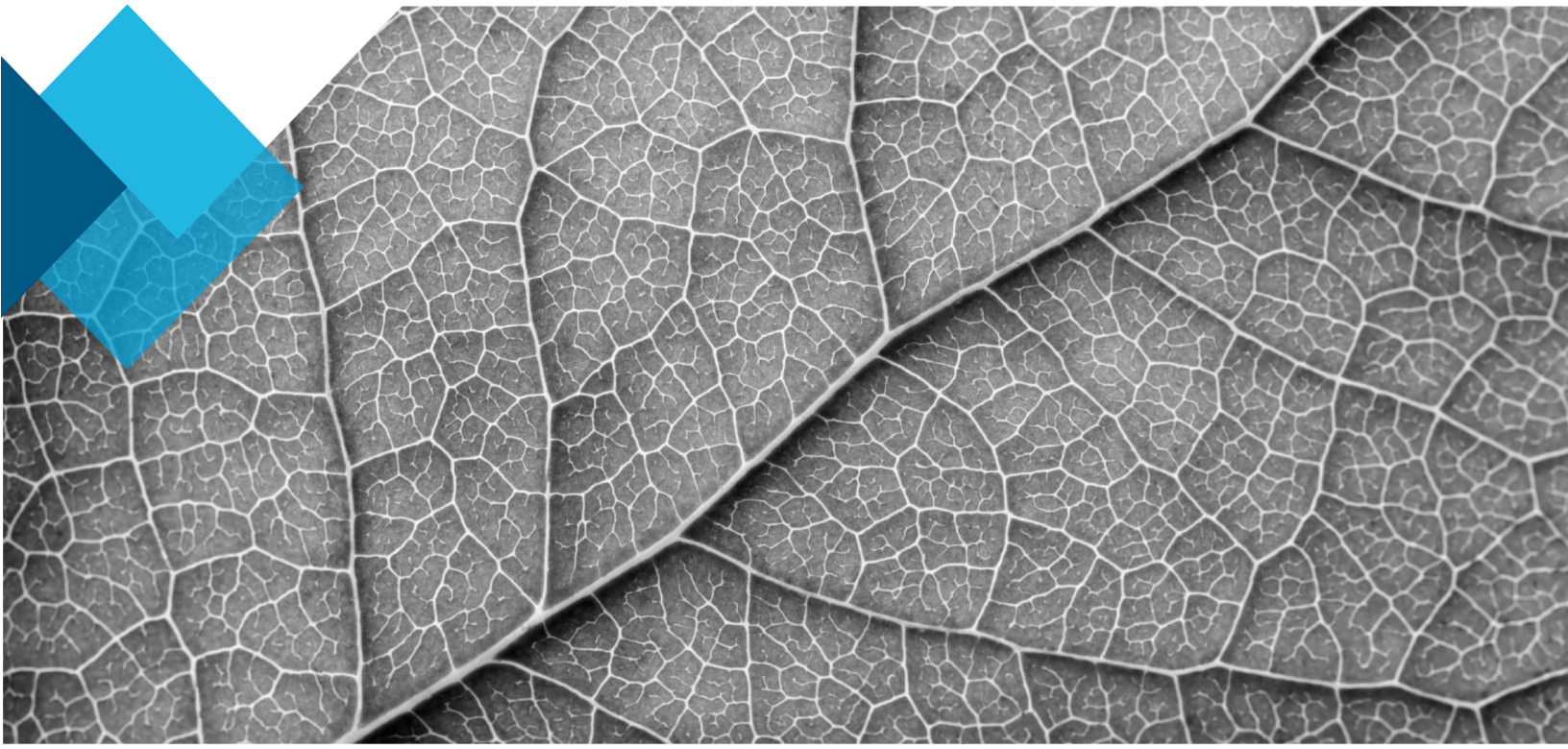
To be discussed in 2024 budgeting

SNC·LAVALIN

Therriault Dam

Geotechnical Investigation Report

M.D. of Pincher Creek No. 9



Geoscience & Materials

September 14, 2023

Internal Ref: 694661-0000-41EB-0003-PA

Notice to Reader

This report has been prepared and the work referred to in this report has been undertaken by SNC-Lavalin Inc. (SNC-Lavalin), for the exclusive use of the M.D of Pincher Creek No. 9, who has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions, and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions, and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made with respect to the professional services provided to the M.D of Pincher Creek No. 9 or the findings, conclusions, and recommendations contained in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered, or project parameters change, modifications to this report may be necessary.

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Executive Summary

.

The Therriault Community Dam is a zoned earthfill dam located in SW-27-T5-R29-W4 approximately 10 km south and 8 km east of Pincher Creek, Alberta. A Dam Safety Review (DSR) was completed by SNC-Lavalin Inc. in 2021. As per the DSR recommendations, a geotechnical investigation was listed to better evaluate the slope stability factors based on observations of soil conditions. No visible evidence of significant dam instability was discovered during the site inspection. In the DSR, the geotechnical assessment based on literature review indicated that the potential FoS of its downstream slope under steady state condition may also be inadequate, given ongoing seepage issues. Further evaluation of the engineering properties and groundwater within the dams was strongly recommended to assess the potential risks. SNC-Lavalin was retained by the M.D of Pincher Creek No. 9 to complete a geotechnical investigation as per the Dam Safety Review recommendations.

SNC-Lavalin performed a geotechnical investigation in March 2023, an unmanned aerial vehicle (UAV) photogrammetry survey and a freeboard assessment. The UAV survey and freeboard assessment will be reported under separate cover. The geotechnical investigation and subsequent slope stability analyses found that the slopes of the dam likely provide adequate global stability as required by provincial legislation and Canadian Dam Association guidelines.

SNC-Lavalin recommends that:

- The M.D of Pincher Creek continue to review instrument data and perform visual inspections in accordance with dam safety best practices, Province of Alberta regulations and Canadian Dam Association guidelines.
    - Visual inspections should be conducted routinely throughout the year, with a focus on scheduling inspections during early spring before vegetation growth obscures potential cracks and other features of interest, during drawdown conditions, and after periods of heavy rainfall.
- Although from a slope stability point of view, the current conditions appear stable, flow of seepage water through dams and embankments may facilitate the movement of soil particles which, if not controlled, can result in progressive internal erosion and potential failure with passage of time. It is recommended to begin planning to install a filter-type toe berm with designed grain-size distribution, to contain the potential migration of fine-grained particles and fine sand which could emanate at the toe. The purpose of such a retrofit features is to minimize the risk of internal erosion and undermining the abutment. The filter toe berm must be also protected from precipitation/runoff erosion on its exposed surface (generally by placing a veneer of erosion-resistant material).
    - For illustration and planning purposes, a rough estimate indicates the filter-type toe berm should be placed in the range of 30 m long parallel to the dam centerlne, 4 m wide and 3 m high).
    - The extent of the area to be treated should be confirmed on site by progressively stripping the vegetation and topsoil, and examining the seepage-affected areas and the size. The filter toe berm needs to be extended a minimum of 5 m along ground surface beyond exposed seepage areas.
    - Since the modeled exit gradient is below the estimated critical gradient, this recommendation is not considered urgent, but would be a prudent measure to assure long-term dam safety.

Table of Contents

In-Text Tables

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Appendices

1 Introduction

SNC-Lavalin Inc. (SNC-Lavalin) was retained by the The Municipal District of Pincher Creek No. 9 (the MD) to conduct a geotechnical investigation for the stability analysis of the existing Therriault Dam. The dam is located to the south east of the Town of Pincher Creek, between Range Road 294 and Range Road 292 on Township Road 54. SNC-Lavalin's Dam Safety Review (DSR) report (20220314-683055) dated March 14, 2022, noted that seepage was observed on the south-eastern part of the downstream slope and toe. This seepage was identified as a concern because it was possibly mobilizing surface soils which may cause fines migration from within the dam. Furthermore, there were no available subsurface condition records for the dam during the DSR.

2 Background and History

SNC-Lavalin understands that the dam was constructed in 1967, with additional construction completed to increase the storage capacity in 1989 (Genivar, 2010a). Again in 2002, the dam was raised by 0.6 m above the 1989 design elevation. The Therriault Dam provides storage capacity to supplement downstream stockwatering needs along Indian Farm Creek. As per design drawings, the dam consisted of a zoned earthfill and the length of the dam is approximately 106 m with a crest width of 7 m and a maximum height of approximately 14.2 m. Alberta Environment and Parks (AEP) has licensed the original dam and the raised dam, with Priority No. 1967973101 and No. 1988072101, respectively.

It is understood that the dam has undergone modifications and repairs over the past years due to overtopping and erosion damage. In June 1995, there was a heavy rainfall of approximately 81.6 mm which caused the dam to overflow. The downstream face of the dam and emergency spillway was reconstructed due to erosion damage. Similarly in the years 2000 and 2002, repairs were done to the toe of the right abutment, downstream face and outlet of the spillway. Outlet pipe was extended 10 m and a toe berm was added to the dam over the extension. Major reconstruction was undertaken in 2005 to spillway outlet channel and downstream end of the emergency spillway in reaction to a three-day rainfall event of approximately 179.5 mm. Erosion damage was also noted due to rainfall events in 2010.

In SNC-Lavalin's DSR, seepage was observed on the east abutment, while the overall slope did not exhibit any visible deformation. The seepage was assessed to be a potentially critical dam safety condition. A geotechnical investigation was undertaken by SNC-Lavalin in spring 2023 to assess seepage and internal erosion, and to characterize the dam fill, groundwater conditions, and foundation.

Stability modelling performed during the preliminary analyses in the DSR, using assumed soil parameters in the absence of any subsurface data, indicated that the factor of safety (FoS) for overall global stability could be below the minimum values recommended in the Canadian Dam Association (CDA) safety guidelines for dams.

2.1 Site Description

The dam is situated on Indian Farm Creek southeast of the Town of Pincher Creek. The length of the dam is approximately 106 m with a crest width of 7 m and a height of up to approximately 14.2 m. A conduit with a 760 mm diameter corrugated steel pipe allows the reservoir to be drained. There is a drop inlet spillway

that connects to the conduit outlet and an emergency spillway channel located approximately 170 m to the east of the drop spillway that is partially armoured with riprap. Relevant physical characteristics of the dam are as follows:

- Dam Type: Homogenous earthfill embankment with an earth spillway;
- Full Supply Level (FSL)~ 1220.11 m;
- Length: ~ 106 m;
- Maximum Height: ~ 14.2 m;
- Existing Outlet Elevation (from survey): 1208.5 metres above sea level (masl);
- Crest Elevation: 1222.4 masl;
- Average Toe Elevation: 1208 masl; and
- Estimated Catchment Area: 54 km².

2.2 Preliminary Works

Detailed discussion of preliminary works were presented in the following documents:

- 2010 Therriault DSR, completed by Genivar (Genivar, 2010a);
- 1999 Operation, Maintenance and Surveillance Manual, Therriault Dam (UMA, 1999b); and
- 2021 Dam Safety Review Cridland Dam, Therriault Dam, Sandy Lake Project Dam, Fish Lake Project Dam, Foothill Lake Community Dam (SNC-Lavalin, March 14, 2022c).

2.3 Regulatory Background

Dams in Alberta are regulated by the Government of Alberta through:

- The Alberta Water Act: Water (Ministerial) Regulation – Part 6 (WMR; GoA, 2018), and
- The Alberta Dam and Canal Safety Directive (ADCSD; AEP, 2018).

The ADCSD indicates that dams should comply with best practices issued by the CDA, a federal governing body that provides standards and guidelines for classifying the hazards and potential consequences of dam failure and provides standards for design, construction, maintenance and asset management for dam owners. The most recent relevant CDA guidelines issued are:

- Dam Safety Guidelines, 2007 (Revised 2013), and accompanying bulletins.

In Alberta, a dam should be regulated if it meets any one or more of the following criteria as per Section 27(1) of the WMR:

a) It provides both a live storage capacity of 30,000 m^3 or more and is 2.5 m or more in height;

b) It is classified as being a significant, high, very high, or extreme consequence structure regardless of height/capacity; or

c) It exists for the purpose of storing flowable tailings.

The Alberta Dam and Canal Safety Directive, published in 2018 (the Directive), requires dam owners to meet a number of requirements for their dams, including:

› Following the general responsibilities, accountabilities, and due diligence described in Section 29 of the WMR;

› Determining, reviewing, and re-assessing the consequence classification of the facility every 10 years (WMS Section 34.1 & Part 3 of the Directive);

› Identifying, assessing, developing, and implementing measures to mitigate and manage risks posed by safety deficiencies (ADCSD Part 4.5);

› Design requirements and practices (ADCSD Part 5.5, further discussed in **Section 2**); and

› Engineering inspections (ADCSD Part 5.19).

The Directive also provides criteria to determine the incremential consequences of dam failure. SNC-Lavalin conducted a preliminary assessment of the consequences of a potential dam failure for this dam. Based on the assessment, it was recommended to assign the consequence classification of “Significant” for the Therriault Dam (SNC-Lavalin, 2021b).

2.4 Scope of Work

The scope of work of this geotechnical analysis was discussed and agreed to by SNC-Lavalin and the M.D. of Pincher Creek and consisted of:

1. Field Investigation;

2. Installation and Monitoring of Vibrating Wire Piezometers; and

3. Geotechnical Slope Stability Analysis and Reporting.

The analyses and recommendations presented in this report are based on the data obtained from the boreholes drilled at the locations shown on 694661-0000-4GDD-1000 (Appendix I). This report does not reflect any variations which may occur between the borehole locations. In the performance of subsurface explorations, specific information is obtained at specific locations at specific times. However, it is known that variations in soil, bedrock, and groundwater exist on most sites between borehole locations. The nature and extent of variations may not become evident until the course of construction. If variations are then evident, it will be necessary for a re-evaluation of the recommendations contained within this report.

3 Geotechnical Analysis

3.1 Geology

There is limited historical information on the design, foundation materials, and construction materials used for the dam. Based on available Alberta Geological Survey (AGS) surficial geology maps, the dam is located on a stagnant ice moraine surficial deposit.

3.1.1 Geotechnical Field Investigation

Prior to the field activities, a Hazard Assessment and Safety Plan (HASP) was completed to identify and mitigate the likely hazards during the field activities. Underground utilities clearances were obtained through Alberta One-Call and an independent contractor to identify underground utilities prior to initiating drilling. Drilling activities were undertaken between March 22 and 23, 2023 and consisted of advancing two (2) borehole to 23.1 m, BH23-1 and BH23-2 from the dam crest. The locations of boreholes and general information are summarized in Table 3-1.

Both the boreholes were advanced, using 100 and 150 mm solid stem augers with a track-mounted Mobile drill rig operated by Val's Drilling, under the full-time supervision of experienced geotechnical personnel from SNC-Lavalin. Soil samples were generally taken at every 3 m up to 6m below ground surface (bgs) and then 1.5 m intervals up to the termination depths; while performing the Standard Penetration Test (SPT) in accordance with ASTM D1586. SPT consisted of freely dropping a 63.5 kg (140 lb) automatic hammer for a vertical distance of 0.76 m (30 inches) to drive a 51 mm (2 inch) outer diameter (O.D.) split barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m (12 inches) was recorded as the SPT 'N' value of the soil. SPT 'N' values indicated the consistency of cohesive soils or the relative density of non-cohesive soils. Pocket Penetrometer tests were also conducted on cohesive samples collected from the split-spoon sampler to provide a general indication of soil strength. Four Shelby tubes were taken for unconfined compressive strength (UCS) and direct shear testing.

Table 3-1: Summary of Borehole Location and Depth

Borehole No.	Northing (m)	Easting (m)	Approximate Elevation (m)	Depth (mbgs)	Notes
BH23-01	5477346	294930	1222.2	23.1	Two Vibrating wire piezometers were installed and backfilled with cement-bentonite grout.
BH23-02	5477286	295034	1220	23.1	Backfilled with cement-bentonite grout.

3.1.2 Subsurface Conditions

Detailed descriptions of the subsoil conditions encountered in each borehole are presented in the Borehole Logs provided in Appendix II. Classification and identification of soils are based on commonly accepted methods employed in the practice of geotechnical engineering, according with Unified Soil Classification System (USCS). The stratigraphic boundaries shown on the Borehole Logs represent transitions between soil types rather than distinct lithological boundaries. It should be recognized that subsurface conditions often vary both with depth and laterally between individual borehole locations.

Topsoil

A layer of topsoil was encountered in both borehole locations. The thickness of topsoil was approximately 300 to 380 mm. It should be noted that the thickness of topsoil was approximated visually during geotechnical drilling; hence, it may vary throughout the site.

Fill Soils

Fill soils were encountered in boreholes BH23-01 and BH23-02 to depths of approximately 13.7 mbgs and 4.6 mbgs, respectively.These soils were described as brown to grey, medium plastic, stiff to very stiff, and moist SILTY CLAY sandy with trace gravel. A layer of sandy silt with trace gravel was encountered in BH23-2 at 0.6 mbgs. SPT N values ranged from 11 to 26; and hence, the consistency of the soil in this layer can be described as stiff to very stiff. The natural moisture content of samples ranged from 9.4% to 25.1%; most moisture contents were approximately a few percentage points above the plastic limit.

Glacial Till

Silty clay till was encountered in both boreholes below the fill soils. Based on visual identification and lab tests, this layer was described as having medium plasticity, some sand to sandy, trace gravel, brown or grey in colour, and oxidized in zones. Water content in this layer ranged from 10.7% to 30.4%. SPT N values ranged from 11 to 33; and hence, the consistency of the soil in this layer can be described as stiff to hard.

Shale Bedrock

Bedrock coring or sampling was not in the scope of the investigation. Highly weathered brownish grey shale of the Bearpaw Formation was encountered below the glacial till layer in BH23-1 at a depth of 23 mbgs. Borehole BH23-2 encounterd auger refusal on inferred bedrock at 23.0 mbgs.

Groundwater Seepage and Sloughing

Groundwater seepage conditions were encountered within localized, saturated sand seams during drilling of BH23-2 on the east abutment. Seepage and wet soils and sand seams were reported at depths of approximately 16.8 and 18.8 m, elevations 1203.2m 1201.7 m, respectively.

Groundwater seepage is stated at the pertinent elevations in the borehole logs. No groundwater seepage or visibly wet soil were encountered in Borehole BH23-1. It is common for water tables to be lower in the winter season as compared to the summer season. Additionally, groundwater levels are subject to reservoir opeating levels, meteorological events, site gradient, and other salient factors resulting in the water table varying with time.

3.1.3 Laboratory Testing

All recovered samples were transported to SNC-Lavalin's laboratory located in Saskatoon. A laboratory testing program was carried out to classify and evaluate the engineering properties of soils in select samples collected during the investigation. The laboratory tests included moisture content, Atterberg limits, grain size distribution and hydrometer, Unconfined Compressive Strength (UCS), and Direct Shear test (DS). Index tests and unconfined compressive strength tests on selected samples were carried out, and the results are summarized in Table 3-2 and Table 3-3, respectively.

Table 3-2: Index Testing Results

Borehole No.	Sample No.	Depth (m)	Gravel %	Sand %	Silt %	Clay %	LL %	PL %	PI %	USCS Symbol
BH23-01	AS-SG-7	6.7	3.2	29.7	36.1	31	41.3	14.3	27.0	CI
BH23-01	SS-SG-13	15.2	14.8	28.9	31.3	25	39.6	14.5	25.1	CI
BH23-01	SS-SG-16	19.8	8.4	29.9	34.2	27.5	38.8	14.9	23.8	CI
BH23-02	AS-SG-2	0.6	9.4	43.8	23.1	23.7				
BH23-02	SS-SG-4	3.05	11.5	32.1	29.9	26.5	36.6	14.1	22.6	CI
BH23-02	SS-SG-8	7.6	3.3	21.1	40.6	35	38.9	14.3	24.6	CI

Table 3-3:Summary of Undrained Shear Strength And Direct Shear Test Results

Borehole No.	Sample No.	Depth (m)	Unconfined Compressive Strength UCS (kPa)	
BH23-01	ST-SG-15 (UCS)	18.3	188	
BH23-02	ST-SG-9 (UCS)	9.1	214	
BH23-02	ST-SG-12 (USC)	13.7	216	
			Envelope Peak Angle - Peak Intercept (kPa)	
BH23-01	ST-SG-5 (DS)	5.0	29°	20

3.1.4 Instrumentation Review

Vibrating wire piezometers were installed in BH23-1 at depths of approximately 12 and 18 mbgs. These piezometers were fully-grouted in place with a bentonite-cement grout mixture in accordance with standard practice (Mikkelsen, 2002). VWP's were soaked in flat water for saturation before installation according with manufacturer's guidelines. Initial readings were taken before soaking and installation. Multichannel Datalogger DT2055 B was installed and connected to VWP's to take readings at set interval of 12 hours. Another site visit was done on April 21st, 2023 to download data from datalogger and to complete an unmanned aerial vehicle (UAV) photogrammetry survey.

VWP data was processed and analyzed using Office 365 Excel. The pressure is calculated from a manufacturer's calibration equation and parameters are specific to each VWP. In this case, the automatic dataloggers and data collection software are set up to calculate the pressure. The pressure is added to the tip elevation to determine the piezometer elevation. A thermistor in the VWP directly measures the soil temperature.

The piezometric elevation showed slight variation of pressure up to April 21, indicating the instruments were stabilizing after the installation. A longer drawdown duration would need to be in place for any correlation between VWP pressures and reservoir levels to become potentially evident. It should be noted that rapid reservoir drawdown is known to be a leading factor in upstream embankment slope failure due to decreasing the total stress (weight of the water) and high porewater pressure at the soil. Therefore, a more gradual reservoir drawdown should be planned if undertaken, to minimize the risk of upstream face slope instability.

3.2 Slope Stability

3.2.1 Methodology

The Slope/W package Geostudio 2021.4 (version 11.0.1.21429) by Geoslope International was used to conduct the slope stability and seepage analyses and to estimate factors of safety. The method of analysis used for this study was the Morgenstern-Price method for a 2D limit equilibrium model.

The 2018 Dam Safety Directive indicates in section 5.6 that:

"(1) A dam/canal owner must demonstrate that the target stability criteria and selected factors of safety used in the design of structures for a dam or canal:

(a) are consistent with local industry and best practices;

(b) are supported by a comprehensive risk management system;

(c) have been selected with oversight by independent qualified professionals; and

(d) are justifiable having regard to, at a minimum, all of the following:

(i) potential variability in material properties;

(ii) site and subsurface conditions;

(iii) modes of failure;

(iv) accumulated experience with a particular soil or rock mass;

(v) variable construction and operating conditions;

(vi) soil response and its variation with confining stress and stress level;

(vii) time-dependent, deformation-dependent, and stress-path-dependent processes that may affect the critical material properties such as the operational pore pressures and shear strengths;

(viii) strain-incompatibility of different materials and its foundation; and

(ix) the ability and practicality of implementing an effective risk management system to reduce or mitigate the residual risks associated with the uncertainties of the selected factors over the lifecycle of the structures."

3.2.2 Downstream Slope & Global Stability

The recommended minimum FoS criteria for dam embankments according to the CDA (2013) for static and seismic loading conditions are shown in Table 3-4 andTable 3-5.

Table 3-4 : Factors of Safety Criteria for Slope Stability – Static Assessment (construction, operation, and transition phase)

Loading Condition	Minimum Factor of Safety [1]	Slope
End of construction before reservoir filling	1.3	Upstream and downstream
Long-term (steady-state seepage, normal reservoir level)	1.5	Downstream
Full or partial rapid drawdown	1.2-1.3[2]	Upstream

Note [1] Factor of Safety is the factor required to reduce operational shear strength parameters to bring a potential sliding mass into a state of limiting equilibrium, using generally accepted methods of analysis.

Note [2] Higher factors of safety may be required if drawdown occurs relatively frequently during normal operation.

Table 3-5: Factors of Safety Criteria for Slope Stability – Pseudo-static Assessment (construction, operation, and transition phase)

Loading Condition	Minimum Factor of Safety [1]	Slope
Pseudo-static	1.0	Upstream and downstream
Post-earthquake[2]	1.2-1.3	Upstream and downstream

Note [1] Factor of Safety is the factor required to reduce operational shear strength parameters to bring a potential sliding mass into a state of limiting equilibrium, using generally accepted methods of analysis.

Note [2] Post-earthquake stability indicates that movements from an earthquake have moved and “remolded” the dyke material, which would change its strength properties. This is only checked if the dam has a FOS <1 in a Pseudo-static analysis.

The following loading cases were analyzed and the factor of safety for each calculated:

› static stability of the downstream slope at Full Supply Level (FSL);

› rapid drawdown of the upstream slope; and

› pseudo-static seismic stability of the downstream slope at FSL.

3.2.3 Surface and Subsurface Geometry

The surface and subsurface geometry of the models was based on select cross sections of the dams provided in the 2010 DSR reports by Genivar (2010a) and 1999 OMS Manuals by UMA Engineering (UMA, 1999b), and confirmed on the downstream slope with the UAV photogrammetry survey.

3.2.4 Material Parameters

The material properties selected and used in the analyses were based on the results of the field and laboratory investigations, from SNC-Lavalin’s judgment, and experience with similar materials from previous projects. The selected design properties are shown in Table 3-6.

Table 3-6: Material Properties Selected for Slope Stability Analysis

Material	Wet Density, γ (kN/m^3)	Effective Friction Angle, φ, (°)	Effective Cohesion, c', (kPa)	Undrained Shear Strength, S_u, (kPa)
Embankment Fill	20.5	29	10	60
Foundation Till	21	30	50	90
Pervious Filter	18	35	0	-

Generally, the design process begins with assuming that fill material has no cohesion while the source material, the in-situ till, would have an effective cohesion (c'). This till assumption is deemed reasonable, as the in-situ material has experienced millennia of pressure from hundreds of metres of ice surcharge and is heavily over-consolidated. Once excavated and replaced as fill material, the original strength is not regained, no matter how well compacted by mechanized equipment. In the initial modelling, SNC-Lavalin assumed zero cohesion in the clay embankment fill. This parameter selection resulted in factors of safety of 1.2 (static downstream face), which would indicate the dam is inherently unstable with respect to its slope faces. This is judged not to be the case, as observed by the direct shear test (DS) completed on undisturbed-type sample taken from the dam, in BH23-01 at 5.0 m depth, and as evidenced by years of successful operation without evidence of slope deformation. At lower normal/confinement stress in the Direct Shear test, the intercept of shear stress appears lower than 20 kPa. An effective cohesion of 10 kPa was selected for the embankment fill to account for the potential intercept in the Direct Shear test for lower confining pressures. This was judged to approximately model the performance of the dam.

3.2.5 Phreatic Surface

Both boreholes were generally dry upon completion; however, seepage was noted in BH23-2 at depth 16.8 and 18.8 m, at elevations 1203.2m 1201.7 m respectively. The seepage rates were relatively low, given the absence of standing water in the bottom of the boreholes prior to grouting. The phreatic surfaces are modelled as long-term steady state conditions for FSL, although the levels typically fluctuate seasonally due to reservoir level variation and environmental factors such as groundwater conditions and precipitation. This modeled phreatic surface elevation is considered conservative in the analysis of slope stability.

3.3 Seismic Analysis

The seismic analysis criteria in the CDA Guidelines requires dams to be designed and evaluated to withstand ground motions associated with an Earthquake Design Ground Motion (EDGM), without the release of the reservoir. The selection of the EDGM is based on the consequences of dam failure. For low consequence dams, the EDGM is based on the annual exceedance probability of 0.01 which is equivalent to the 1:100-year return period seismic event. The peak ground acceleration (pga) for a 1-in-100-year return period is 0.017 g, and the PGA for a 1-in-1,000-year return period is 0.080 g.

A horizontal force (seismic coefficient) was applied to the failure mass which is proportional to the design horizontal acceleration for the analysis of seismic condition. One-half of the PGA (0.5*PGA) (recommended by Hynes-Griffin and Franklin in 1984) is typically used for the non-rigid response of the dam embankments and foundations. As recommended by CDA (2013) Guidelines' Bulletins, the vertical component of an earthquake was not employed in the stability analyses.

3.3.1 Slope Stability Analysis Results

A summary of the calculated FoS for the dams are provided in Table 3-7 and figures of the slope stability models output plots are included in Appendix IV.

Seepage analyses to estimate the porewater pressures and the phreatic surfaces generated from the loading scenarios were estimated using the commercially available GeoStudio Seep/W (2021) finite element program. Stability analyses were conducted using the GeoStudio Slope/W (2021) limit equilibrium program.

Steady-state seepage analyses were conducted to estimate the long-term porewater pressures within the dam. Transient seepage analyses were conducted to simulate the partial drawdown of the reservoir prior to dam excavation. Porewater pressures and phreatic surfaces generated in the seepage analyses were used in the stability analyses. Stability analyses employed the Morgenstern-Price method with optimization of the slip surface.

The FoS for the dams were analyzed for the FSL and rapid drawdown (RDD) cases for the static loading condition; for Therriault dams meet the minimum recommended FoS for downstream steady state slope stability. The calculated FoS under seismic loading based on the pseudo-static analyses also meets the minimum requirements as per CDA (2013). Slip surfaces that are less than 1 m depth below the surface are not considered significant and are not reported.

Table 3-7 Modelling Results Summary

Dam	Loading Conditions	Reservoir Elevation (m)	Factor of Safety[1]			Appendix Figure No.
			Upstream[3]	Downstream	Pseudo-Static at FSL	
Therriault	FSL	1,220.11	-	1.6	1.3	1-4 / 2-4
	FSL - Seepage	1,220.11		1.7	1.4	3-4
	RDD	1,209.00	1.4	-	-	4-4

The software modeling and selected input material parameters indicate the dam has adequate FoS in relation to the CDA guidelines.

3.4 Seepage and Hydraulic Gradients

According to the 2010 Dam Safety report completed by Genivar[1], seepage through the east abutment was identified after reservoir level was raised to the FSL of 1220.11 m in 1989. During the site visit on June 14, 2021 that SNC-Lavalin completed, seepage and a ponded area were visually observed on the downstream slope of the east abutment (see Figure 3-1 and Figure 3-2 below). An site plan with the approximate location of photogrphs of observed seepage is presented in Figure 3-3 below. It was not possible to observe the ponded area during the site investigation completed between March 22 and 23 of 2023, due to snow coverage and melting of previous winter precipitations.

[1] Therriault Dam – 2010 Dam Safety Review, by Genivar March 2010.

Figure 3-1: Area of Observed Seepage (June 14, 2021)

Figure 3-2: ohArea of observed seepage (June 14, 2021)

Figure 3-3: Approximate location of the photographs of the observed seepage in June 2021 (yellow pins).

During drilling BH23-02 a sandy silt layer was found between elevations of approximately 1218.5 m and 1219.4 m. Borehole C34 drilled in the spillway area by UMA (June 13, 1985) logged a layer of GP-GM (poorly graded gravel-silty gravel) below elevation 1218.0 m with 0.7 m thickness, overlying the clay till deposit. It appears that naturally occurring layers of sandy silts and silty gravels have existed in the east abutment before construction of the dam and seepage started to occur when reservoir levels reached elevations at and above the elevations of the more permeable gravelly layers.

From seepage modeling analysis on a section close to BH23-02, at conditions of water surface at the FSL of 1220.8 m, a seepage flux was estimated between approximately 0.5 to 2.0 liters/minute-meter. The estimated critical hydraulic gradient, based on the soil testing results, is between 1.0 and 1.1. The hydraulic gradient from the seepage analysis in the abutment area, results in 0.35, which is lower than the critical gradient (See Figure 5 of 5 in Appendix IV).

During drilling of borehole BH23-2 on the east abutment, seepage and wet soils and sand seams were reported at depths of approximately 16.8 and 18.3 m, corresponding to approximate elevations of 1203.2 m and 1201.7 m, respectively.

4 Recommendations

Based on the field investigation results and analysis, SNC-Lavalin recommends that:

- The M.D of Pincher Creek continue to review instrument data and perform visual inspections in accordance with dam safety best practices, Province of Alberta regulations and Canadian Dam Association guidelines.
    - Instrument monitoring involves reading the two (2) vibrating wire piezometers, by connecting a laptop to the datalogger in the field and replacing the batteries in the datalogger. Subsequently, the data is reviewed in the office and pressure trends are analyzed. For a once-annual visit, the work could be cost approximately $4,000 each year.
    - Visual inspections should be conducted routinely throughout the year, with a focus on scheduling inspections during early spring before vegetation growth obscures potential cracks and other features of interest, during drawdown conditions, and after periods of heavy rainfall. The entire dam length, including crest and slopes and abutments need to be inspected each time. Routine inspections could be conducted by M.D. staff, using a form.
        - Detailed dam safety inspections with reports could be conducted by a qualified professional, typically costing in the range of $10,000 per inspection with report.
- Although from a slope stability point of view, the current conditions appear stable, flow of seepage water through dams and embankments may facilitate the movement of soil particles which, if not controlled, can result in progressive internal erosion and potential failure with passage of time. It is recommended to begin planning to install a filter-type toe berm with designed grain-size distribution, to contain the potential migration of fine-grained particles and fine sand which could emanate at the toe. The purpose of such a retrofit features is to minimize the risk of internal erosion and undermining the abutment. The filter toe berm must be also protected from precipitation/runoff erosion on its exposed surface (generally by placing a veneer of erosion-resistant material).
    - For illustration and planning purposes, a rough estimate indicates the filter-type toe berm should be placed in the range of 50 m long parallel to the dam centerline, 4 m wide and 3 m high, approximately situated as shown by a white dotted ellipse in Figure 3-3 above. A typical section of a toe berm is shown in Figure 3-4 below, but designed for filtration rather than overland flow protection.
    - The extent of the area to be treated should be confirmed on site by progressively stripping the vegetation and topsoil, and examining the seepage-affected areas and size. The filter toe berm needs to be extended a minimum of 5 m along ground surface beyond seepage areas.
    - Since the modeled exit gradient is below the estimated critical gradient, this recommendation is not considered urgent, but would be a prudent measure to assure long-term dam safety. The timing of such construction should be planned within the next one to five years, and also depends on actual seepage behaviour.
    - The cost for design, construction, environmental monitoring and contract administration of such a toe berm could range from approximately $150,000 to $300,000. The range depends on actual dimensions of the berm required during detailed design.

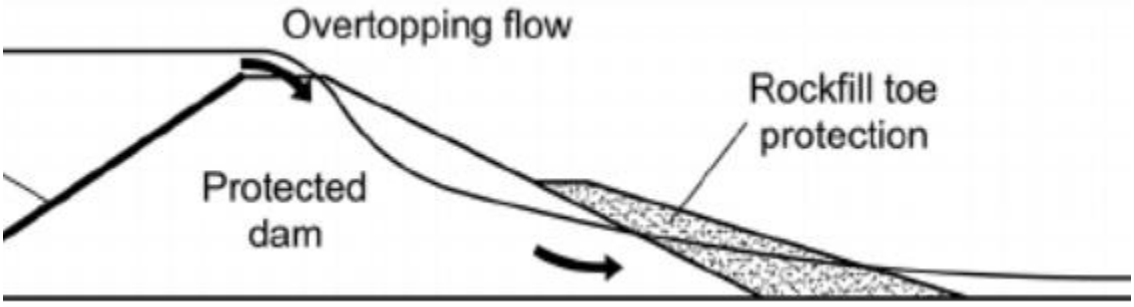

Figure 4-4: Typical toe berm. Source: https://www.researchgate.net/figure/Scheme-of-rockfill-toe-protection-against-through-flow-of-a-rockfill-dam_fig2_259459471

5 Closure

We trust that this report meets your requirements. If you have any questions or further information is required, please do not hesitate to contact the undersigned.

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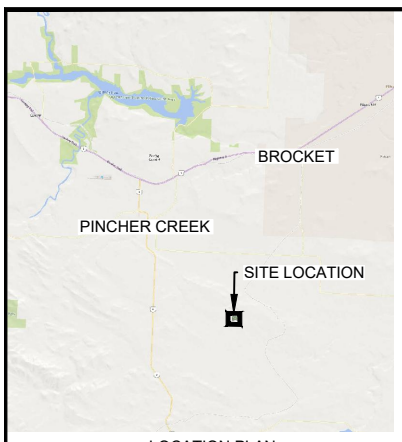
Appendix I

Site and Borehole Location Plan



LOCATION PLAN

N

BH23-01

BH23-02

Test Pit No.	Northing (m)	Easting (m)	Approximate Elevation (m)	Depth (mbgs)	Notes
BH23-01	5477342	294922	1222.2	23.1	Two Vibrating wire piezometers were installed and backfilled with cement bentonite grout
BH23-02	5477286	295034	1220	23.1	Backfilled with cement bentonite grout

DRAFT

LEGEND

● BOREHOLE

NOTES

1. Drawing is in metres (m), and located in UTM, NAD83, Zone 12.
2. Imagery provided by Autodesk Live Maps (year unknown).

SCALE 1:1,000 0 10 20 30 40 50 m

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CLIENT
M.D. of Pincher Creek No. 9

PROJECT LOCATION
PINCHER CREEK, ALBERTA

TITLE
BOREHOLE LOCATION PLAN

REFERENCE DRAWINGS		REVISIONS						
				-				
-	-	PA	2023-04-21	ISSUED FOR INFORMATION	SG	AC	-	-
DWG No	DESCRIPTION	REV	DATE	DESCRIPTION	DES	DRN	CHK	APP

DATE	2023-04-21	DWG No	694661-0000-4GDD-1000	FIG	-	REV	PA

Appendix II

Borehole Logs

BOREHOLE RECORD

BH23-01

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CLIENT: M. D OF PINCHER CREEK NO. 9
PROJECT: Therriault Dam- Geotechnical Investigation
LOCATION: Pincher Creek, AB
DATES: START: 22-March-23 END: 23-March-23

PROJECT NO. : 694661
COORDINATES : 5477346 N 294930 E
WATER LEVEL : 0m on 22-March-23

BH SIZE : 150 mm
DATUM : NAD 83 UTM 11 U
ELEVATION (m) : 1222.2

DEPTH(m)	ELEVATION(m)	STRATIGRAPHY	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE & NO	USCS SYMBOL	SPT (N) VALUE	OTHER TESTS	WATER WELL/ PIEZOMETER
0	1222.20								
	1221.90		TOPSOIL, trace organics, trace rootlets, trace gravel, brown, very moist		SS-SG19		26		
1			CLAYEY SILT, some sand, trace gravel, brown, moist, stiff		AS-SG-1				
	1220.70		SILTY CLAY, some sand to sandy, trace gravel/cobbles, medium plasticity, trace rootlets, trace to some organics, brown, moist, stiff to very stiff		AS-SG-2				
2									
3					SS-SG-3		11		
			sand seams at 3.7 m		AS-SG-4				
4									
			shelby tube taken at 4.6 m		ST-SG-5				
5									
6			brown to grey and trace organics at 6.1 m		SS-SG-6		17		
			grey below 6.7 m		AS-SG-7	CI		Gravel=3.2% Sand=29.7% Silt=36.1% Clay=31%	
7									
			trace to some organics below 7.6 m		SS-SG-8		16		
8									
9					SS-SG-9		15		
10									
11			Brownish grey and trace to some organics below 7.6 m		SS-SG-10		18		
12									
					SS-SG-11		20		
13									

Su Based on Unconfined Compressive Strength: (kPa) ▲
Su Based on Pocket Penetrometer : (kPa) ★
50 100 150 200
Su Scale (kPa)
W_P W W_L
WATER CONTENT & ATTERBERG LIMITS
SPT (N), BLOWS/0.3m
10 20 30 40 50 60 70 80 90
%WC, PL-LL, or SPT N Value Scale (% or N)

CONTRACTOR: Val's Drilling
DRILL RIG TYPE: Hydraulic Top Drive
DRILLING METHOD: Solid Stem Auger

LOGGED BY: SG
REVIEWED BY: MA
APPROVED BY: JZ

▽ *Water level during drilling

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BOREHOLE RECORD

BH23-01

SNC·LAVALIN

CLIENT: M. D OF PINCHER CREEK NO. 9

PROJECT: Therriault Dam- Geotechnical Investigation

LOCATION: Pincher Creek, AB

DATES: START: 22-March-23 END: 23-March-23

PROJECT NO. : 694661

COORDINATES : 5477346 N 294930 E

WATER LEVEL : 0m on 22-March-23

BH SIZE : 150 mm

DATUM : NAD 83 UTM 11 U

ELEVATION (m) : 1222.2

DEPTH(m)	ELEVATION(m)	STRATIGRAPHY	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE & NO	USCS SYMBOL	SPT (N) VALUE	OTHER TESTS	WATER WELL/ PIEZOMETER
13									
	1208.50								
14			SILTY CLAY TILL, sandy, trace gravel, trace organics, medium plasticity, grey, moist, very stiff		SS-SG-12		33		
15			some gravel and sandy below 15.2		SS-SG-13	CI	18	Gravel=14.8% Sand=28.9% Silt=31.3% Clay=25%	
16									
17					SS-SG-14		18		
18									
19					ST-SG-15				
20					SS-SG-16	CI	23	Gravel=8.4% Sand=29.9% Silt=34.2% Clay=27.5%	
21									
22					SS-SG-17		24		
23	1199.20				SS-SG-18		50		
	1199.10		SHALE, highly weathered, moist, brownish grey						
24			Notes: - End of borehole at 23.1 mbgl - Borehole open to 22.7 and dry upon completion - Two Vibrating wire peizometers installed and backfilled with cement bentonite grout. - Peizometer Tip elevation (m) VW159257 1210.2 VW160584 1204.2						
25									
26									

Su Based on Unconfined Compressive Strength: (kPa) ▲
Su Based on Pocket Penetrometer : (kPa) ★
50 100 150 200
Su Scale (kPa)
W_P W W_L
WATER CONTENT & ATTERBERG LIMITS
SPT (N), BLOWS/0.3m
10 20 30 40 50 60 70 80 90
%WC, PL-LL, or SPT N Value Scale (% or N)

CONTRACTOR: Val's Drilling
DRILL RIG TYPE: Hydraulic Top Drive
DRILLING METHOD: Solid Stem Auger

LOGGED BY: SG
REVIEWED BY: MA
APPROVED BY: JZ

▽ *Water level during drilling

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BOREHOLE RECORD

BH23-02

SNC·LAVALIN

CLIENT: M. D OF PINCHER CREEK NO. 9

PROJECT: Therriault Dam- Geotechnical Investigation

LOCATION: Pincher Creek, AB

DATES: **START:** 23-March-23 **END:** 23-March-23

PROJECT NO. : 694661

COORDINATES : 5477286 N 295034 E

WATER LEVEL : 0m on 23-March-23

BH SIZE : 100 mm

DATUM : NAD 83 UTM 11 U

ELEVATION (m) : 1220

DEPTH(m)	ELEVATION(m)	STRATIGRAPHY	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE & NO	USCS SYMBOL	SPT (N) VALUE	OTHER TESTS
0	1220.00							
	1219.62		TOPSOIL, trace organics, trace rootlets, trace gravel, brown, very moist		SS-SG-1		24	
1	1219.40		CLAYEY SILT, some sand, trace gravel, brown, moist, stiff		AS-SG-2			Gravel=9.4% Sand=43.8% Silt=23.1% Clay=23.7%
	1218.50		SANDY SILT, clayey, trace gravel, brown, moist, compac					
2			SILTY CLAY, sandy, some gravel/cobbles, medium plasticity, trace rootlets/topsoil, brown, moist, very stiff		AS-SG-3			
3			sand seams and trace rootlets below 3.1 m		SS-SG-4	CI	19	
4					AS-SG-5			Gravel=11.5% Sand=32.1% Silt=29.9% Clay=26.5%
	1215.40		SILTY CLAY TILL, sandy, trace gravel, medium plasticity, grey, moist, very stiff					
5					AS-SG-6			
6					SS-SG-7		19	
7								
8					SS-SG-8	CI	19	Gravel=3.3% Sand=21.1% Silt=40.6% Clay=35%
9			shelby tube taken at 9.1 m		ST-SG-9			
10								
11			trace cobbles at 10.7 m		SS-SG-10		13	
12			sand seams below 12.2 m		SS-SG-11		19	
13								

Su Based on Unconfined Compressive Strength: (kPa) ▲
Su Based on Pocket Penetrometer : (kPa) ★
50 100 150 200
Su Scale (kPa)
W_P W W_L
WATER CONTENT & ATTERBERG LIMITS
SPT (N), BLOWS/0.3m
10 20 30 40 50 60 70 80 90
%WC, PL-LL, or SPT N Value Scale (% or N)

WATER WELL/ PIEZOMETER

CONTRACTOR: Val's Drilling
DRILL RIG TYPE: Hydraulic Top Drive
DRILLING METHOD: Solid Stem Auger

LOGGED BY: SG
REVIEWED BY: MA
APPROVED BY: JZ

▽ *Water level during drilling

Printed May 17 2023 10:37:2

BOREHOLE RECORD

BH23-02

SNC·LAVALIN

CLIENT: M. D OF PINCHER CREEK NO. 9

PROJECT: Therriault Dam- Geotechnical Investigation

LOCATION: Pincher Creek, AB

DATES: **START:** 23-March-23 **END:** 23-March-23

PROJECT NO. : 694661

COORDINATES : 5477286 N 295034 E

WATER LEVEL : 0m on 23-March-23

BH SIZE : 100 mm

DATUM : NAD 83 UTM 11 U

ELEVATION (m) : 1220

DEPTH(m)	ELEVATION(m)	STRATIGRAPHY	SOIL DESCRIPTION	GRAPHIC	SAMPLE TYPE & NO	USCS SYMBOL	SPT (N) VALUE
13							
14			shelby tube taken at 13.7 m		ST-SG-12		
15			seams of sand and silt below 15.2 m		SS-SG-13		11
16							
17			wet below 16.8 m		SS-SG-14		13
18							
19			wet sand seams below 18.3 m		SS-SG-15		24
20					SS-SG-16		22
21			trace organics at 21.3 m		SS-SG-17		25
22							
23	1197.00*				SS-SG-18		50
	1196.90		SILTY CLAY, sandy, trace shale fragments, moist, grey, hard				
24			Notes: - End of borehole at 23.1 mbgl - Borehole open to 22.9 and dry upon completion - backfilled with cement bentonite grout				
25							
26							

Su Based on Unconfined Compressive Strength: (kPa) ▲
Su Based on Pocket Penetrometer : (kPa) ★
50 100 150 200
Su Scale (kPa)
W_P W W_L
WATER CONTENT & ATTERBERG LIMITS
SPT (N), BLOWS/0.3m
10 20 30 40 50 60 70 80 90
%WC, PL-LL, or SPT N Value Scale (% or N)

OTHER TESTS

WATER WELL/ PIEZOMETER

▽ *Water level during drilling

CONTRACTOR: Val's Drilling

DRILL RIG TYPE: Hydraulic Top Drive

DRILLING METHOD: Solid Stem Auger

LOGGED BY: SG

REVIEWED BY: MA

APPROVED BY: JZ

Appendix III

Laboratory Results

MOISTURE CONTENT TEST REPORT

(Test Reference: ASTM D 2216)

SNC·LAVALIN

MOISTURE CONTENT RESULTS

Sample #	Test Hole	Depth(m)	M/C %	Sample #	Test Hole	Depth(m)	M/C %
SG1	BH23-01		**12.5**	SG17	BH23-02		**18.4**
SG2	BH23-01		**16.4**	SG18	BH23-02		**12.1**
SG3	BH23-01		**17.3**				
SG4	BH23-01		**18.9**				
SG5	BH23-01		**15.3**				
SG6	BH23-01		**16.2**				
SG7	BH23-01		**16.9**				
SG8	BH23-01		**17.5**				
SG9	BH23-01		**16.7**				
SG10	BH23-01		**19.8**				
SG11	BH23-01		**17.8**				
SG12	BH23-01		**16.8**				
SG13	BH23-01		**16.4**				
SG14	BH23-01		**16.9**				
SG15	BH23-01		**19.2**				
SG16	BH23-01		**18.0**				
SG17	BH23-01		**17.3**				
SG18	BH23-01		**10.7**				
SG19	BH23-01		**20.9**				
SG1	BH23-02		**25.1**				
SG2	BH23-02		**9.4**				
SG3	BH23-02		**15.1**				
SG4	BH23-02		**16.5**				
SG5	BH23-02		**16.3**				
SG6	BH23-02		**16.3**				
SG7	BH23-02		**18.1**				
SG8	BH23-02		**19.0**				
SG9	BH23-02		**18.5**				
SG10	BH23-02		**18.3**				
SG11	BH23-02		**19.4**				
SG12	BH23-02		**19.4**				
SG13	BH23-02		**20.7**				
SG14	BH23-02		**30.4**				
SG15	BH23-02		**17.7**				
SG16	BH23-02		**17.6**				

Checker: **Reviewer:**

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Engineering interpretation will be provided by SNC Lavalin upon request

Client: M.D of Pincher Creek.
Project: Therriault Dam
Project #: 694661
Date: March 31 2023

Geoscience & Materials

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

Sample: BH23-01 SG-16 at (air-dried)

PLASTIC LIMIT		LIQUID LIMIT (METHOD B)			
		# of Blows	25	26	
Tare Wt, g	14.11	Tare Wt, g	14.40	13.89	
Wet + Tare, g	26.05	Wet + tare, g	26.94	25.20	
Dry + Tare, g	24.50	Dry + tare, g	23.44	22.05	
M%	14.9%	Water content	38.7%	38.6%	AVERAGE
		Adjusted W/C	38.7%	38.8%	38.8%

SUMMARY		COMMENTS
Plastic Limit:	**14.9%**	-
Liquid Limit:	**38.8%**	
Plasticity Index:	**23.8%**	
Classification:	**CI**	
Natural Water Content:	**18.0%**	

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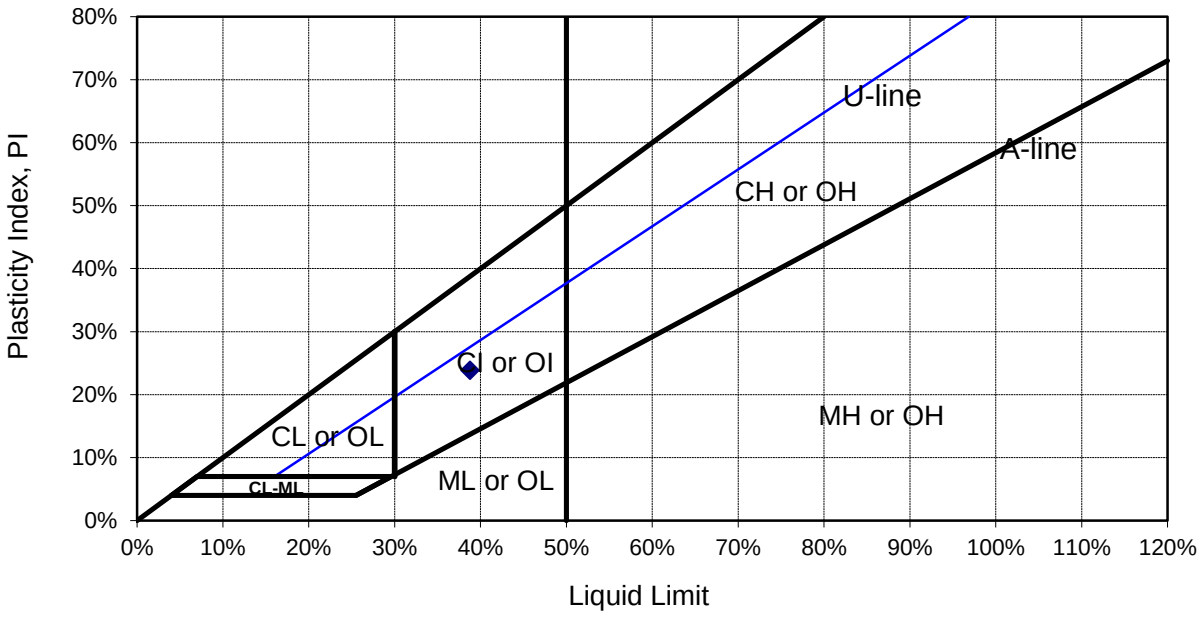

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Client: M.D of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 31-Mar-2023

Geoscience & Materials

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Sample: BH23-01 SG-7 at (air-dried)

PLASTIC LIMIT		LIQUID LIMIT (METHOD B)			
		# of Blows	21	22	
Tare Wt, g	14.2	Tare Wt, g	14.45	13.98	
Wet + Tare, g	25.38	Wet + tare, g	25.82	25.35	
Dry + Tare, g	23.98	Dry + tare, g	22.44	21.99	
M%	14.3%	Water content	42.3%	41.9%	AVERAGE
		Adjusted W/C	41.4%	41.3%	41.3%

SUMMARY		COMMENTS
Plastic Limit:	**14.3%**	-
Liquid Limit:	**41.3%**	
Plasticity Index:	**27.0%**	
Classification:	**CI**	
Natural Water Content:	**16.9%**	

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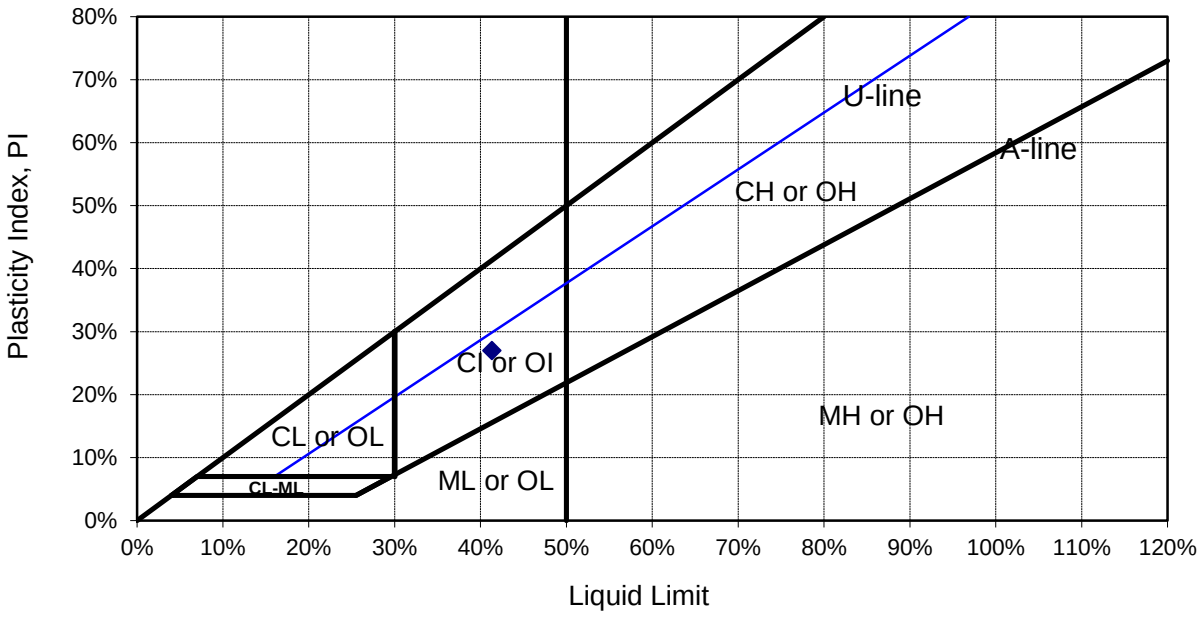

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Client: M.D of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 31-Mar-2023

Geoscience & Materials

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

SNC·LAVALIN

Sample:	BH23-02 SG-8 at	(air-dried)

PLASTIC LIMIT		LIQUID LIMIT (METHOD B)			
		# of Blows	24	26	
Tare Wt, g	14.24	Tare Wt, g	14.24	13.52	
Wet + Tare, g	26.86	Wet + tare, g	28.69	23.75	
Dry + Tare, g	25.28	Dry + tare, g	24.61	20.91	
M%	14.3%	Water content	39.3%	38.4%	AVERAGE
		Adjusted W/C	39.2%	38.6%	38.9%

SUMMARY		COMMENTS
Plastic Limit:	**14.3%**	-
Liquid Limit:	**38.9%**	
Plasticity Index:	**24.6%**	
Classification:	**CI**	
Natural Water Content:	**19.0%**	

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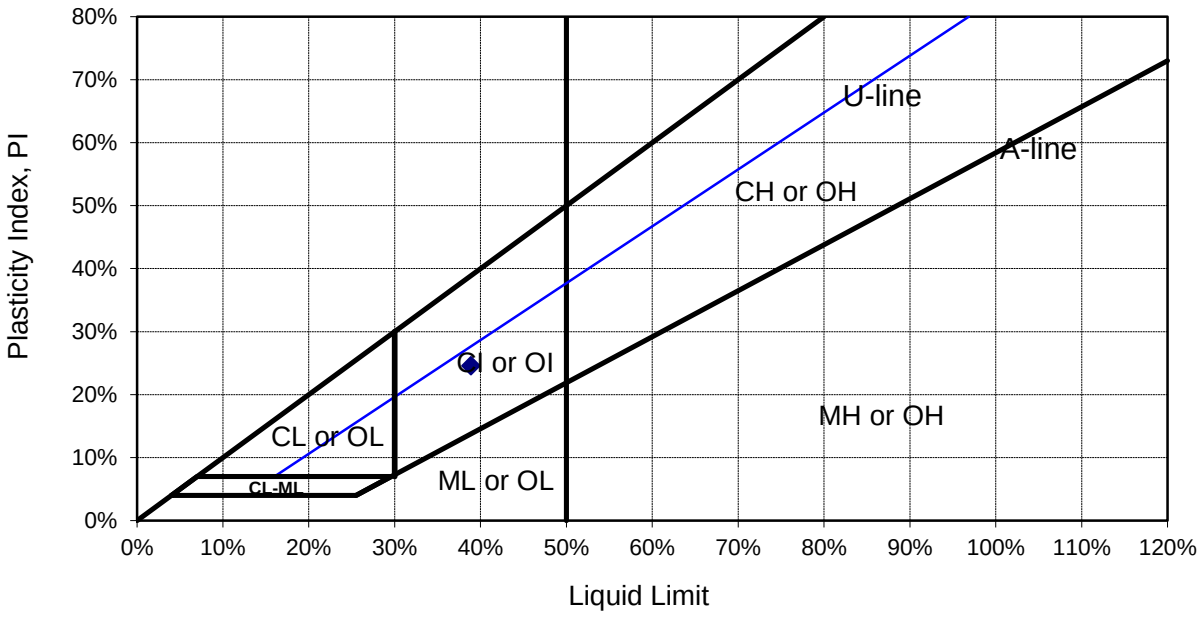

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Client: M.D of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 3-Apr-2023

Geoscience & Materials

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

Sample: BH23-02 SG-4 at (air-dried)

PLASTIC LIMIT		LIQUID LIMIT (METHOD B)			
		# of Blows	19	21	
Tare Wt, g	14.23	Tare Wt, g	13.77	14.48	
Wet + Tare, g	22.82	Wet + tare, g	25.79	26.86	
Dry + Tare, g	21.76	Dry + tare, g	22.49	23.48	
M%	14.1%	Water content	37.8%	37.6%	AVERAGE
		Adjusted W/C	36.6%	36.7%	36.6%

SUMMARY		COMMENTS
Plastic Limit:	**14.1%**	-
Liquid Limit:	**36.6%**	
Plasticity Index:	**22.6%**	
Classification:	**CI**	
Natural Water Content:	**16.5%**	

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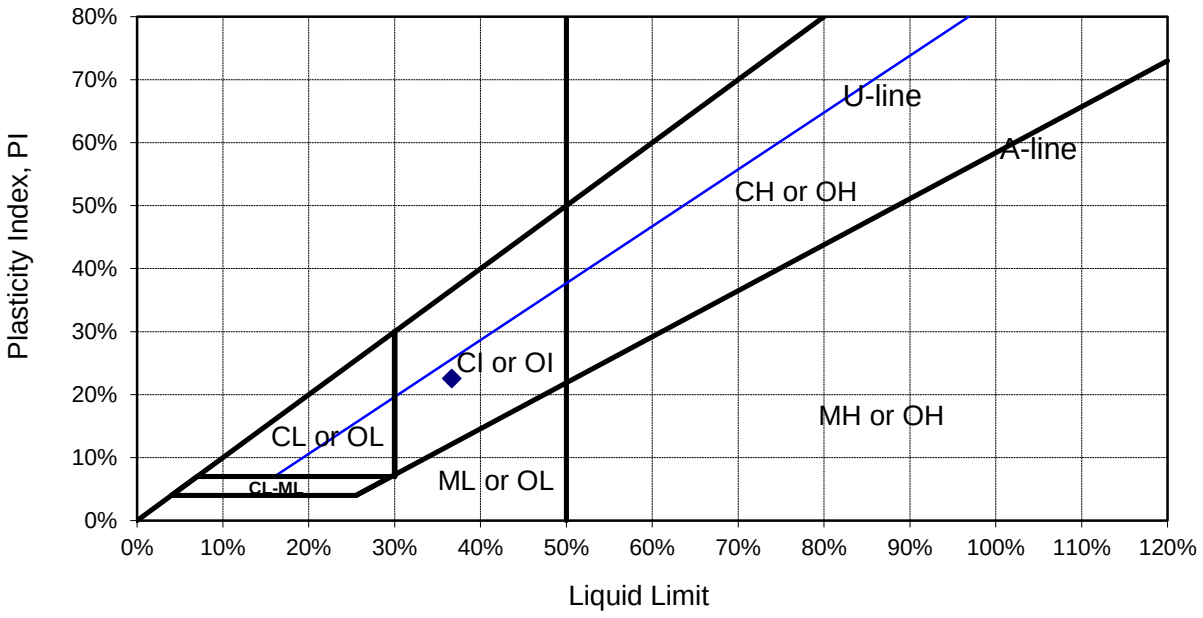

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Client: M.D of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 3-Apr-2023

Geoscience & Materials

ATTERBERG LIMITS TEST REPORT

(Test Reference: ASTM D 4318)

Sample: BH23-01 SG-13 at (air-dried)

PLASTIC LIMIT		LIQUID LIMIT (METHOD B)			
		# of Blows	19	21	
Tare Wt, g	14.39	Tare Wt, g	14.17	14.31	
Wet + Tare, g	24.73	Wet + tare, g	26.01	25.31	
Dry + Tare, g	23.42	Dry + tare, g	22.52	22.18	
M%	14.5%	Water content	41.8%	39.8%	AVERAGE
		Adjusted W/C	40.4%	38.9%	39.6%

SUMMARY		COMMENTS
Plastic Limit:	**14.5%**	-
Liquid Limit:	**39.6%**	
Plasticity Index:	**25.1%**	
Classification:	**CI**	
Natural Water Content:	**16.4%**	

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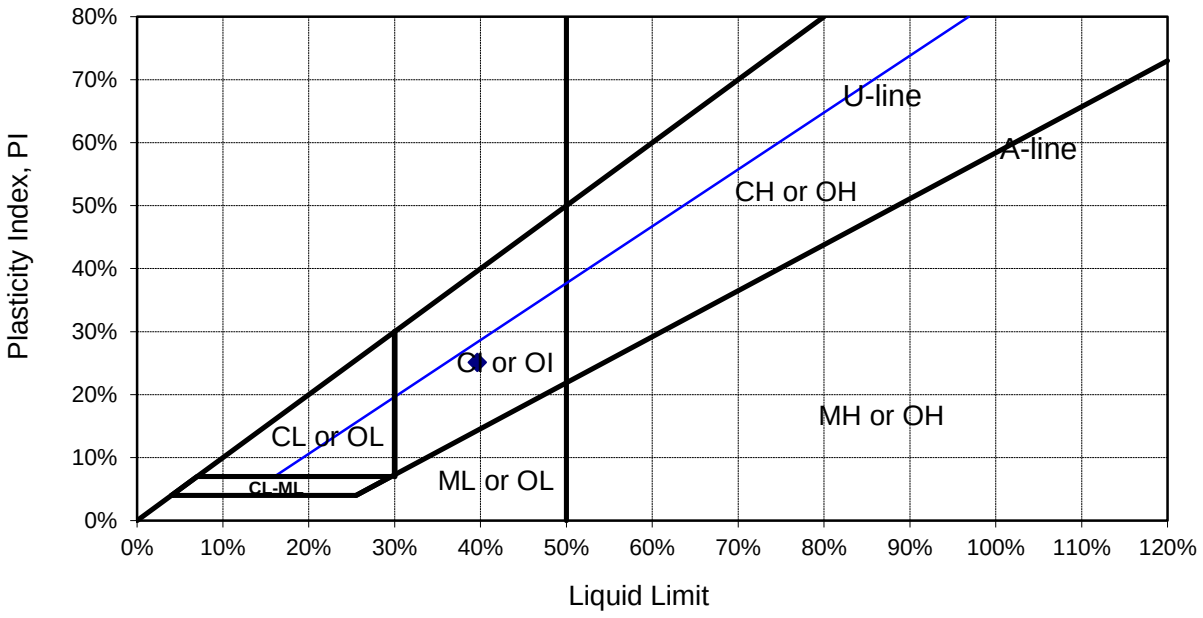

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Engineering interpretation will be provided by SNC Lavalin upon request

Client: M.D of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 3-Apr-2023

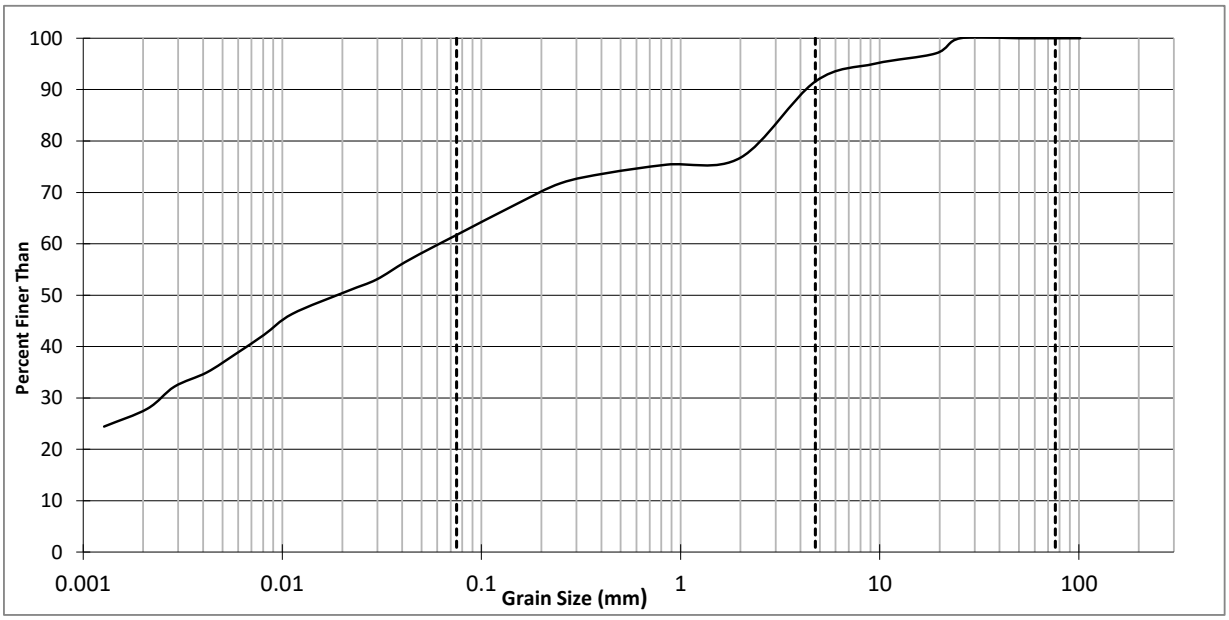
Geoscience & Materials

HYDROMETER TEST REPORT

(Test Reference: ASTM D7928)

Sample: SG16 BH23-01

Mechanical Analysis			Hydrometer Analysis		Summary of Analysis	
Sieve	Dia. (mm)	% Finer	Dia. (mm)	% Finer	Particle Size Distribution Summary	
4"	101.6	100	0.0571	59.3	% Cobble	0.0
3"	76.2	100	0.0411	56.4	% Gravel	8.4
2"	50.8	100	0.0296	53.0	% Sand	29.9
1"	25.4	100	0.0212	50.8	% Silt Size (<75µ>2µ)	34.2
3/4"	19.1	97	0.0112	46.4	% Clay Size (<2µ)	27.5
3/8"	9.50	95	0.0081	42.3		
#4	4.75	92	0.0058	38.6	Dispersing Agent used:	
#10	2.00	77	0.0042	35.0	*Sodium Hexametaphosphate*	
#20	0.850	75	0.0029	32.2		
#40	0.425	74	0.0021	27.9		
#60	0.250	72	0.0013	24.4	Comments:	
#100	0.150	68			-	
#200	0.075	62				



FINES (silt, clay) 61.7 %	SAND 29.9 %	GRAVEL 8.4 %	COBBLE 0.0 %

Checker: **Reviewer:**

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Engineering interpretation will be provided by SNC Lavalin upon request

Client: MD of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 2023-03-23

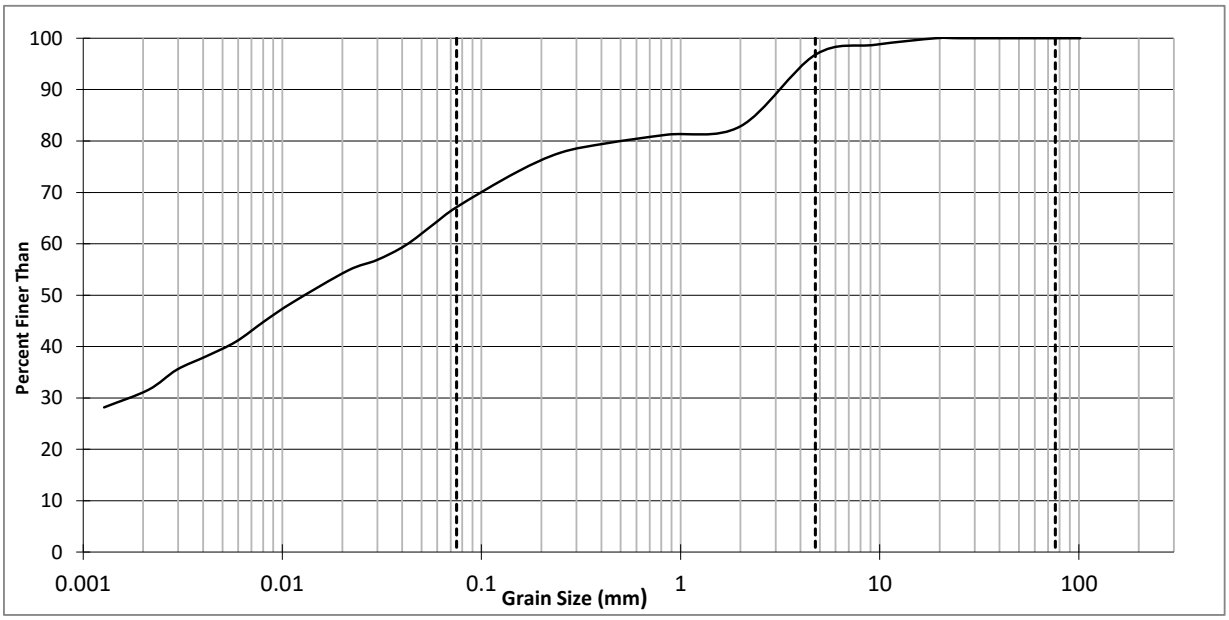
Geoscience & Materials

HYDROMETER TEST REPORT

(Test Reference: ASTM D7928)

Sample: SG7 BH23-01

Mechanical Analysis			Hydrometer Analysis		Summary of Analysis	
Sieve	Dia. (mm)	% Finer	Dia. (mm)	% Finer	Particle Size Distribution Summary	
4"	101.6	100	0.0575	63.8	% Cobble	0.0
3"	76.2	100	0.0416	59.7	% Gravel	3.2
2"	50.8	100	0.0299	56.8	% Sand	29.7
1"	25.4	100	0.0213	54.8	% Silt Size (<75µ>2µ)	36.1
3/4"	19.1	100	0.0113	48.7	% Clay Size (<2µ)	31.0
3/8"	9.50	99	0.0082	45.0		
#4	4.75	97	0.0059	41.0	Dispersing Agent used:	
#10	2.00	83	0.0042	38.2	*Sodium Hexametaphosphate*	
#20	0.850	81	0.0030	35.5		
#40	0.425	80	0.0021	31.6		
#60	0.250	78	0.0013	28.2	Comments:	
#100	0.150	74			-	
#200	0.075	67				



FINES (silt, clay) 67.1 %	SAND 29.7 %	GRAVEL 3.2 %	COBBLE 0.0 %

Checker: **Reviewer:**

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Engineering interpretation will be provided by SNC Lavalin upon request

Client: MD of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 2024-04-10

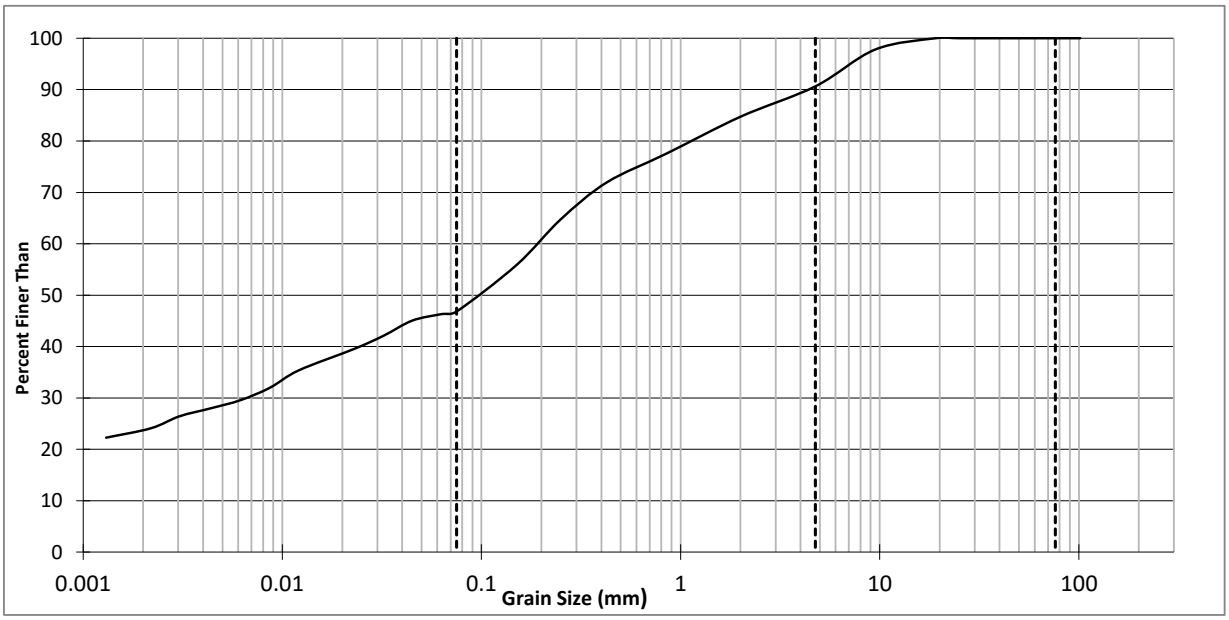
Geoscience & Materials

HYDROMETER TEST REPORT

(Test Reference: ASTM D7928)

Sample: SG2 BH23-02

Mechanical Analysis			Hydrometer Analysis		Summary of Analysis	
Sieve	Dia. (mm)	% Finer	Dia. (mm)	% Finer	Particle Size Distribution Summary	
4"	101.6	100	0.0633	46.3	% Cobble	0.0
3"	76.2	100	0.0450	45.1	% Gravel	9.4
2"	50.8	100	0.0322	42.1	% Sand	43.8
1"	25.4	100	0.0230	39.6	% Silt Size (<75µ>2µ)	23.1
3/4"	19.1	100	0.0121	35.4	% Clay Size (<2µ)	23.7
3/8"	9.50	98	0.0087	32.0		
#4	4.75	91	0.0062	29.6	Dispersing Agent used:	
#10	2.00	85	0.0044	28.0	*Sodium Hexametaphosphate*	
#20	0.850	78	0.0030	26.4		
#40	0.425	72	0.0022	24.1		
#60	0.250	65	0.0013	22.3	Comments:	
#100	0.150	56			-	
#200	0.075	47				



FINES (silt, clay) 46.8 %	SAND 43.8 %	GRAVEL 9.4 %	COBBLE 0.0 %

Checker: **Reviewer:**

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Engineering interpretation will be provided by SNC Lavalin upon request

Client: MD of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 2023-04-10

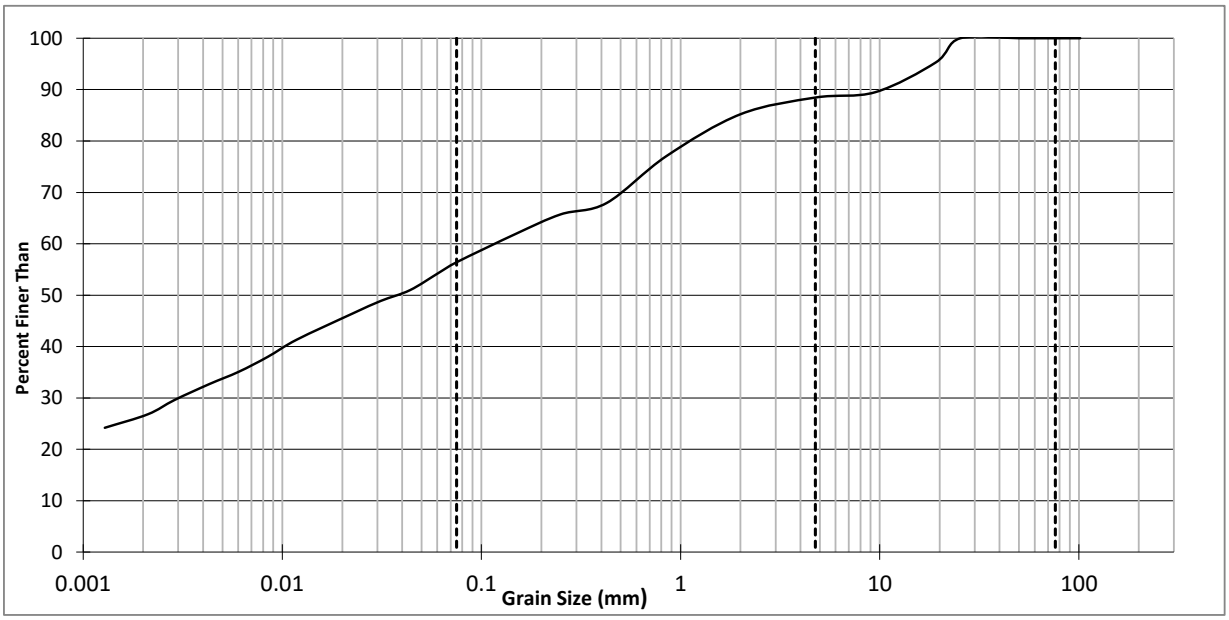
Geoscience & Materials

HYDROMETER TEST REPORT

(Test Reference: ASTM D7928)

Sample: SG4 BH23-02

Mechanical Analysis			Hydrometer Analysis		Summary of Analysis	
Sieve	Dia. (mm)	% Finer	Dia. (mm)	% Finer	Particle Size Distribution Summary	
4"	101.6	100	0.0609	54.3	% Cobble	0.0
3"	76.2	100	0.0438	51.0	% Gravel	11.5
2"	50.8	100	0.0312	48.9	% Sand	32.1
1"	25.4	100	0.0224	46.4	% Silt Size (<75µ>2µ)	29.9
3/4"	19.1	95	0.0118	41.3	% Clay Size (<2µ)	26.5
3/8"	9.50	89	0.0085	38.0		
#4	4.75	88	0.0060	35.1	Dispersing Agent used:	
#10	2.00	85	0.0043	32.7	*Sodium Hexametaphosphate*	
#20	0.850	77	0.0029	29.6		
#40	0.425	68	0.0021	26.8		
#60	0.250	66	0.0013	24.2	Comments:	
#100	0.150	62			-	
#200	0.075	56				



FINES (silt, clay) 56.4 %	SAND 32.1 %	GRAVEL 11.5 %	COBBLE 0.0 %

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Client: MD of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 2023-04-10

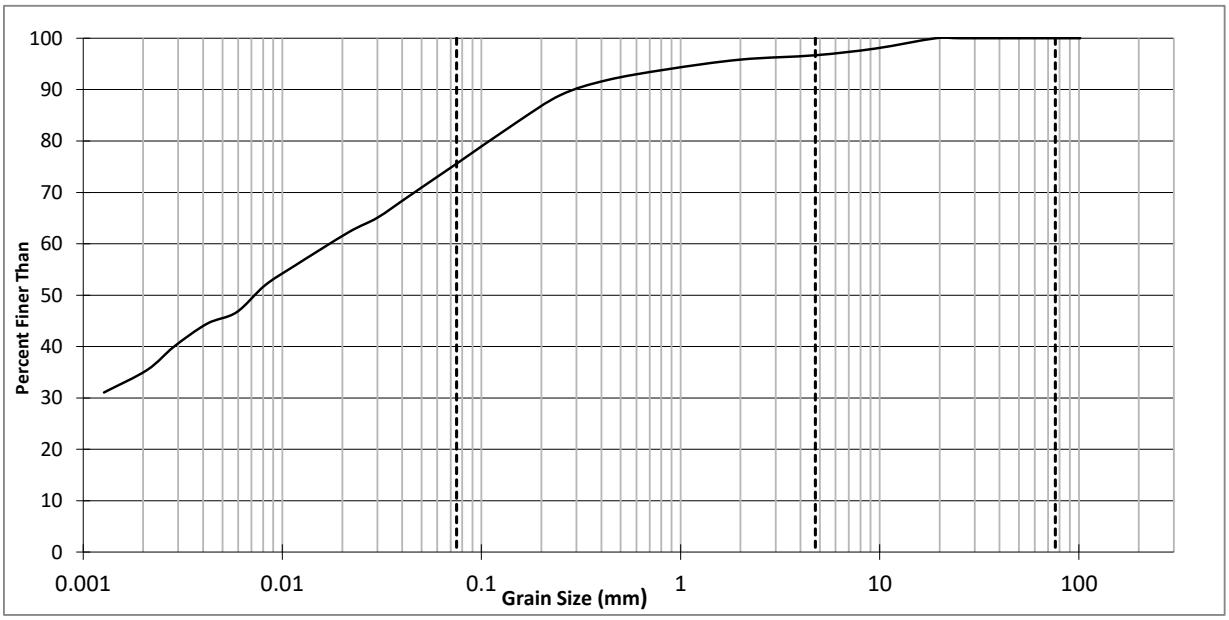
Geoscience & Materials

HYDROMETER TEST REPORT

(Test Reference: ASTM D7928)

Sample: SG8 BH23-02

Mechanical Analysis			Hydrometer Analysis		Summary of Analysis	
Sieve	Dia. (mm)	% Finer	Dia. (mm)	% Finer	Particle Size Distribution Summary	
4"	101.6	100	0.0579	72.6	% Cobble	0.0
3"	76.2	100	0.0416	68.8	% Gravel	3.3
2"	50.8	100	0.0300	65.1	% Sand	21.1
1"	25.4	100	0.0214	62.2	% Silt Size (<75µ>2µ)	40.6
3/4"	19.1	100	0.0114	55.6	% Clay Size (<2µ)	35.0
3/8"	9.50	98	0.0082	51.9		
#4	4.75	97	0.0059	46.7	Dispersing Agent used:	
#10	2.00	96	0.0042	44.4	*Sodium Hexametaphosphate*	
#20	0.850	94	0.0029	40.0		
#40	0.425	92	0.0021	35.4		
#60	0.250	89	0.0013	31.1	Comments:	
#100	0.150	84			-	
#200	0.075	76				



FINES (silt, clay) 75.6 %	SAND 21.1 %	GRAVEL 3.3 %	COBBLE 0.0 %

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Project: Therriault Dam
Project #: 694661
Date: 2023-04-10

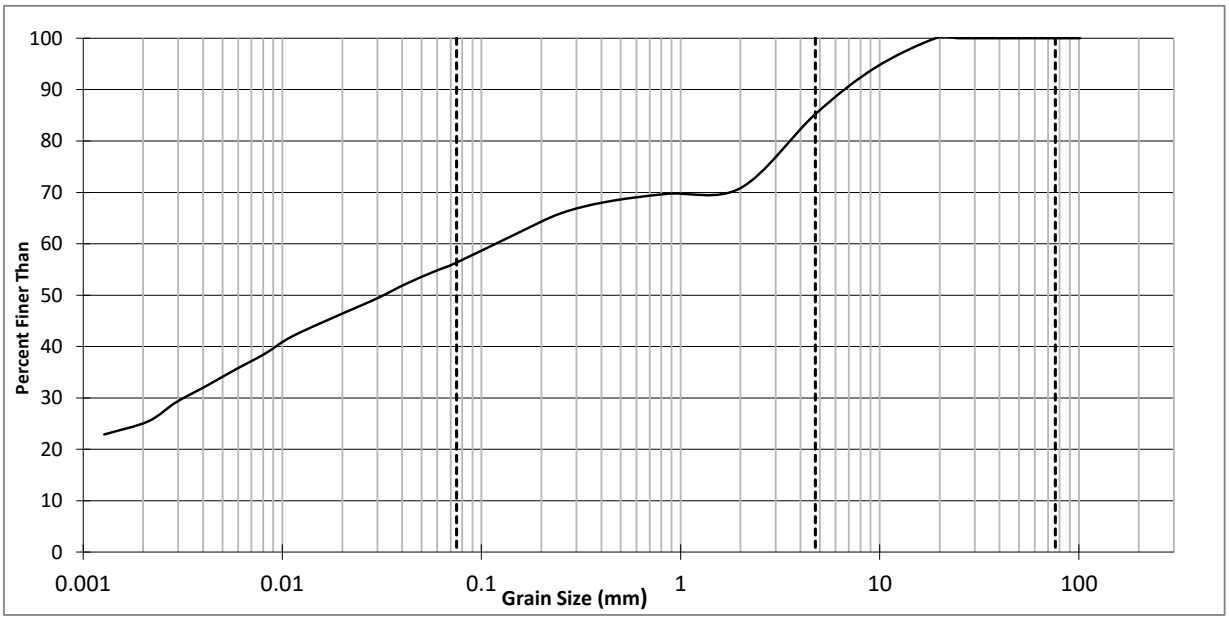
Geoscience & Materials

HYDROMETER TEST REPORT

(Test Reference: ASTM D7928)

Sample: SG13 BH23-01

Mechanical Analysis			Hydrometer Analysis		Summary of Analysis	
Sieve	Dia. (mm)	% Finer	Dia. (mm)	% Finer	Particle Size Distribution Summary	
4"	101.6	100	0.0575	54.5	% Cobble	0.0
3"	76.2	100	0.0413	52.1	% Gravel	14.8
2"	50.8	100	0.0297	49.3	% Sand	28.9
1"	25.4	100	0.0213	46.9	% Silt Size (<75µ>2µ)	31.3
3/4"	19.1	100	0.0113	42.0	% Clay Size (<2µ)	25.0
3/8"	9.50	94	0.0081	38.6		
#4	4.75	85	0.0058	35.5	Dispersing Agent used:	
#10	2.00	71	0.0042	32.4	*Sodium Hexametaphosphate*	
#20	0.850	70	0.0029	29.1		
#40	0.425	68	0.0021	25.4		
#60	0.250	66	0.0013	22.9	Comments:	
#100	0.150	62			-	
#200	0.075	56				



FINES (silt, clay) 56.3 %	SAND 28.9 %	GRAVEL 14.8 %	COBBLE 0.0 %

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Client: MD of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 2023-04-10

Geoscience & Materials

UNCONFINED COMPRESSION TEST REPORT

(Test Reference: ASTM D 2166)

SNC·LAVALIN

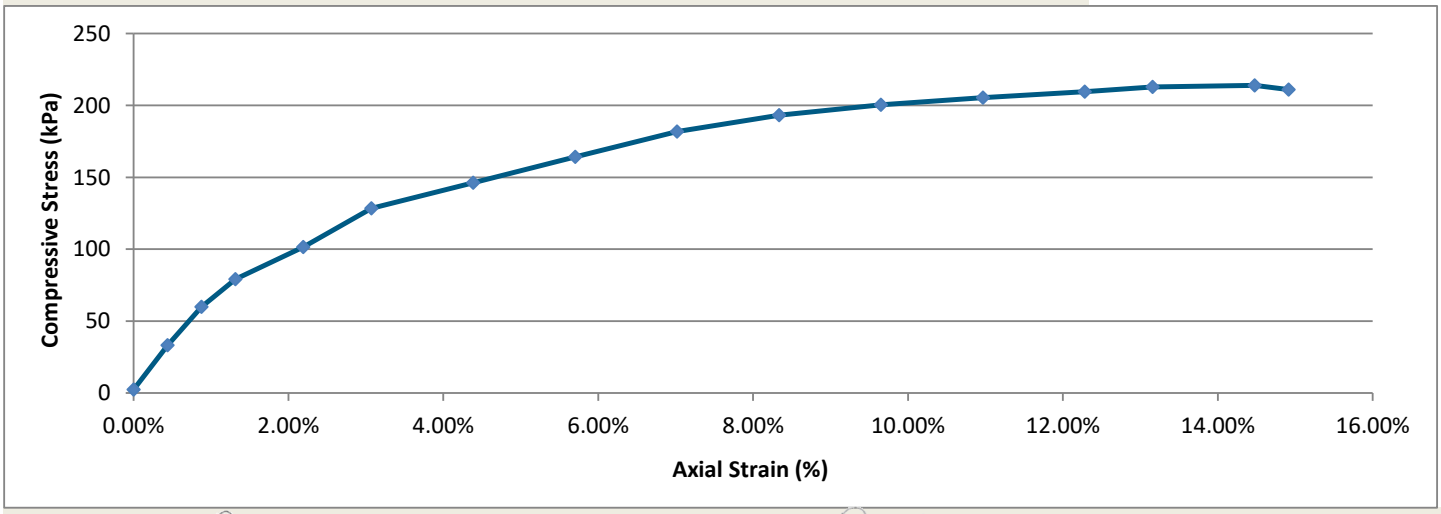
Sample: SG-09 BH 23-02 at

Water Content %	19.5%	Average Pocket Pen Result		N/A	
Mass of Test Specimen, g	1279.18	Stress	load/(corr. area)		
Wet Density, kg/m^3	2113	Corr. Area	A_o/(1 - unit strain)		
Dry Density, kg/m^3	1768	Unit Strain	$\Delta L/L_o$		
Specific Gravity (Assumed)	2.70	L_o/D_o	1.99		
Degree of Saturation	1.00	Strain Rate	0.88	%/min	
Initial Diameter, D_o, cm	7.29				
Initial Area, A_o, cm^2	41.77	Unconfined Compressive Strength, q_u			
Initial Height, L_o, cm	14.50	**214**	**kPa**		
Initial Volume, V_o, cm^3	605.48				

Consistency	q_u, kPa
Very soft	0-24
Soft	24-48
Medium	48-96
Stiff	96-192
Very stiff	192-383
Hard	>383

Elapsed Time,min	Load-cell Dial Reading	Axial Load,kg	Strain Dial	Total Strain,mm	Unit Strain	Corrected Area, cm2	Stress, kPa
0.0	8	1.01	0	0.00	0.00%	41.77	2.4
0.5	38	14.20	25	0.64	0.44%	41.95	33.2
1.0	63	25.76	50	1.27	0.88%	42.13	60.0
1.5	82	34.18	75	1.91	1.32%	42.32	79.2
2.5	105	44.17	125	3.18	2.19%	42.70	101.4
3.5	134	56.45	175	4.45	3.07%	43.09	128.5
5.0	154	65.14	250	6.36	4.39%	43.68	146.2
6.5	175	74.17	325	8.27	5.70%	44.29	164.2
8.0	196	83.26	400	10.18	7.02%	44.92	181.8
9.5	211	89.76	475	12.08	8.34%	45.56	193.2
11.0	222	94.44	550	13.99	9.65%	46.23	200.3
12.5	231	98.27	625	15.90	10.97%	46.91	205.4
14.0	239	101.73	700	17.81	12.28%	47.61	209.5
15.0	245	104.35	750	19.08	13.16%	48.09	212.8
16.5	250	106.53	825	20.99	14.48%	48.84	213.9
17	248	105.66	850	21.62	14.92%	49.09	211.1

Post Test



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Client: M. D of Pincher Creek
Project:
Project #: 694661
Date: 25-Apr-2023

Geoscience & Materials

UNCONFINED COMPRESSION TEST REPORT

(Test Reference: ASTM D 2166)

SNC·LAVALIN

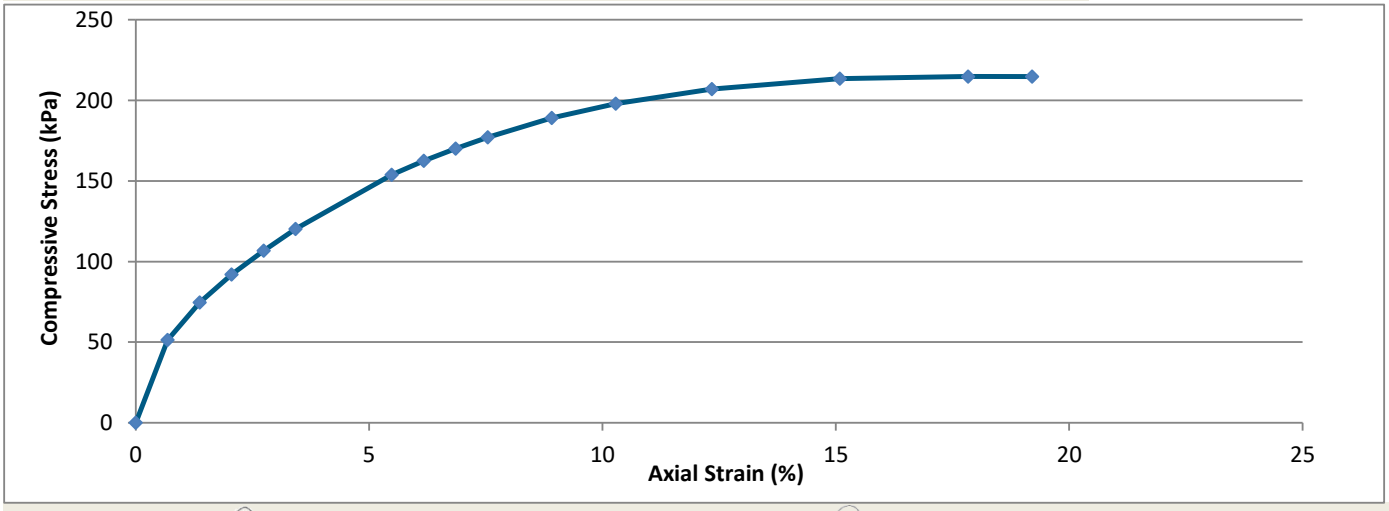
Sample: SG-12 BH 23-02 at 45-47.5ft

Water Content %	17.7%	Average Pocket Pen Result	N/A
Mass of Test Specimen, g	1308.76	Stress	load/(corr. area)
Wet Density, kg/m^3	2172	Corr. Area	A_o/(1 - unit strain)
Dry Density, kg/m^3	1846	Unit Strain	$\Delta L/L_o$
Specific Gravity (Assumed)	2.70	L_o/D_o	2.01
Degree of Saturation	1.00	Strain Rate	1.37% /min
Initial Diameter, D_o, cm	7.26		
Initial Area, A_o, cm^2	41.35	Unconfined Compressive Strength, q_u	
Initial Height, L_o, cm	14.57	**216**	**kPa**
Initial Volume, V_o, cm^3	602.59		

Consistency	q_u, kPa
Very soft	0-24
Soft	24-48
Medium	48-96
Stiff	96-192
Very stiff	192-383
Hard	>383

Elapsed Time,min	Axial Load,N	LVDT, mm	Total Deviation	Unit Strain, %	Corrected Area, cm2	Stress, kPa
0.0	1	0.00	0.0	0.00	0.004135	0.00
0.5	215	0.99	1.0	0.68	0.004163	51.40
1.0	314	1.99	2.0	1.37	0.004192	74.66
1.5	389	2.99	3.0	2.05	0.004221	91.91
2.0	455	3.99	4.0	2.74	0.004251	106.79
2.5	516	4.99	5.0	3.42	0.004281	120.29
4.0	674	8.00	8.0	5.49	0.004375	153.84
4.5	717	8.99	9.0	6.17	0.004407	162.48
5.0	756	9.99	10.0	6.85	0.004439	170.08
5.5	793	10.99	11.0	7.54	0.004472	177.10
6.5	859	12.99	13.0	8.91	0.004539	189.01
7.5	913	14.99	15.0	10.29	0.004609	197.88
9.0	977	17.99	18.0	12.34	0.004717	206.91
11.0	1040	21.99	22.0	15.09	0.004870	213.37
13.0	1082	25.99	26.0	17.83	0.005032	214.81
14.0	1100	27.99	28.0	19.21	0.005118	214.74

Post Test



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Engineering interpretation will be provided by SNC Lavalin upon request

Client: M. D of Pincher Creek
Project:
Project #: 694661
Date: 21-Apr-2023

Geoscience & Materials

UNCONFINED COMPRESSION TEST REPORT

(Test Reference: ASTM D 2166)

SNC·LAVALIN

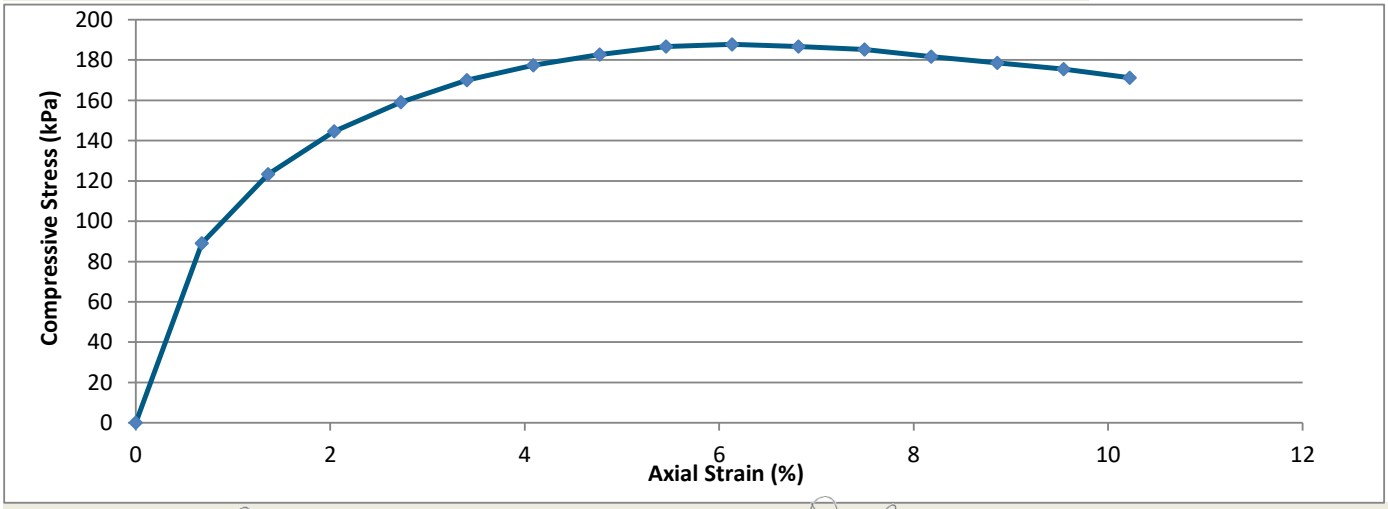
Sample: SG-15 BH 23-01 at 60ft

Water Content %	15.7%	Average Pocket Pen Result		N/A	
Mass of Test Specimen, g	1305.13	Stress	load/(corr. area)		
Wet Density, kg/m^3	2139	Corr. Area	A_o/(1 - unit strain)		
Dry Density, kg/m^3	1849	Unit Strain	$\Delta L/L_o$		
Specific Gravity (Assumed)	2.70	L_o/D_o	2.02		
Degree of Saturation	0.92	Strain Rate	1.36%	/min	
Initial Diameter, D_o, cm	7.28				
Initial Area, A_o, cm^2	41.59	Unconfined Compressive Strength, q_u			
Initial Height, L_o, cm	14.67	**188**	**kPa**		
Initial Volume, V_o, cm^3	610.13				

Consistency	q_u, kPa
Very soft	0-24
Soft	24-48
Medium	48-96
Stiff	96-192
Very stiff	192-383
Hard	>383

Elapsed Time,min	Axial Load,N	LVDT, mm	Total Deviation	Unit Strain, %	Corrected Area, cm2	Stress, kPa
0.0	0	0.00	0.0	0.00	0.004159	0.00
0.5	373	1.00	1.0	0.68	0.004188	89.07
1.0	520	2.00	2.0	1.36	0.004217	123.32
1.5	614	3.00	3.0	2.04	0.004246	144.61
2.0	680	4.00	4.0	2.73	0.004276	159.04
2.5	732	5.00	5.0	3.41	0.004306	170.01
3.0	769	6.00	6.0	4.09	0.004336	177.33
3.5	798	7.00	7.0	4.77	0.004367	182.72
4.0	821	8.00	8.0	5.45	0.004399	186.63
4.5	832	9.00	9.0	6.13	0.004431	187.78
5.0	833	10.00	10.0	6.82	0.004463	186.63
5.5	833	11.00	11.0	7.50	0.004496	185.27
6.0	823	12.00	12.0	8.18	0.004530	181.69
6.5	815	13.00	13.0	8.86	0.004563	178.60
7.0	807	14.00	14.0	9.54	0.004598	175.51
7.5	793	15.00	15.0	10.22	0.004633	171.17

Post Test



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Client: M. D of Pincher Creek
Project:
Project #: 694661
Date: 21-Apr-2023

Geoscience & Materials

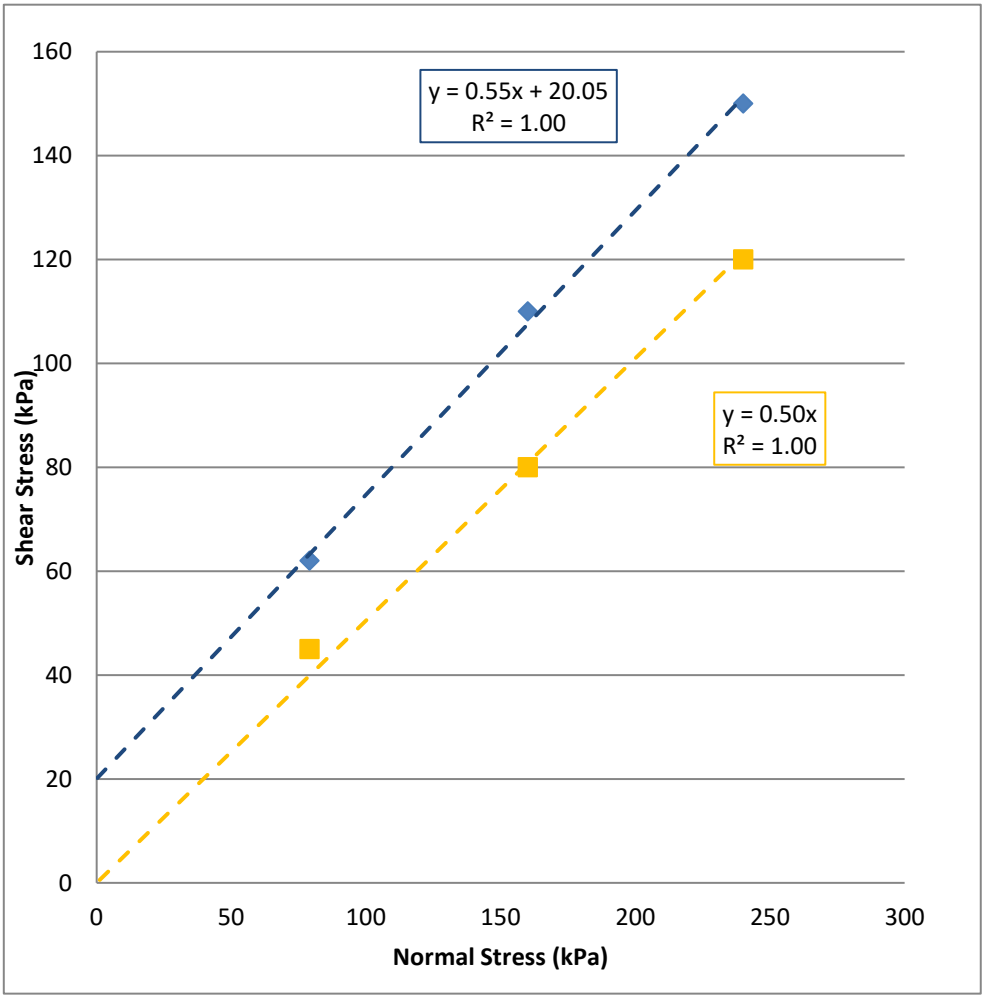
DIRECT SHEAR TEST REPORT

(Test Reference: ASTM D 3080)

SNC·LAVALIN

Sample: SG-5 - at 15-17.5ft

	Pre-test Conditions				Post-test Results		
#	Normal Stress	Pre M/C	Void Ratio	% Saturation	Peak Shear	Post Peak	Post M/C
1	79 kPa	13.7%	0.43	86.3%	62 kPa	45 kPa	19.4%
2	160 kPa	14.9%	0.46	88.4%	110 kPa	80 kPa	17.3%
3	240 kPa	13.5%	0.42	86.4%	150 kPa	120 kPa	16.7%



ENVELOPE		
Peak Angle	◆	**28.7 º**
Peak Intercept		**20 kPa**
Post Peak Angle	■	**26.6 º**
Post Peak Intercept		**kPa**
Shear Rate:		**0.00762 mm/min**
Assumed Sp. G.		**2.7**

Equipment:	Karol Warner Model 2001D
Range for rate of strain:	0.0003mm/min to 0.76mm/min
Load Capacity:	680 kg
Maximum traverse displacement:	10 mm

Sample information

Test performed on inundated sample? Yes

Maximum Observed Particle Size

Sample 1	Sample 2	Sample 3
< 5mm	< 5mm	< 5mm

Comments:

1. No area correction was applied to computation of shear
2. Due to inevitable sample loss and distortion of sample shape during testing - final densities can not be accurately measured
3. Used as received moisture content
4. Trendlines calculated using basic linear regression

Checker: Don Hughston **Reviewer:**

Client: M.D of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 27-Apr-23

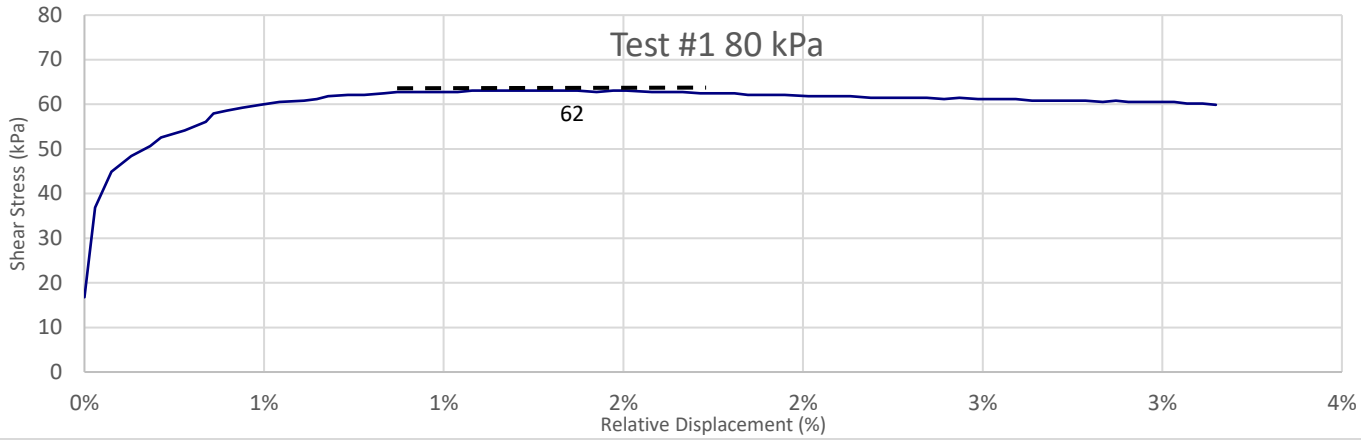
Geoscience & Materials

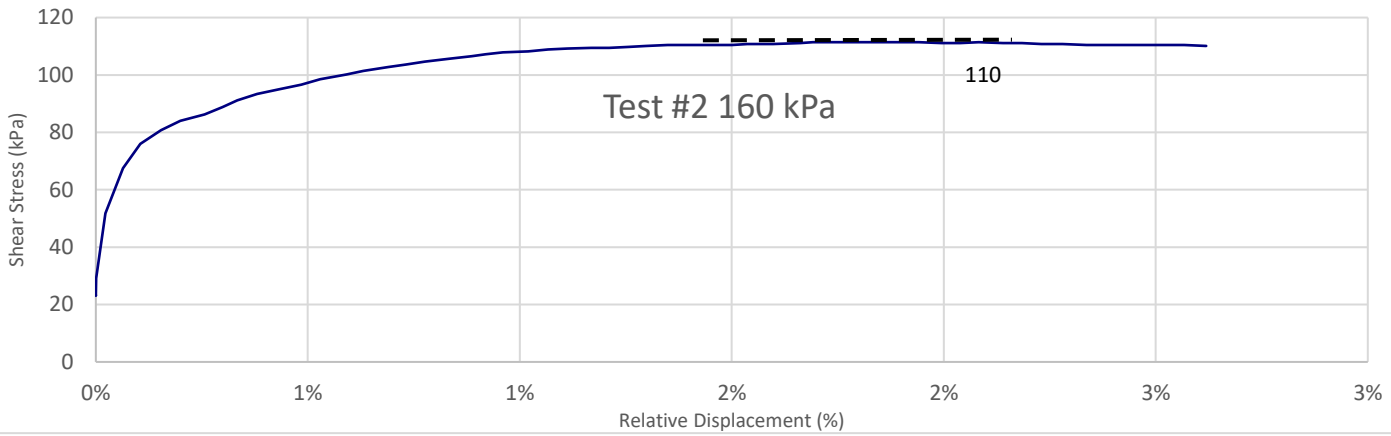
DIRECT SHEAR TEST REPORT

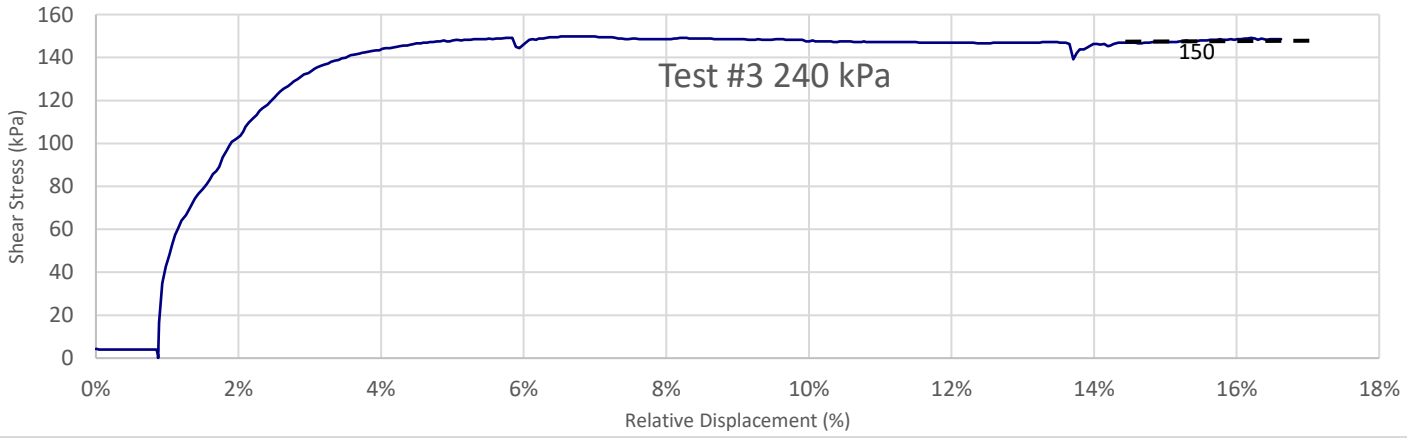
(Test Reference: ASTM D 3080)

SNC·LAVALIN

Sample: SG-5 - at 15-17.5ft







Checker: Don Hamblin **Reviewer:**

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Project: Therriault Dam
Project #: 694661
Date: 27-Apr-23

Geoscience & Materials

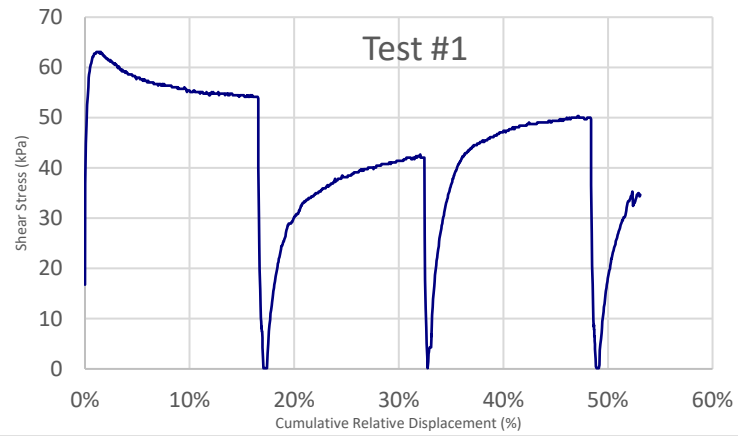
DIRECT SHEAR TEST REPORT

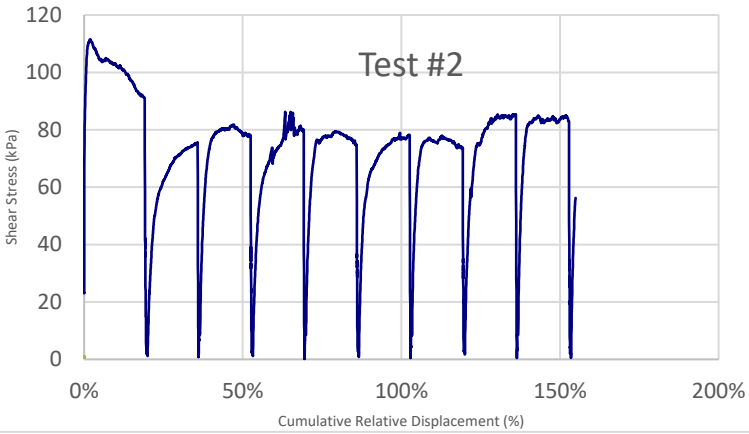
(Test Reference: ASTM D 3080)

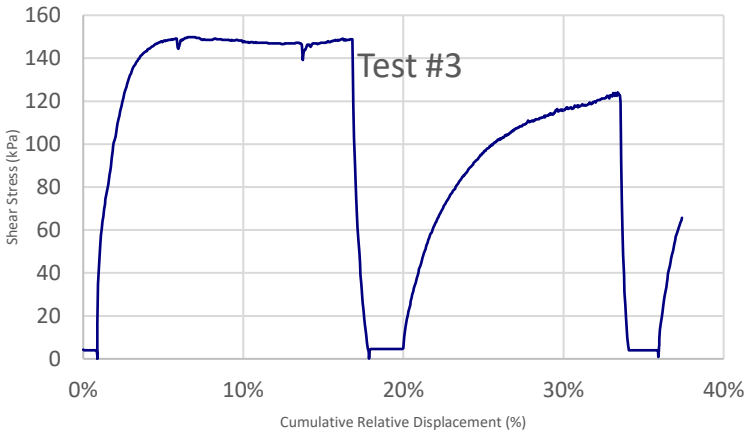
SNC·LAVALIN

Sample: SG-5 - at 15-17.5ft

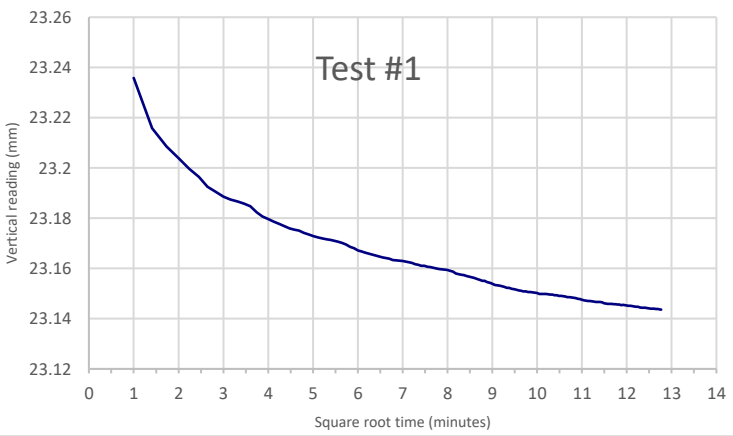
SHEAR STRENGTH GRAPHS

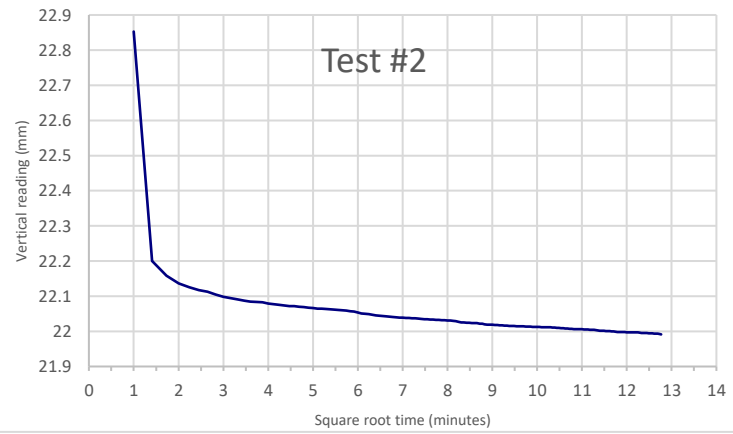


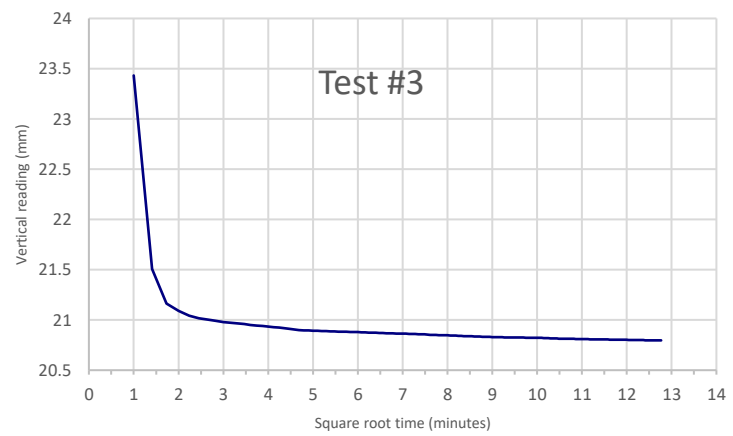




CONSOLIDATION GRAPHS







Checker: Don Hopkinson **Reviewer:** KH

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Client: M.D of Pincher Creek
Project: Therriault Dam
Project #: 694661
Date: 27-Apr-23

Geoscience & Materials

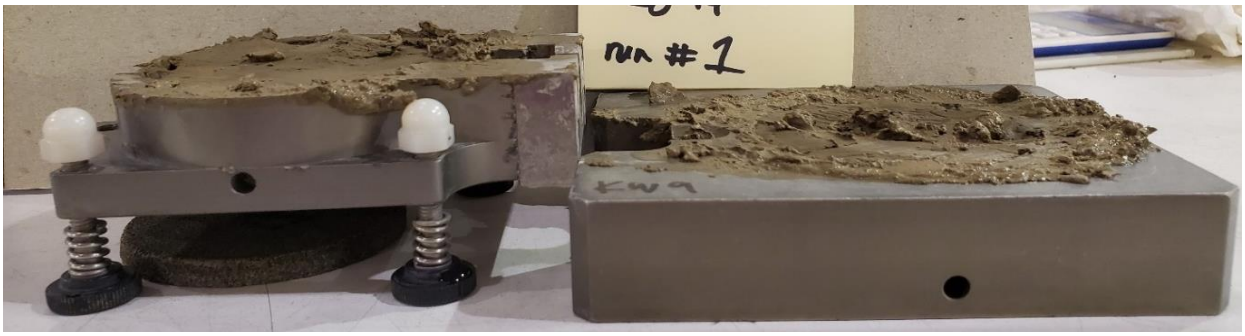
DIRECT SHEAR TEST REPORT

(Test Reference: ASTM D 3080)

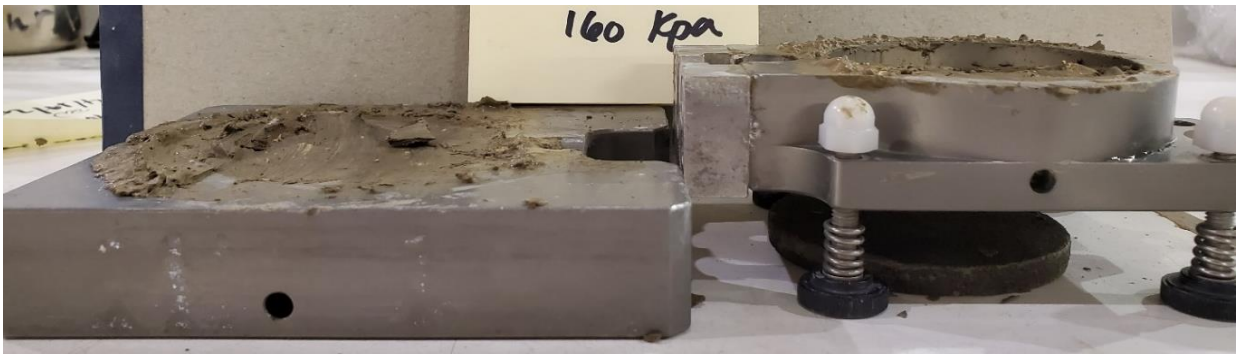
Sample: SG-5 - at 15-17.5ft

SNC·LAVALIN

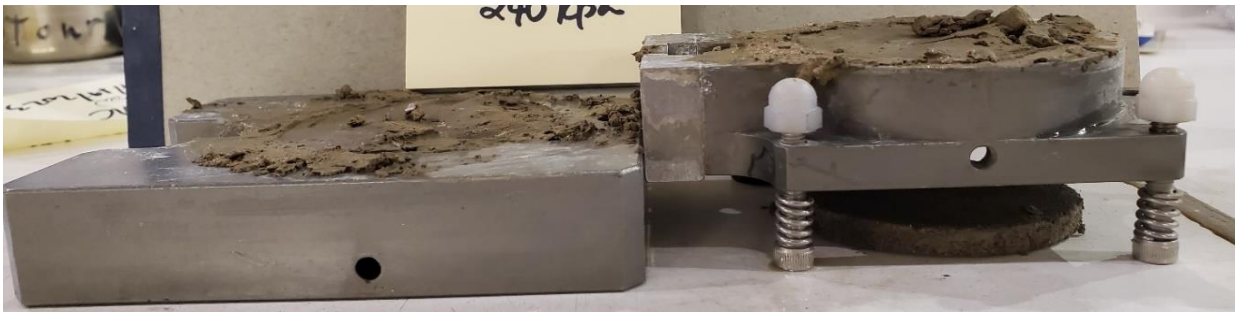
Normal Stress
79 kPa



160 kPa



240 kPa



Checker: Don Hazlitt **Reviewer:** Kelly

The testing services reported here have been performed in accordance with accepted local industry standards.
The results presented are for the sole use of the designated client only.
This report constitutes a testing service only. It does not represent any interpretation or opinion regarding specification compliance or material suitability.
Engineering interpretation will be provided by SNC Lavalin upon request

Client:	M.D of Pincher Creek
Project:	Therriault Dam
Project #:	694661
Date:	27-Apr-23

Geoscience & Materials

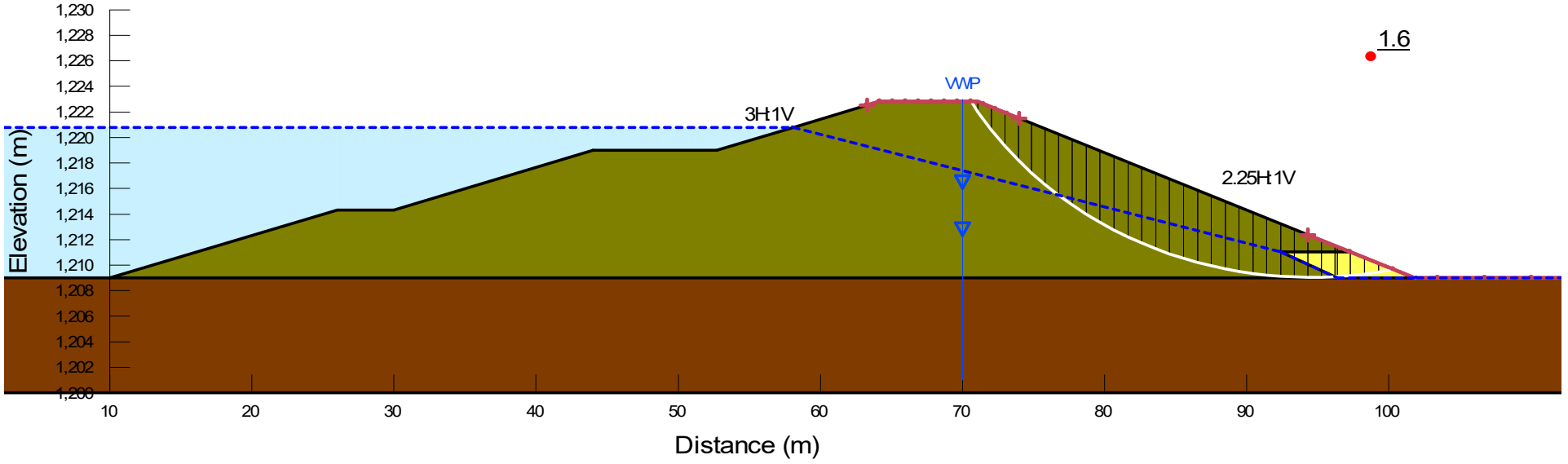
Appendix IV

Stability Analysis Plots

1. DS Stability FSL 1220.8m

WL: 1,220.8 mm

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
	Embankment Fill	Mohr-Coulomb	20.5	10	29	1
	Foundation Till	Mohr-Coulomb	21	50	30	1
	Pervious Filter	Mohr-Coulomb	18	0	35	1

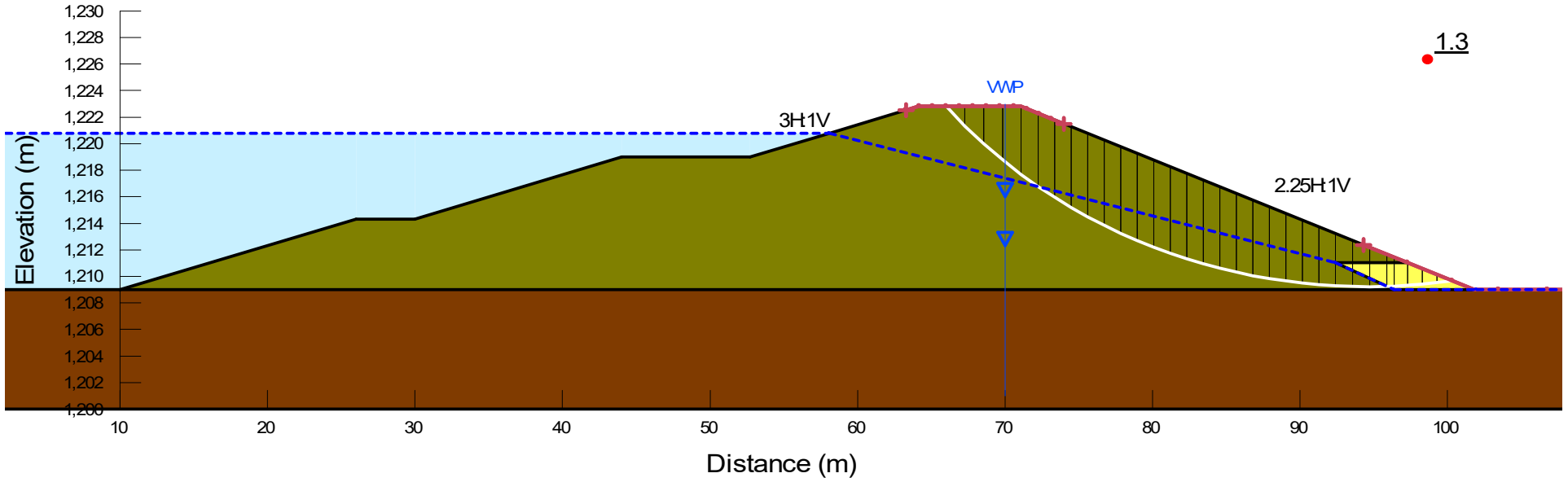


SNC·LAVALIN	Project: Therriault Dam - Slope Stability Analisys	Figure: 1 of 5
	Document No.: 694661-0000-41EB-0003-PA	Condition: FSL 1220.8 m
	Date: May 05, 2023	

2. DS Stability - Pseudo-Static

Horz Seismic Coef.: 0.08 g
WL: 1,220.8 mm

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
	Embankment Fill	Mohr-Coulomb	20.5	10	29	1
	Foundation Till	Mohr-Coulomb	21	50	30	1
	Pervious Filter	Mohr-Coulomb	18	0	35	1

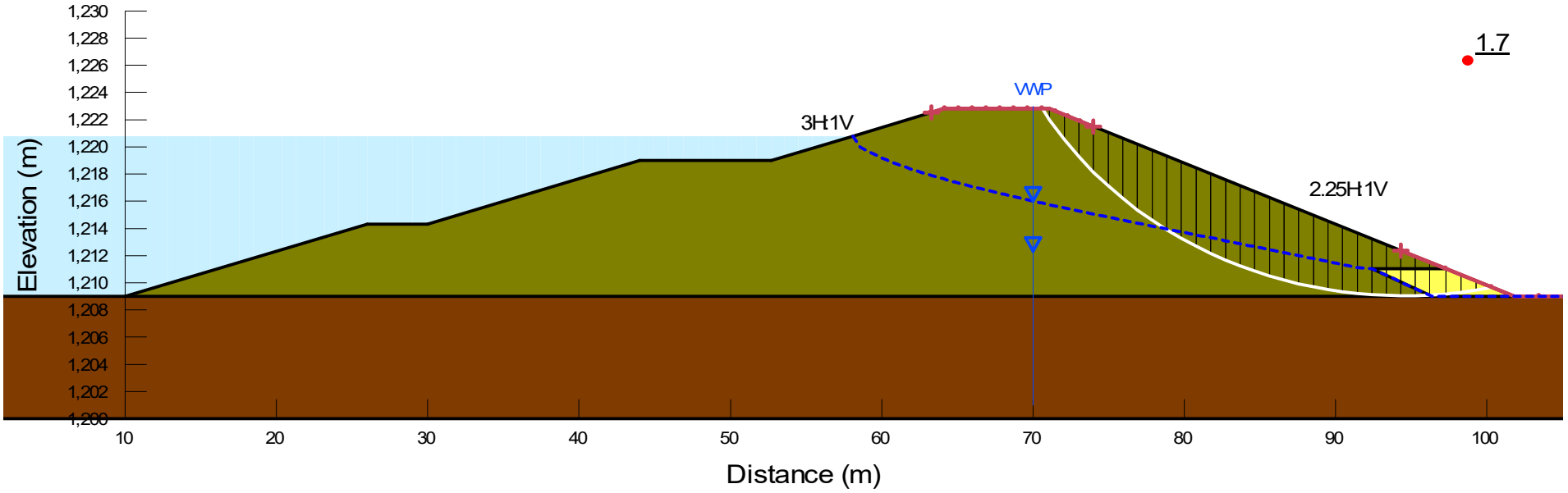


SNC·LAVALIN	Project: Therriault Dam - Slope Stability Analisys	Figure: 2 of 5
	Document No.: 694661-0000-41EB-0003-PA	Condition: FSL 1220.8 m + Pseudo-Static
	Date: May 05, 2023	

4. Slope Stability

Steady-State Seepage Grain-Size

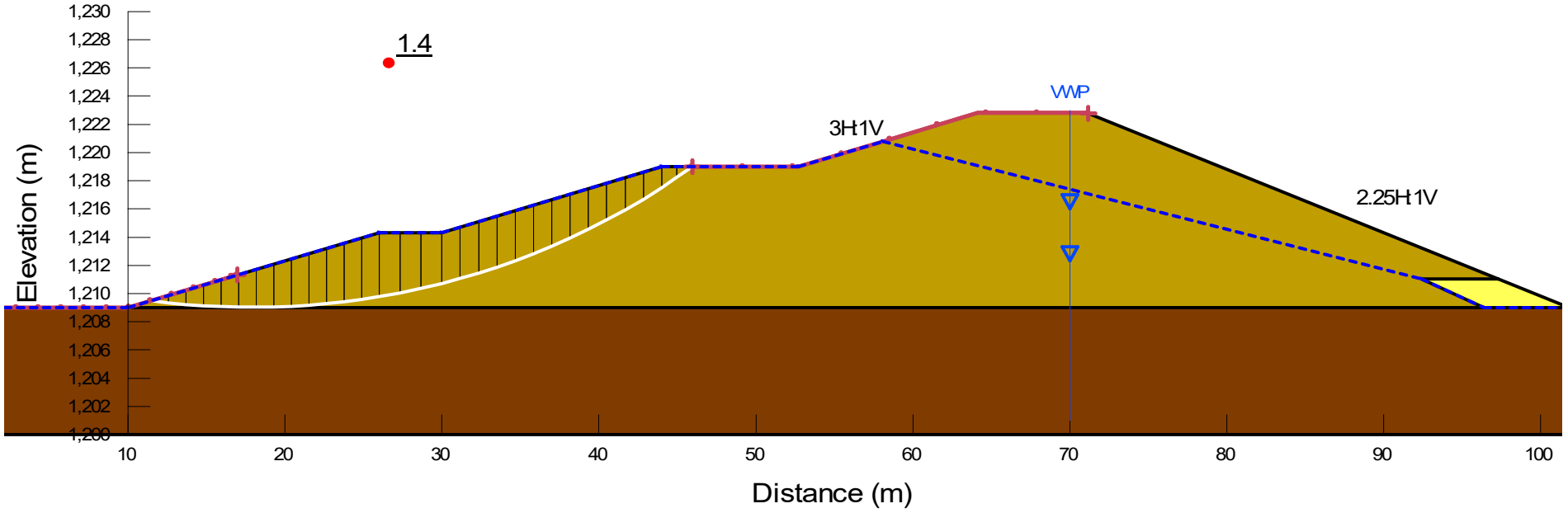
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Embankment Fill G-S	Mohr-Coulomb	20.5	10	29
	Foundation Till	Mohr-Coulomb	21	50	30
	Pervious Filter	Mohr-Coulomb	18	0	35



SNC·LAVALIN	Project: Therriault Dam - Slope Stability Analisys	Figure: 3 of 5
	Document No.: 694661-0000-41EB-0003-PA	Condition: Pore-Pressure Seepage
	Date: May 05, 2023	

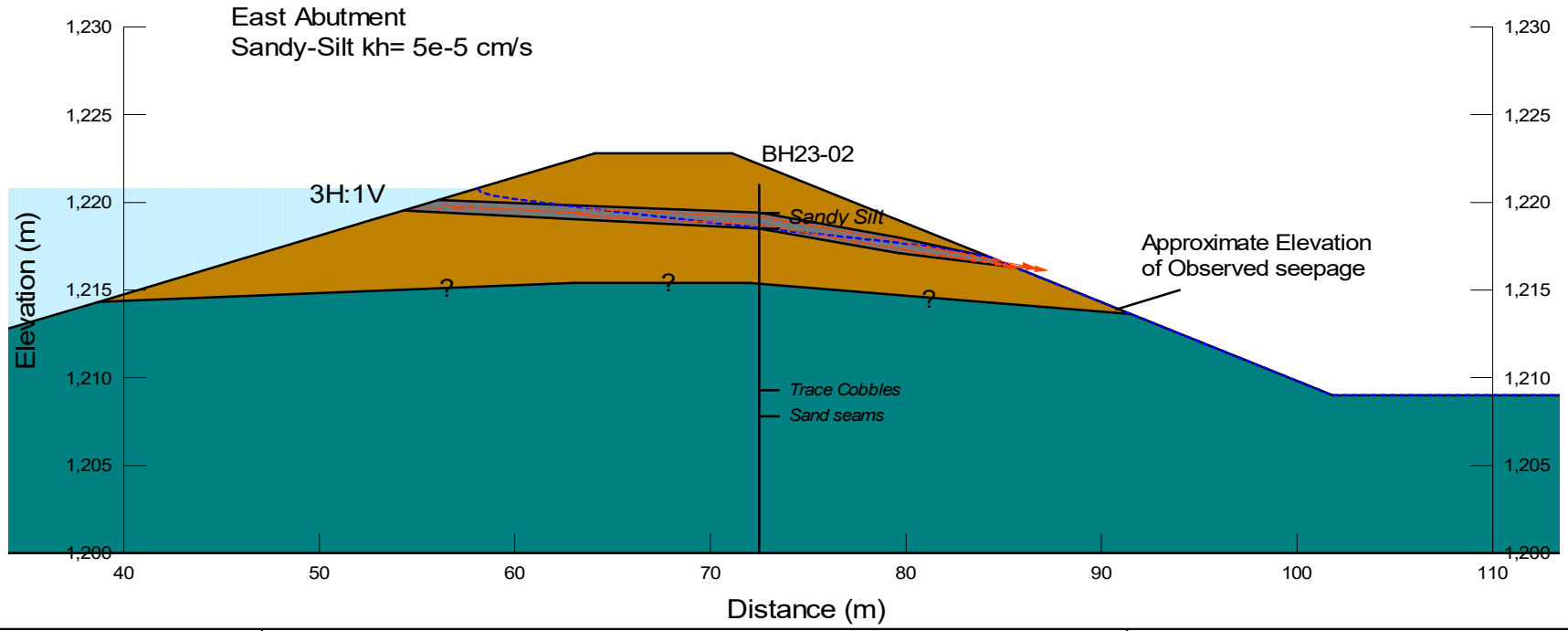
3. US Stability - RDD

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
	Embankment Fill DD	Mohr-Coulomb	20.5	5	27	1
	Foundation Till	Mohr-Coulomb	21	50	30	1
	Pervious Filter	Mohr-Coulomb	18	0	35	1



SNC·LAVALIN	Project: Therriault Dam - Slope Stability Analisys	Figure: 4 of 5
	Document No.: 694661-0000-41EB-0003-PA	Condition: U/S Rapid Drawdown
	Date: May 05, 2023	

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky'/Kx' Ratio	Volumetric Water Content
	Sandy Silt 1	Saturated Only			5e-05	1	0.35
	Silty_Clay Fill	Saturated / Unsaturated	Silty Clay	Embankment Fill		1	
	SiltyClay Till	Saturated Only			4e-08	1	0.48



SNC·LAVALIN	**Project: Therriault Dam - Seepage Analisys**	**Figure:** 5 of 5
	Document No.: 694661-0000-41EB-0003-PA	
	Date: May 25, 2023	

Appendix V

Seismic Hazard Calculator Output

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 49.414N 113.827W **User File Reference:** Therriault Dam, Pincher Creek 2023-04-05 15:01 UT

Requested by: SNC-Lavalin

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.165	0.098	0.062	0.021
Sa (0.1)	0.243	0.143	0.090	0.030
Sa (0.2)	0.284	0.175	0.115	0.043
Sa (0.3)	0.257	0.165	0.113	0.045
Sa (0.5)	0.203	0.133	0.092	0.036
Sa (1.0)	0.120	0.080	0.055	0.021
Sa (2.0)	0.057	0.038	0.027	0.010
Sa (5.0)	0.019	0.013	0.009	0.003
Sa (10.0)	0.007	0.005	0.003	0.001
PGA (g)	0.132	0.080	0.051	0.017
PGV (m/s)	0.118	0.077	0.052	0.020

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

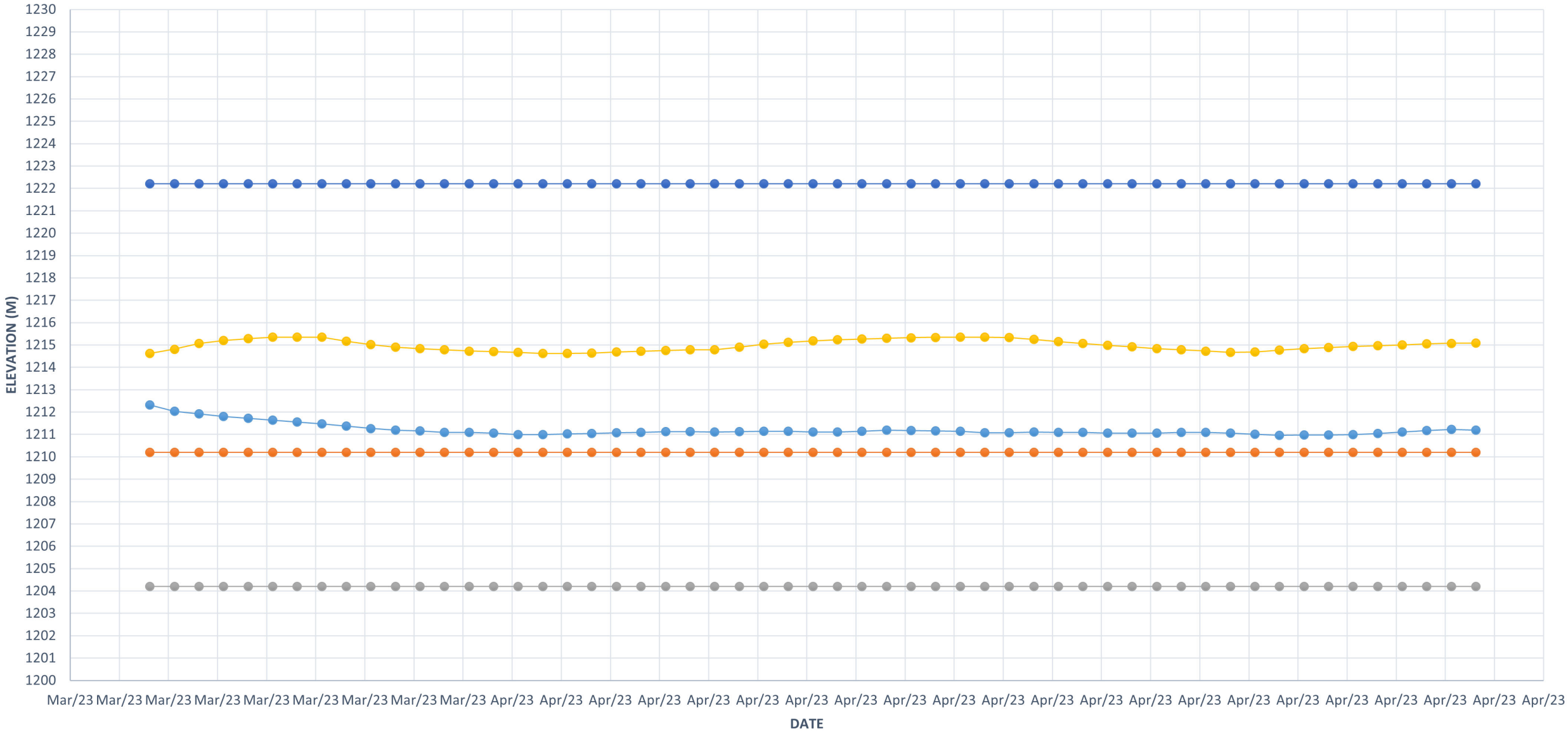
Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

Appendix VI

Vibrating Wire Piezometer Plots of Data

Vibrating Wire Piezometer Trends



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403.253.4333
www.snclavalin.com

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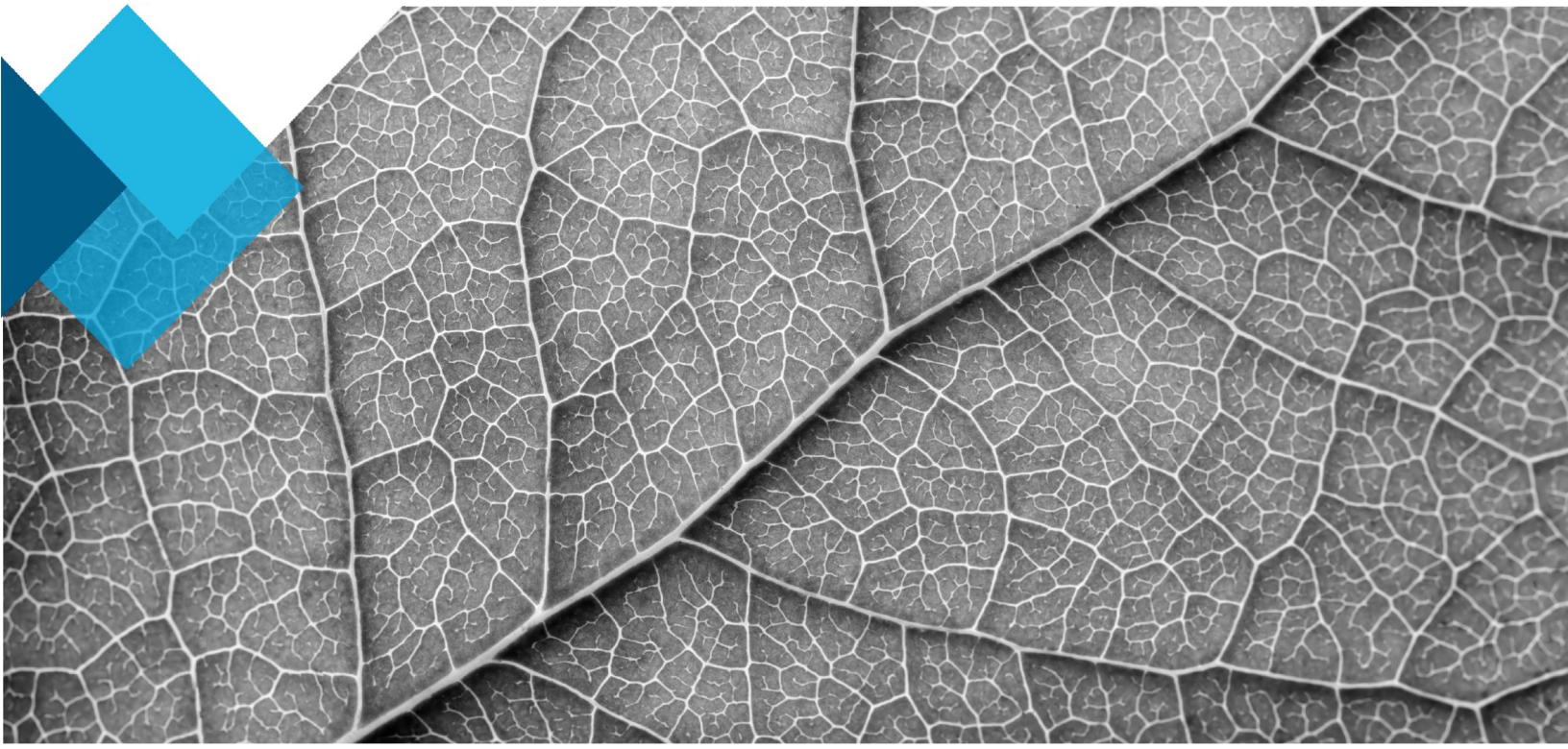
Therriault Dam

Hydrotechnical Investigation Report

M.D. of Pincher Creek No. 9



Geoscience & Materials

September 21, 2023

Internal Ref: 694661-0000-41EB-0004-00

Notice to Reader

This report has been prepared and the work referred to in this report has been undertaken by SNC-Lavalin Inc. (SNC-Lavalin), for the exclusive use of the M.D. of Pincher Creek No. 9, who has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions, and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions, and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made with respect to the professional services provided to the M.D. of Pincher Creek No. 9 or the findings, conclusions, and recommendations contained in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered, or project parameters change, modifications to this report may be necessary.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

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Executive Summary

The Therriault Community dam is a zoned earthfill dam located in SW-27-T5-R29-W4 approximately 8 km south and 9 km east of Pincher Creek, Alberta. A Dam Safety Review (DSR) was completed by SNC-Lavalin Inc. in 2021. As per DSR recommendations, a hydrotechnical investigation was required to characterize the discharge capacity of the emergency spillway and complete a freeboard assessment. No visible evidence of significant dam instability was discovered during the site inspection. However, the hydrotechnical review found that the flood inundation boundary could encroach upon multiple residences and the available freeboard is likely inadequate for certain operating conditions and the current consequence classification of “Significant” is appropriate for the Therriault Dam. Additional information on the dam consequence classification can be found in report 683055_Pincher Creek Dam Safety Engineering Report issued on March 14, 2022.

SNC-Lavalin performed a geotechnical investigation in March 2023, an unmanned aerial vehicle (UAV) photogrammetry survey and a freeboard assessment. The geotechnical investigation was reported under a separate cover (SNC-Lavalin 2023). As per SNC-Lavalin Inc. proposal 682454-22-CD-1947, dated December 8, 2022, a UAV survey was conducted on April 21, 2023. The data from this survey was used to characterize the discharge capacity of the emergency spillway.

The UAV survey and freeboard analysis identified the following:

- The elevation of the dam and the embankment is not consistent across the northern boundary of the reservoir. The dam crest elevation near the operational spillway and riparian outlet is approximately 1222.4 metres above sea level (m asl). However, a low point, approximately 40 m west of the emergency spillway was found to be at elevation 1221.9 m asl. In the case of a large flood event that exceeds the capacity of the emergency spillway, this low point would be the first location to overtop.
- The capacity of the spillways was found to be insufficient to pass the inflow design flood (IDF) and minimum freeboard requirements are not met. At present, both the main dam section and the low-spot would expect to be overtopped.
- Without accounting for wind set-up and wave run-up, the minimum emankment elevation of 1221.9 m asl would be expected to overtop for events smaller than the 100-year return period storm event.
- During the Full Supply Level (FSL) event there is approximately 2.3 m of available freeboard at the main dam section and 1.8 m of freeboard available at the low section of the embankment. The required normal freeboard at the low section of the embankment is 2.17 m and is not achieved.

Based on the UAV survey results and the freeboard analysis, SNC-Lavalin recommends that further study be completed to identify the most cost effective method for achieving freeboard requirements. A more detailed wind set-up and wave run-up analysis would provide a refined freeboard requirement that could be used to inform decisions about what construction activities would be the most beneficial.

Based upon the results from a more detailed wind set-up and wave run-up analysis, a combination of various construction activities could be undertaken to achieve minimum freeboard requirements. The individual construction activities are as follows.

- **Activity 1**: Increase the capacity of the existing spillway from by widening it from 12 m to the historical 40 m. An increase to the spillway capacity will reduce the peak water elevation in the reservoir for the IDF. As a result of increased spillway capacity, additional armouring would likely be required to protect the spillway outlet channel.
- **Activity 2**: Raise the minimum embankment elevation from 1221.9 m to 1222.4 m.
- **Activity 3**: Construct design elements to alleviate the wave run-up action at the 1:1 (H:V) (45 degrees) steep location. The design elements could include the following:
  - Reduce the slope from 1:1 to 2:1 or 3:1 (H:V). The existing 1:1 (H:V) slope is assumed to be 10 m in height and large volumes of material would be required to achieve a 2:1 or 3:1 (H:V) slope.
  - Incorporate a wave damping berm near the top of the slope. This could allow for a steeper slope to be constructed while still achieving a reduction in wave run-up.
  - Incorporate a crown wall on the dam to reduce wave actions on the embankment slope.
- **Activity 4**: Lower the FSL in the reservoir. This will increase the available storage capacity in the reservoir prior to an IDF event. This could be the cheapest option to implement, but would likely be the least effectual.
- **Activity 5**: Raise the entire dam crest height. This would likely be the most expensive option to implement and would be recommended if the additional analysis found that the previous options would not be sufficient to achieve freeboard requirements.
- **Activity 6**: Construct second spillway in the location where the dam crest has an elevation of 1221.9 m. This option could be an alternative to Activities 1, 2 and 3. A second spillway would increase the discharge capacity of the spillway system and reduce the material quantity to be placed along the crest of the berm. This could also reduce the cost of implementing various elements from Activity 3. However, the channel downstream of the area would need to be armoured and maintained similar to the existing spillway.

Scenarios are presented below to describe the more likely combination of activities that would be required to achieve freeboard requirements. These scenarios include the following:

- **Scenario 1** - Activity 1 and 2: Widen the spillway to 40 m and raise the minimum embankment elevation to the crest elevation of the dam.
- **Scenario 2** – Activity 1 to 3: Widen the spillway to 40 m, raise the minimum embankment elevation to the crest elevation of the dam, and modify a localized zone of steep reservoir embankment identified by the drone survey, located west of the spillway.
- **Scenario 3** – Activity 1, 2, and 4: Widen the spillway to 40 m, raise the minimum embankment elevation to the crest elevation of the dam, and lower the FSL.
- **Scenario 4** – Activity 1 to 5: Widen the spillway to 40 m and raise the entire dam and embankment crest elevation to provide the required Minimum Freeboard.
- Potential costs for planning purposes are presented in Recommendations section in the main body of this report.

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Table of Contents

In-Text Figures

In-Text Tables

1 Introduction

SNC-Lavalin Inc. (SNC-Lavalin) was retained by the Municipal District of Pincher Creek (the M.D.) to conduct an unmanned aerial vehicle (UAV) survey and freeboard analysis for the existing Therriault Dam. The dam is located to the southeast of the Town of Pincher Creek, between the Range Road 294 and Range Road 292 on Township Road 54. SNC-Lavalin's Dam Safety Review (DSR) report (20220314-683055) dated March 14, 2022, noted that the emergency spillway capacity was unknown and expected to be insufficient to maintain minimum freeboard requirements during design flood conditions. This report describes the UAV survey that was completed to define the spillway geometry and analyses to characterize the spillway capacity and freeboard requirements. A wind run-up and wave set-up analysis and flood routing analysis were carried out to predict the freeboard for inflow design flood (IDF) conditions. Recommendations to achieve Canadian Dam Association (CDA) guidelines are presented based on the results of the analyses.

2 Background and History

SNC-Lavalin understands that the dam was constructed in the 1967, with construction completed to increase the storage capacity in 1989 (Genivar, 2011). Again in 2002, the dam was raised by 0.6 m above the 1989 design elevation. The Therriault Dam provides storage capacity to supplement downstream stock watering needs along Indian Farm Creek. As per available drawings, the Dam consisted of a zoned earthfill and the length of the dam is approximately 106 m with a crest width of 7 m and a maximum height of approximately 14.2 m. Alberta Environment and Parks (AEP) has licensed the original dam and the raised dam, with Priority No. 1967973101 and No. 1988072101, respectively.

It is understood that the dam has undergone modifications and repairs over the past years due to overtopping and erosion damage. In June 1995, there was a heavy rainfall of approximately 81.6 mm, as recorded at the Pincher Creek Airport, which caused the dam to overflow. The downstream face of the dam and emergency spillway was reconstructed due to erosion damage. Similarly in the years 2000 and 2002, repairs were done to the toe of the right abutment, downstream face and outlet of the spillway. The outlet pipe from the drop spillway and riparian outlet was extended 10 m and a toe berm was added to the dam over the extension. Major reconstruction was undertaken in 2005 to spillway outlet channel and downstream end of the emergency spillway in reaction to a three-day rainfall event of approximately 179.5 mm. Erosion damage was also noted due to rainfall events in 2010.

2.1 Site Description

The dam is situated on Indian Farm Creek southeast of the Town of Pincher Creek. The length of the dam is approximately 106 m with a crest width of 7 m and a height of up to approximately 14.2 m. A conduit with a 760 mm diameter corrugated steel pipe allows the reservoir to be drained. There is a drop inlet spillway that connects to the conduit outlet and an emergency spillway channel located approximately 170 m to the east of the drop spillway that is partially armoured with riprap. Relevant physical characteristics of the dam are as follows:

- Dam Type: Homogenous earthfill embankment with an earth spillway;
- Full Supply Level (FSL)~ 1220.1 m;
- Length: ~ 106 m;

- Maximum Height: ~ 14.2 m;
- Existing Outlet Elevation (from survey): 1208.5 metres above sea level (m asl);
- Crest Elevation: 1222.4 m asl;
- Average Toe Elevation: 1208 m asl; and
- Estimated Catchment Area: 54 km².

2.2 Preliminary Works

Detailed discussion of preliminary works were presented in the following documents:

- 2010 Therriault DSR, completed by Genivar (Genivar, 2011);
- 1999 Operation, Maintenance and Surveillance Manual, Therriault Dam (UMA, 1999); and
- 2021 Dam Safety Review Cridland Dam, Therriault Dam, Sandy Lake Project Dam, Fish Lake Project Dam, Foothill Lake Community Dam (SNC-Lavalin, March 14, 2022).

2.3 Regulatory Background

Dams in Alberta are regulated by the Government of Alberta through:

- The Alberta Water Act: Water (Ministerial) Regulation – Part 6 (WMR; GoA, 2018); and
- The Alberta Dam and Canal Safety Directive (ADCSD; AEP, 2018).

The ADCSD indicates that dams should comply with best practices issued by the CDA, a federal governing body that provides standards and guidelines for classifying the hazards and potential consequences of dam failure and provides standards for design, construction, maintenance and asset management for dam owners. The most recent relevant CDA guidelines issued are:

- Dam Safety Guidelines, 2007 (Revised 2013), and accompanying bulletins.

In Alberta, a dam should be regulated if it meets any one or more of the following criteria as per Section 27(1) of the WMR:

a) It provides both a live storage capacity of 30,000 m^3 or more and is 2.5 m or more in height;

b) It is classified as being a significant, high, very high, or extreme consequence structure regardless of height/capacity; or

c) It exists for the purpose of storing flowable tailings.

The Alberta Dam and Canal Safety Directive, published in 2018 (the Directive), requires dam owners to meet a number of requirements for their dams, including:

- Following the general responsibilities, accountabilities, and due diligence described in Section 29 of the WMR;
- Determining, reviewing, and re-assessing the consequence classification of the facility every 10 years (WMS Section 34.1 & Part 3 of the Directive);

- Identifying, assessing, developing, and implementing measures to mitigate and manage risks posed by safety deficiencies (ADCSD Part 4.5);
- Design requirements and practices (ADCSD Part 5.5, further discussed in **Section 2**); and
- Engineering inspections (ADCSD Part 5.19).

The Directive also provides criteria to determine the incremental consequences of dam failure. SNC-Lavalin conducted a preliminary assessment of the consequences of a potential dam failure for this dam. Based on the assessment, it was recommended to assign the consequence classification of “Significant” for the Therriault Dam (SNC-Lavalin, 2022).

2.4 Scope of Work

The scope of work of the UAV survey and freeboard analysis was discussed and agreed to by SNC-Lavalin and the M.D. of Pincher Creek and consisted of:

1. UAV survey; and
2. Freeboard analysis:
    a. Spillway capacity analysis;
    b. Flood routing analysis; and
    c. Wind set-up and wave run-up analysis.

The analyses and recommendations presented in this report are based on the data obtained from UAV survey, historical DSR studies and documents, and publicly available discharge and climate data from Environment Canada.

3 UAV Survey

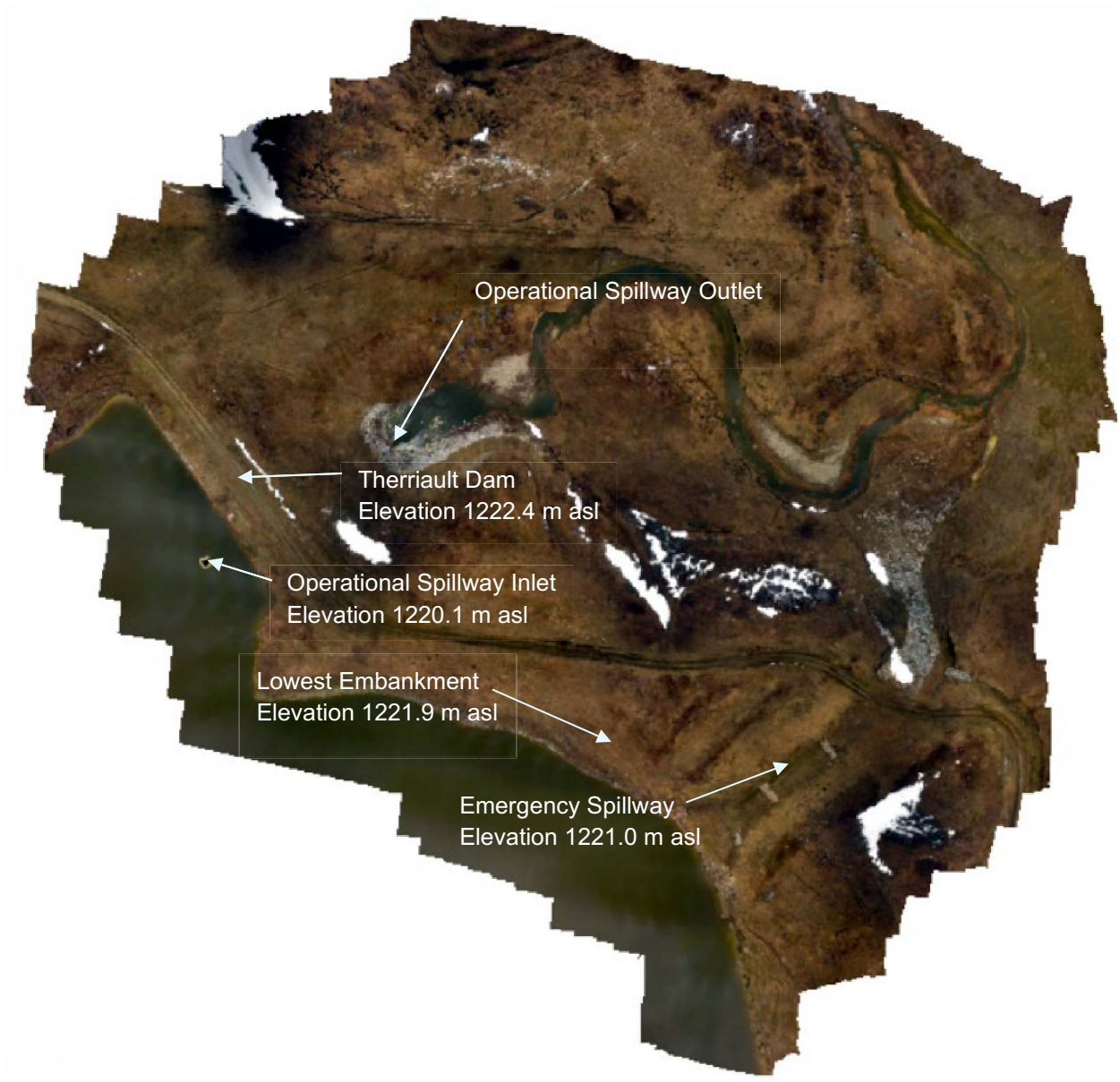
A UAV survey was completed by AKS Geoscience on April 21, 2023. The extents of the survey included the Therriault Dam, emergency spillway, and downstream channel below the operational spillway outlet to a distance of approximately 400 m. The orthophoto produced from the survey is shown in **Figure 3-1**.

There was a vertical elevation offset when comparing the elevations from the UAV surveys to previously known elevations of the dam structures. A vertical adjustment was applied to the elevations to align the operational spillway elevation to 1220.1 m (Genivar, 2011). Other reference points used to check the elevation adjustment was suitable included the operational spillway outlet soffit and invert elevations. These elevations were found to be within 50 mm of expected values. Based on the adjusted UAV survey, the elevations of the dam structures were as follows:

- Dam crest elevation: 1222.4 m asl;
- Minimum embankment elevation: 1221.9 m asl;
- Emergency spillway invert elevation: 1221.0 m asl; and
- Operational spillway invert elevation: 1220.1 m asl.

The UAV survey identified a low section along the embank approximately 40 m west of the emergency spillway that would be the first location to overtop in the event of a large flood that exceeds the capacity of the spillways.

Figure 3-1: UAV Orthophoto of Therriault Dam



4 Freeboard Analysis

A freeboard analysis was completed to assess the capacity of the spillway structures and whether sufficient freeboard is available during FSL and IDF conditions.

Canadian Dam Association (CDA, 2013) guidelines require the following:

- No overtopping by 95% of the waves caused by the most critical wind with an annual exceedance probability of 1/1000 when the reservoir is at its maximum normal elevation (FSL); and
- No overtopping by 95% of the waves caused by the most critical wind when the reservoir is at its maximum extreme level during the passage of the IDF.

For “Significant” consequence dams, it is suggested that the annual exceedance probability value of wind for calculation of freeboard during IDF is 1/10.

CDA guidelines (2013) suggest that dams with a “Significant” consequence classification be designed for an IDF between 100-year and 1000-year return periods on the basis of incremental flood analysis, exposure, and consequence of failure.

4.1 Inflow Design Flood

A 1000-year return period storm was used for the flood routing analysis based on results from the 2021 DSR (SNC-Lavalin, 2022). The regional flood frequency analysis from the 2021 DSR was updated with new information to refine the 1000-year return period design flow.

4.1.1 Regional Flood Frequency Analysis

A regional flood frequency analysis for the Therriault Dam was developed based on the Therriault catchment of 54 km^2 (reference catchment, see **Figure 4-1**). The catchment was delineated using topographic data of the freely available Canadian Digital Terrain Model (CDEM[1]). The resolution of the CDEM data is approximately 25 m.

[1] https://open.canada.ca/data/en/dataset/7f245e4d-76c2-4caa-951a-45d1d2051333

Figure 4-1: Spatial extent of Therriault Dam catchment (reference catchment, 54 km^2), shown in white outline

SNC-Lavalin assessed a regional flood frequency analysis based on the historical peak discharge of selected nearby hydrometric stations (**Table 4-1**). Distribution curves were selected on the best fit for the past hydrologic events at each individual station to estimate the future probabilities of occurrence.

Four hydrometric stations were selected based on their similarity in elevation distribution, their available years of record, and their proximity to the study sites. A regression relationship based on catchment area to discharge was developed from all the frequency analysis of each station. The resulting regression relationship was then applied to the Therriault Dam catchment to estimate the peak flood discharge from 10-year flood events up to 1,000-year flood events (**Table 4-2**).

Table 4-1: Hydrometric Stations used for the Regional Flood Frequency Analysis

Station Name	Gauge ID	Area [km^2]	Records [years]
Drywood Creek Near Twin Butte	05AD016	29	44
Todd Creek near Highway No 22	05AA909	74	34
Beaver Creek near Brocket	05AB013	256	48
Rolph Creek near Kimball	05AE005	192	64

Table 4-2: Peak Flood Discharges (m3/s) for Different Return Periods (10 to 1000 years) for the Reference Catchment

Return Period (years)	Therriault Dam Catchment (54 km^2)
1000	64
100	42
50	35
10	21

4.1.2 Inflow Hydrograph

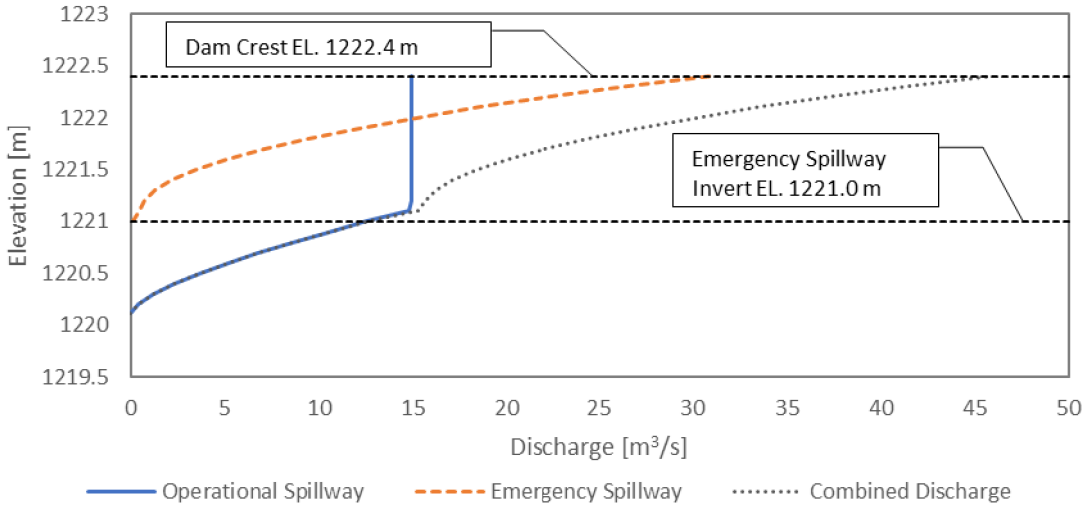
The regional flood frequency analysis provides a prediction of the peak instantaneous inflows. However, for the design of a 24-hour storm, it would be overly conservative to assume the instantaneous peak flows are constant throughout the full storm duration. A simplified hydrologic model was developed in HEC-HMS to compare peak discharge to results from the regional flood frequency analysis and produce an inflow hydrograph for the flood routing analysis. HEC-HMS is a hydrological modelling system developed by the U.S. Army Corps of Engineers designed to simulate hydrologic processes.

4.2 Spillway Capacity

A spillway capacity analysis was conducted as part of the 2021 study (SNC-Lavalin, 2022). The operational spillway was found to have capacity up to 15 m^3/s, and the emergency spillway capacity was not defined because of missing geometry information. The digital elevation model produced from the UAV survey was used to create a one-dimensional (1D) hydraulic model that could simulate flow in the emergency spillway using the latest Hydraulic Engineering Center River Analysis System (HEC-RAS version 5.0.7). HEC-RAS is developed by the U.S. Army Corps of Engineers and is widely used in the industry to model hydraulics of water flow through natural rivers and other channels.

A discharge rating curve was developed for the emergency spillway based on upstream elevation in the Therriault Reservoir. The discharge rating curves for the operational and emergency spillways are presented in **Figure 4-2**.

Figure 4-2: Therriault spillway discharge rating curves

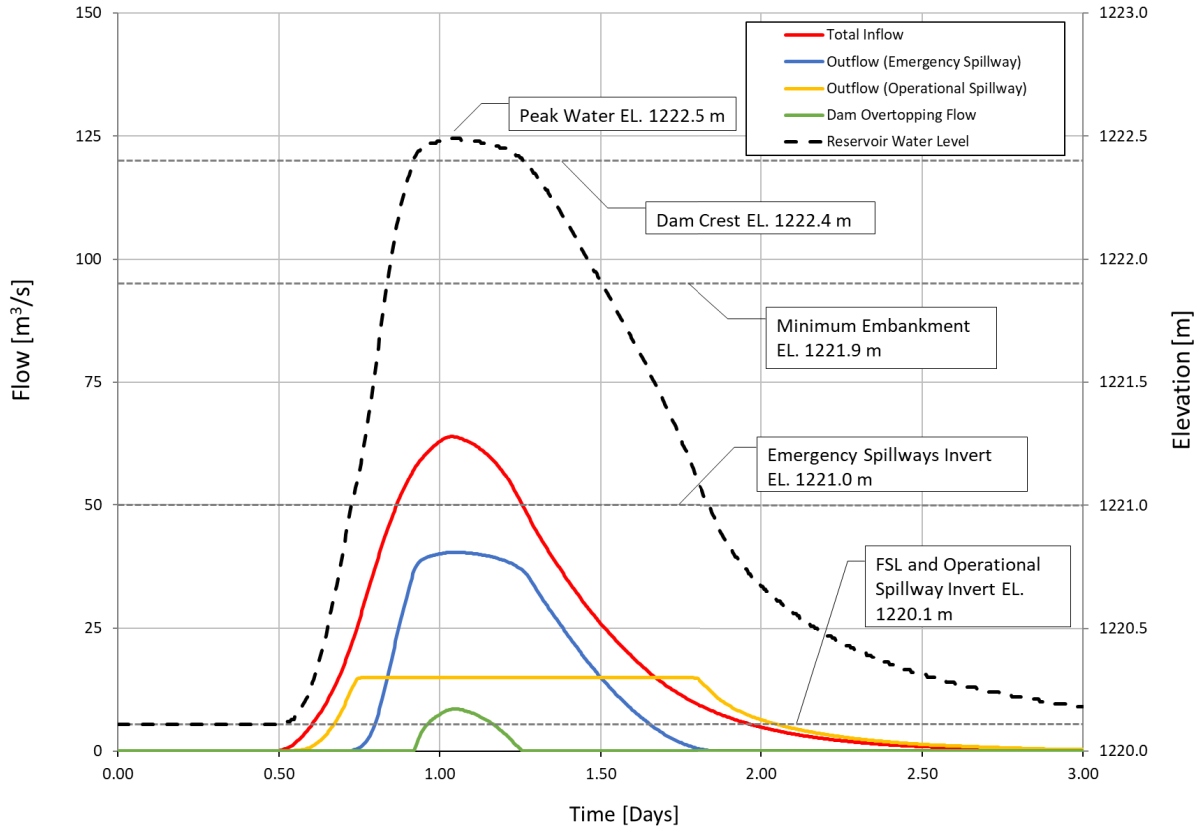


4.3 Flood Routing

A flood routing model was developed in HEC-HMS to predict the peak water level in the Therriault Reservoir for IDF conditions. The elevation-storage curve presented in the 1999 Operation, Maintenance, and Surveillance (OMS) manual (UMA, 1999) was used to define the storage capacity of the reservoir. The IDF hydrograph described in **Section 4.1** and discharge curves described in **Section 4.2** were used to define the remaining model inputs. The modelled dam crest elevation was 1222.4 m asl. The minimum surveyed

embankment elevation of 1221.9 m asl was not included in the model. The visual flood routing curves are shown in **Figure 4-3**. For the 1000-year return period IDF, the dam crest elevation of 1222.4 m asl is predicted to be overtopped and for there to be no available freeboard.

Figure 4-3: 1000-year return period flood routing



4.4 Wind and Wave Analysis

4.4.1 Wind Speed Characterization

A frequency analysis of maximum hourly wind speeds as recorded at three Environment Canada climate stations near Pincher Creek (see **Table 4-3**) between 1979 and 2022 resulted in 2, 10- and 1,000-year return period wind speeds from 93 to 113 km/h (from the west wind), respectively. The archived wind speeds are understood to be characteristic of winds at a 10 m elevation above ground and to represent the average hourly wind speed. The results of the wind speed frequency analysis by wind directions are shown in **Table 4-4**.

Table 4-3: Local Climate Station used for the Wind Speed Frequency Analysis

Climate ID	Station Name	Time Period
3035202	Pincher Creek A	1979 - 1994
3035206	Pincher Creek (AUT)	1994 - 2012
3035198	Pincher Creek	2011 - 2023

Table 4-4: Results of the Wind Speed Frequency Analysis by Wind Direction

Wind Direction	2-year Return Period	10-year Return Period	1000-year Return Period
All Directions (Combined)	94	104	114
Southwest	80	95	110
West	93	103	113

4.4.2 Wave Run-up and Wind Set-up

Wave run-up and wind set-up for the FSL and IDF water levels were estimated using procedures outlined in the Coastal Engineering Manual (USACE, 2011).

Based upon the CDA (2013) guidance for freeboard requirements a wave run-up and wind set-up analysis was completed for wind speeds events with 1000-year and 10-year return periods and appropriate water levels. Wave run-up (and wind set-up) was also estimated at two locations:

- The main embankment section at the dam, with a crest elevation of 1222.4 m asl;
- The measured low-spot on the remaining reservoir embankment west of the spillway, with a crest elevation of 1221.9 m asl.

The main dam embankment section slope, based on available information from the 1999 OMS (UMA 2000), was taken to be a combination of a lower and upper 3:1 (H:V) slope in combination with a 6.5 m wide bench, at an elevation of 1219.0 m asl. The slope in front of the measured low-spot, based on available information, was taken to be a uniform 1:1 (H:V) slope.

In all cases, the wave run-up and wind set-up was estimated for both a SW wind direction and for the maximum windspeed, regardless of direction. In all cases, the available open water fetch was taken to be the effective fetch in a SW direction across the reservoir and the incident wave direction was taken to be perpendicular to the embankment. No allowance was made for potential sheltering effects resulting from the various islands or headlands in and around the reservoir.

The depth of water in each case was based on a reservoir floor elevation of 1208 m asl.

Wind speeds in each case were increased by 1.2 to account for overwater/overland effects and by factor of 1.1 to account for the difference in air versus reservoir water temperature. No adjustment was made to account for gustiness over a duration shorter than one hour.

The resulting freeboard criteria at each section (based on strongest winds over SW direction) are presented in **Table 4-5**. The most critical wave run-up heights were calculated at the embankment that is assumed to have a 1:1 (H:V) slope based on drawings from the 1999 OMS (UMA). The steeper slope increases the height of wave action when compared the main dam embankment which has a 3:1 (H:V) slope near the crest.

Based on the analysis, it was found that the normal freeboard requirements are not met at the lowest spot along the embankment. Minimum freeboard requirements are not met because the IDF is predicted to overtop the dam and no freeboard is available.

It should be noted that the results presented in **Table 4-5** are considered to only be representative, as it is possible wind speeds are over-estimated, but exposure (fetch and wind/wave direction considerations) are not fully evaluated. On the other hand, the estimation of wind speeds does not consider gustiness factors (thunderstorm squall lines or tornados) nor do they consider future climate change effects on both intensity or frequency of future wind events. The likelihood of IDF or FSL water levels and the associated wind events and their likely seasonal concurrence are also not considered.

Table 4-5: Wave Run-up Wind Set-up Heights

Freeboard (Return Period) Water Level and Wind Event AEP	Wave Run-Up [m]	Wind Set-Up [m]	Freeboard Required [m]	Available Freeboard [1] [m]	Remaining Freeboard [1] [m]	Comment
Main Dam Embankment – crest elevation 1222.4 m asl						
Minimum freeboard: IDF water level (1222.5 m asl) and 1/10 Wind Event	0.75	0.01	0.76	0	-0.86	Wave run-up height assumes crest raised 0.86 m at 3:1 slope
Normal freeboard: FSL (1220.1 m asl) and 1/1000 Wind Event	0.81	0.02	0.83	2.3	1.47	Based on existing main dam crest elevation
Measured Low-spot on Embankment – crest elevation 1221.9 m asl						
Minimum freeboard: IDF water level (1222.5 m asl) and 1/10 Wind Event	1.92	0.01	1.93	0	-2.03	Wave run-up height assumes crest raised 2.03 m at 1:1 slope
Normal freeboard: FSL (1220.1 m asl) and 1/1000 Wind Event	2.15	0.02	2.17	2.3	0.13	Based on existing main dam crest elevation

Note 1: Available and remaining freeboard are calculated relative to the main dam embankment crest elevation (1222.4 m asl)

5 Conclusions and Recommendations

The UAV survey and freeboard analysis identified the following:

- The elevation of the dam and the embankment is not consistent across the northern boundary of the reservoir. The dam crest elevation near the operational spillway and riparian outlet is approximately 1222.4 m asl. However, a low point, approximately 40 m west of the emergency spillway was found to be at elevation 1221.9 m asl. In the case of a large flood event that exceeds the capacity of the emergency spillway, this low point would be the first location to overtop.
- The capacity of the spillways was found to be insufficient to pass the IDF and minimum freeboard requirements are not met. At present, both the main dam section and the low-spot would expect to be overtopped.
- Without accounting for wind set-up and wave run-up, the minimum emankment elevation of 1221.9 masl would be expected to overtop for events smaller than a 100-year return period storm event.
- During the FSL event there is approximately 2.3 m of available freeboard at the dam section and 1.8 m of freeboard available at the low section of the embankment. The required normal freeboard at the low section of the embankment is 2.17 m and is not achieved.

Based on the UAV survey results and the freeboard analysis, SNC-Lavalin recommends that further study be completed to identify the most cost effective method for achieving freeboard requirements. A more detailed wind set-up and wave run-up analysis would provide a refined freeboard requirement that could be used to inform decisions about what dam modifications would be the most beneficial. The wind/wave analysis completed was a simplified desktop analysis that is often suitable for small reservoirs. However, given the steep embankment slope and high winds in the Pincher Creek area and the various islands and headlands around the perimeter of the reservoir, the wave desktop scale analysis may have been conservative. Additionally, wave action was found to be a highly influencing factor for the IDF freeboard calculation. A more detailed wind set-up and wave run-up analysis would include:

- Consideration of the seasonal variability and coincidence of storm events to refine the wind speeds used in the analysis.
- 2D wind/wave modelling to incorporate islands and headlands within the reservoir and reduce fetch lengths used for calculation wind set-up and wave run-up heights.

Based upon the results from a more detailed wind set-up and wave run-up analysis, a combination of various construction activities could be undertaken to achieve minimum freeboard requirements. The individual construction activities are as follows:

- **Activity 1**: Increase the capacity of the existing spillway by widening it from 12 m to the historical 40 m. An increase to the spillway capacity will reduce the peak water elevation in the reservoir for the IDF. As a result of increased spillway capacity, additional armouring would likely be required to protect the spillway outlet channel.
  - High level estimates of construction cost are in the range of up to $300,000.
- **Activity 2**: Raise the minimum embankment elevation in the low-spot from 1221.9 m to 1222.4 m.
  - High level estimates of construction cost are in the range of $50,000 to $100,000.

- **Activity 3**: Construct design elements to alleviate the wave run-up action at the 1:1 (H:V) (45 degrees) steep location. The design elements could include the following:
  - Reduce the slope from 1:1 to 2:1 or 3:1 (H:V). The existing 1:1 (H:V) slope is assumed to be 10 m in height and large volumes of material would be required to achieve a 2:1 or 3:1 (H:V) slope.
  - Incorporate a wave damping berm near the top of the slope. This could allow for a steeper slope to be constructed while still achieving a reduction in wave run-up.
  - Incorporate a crown wall on the dam to reduce wave actions on the embankment slope.
  - High level estimates of construction cost are in the range of up to $100,000.
- **Activity 4**: Lower the FSL in the reservoir. This will increase the available storage capacity in the reservoir prior to an IDF event. This could be the cheapest option to implement, but would likely be the least effectual.
- **Activity 5**: Raise the entire dam crest height. This would likely be the most expensive option to implement and would be recommended if the additional analysis found that the previous options would not be sufficient to achieve freeboard requirements.
  - High level estimates of construction cost are in the range of up to $100,000 to $200,000.
- **Activity 6**: Construct a second spillway in the location where the dam crest has an elevation of 1221.9 m. This option could be an alternative to Activities 1, 2 and 3. A second spillway would increase the discharge capacity of the spillway system and reduce the material quantity to be placed along the crest of the berm. This could also reduce the cost of implementing various elements from Activity 3. However, the channel downstream of the area would need to be armoured and maintained similar to the existing spillway.
  - High level estimates of construction cost are in the range of up to $200,000 to $300,000.

Scenarios are presented below to describe the more likely combination of activities that would be required to achieve freeboard requirements. These scenarios include the following:

- **Scenario 1** - Activity 1 and 2: Widen the spillway to 40 m and raise the minimum embankment elevation to the crest elevation of the dam.
- **Scenario 2** – Activity 1 to 3: Widen the spillway to 40 m, raise the minimum embankment elevation to the crest elevation of the dam, and modify a localized zone of steep reservoir embankment identified by the drone survey, located west of the spillway.
- **Scenario 3** – Activity 1, 2, and 4: Widen the spillway to 40 m, raise the minimum embankment elevation to the crest elevation of the dam, and lower the FSL.
- **Scenario 4** – Activity 1 to 5: Widen the spillway to 40 m and raise the entire dam and embankment crest elevation to provide the required Minimum Freeboard.

6 Closure

We trust that this report meets your requirements. If you have any questions or further information is required, please do not hesitate to contact the undersigned.

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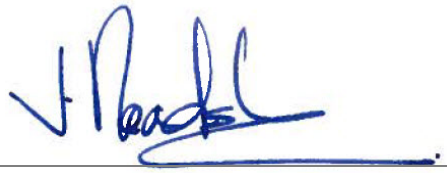

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7 References

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September 8, 2023 Project: 694661

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Via Email: admininfra@mdpinchercreek.ab.ca; asbfieldman@mdpinchercreek.ab.ca

ATTENTION: David Desabrais, P.Eng. and Shane Poulsen

REFERENCE: Fish Lake Culvert Assessment

SNC-Lavalin Inc. (SNC-Lavalin) was retained by the Municipal District of Pincher Creek (the MD) to assess the viability of lowering the culvert connecting the east and west reservoirs upstream of the Fish Lake Project Dam. The Fish Lake Project Dam is an earthfill dam located in SE-32-4-30-W4. It was originally built in 1954 to combine and raise the water level of two natural interconnecting lake bodies (Genivar, 2010). The lake has a gated outlet channel and a spillway to allow excess inflows to be discharged.

The west reservoir is upstream and approximately five times the size of the east reservoir and stores most of the water in Fish Lake. Discharge from the gated outlet in the east reservoir is used by farmers during periods of low precipitation. However, the culvert connecting the two reservoirs is relatively high and does not allow discharge from the west reservoir to the east when the water levels in the lakes are low. Based on communication with the MD, it is understood that there is no minimum water elevation in the west reservoir due to environmental restrictions.

This letter describes the analysis to assess the hydraulic capacity of the existing culvert connecting the two reservoirs and whether a new culvert could be installed at a lower elevation to provide access to more of the water stored in the west reservoir without reducing the hydraulic functionality of the reservoirs. Flood conditions were not modelled in this analysis because they are expected to be unaffected by the assessed culvert adjustment options.

1 Background Information

Dam safety reviews for Fish Lake were completed in 1999 (UMA 1999), 2010 (Genivar 2010), and 2021 (SNC-Lavalin 2022). The 1999 Operation, Maintenance, and Surveillance (OMS) Manual (UMA 1999) provides historical background on the storage capacity of each reservoir and discharge capacities of the outlet and spillway from the east reservoir.

The full supply level (FSL) of Fish Lake is 1508.55 masl and is governed by the spillway invert elevation. The gated outlet capacity is relatively low compared to the spillway and used to discharge water from the lake for use by farmers downstream.

1.1 Survey Information

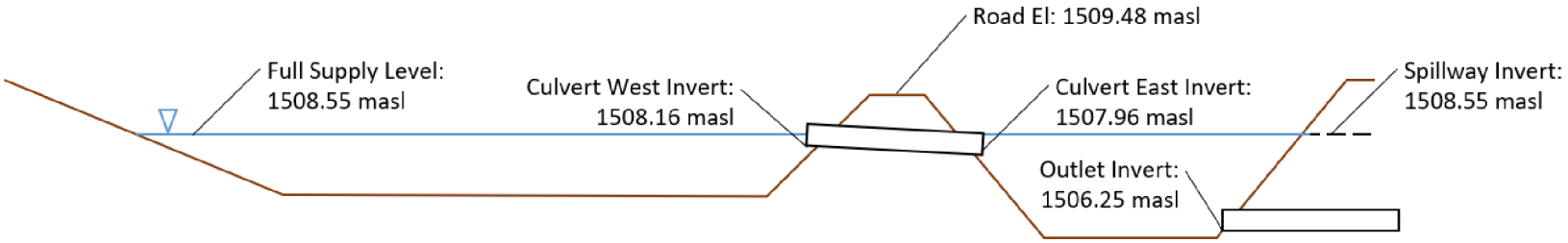
The existing culvert details were surveyed by Martin Geomatic Consultants Ltd. June 15, 2023. The results of the survey indicated the following measurements:

- Top of road: 1509.48 masl;
- East culvert invert: 1507.96 masl;
- West culvert invert: 1508.16 masl;
- Diameter of culvert: 0.76 m;
- Length of culvert: 15.6 m;
- Water elevation: 1508.50 masl; and
- Full supply level: 1508.55 masl.
- Culvert slope: 1.3%

Figure 1 shows an aerial photo of the Fish Lake reservoirs and **Figure 2** shows a schematic of the reservoirs and hydraulic structures.

Figure 1: Aerial View of Fish Lake Reservoirs

Figure 2: Fish Lake Hydraulic Structure Schematic



1.2 Existing Hydraulic Structure Information

Background information about the storage capacity and discharge capacity for the Fish Lake outlet structures was retrieved from the 1999 OMS manual (UMA 1999). **Figure 3** shows the storage capacity curves of the Fish Lake reservoirs and the stored water volume available for use by downstream farmers. Based on the storage curves and measurements from aerial photos, the pond area at full supply level is estimated to be 60 ha and 300 ha in the east and west reservoirs, respectively.

Figure 4 shows the discharge curve for the gated outlet used to allow flow to be conveyed downstream during dry conditions.

Figure 3: Fish Lake Reservoir Existing Storage Curves

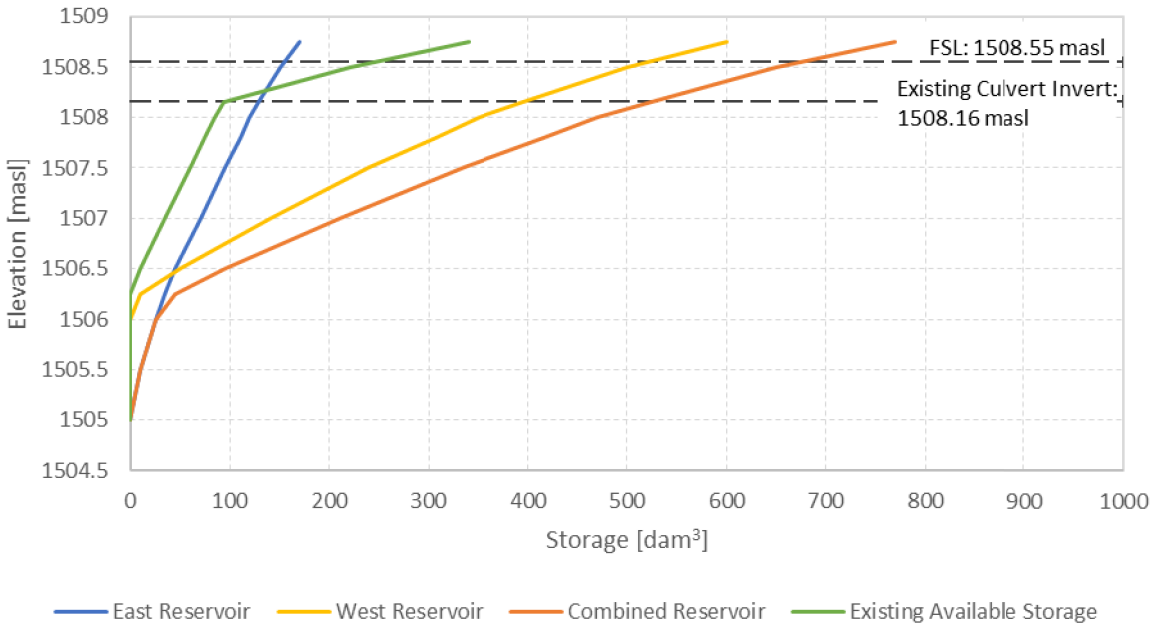
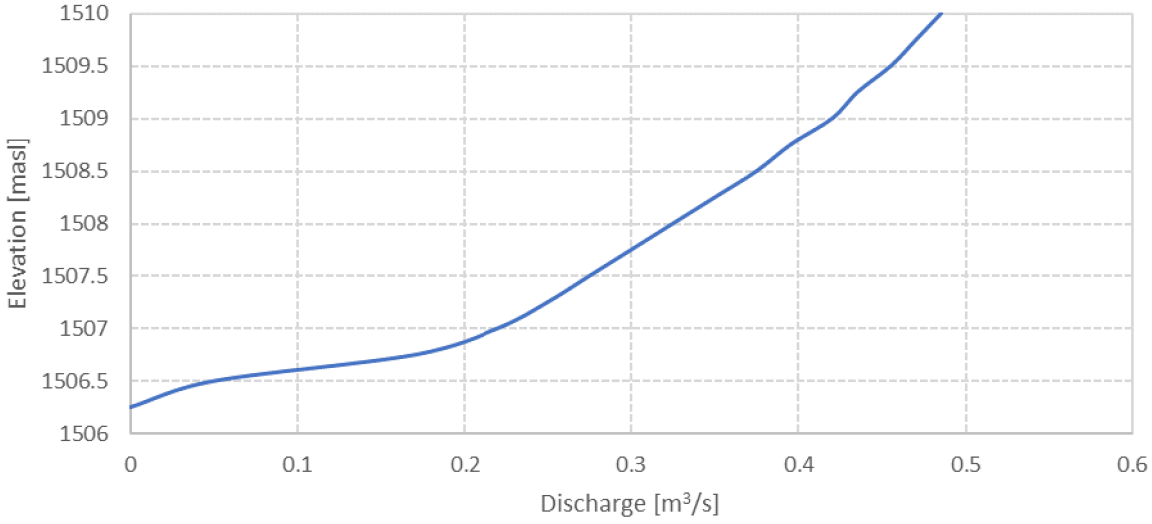


Figure 4: East Reservoir Gated Outlet Discharge Curve



2 Hydrotechnical Analysis

2.1 Methods

The hydraulic modelling of the reservoirs and hydraulic structures was completed using PCSWMM. The model was used to assess four different culvert invert elevations as follows:

- **Existing Conditions**: Culvert west invert = 1508.16 m;
- **Option 1**: Culvert west invert = 1507.80 m;
- **Option 2**: Culvert west invert = 1507.50 m; and
- **Option 3**: Culvert west invert = 1507.16 m.

Options 1 to 3 were selected to provide an equal increment to culvert elevation to a maximum culvert invert elevation reduction of 1 m. All four model scenarios assume the storage capacity of the reservoirs and east pond outlet discharge capacity are equal to existing conditions (Section 1.2). The culverts in each scenario are assumed to have the same diameter, slope, and length as the surveyed culvert. Each scenario was simulated over a 10-day period with an initial water level equal to the FSL, no additional inflows, and the gated outlet fully open for 24 hours a day. For FSL conditions, the existing culvert only flows approximately half full (0.39 m depth) at the west inlet. A 10-day period was selected to understanding the hydraulic characteristics of the culvert, and it is understood that the outlet would not likely be opened fully opened over such a long period.

2.2 Results

The hydraulic modelling found that the flow-capacity performance of the culvert would increase at a lower elevation and that peak discharge through the culvert is primarily dependent on the difference in water elevation between the two reservoirs. Lowering the culvert by 1 m (Option 3) would provide downstream water users access to an additional 223 dam^3 (223,000 m^3) of stored water in the west reservoir. **Figure 5** shows the discharge through the existing culvert and downstream outlet with the water elevation in the west and east reservoirs over a 10-day period. **Figure 6** shows a comparable figure for Option 3 conditions. The peak flow predicted through the culvert is approximately 0.22 m^3/s for the existing conditions and 0.30 m^3/s for all three Options. Peak discharge is predicted to occur after fully opening the downstream outlet for between 12 and 24 hours. The discharge through the culvert remains close to its peak over a longer period as the culvert elevation is reduced.

Figure 5: Modelled Discharge and Lake Elevations for Existing Conditions

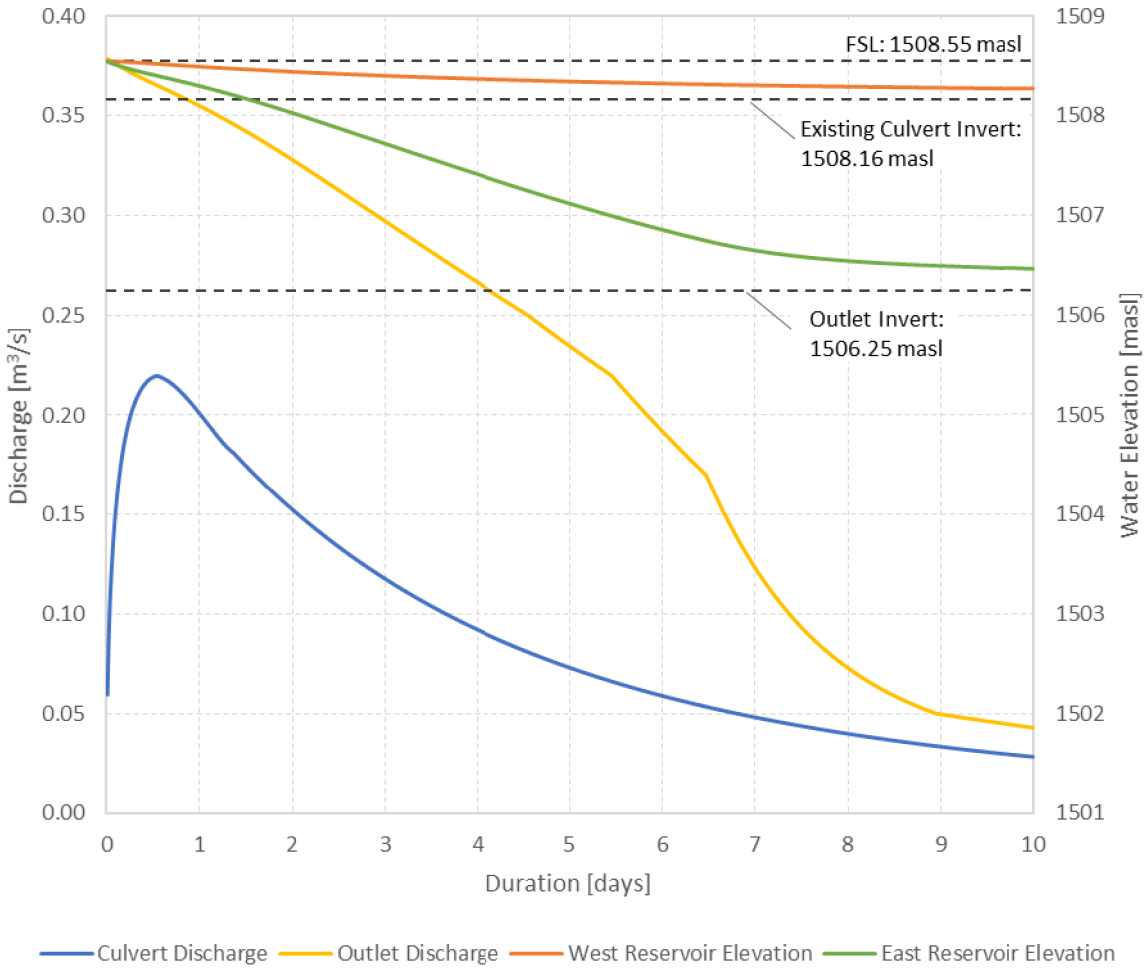
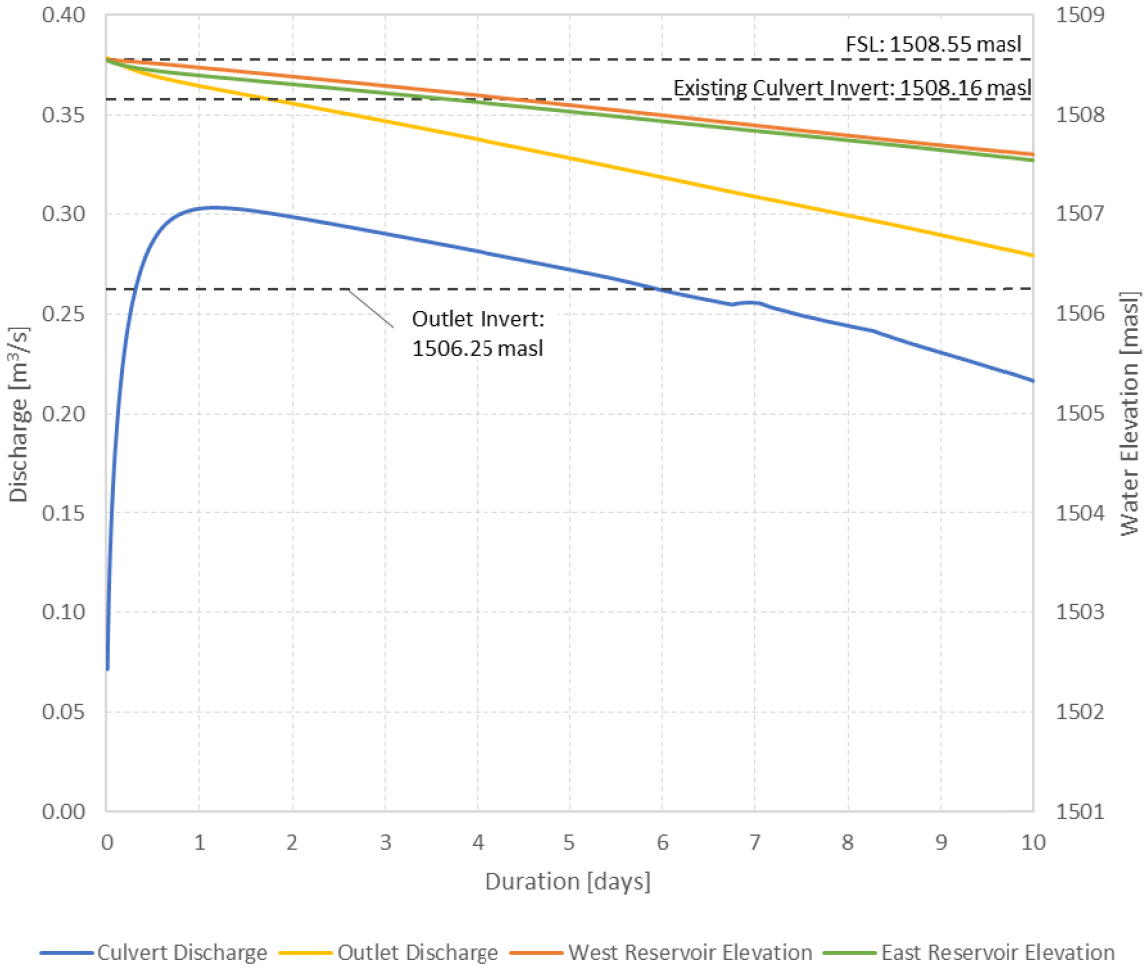


Figure 6: Modelled Discharge and Lake Elevations for Option 2 Conditions



For Option 3, the remaining unavailable storage in the west reservoir would be 172 dam^3 and the reservoir surface area would be approximately 180 ha. **Figure 7** shows the accessible stored water volume at various elevations for the modelled scenarios. **Table 1** shows the resulting volume released downstream through the downstream outlet.

Figure 7: Combined Available Reservoir Storage for Modelled Scenarios

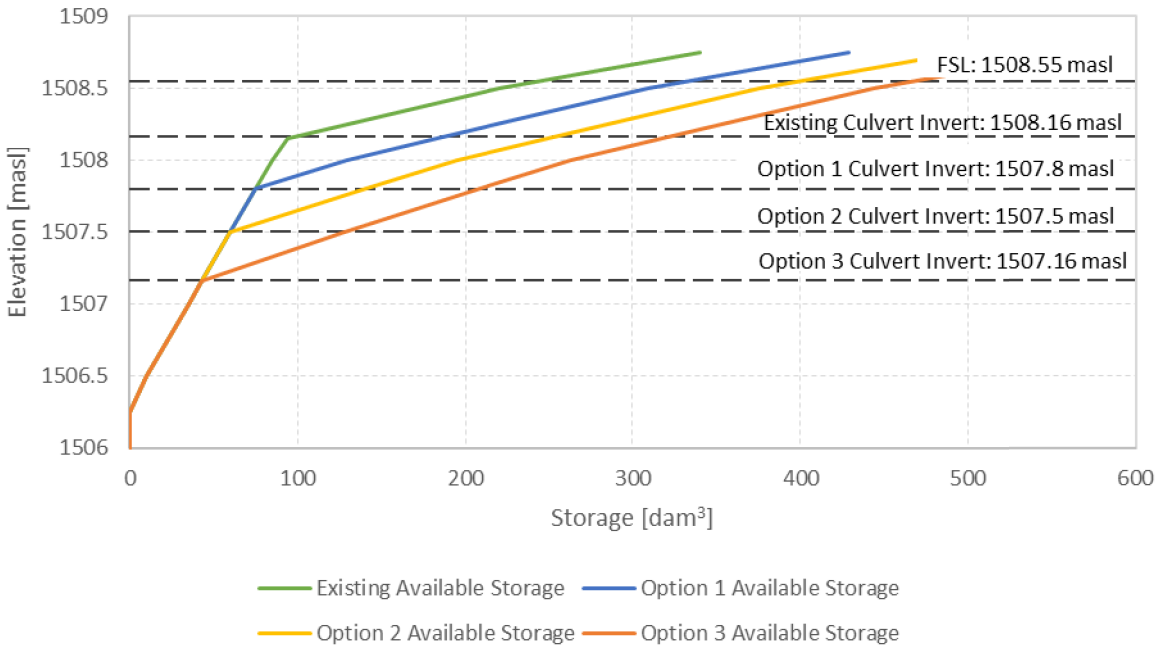


Table 1: Modelled Water Elevation and Volume Discharged in 10-Day Simulation Period

Scenario	Final West Reservoir Elevation [masl]	Final East Reservoir Elevation [masl]	West Reservoir Discharged Volume [dam³]	Total Discharge from East Reservoir [dam³]
Existing Conditions	1508.27	1506.46	88.4	198.8
Option 1	1507.94	1506.64	182.4	284.2
Option 2	1507.71	1507.18	233.5	308.5
Option 3	1507.60	1507.54	257.5	314.3

3 Summary and Recommendations

The culvert connecting the west and east reservoirs in Fish Lake was constructed at a height that limits access to a significant volume of water stored in the west reservoir. Lowering this culvert would provide access to more of the stored water in the west reservoir for famers throughout periods of low precipitation. The peak discharge through the culvert is expected to increase from 0.22 m^3/s to 0.30 m^3/s when the west reservoir is at FSL for all alternative options considered. By lowering the culvert up to 1 m, an additional 223 dam^3 of stored water in the west reservoir could be made accessible to farmers.

The following actions are recommended:

- Replace the existing culvert with a new corrugated steel pipe culvert situated nearby, founded at a lower elevation with equal diameter (0.76 m), similar length (15.9 m), and equal or steeper slope (1.3%);
- The elevation of the culvert inlet should be selected based upon the desired available storage in the west reservoir; and
- Dredging or excavation and armouring upstream and downstream of the culvert may be required to prevent future clogging or blockage of the culvert inlet and outlet.

4 References

Genivar, 2010. 2010 Dam Safety Reviews – Cridland Dam, Foothill Lake Dam, Fish Lake Dam, Sandy Lake Dam. Prepared for Municipal District of Pincher Creek. May 2010.

SNC-Lavalin, 2022. 2021 Dam Safety Review - Cridland Dam, Therriault Community Dam, Sandy Lake Project Dam, Fish Lake Project Dam, Foothill Lake Community Dam. Prepared for Minicipal District of Pincher Creek. File No. 20220314_683055-EB. March 14, 2022.

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5 Notice to Reader

This report has been prepared and the work referred to in this report has been undertaken by SNC-Lavalin Inc. (SNC-Lavalin), for the exclusive use of the M.D. of Pincher Creek No. 9, which has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made with respect to the professional services provided to M.D. of Pincher Creek No. 9 or the findings, conclusions and recommendations contained in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered or project parameters change, modifications to this report may be necessary.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

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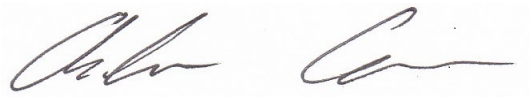
6 Closure

SNC-Lavalin trust this letter meets your requirements at this time. If any more information or clarification is needed, please contact the undersigned.

Prepared by:



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Recommendation to Council

TITLE: Road Closure Bylaw 1339-22 East of SE 4-7-2 W5 (Maloff)	
PREPARED BY: Laura McKinnon	**DATE: October 18, 2023**
DEPARTMENT: Planning and Development	
2023/10/18 **Department Supervisor** / **Date**	**ATTACHMENTS:** 1. **Bylaw No. 1339-22** 2. **Descriptive Plan for Proposed Consolidation**

APPROVALS:

		Roland Milligan	2023/10/18
Department Director	**Date**	**CAO**	**Date**

RECOMMENDATION:

That Council give second, and third and final reading to Road Closure Bylaw No. 1339-22.

BACKGROUND:

In March 2022, the MD approved the proposal from landowner Peter Maloff, requesting to close and purchase a portion of undeveloped MD road allowance located between the SE 4-7-2 W5 and the SW 3-7-2 W5.

Road Closure Bylaw No. 1339-22 received first reading at the June 23, 2022 Council meeting, with the required public hearing being advertised and held on August 23, 2022.

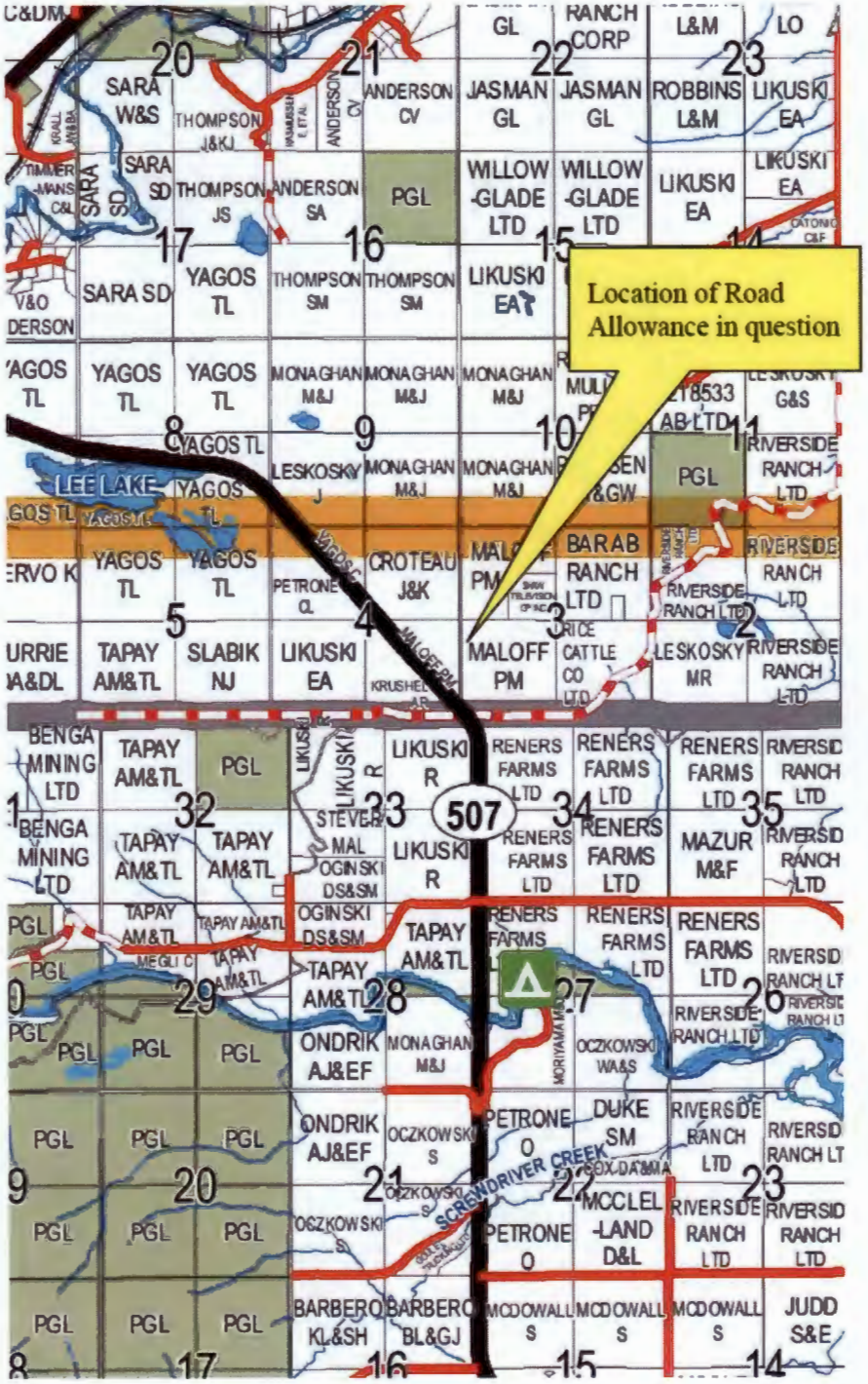
Road Closure Bylaw No. 1339-22 was signed by the Minister of Transportation on October 2, 2023 and is being presented for second, and third and final reading.

FINANCIAL IMPLICATIONS:
None

Recommendation to Council

Map Showing Location

Location of Request



MD OF PINCHER CREEK NO. 9
BYLAW NO. 1339-22

A BYLAW OF MD OF PINCHER CREEK NO. 9 FOR THE PURPOSE OF CLOSING TO PUBLIC TRAVEL AND CREATING TITLE TO AND DISPOSING OF PORTIONS OF A PUBLIC HIGHWAY IN ACCORDANCE WITH SECTION 22 OF THE MUNICIPAL GOVERNMENT ACT, CHAPTER M26, REVISED STATUTES OF ALBERTA 2000, AS AMENDED.

WHEREAS, the lands hereafter described are no longer required for public travel,

WHEREAS, application has been made to Council to have the roadway closed, and

WHEREAS, the Council of MD OF PINCHER CREEK NO. 9 deems it expedient to provide for a bylaw for the purpose of closing to public travel certain roads or portions thereof, situated in the said municipality and thereafter creating title to and disposing of same, and

WHEREAS, notice of intention of Council to pass a bylaw has been given in accordance with Section 606 of the Municipal Government Act, and

WHEREAS, Council was not petitioned for an opportunity to be heard by any person claiming to be prejudicially affected by the bylaw

NOW THEREFORE BE IT RESOLVED that the Council of MD OF PINCHER CREEK NO. 9 in the Province of Alberta does hereby close to Public Travel and creating title to and disposing of the following described highways, subject to rights of access granted by other legislation.

ALL THAT PORTION OF GOVERNMENT ROAD ALLOWANCE LYING EAST OF SE 4-7-2-5 AND FORMING PART OF LOT 1, BLOCK 1, DESCRIPTIVE PLAN _____,
CONTAINING 1.50 HECTARES (3.71 ACRES) MORE OR LESS
EXCEPTING THEREOUT ALL MINES AND MINERALS

Received first reading this 28TH day of JUNE, 2022.

_____
Chief Elected Official *Seal*

_____
Chief Administrative Officer

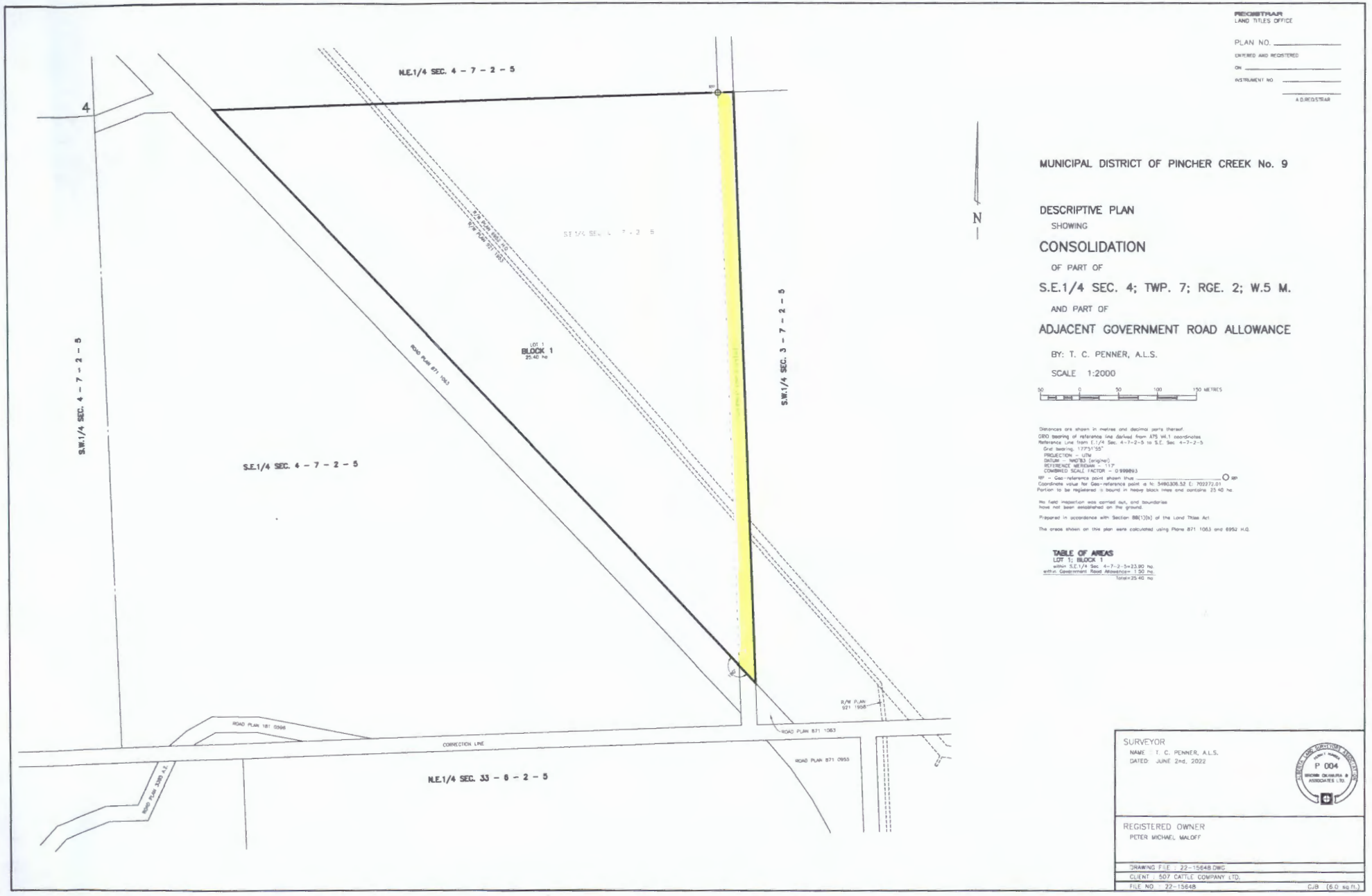
Approved this 2nd day of October, 2023

_____
Minister of Transportation
and Economic Corridors

Received second reading this _____ day of _____, 20__.

Received third reading and finally passed this _____ day of _____, 20__.

Attachment No. 1



REGISTRAR
LAND TITLES OFFICE

PLAN NO. _____
ENTERED AND REGISTERED
ON _____
INSTRUMENT NO. _____
_____
A.D. REGISTRAR

MUNICIPAL DISTRICT OF PINCHER CREEK No. 9

DESCRIPTIVE PLAN
SHOWING
CONSOLIDATION
OF PART OF
S.E.1/4 SEC. 4; TWP. 7; RGE. 2; W.5 M.
AND PART OF
ADJACENT GOVERNMENT ROAD ALLOWANCE

BY: T. C. PENNER, A.L.S.

SCALE 1:2000

50 0 50 100 150 METRES

Distances are shown in metres and decimal parts thereof.
GRID bearing of reference line derived from ATS 94.1 coordinates.
Reference Line from E.1/4 Sec. 4-7-2-5 to S.E. Sec. 4-7-2-5
Grid bearing 177°51'55"
PROJECTION – UTM
DATUM – NAD'83 (original)
REFERENCE MERIDIAN – 117
COMBINED SCALE FACTOR – 0.999893
RP – Geo-reference point shown thus: ○ RP
Coordinate value for Geo-reference point is N: 5490306.52 E: 702272.01
Portion to be registered is bound in heavy black lines and contains 25.40 ha.

No field inspection was carried out, and boundaries have not been established on the ground.

Prepared in accordance with Section 88(1)(b) of the Land Titles Act

The areas shown on this plan were calculated using Plans 871 1063 and 6952 H.Q.

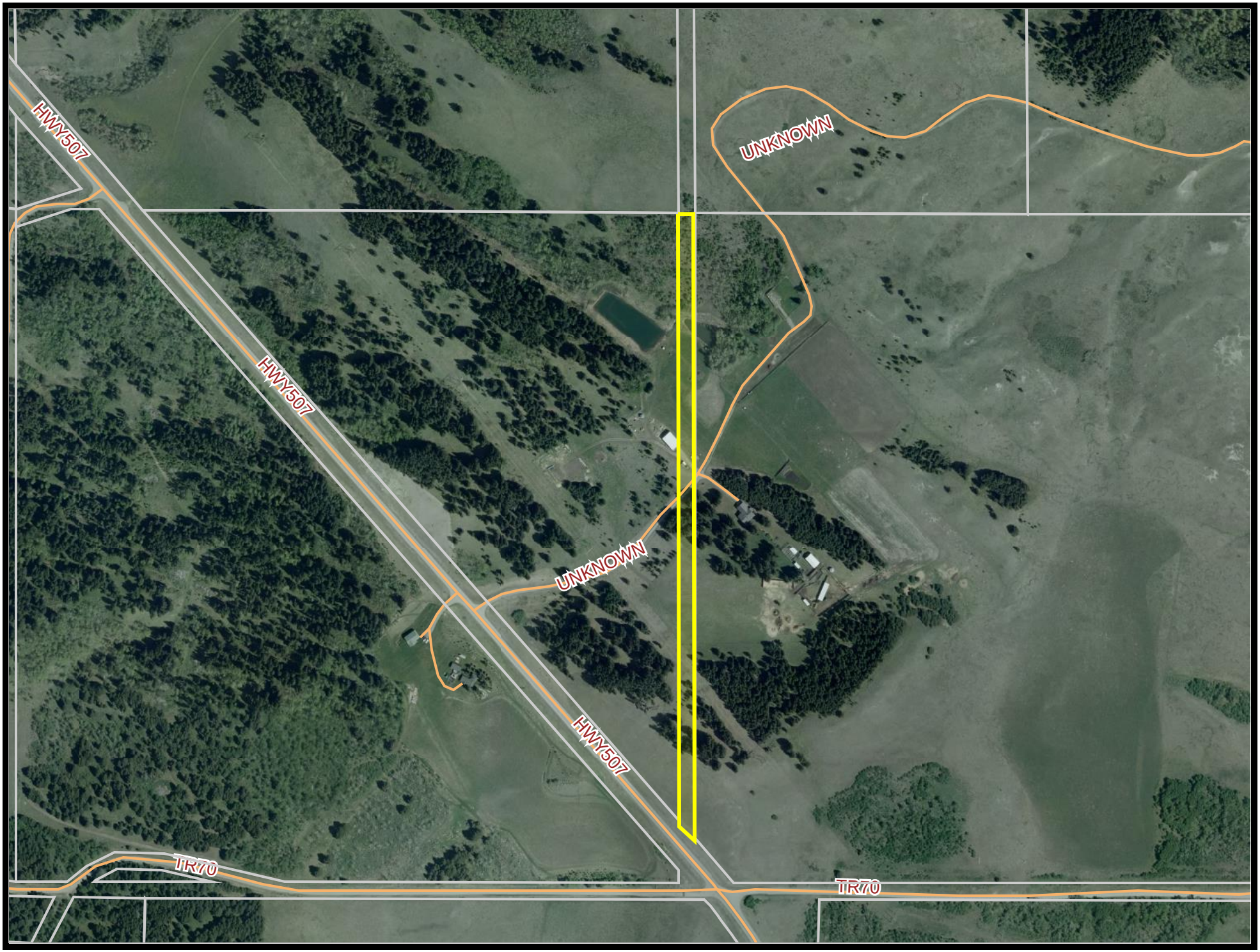
TABLE OF AREAS
LOT 1; BLOCK 1
within S.E.1/4 Sec. 4-7-2-5=23.90 ha.
within Government Road Allowance= 1.50 ha.
Total=25.40 ha.

SURVEYOR
NAME: T. C. PENNER, A.L.S.
DATED: JUNE 2nd, 2022

ALBERTA LAND SURVEYOR ASSOCIATION
P 004
BROWN OKAMURA & ASSOCIATES LTD.

REGISTERED OWNER
PETER MICHAEL MALOFF

DRAWING FILE: 22-15648.DWG
CLIENT: 507 CATTLE COMPANY LTD.
FILE NO.: 22-15648 C/B (6.0 sq.ft.)


HWY507
HWY507
HWY507
UNKNOWN
UNKNOWN
TR70
TR70

CHIEF ADMINISTRATIVE OFFICER'S REPORT

October 6, 2023 to October 20, 2023

Discussion:

October 9	Thanksgiving Statutory Holiday
October 10	Council Committee and Council Meetings
October 11	Joint Health and Safety Committee Meeting
October 12	Head Count Meeting (Budget)
October 12	Special Meeting – Capital Budget
October 13	Health and Safety Budget Discussion
October 16	SDO
October 17	Chelsae Petrovic, MLA Livingstone-MacLeod Visit
October 17	Water Supply Meeting, David Hunt EPA
October 18	Competency Check for Processes
October 19	ARMAA/LGAA Zone 1 meeting, Picture Butte
October 20	Chamber Awards

Upcoming

October 23	SMT Meeting
October 23	PW Operation Budget Discussion
October 23	AES Operation Budget Discussion
October 23	Health and Safety Operation Budget Discussion
October 24	Council Committee, 2023 Organizational, and Council Meetings
October 25	Regional Meeting CNP
October 26	Open House for LUB Updates and Draft Strategic Plan

RECOMMENDATION:

That Council receive for information, the Chief Administrative Officer's report for the period October 6, 2023 – October 20, 2023.

Prepared by: CAO, Roland Milligan Date: October 18, 2023

Respectfully presented to: Council Date: October 24, 2023

Administrative Support Activity since last Council Meeting
– prepared by Jessica McClelland, EA

Letters from last Council:

Advertising/Social:

- Reminder for Snow Removal Paperwork
- Pincher Energy Newsletter September
- Notice of Special Meeting – October 12, 2023
- Open House – Thursday October 26, 2023
- Sharing Foothills and Forage Grazing Association Seminar
- Condolences for loss of previous Councillor Hlady

Other Activities:

- Council Package/Meeting
- Preparing for Halloween in the Village (October 28, 2023 1 to 4)
- Signage for Eco Centre
- Organizing for RMA
- Working with Safety/PW for public service announcement for winter

Invitations to Council:

- Lorne Thompson – checking his schedule
- Irrigation District – spoke with Ministers Assistant, meeting will be scheduled following RMA and will be virtual

Upcoming Dates of Importance:

Regular Committee, Council – October 24, 2023
Organizational Meeting – October 24, 2023
Regional Council Meeting – October 25, 2023
Open House – October 2, 2023
RMA Edmonton – November 5-9, 2023
Regular Committee, Council – November 14, 2023
Coffee with Council – Summerview November 16, 2023

ROYAL CANADIAN LEGION PINCHER CREEK BRANCH #43
P.O. BOX 131, 691 MAIN STREET, PINCHER CREEK, ALBERTA T0K1W0
Tel: 403 627 4024

October 5, 2023

Municipal District of Pincher Creek #9
Box 279
Pincher Creek, Alberta
T0K 1W0

During the coming months, the Royal Canadian Legion Pincher Creek Branch #43 will be honoring and remembering our Veterans and their families, through our sale of Poppies and Wreaths and our REMEMBRANCE DAY SERVICES.

The Royal Canadian Legion Pincher Creek Branch #43 request permission for:

1. Pincher Creek Branch #43 Members and Pincher Creek Branch #43 Ladies Auxiliary Members to canvas businesses, individuals and organizations beginning October 11, 2023 for the sale of wreaths and donations to the Royal Canadian Legion Pincher Creek Branch #43 Poppy Fund.

2. To distribute poppy boxes, as soon as authorized by Dominion Command

3. Youth Groups to canvas the residential areas with poppies on the first Saturday in November

4. Declare the week of November 5 to 11 as “Veterans’ Week”

Funds received from donations and the sales of poppies and wreaths are used exclusively to assist Veterans of the Canadian Forces and the RCMP and their families, who need assistance.

Thank you for considering our request and we await your response.

Yours sincerely

Angie Moen, Poppy Chairman
Royal Canadian Legion Pincher Creek Branch #43

LEST WE FORGET

Irrigators warned to plan for shortages

H2c

Alex McCuaig

Published: October 5, 2023

Rainfall in late September was among the largest seen in weeks and was also widespread and felt from the Eastern Slopes to the Saskatchewan border. | File photo

The situation along rivers and in reservoirs across southern Alberta received a reprieve from deteriorating conditions on the last day of September, but challenges remain as the last few irrigation districts shut off their taps for the season.

Rainfall in late September was among the largest seen in weeks and was also widespread and felt from the Eastern Slopes to the Saskatchewan border. The rainfall resulted in one-day accumulations ranging from 38 millimetres in Pincher Creek to 8.5 mm in Medicine Hat.

However, more precipitation will be needed to restore the South Saskatchewan River basin's depleted reservoirs and thirsty rivers, which have faced multiple water shortage advisories.

"All eyes will be on the snowpack and seeing where that comes in," said David Westwood, general manager of the St. Mary River Irrigation District.

"We are going to need a pretty significant snowpack to come back to any semblance to what we would call a regular type of allocation at this stage because we have such low storage going into winter."

SMRID shut down Sept. 22 after a summer that saw its water storage drawn down to a quarter of capacity system-wide and the St. Mary Reservoir essentially drained.

"It's down to less than three percent of its full supply," Westwood said about the St. Mary Reservoir, which is managed by the Alberta government.

"That's the one we're going to really want to make sure gets replenished. At this stage, we're going to need some precipitation events this fall, a good snowpack and rains again in the spring if we are going to get back on track to where we like the storage to be."

SMRID was left with little choice than to shut down a couple of weeks early this year as volumes in the reservoirs dipped lower. The hot summer with little rain made it difficult to create enough pressure to move water down pipelines and canals.

Westwood said while he is optimistic for next season, the reality of the current situation should have irrigators planning ahead for tightened water supplies next season.

"We're already hearing from irrigators saying we're expecting it to be low, so we will carefully consider what we plant and where we plant and if we will seed all of our land," he said.

Most irrigation districts made it through the season with time left to set up for next season, but municipalities that rely on the Oldman River are facing more immediate concerns as stream flows drop going into winter freeze-up.

Doug Kaupp, general manager of water and waste water for the city of Lethbridge, boiled down the issue facing the community, which also supplies water to Coaldale and Lethbridge County as well as industry.

"We only have one source, I don't have another river to tap or well standing by," he said.

"We depend on the reliability of that river."

Stream flows on the Oldman River through Lethbridge have remained at levels mostly higher than 20 cubic metres a second in recent weeks. The rate is nearing the lower level of the city's ability to effectively capture and process water, which requires a bare minimum of 13 cubic metres a second.

The looming issue for the regional water supply is that current stream flows are being maintained by releases from the Oldman Dam reservoir.

The Alberta government-controlled reservoir has seen levels decline since it reached its 495 million cubic metre maximum capacity in mid-June. It fell to a little more than 28 percent full by the beginning of October and continues to release more water than it's taking in.

"Many a bullet has been dodged thanks to that storage. It's been 20 years since there's been conditions this dire," Kaupp said.

"As long as there is water, everything works."

There are growing concerns that the impacts of El Nino will see a continuation of dry conditions through the winter. The provincial government says it will hold meetings with stakeholders in the coming months to prepare for any eventuality.

As for the water supply situation for Lethbridge, based on data from the end of September, “it’s tight, it’s definitely tight,” said Kaupp.

The last major irrigation district continuing to supply water to farmers is the Lethbridge Northern Irrigation District, which is shutting its system down Oct. 6.

The situation at the Oldman Dam reservoir is expected to improve once diversions cease to the LNID.

The season started late for irrigators on that system for the second time in as many years after the main canal from the reservoir was found in the spring to be leaking. In 2022, LNID irrigators saw water deliveries delayed because of a dispute between the provincial government and Piikani Nation.

The Alberta government has issued a request for bids from contractors to complete repair work on 300 metres of the main canal.

A tender for that work is anticipated to be issued Nov. 3, with construction commencing Dec. 11 and substantial work completed by March 31.

As of Oct. 1, 41 water shortage advisories had been issued across Alberta with seven on the South Saskatchewan River, six on the Oldman River, five each on the Bow and Red Deer river basins and one on the Milk River system.

https://www.producer.com/news/irrigators-warned-to-plan-for-shortages/