Associated Engineering
GLOBAL PERSPECTIVE.
LOCAL FOCUS.

Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive
Saskatoon, SK S7L 6X6 Canada
www.ae.ca

TEL: 306.653.4969

November 26, 2024
Reference/Project No.: P24-01820

Clint Austin
Resort Village of Elk Ridge
221 Arne Pedersen Way
Elk Ridge, SK S0J 2Y0

**Re: RESORT VILLAGE OF ELK RIDGE
WATER TREATMENT PLANT UPGRADES
PRELIMINARY DESIGN SERVICES PROPOSAL**

Dear Clint:

This letter is in response to correspondence with the Resort Village of Elk Ridge (the Village) requesting a proposal from Associated Engineering (Associated) to provide preliminary design services related to upgrade of the Village's Water Treatment Plant (WTP).

1 PROJECT UNDERSTANDING

Associated understands the Village wishes to undertake upgrades to their WTP. The main objective of this project is to increase the water treatment capacity and water quality of the Village's WTP to meet provincial drinking water quality standards for current and future community populations. The project objectives and purposes are further defined in **Schedule B – Project Description** of the attached draft **Form of Agreement**. An overview of the existing water treatment process and description of the baseline situations are provided within **Appendix B – Technical Statement of Work** of the attached draft **Form of Agreement**. The project is partially funded through the Investing in Canada Infrastructure Program (ICIP) and engineering services are being procured according to the terms and conditions of the Kinetic GPO agreement.

2 SCOPE OF SERVICES

The Village intends to execute this project in the following two phases:
- Phase I - Preliminary Design, and
- Phase II - Detailed Design, Engineering, Procurement, and Construction.

The scope of services included as part of this proposal include only those for Phase I - Preliminary Design. Engineering services for Phase II - Detailed Design, Engineering, Procurement, and Construction are anticipated to be added upon completion of Phase I.

The approach to project execution is further defined in **Schedule B – Project Description** of the attached draft **Form of Agreement**, and a detailed description of the project scope is provided in **Schedule C - Scope of Services** of the attached draft **Form of Agreement**.

As outlined in **Schedule C - Scope of Services** of the attached draft **Form of Agreement**, the ICIP eligible costs total is $1,085,000, intended to cover the following scope items:

- Raw water supply system improvements including new well pumps to increase capacity and a prefiltration to improve sediment removal.
- New filtration equipment targeting ammonia, iron, and manganese.
- Filter face piping and connections to existing process piping.
- Backwash pump, piping and connections.
- Analytical and instrumentation equipment.
- Removal of existing filters.
- Repairs and modifications to water treatment plant building as required.
- Electrical and mechanical works to support.
- All temporary works to maintain water supply during construction.
- Engineering and associated work.

Rehabilitation of the existing raw water wells, installation of new raw water wells, expansion of the potable water storage, and replacement of the distribution pumps are currently not in the scope of work defined in ICIP funding. Project cost estimates were previously completed by BCL Engineering Ltd. in 2022. These cost estimates, in both 2022 and 2024 dollars, are summarized in **Table 2-1** below. The 2024 costs have been calculated using an 8.5% escalation factor based on Government of Canada Builder's Construction Price Index and Bank of Canada Inflation rate.

The cost estimating previously completed by BCL Engineering Ltd. did not consider expansion of the potable water storage reservoir. Based on similar projects recently completed by Associated, addition of a reservoir expansion is likely to extend the overall construction costs for the project to upwards of $5,000,000.

Given the discrepancy between the available ICIP funding and the potential overall cost of the upgrades, Associated will complete the Preliminary Design with a focus on both short-term and long-term upgrades. A Preliminary Design Report will be prepared to outline the design requirements to achieve the Village's long-term goals for the WTP and include specific recommendations for ICIP eligible improvements to be completed before the funding deadline.

Table 2-1 Cost Estimates

Upgrade Component	Costs Estimated by BCL Engineering Ltd.		ICIP Eligible	Proposed 2025-2027 ICIP Funded Scope	Proposed Future Scope
	2022	2024			
Well pump replacement	$35,000	$38,000	✓	✓	x
PW6 well screen installation	$70,000	$75,000	✓	✓	x
Pre-filter installation	$45,000	$48,000	✓	✓	x
Well development	$310,000	$329,000	x	X	✓
Treatment upgrades					
Option 1: Greensand process expansion	$410,000	$445,000	✓[1]	✓[1]	x
Option 2: Biological filtration conversion	$430,000	$461,000	✓[1]	✓[1]	x
Option 3: Membrane filtration addition	$1,640,000	$1,779,000	✓	x[2]	✓
Distribution pumping	$190,000	$202,000	x	x	✓
Subtotal	**$1,060,000[3] to $2,720,000[4]**	**$1,150,000[3] to $2,951,000[4]**	**$2,387,000 to $2,409,000**	**$608,000[5] to $630,000[6]**	**$2,310,000**
Contingency (15%)	$159,000 to $408,000	$173,000 to $443,000	$358,000 to $361,000	$80,000 to $83,000	$348,000
Total	**$1,219,000 to $3,128,000**	**$1,323,000 to $3,394,000**	**$2,745,000 to $2,770,000**	**$699,000 to $725,000**	**$2,669,000**

Notes:

1. *ICIP funding includes either Option 1: Greensand Process Expansion or Option 2: Biological Filtration Conversion.*
2. *Option 3: Membrane Filtration Addition is proposed to be excluded from the 2025-2027 ICIP Funded Scope due to cost constraints.*
3. *Lower limit subtotal calculation includes Well Pump Replacement, PW6 well screen installation, Pre-Filter Installation, Well Development, Greensand Process Expansion, and Distribution Pumping.*
4. *Upper limit subtotal calculation includes Well Pump Replacement, PW6 well screen installation, Pre-Filter Installation, Well Development, Biological Filtration Conversion, Membrane Filter Addition, and Distribution Pumping.*
5. *Lower limit subtotal calculation includes Well Pump Replacement, PW6 well screen installation, Pre-Filter Installation, and Greensand Process Expansion.*
6. *Upper limit subtotal calculation includes Well Pump Replacement, PW6 well screen installation, Pre-Filter Installation, and Biological Filtration Conversion.*

3 WORK PLAN

Associated proposes to provide engineering services for the design of the WTP upgrades described above in Section 2. Services are to include the process mechanical, building mechanical, structural, electrical, instrumentation, and controls engineering required to produce those deliverables defined within **Schedule C – Scope of Services** of the attached draft **Form of Agreement**.

Preliminary Design shall focus on the defining the project requirements and constraints, and selection of the best-value approach and technology for water treatment. To accomplish this, the following approach will be executed:

- Provide project management services, including coordination and communication with the Village, oversight and coordination of the design team, project reporting and invoicing.
- Meet with utility staff on-site to review the project scope, observe existing conditions and investigate operational issues.
- Complete a review of the background data annexed to **Appendix B - Technical Statement of Work** of the attached draft **Form of Agreement**.
- Prepare and submit to the Village a technical memorandum detailing the findings of the site assessment and recommending treatment upgrade options.
- Meet with the Village to review the recommended treatment upgrade options.
- Following Village selection of a treatment upgrade option, prepare and submit to the Village a draft Preliminary Design Report, including preliminary sketches as required, a listing of priority items eligible for ICIP funding, a proposed schedule for Phase I and Phase II work, report exclusions, and an opinion of probable cost to highlight variations of previously estimated costs.
- Meet with the Village to review the draft Preliminary Design Report.
- Update the Preliminary Design Report and submit a final copy to the Village.
- Following submission of the Preliminary Design Report amend the **Form of Agreement** to include Phase II scope.

To assist the Village in allocation of ICIP funding, Associated proposes to use the following task-based work plan.

3.1 TASK 100 - PRELIMINARY DESIGN (ICIP FUNDED)

Within this task, Associated proposes to include preliminary design services for:

- Project management.
- Client meetings.
- Background data review.

- Preparation of the following Preliminary Design Report content:
  - Expansion capacity.
  - Raw water supply: establish design basis for pre-filtration system and well pump replacement.
  - Water treatment system upgrades: establish design basis for greensand process expansion or biological filtration conversion.

3.2 TASK 101 - PRELIMINARY DESIGN (VILLAGE FUNDED)

Within this task, Associated proposes to include preliminary design services for:

- Preparation of the following Preliminary Design Report content:
  - Raw water supply: establish design basis for installation of a new well.
  - Water treatment system upgrades: establish design basis for membrane filtration addition and assess the impacts of membrane residuals. Note that a pilot study of membrane technology is not included in this scope.
  - Water storage and distribution upgrades: establish design basis for increase water storage capacity and conversion to vertical turbine distribution pumps.

4 SCHEDULE

It is understood that the Village requires completion of ICIP eligible construction work before March 31, 2027. To facilitate this, Associated propose the following schedule:

Table 4-1 Proposed Project Schedule

Milestone	Date
Award of Phase I Engineering work	December 9, 2024
Phase I – Preliminary Design	
Preliminary investigation	Dec. 9, 2024 through Dec. 23, 2024
Upgrade options technical memorandum submission	February 12, 2025
Upgrade options technical memorandum review meeting	Week of February 17, 2025
Draft Preliminary Design Report submission	June 5, 2025
Draft Preliminary Design Report review meeting	Week of June 8, 2025
Final Draft Preliminary Design Report submission	July 4, 2025
Award of Phase II Engineering Work	July 25, 2025

Milestone	Date
Phase II - Detailed Design, Engineering, Procurement and Construction	
50% Detailed Design submission	September 26, 2025
90% Detailed Design submission	November 28, 2025
Issued for Procurement document submission	January 2, 2026
Procurement period	January 2025 through February 2025
Construction period	Feb. 2026 through Feb. 2027

Notes:
1. *The scheduled outlined above does not consider prolonged client review times, changes in scope, or other unforeseen issues.*
2. *Phase II Milestones are estimates and not included in the scope of this proposal.*

5 PROJECT TEAM

Associated has a strong team of in-house professionals with relevant experience who will work collaboratively to successfully deliver this project. The following staff will provide the key services outlined in this proposal. In addition to those listed below, our team offers a variety of multi-disciplinary professionals upon whose expertise our key team members can draw, including environmental services, community planning and infrastructure management.

Josh Yohnke, P.Tech.
Project Manager

Josh has over 20-years of experience in the water and wastewater industry, including operations, design, project management, and construction management. He has successfully led projects through the various engineering phases; concept to detailed design, tender through to commissioning. His diverse project experience includes water and wastewater treatment, pumping stations, water distribution, wastewater collection. Clients range from small to large municipalities, federal and provincial governments and corporate clients of all sizes.

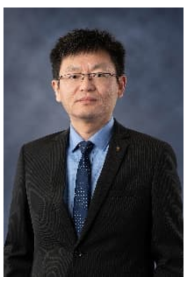
Responsibilities: As Project Manager, Josh will be responsible for project team leadership, design support, client liaison, planning, schedule and budget control, and project delivery.

Shea Allison, Engineer-in-Training
Project Engineer/Process Mechanical Lead

Shea is a Project Engineer with a focus on process mechanical design. She brings a variety of process engineering experience to the team. She has been involved in feasibility studies, conceptual design, preliminary design, detailed design, and project management in the areas of water treatment and supply.

Responsibilities: As Project Engineer, Shea will support the Project Manager in her duties and lead the Project Team through Preliminary Design. Shea will also lead the process mechanical design.

Shengtao Weng, P.Eng.
Process Quality Assurance



Shengtao is a Process Engineer with over 24-years of experience, specializing in water treatment and supply. He has been involved in numerous multi-disciplinary projects involving all phases of design, including assessment, conceptual design, preliminary design, detailed design, construction, and commissioning. in the areas of.

Responsibilities: Shengtao will provide oversight and quality assurance for process mechanical design aspects of the project.

Ashley Hodgson, P.Eng.
Structural Lead

Ashley is a structural engineer in Saskatchewan's Bridge and Structures Group. She has 12-years of building experience, including project management, building condition assessments, detailed design, structural analysis, contract administration, and resident engineering. Ashley has experience delivering numerous multi-disciplinary water and wastewater projects.

Responsibilities: Ashley will be the Structural Lead responsible for designing the structural components of this project.

Brody Masserey, P.Eng.
Electrical, Instrumentation, and Controls Lead

Brody is an electrical engineer with 15-years of experience in the design of electrical distribution, instrumentation and control systems. His experience includes engineering review and design, and electrical lead roles for numerous multi-discipline studies, detailed design projects, and construction contract execution. Many of these projects have included water treatments and supply facilities.

Responsibilities: Brody will be the Electrical, Instrumentation, and Controls Lead responsible for preparing the Electrical design for the project.

6 ENGINEERING FEE

Based on our understanding of the project scope and probable construction costs, as described above in **Section 2 - Scope of Services**, we anticipate the overall engineering fees for the project will be consistent with that presented in the **Table 6-1** below. Phase II Fees are estimated using typical Association of Consulting Engineering Companies - Saskatchewan (ACEC-SK) rates based on an assumed overall construction cost of $5,000,000, with $770,000 of construction costs being eligible for ICIP funding. Phase II engineering fees will be refined following completion of Phase I work.

Table 6-1 Estimated Engineering Fees

Project Phase	ICIP Funded Engineering Fees	Village Funded Engineering Fees	Total Estimated Fees
Phase I – Preliminary Design	**$29,000**	**$41,000**	**$70,000**
Phase II - Detailed Design, Engineering, Procurement, and Construction	**$66,000**	**Up to $362,000**	**Up to $428,000**
Detailed Design	$42,000	Up to $231,000	Up to $273,000
Procurement	$5,000	Up to $27,000	Up to $32,000
Construction	$19,000	Up to $104,000	Up to $123,000
TOTAL ESTIMATED ENGINEERING FEES	**$95,000**	**Up to $403,000**	**Up to $498,000**

In consideration of the above, Associated proposes to complete Phase I of this project on a fixed basis for a fee of **$70,000** including disbursements and excluding applicable taxes. Disbursements include the cost for printing, mileage, communications, and special equipment. A task-based breakdown of the proposed fees is as follows:

Table 6-2 Task-Based Breakdown of Proposed Fees

Task	Proposed Fees
Task 100 - Preliminary Design (ICIP Funded)	$29,000
Task 101 - Preliminary Design (Village Funded)	$41,000
TOTAL PROPOSED PHASE I FEES	**$70,000**

Associated understands the Village has a finite budget to complete the WTP upgrades and integration of membrane filtration may be cost prohibitive. If the Village prefers to forego investigation into the implementation of membrane filtration technologies, proposed fees for Task 101 - Preliminary Design (Village Funded) could be reduced to $39,000. This would result in total proposed Phase I fees of $68,000 including disbursements and excluding applicable taxes.

Table 6-3 Task-Based Breakdown of Proposed Fees Excluding Membrane Filtration

Task	Proposed Fees
Task 100 - Preliminary Design (ICIP Funded)	$29,000
Task 101 - Preliminary Design (Village Funded)	$39,000
TOTAL PROPOSED PHASE I FEES	**$68,000**

All fees listed above have been calculated based on the hourly rates set forth by the Kinetic GPO agreement. A copy of the **Rate Table**, with rates effective to January 1, 2026, is included in **Schedule D – Fee Basis** of the attached draft **Form of Agreement** for your reference. In the event that additional work is required in 2025, we would respectfully request recovery of our costs at the hourly rates, plus disbursements, as listed in this rate table.

Our fees will be billed monthly based on our estimate of the work complete and are due on receipt of invoice. Interest of 1.5% per month applies to overdue accounts.

7 CLOSURE

Thank you for the opportunity to submit this proposal. We trust this meets your expectations and would be pleased to discuss any aspect of the proposal we have presented. We appreciate your confidence in our services and look forward to working together with you on this project.

Attached are two versions of the **Form of Agreement**: one which includes membrane filtration in the scope of work and one which excludes membrane filtration. Should you wish us to proceed, please sign the preferred **Form of Agreement** and return a copy via email. In turn, we will sign the **Form of Agreement** and return a fully executed copy to you.

Yours truly,

Joshua Yohnke, P.Tech.
Project Manager

Scott Miller, P.Eng.
Division Manager, Water

JY/SM/cw

Enclosure:

- Standard Form of Agreement Between Client and Engineer (including membrane filtration)
- Standard Form of Agreement Between Client and Engineer (excluding membrane filtration)

Standard Form of Agreement Between Client and Engineer
(including membrane filtration)

STANDARD FORM OF AGREEMENT
BETWEEN
CLIENT AND ENGINEER

THIS AGREEMENT made in duplicate the ___________day of _____________________in the year _____________ by and between the Parties:

The Resort Village of Elk Ridge
211C Arne Petersen Way
Elk Ridge, SK S0J 0N0

hereinafter called the "Client"

and

Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive
Saskatoon, SK S7L 6X6

hereinafter called the "Engineer"

WHEREAS the Client desires that engineering services be rendered by the Engineer for the following project (the “Project”):

Water Treatment Plant Upgrades for the Resort Village of Elk Ridge

located at: 53.895383 N, -105.99162 W Blk/Par EU Plan No. 102323944 Ext 0

Investing in Canada Infrastructure Project Number: 20220101

and as detailed in Schedule B - Project Description, annexed hereto.

NOW THEREFORE, the Client and the Engineer, for the consideration and upon the terms and conditions hereinafter named, **agree as follows**:

ARTICLE I. GENERAL CONDITIONS OF AGREEMENT

The General Conditions of Agreement, annexed hereto in Schedule A, form a part of this Agreement.

ARTICLE II. ENGINEERING SERVICES

The Engineer will perform the services (the “Services”) described in Schedule C - Scope of Services, annexed hereto.

ARTICLE III. FEE

The Client agrees to pay the Engineer the fees and charges as detailed in Schedule D - Fee Basis, annexed hereto, for furnishing the engineering Services described in Article II. Value Added Taxes are not included in the fees and charges and are payable additional thereto.

ARTICLE IV. ENTIRE AGREEMENT

This Agreement, including Schedules A, B, C and D annexed hereto, constitutes the sole and entire agreement between the Client and Engineer relating to the Project. This Agreement may be amended only by written instrument signed by both the Client and the Engineer. This Agreement is for the exclusive benefit of the Parties signatory thereto. It does not create a contractual relationship with or exist for the benefit of any third party, including contractors, subcontractors and their sureties.

IN WITNESS WHEREOF the Parties hereto have duly executed this Agreement.

RESORT VILLAGE OF ELK RIDGE

Per: Marg Smith-Windsor

Authorized Signatory — Mayor

Per: Michele Bonneau

Witness — Chief Administration Officer

Associated Engineering (Sask.) Ltd.

Per:

Authorized Signatory — Title

Per:

Authorized Signatory — Title

SCHEDULE A
GENERAL CONDITIONS OF AGREEMENT

The following provisions, terms and conditions shall apply hereto:

1. DEFINITIONS

1.1 **Agreement:** This form; the Standard Form of Agreement between Client and Engineer, including any and all Schedules annexed hereto.

1.2 **Additional Services:** Services required of the Engineer, which are outside the scope of Services defined in this Agreement and for which the Engineer will be additionally compensated by the Client.

1.3 **CAO:** The Chief Administrative Officer of the Client.

1.4 **Consultant:** Registered professional engineers, architects and other technical specialists, other than the Engineer, engaged by the Client directly.

1.5 **Contractor:** The party contracting with the Client or Owner for the provision of labour, materials and equipment for the execution of the Work.

1.6 **Contract:** The agreement between the Client or Owner and the Contractor for the provision of labour, materials and equipment for the execution of the Work by the Contractor.

1.7 **Contract Documents:** All documents relating to the Work issued by or through the Engineer which are incorporated into the Contract, and all variations and modifications thereto issued by or approved by the Engineer.

1.8 **Contract Time:** The period from the notice to proceed with the Work to the projected completion date for the Contract as agreed between the Client or Owner and the Contractor in the Contract.

1.9 **Not used.**

1.10 **Field Services:** Shall mean making such periodic visits to the Project site at intervals appropriate to the stage of construction as the Engineer, in the Engineer's sole professional discretion, considers necessary to enable the Engineer to ascertain whether the Contractor is carrying out the Work in general conformity with the Contract Documents, or such other Field Services as are stipulated herein.

1.11 **ICIP:** Investing in Canada Infrastructure Program, under which the Ultimate Recipient Agreement between the Client and the Province of Saskatchewan is authorized.

1.12 **Owner:** Where different from the Client, Owner shall mean the party contracting with the Contractor for the execution of the Work, and the party providing the funding for the Project. In such a case, it is assumed and understood that the Client has a master agreement with the Owner authorizing the Client to act on the Owner's behalf in the provision of services or the execution of the work under this Agreement.

1.13 **Project:** The Project described in the recitals to the Agreement.

1.14 **Services:** The Engineer's Services as set forth in this Agreement and the attached schedules.

1.15 **Shop Drawings:** Drawings, diagrams, illustrations, schedules, performance charts and data, technical brochures and other data provided by the Contractor or other third parties to illustrate details of a component or portion of the Work.

1.16 **Statement of Work:** The key outcomes, answers and results required by the Client that the Engineer is expected to achieve through those deliverables as outlined in Scope of Services in Schedule C, and applicable appendices.

1.17 **Substantial Performance:** Shall have the meaning set out in lien legislation in effect at the place of the Work or, if such legislation does not contain a definition, it shall mean that point in time at which the Work is ready to be used or is being used for its intended purpose and is so certified by the Engineer. The term Substantial Completion, used in some jurisdictions, shall have the same meaning.

1.18 **Subconsultant:** Any registered/licensed professional engineer, architect or other technical specialist engaged directly by the Engineer in connection with the Project.

1.19 **Termination Expenses or Suspension Expenses:** Expenses incurred by the Engineer which are directly attributable to termination or suspension of the Services by the Client for reasons beyond the control of the Engineer and shall include the Engineer's expenses reasonably and necessarily incurred in winding down the Engineer's Services.

1.20 **Total Performance:** Shall mean that the Work as appraised by the Engineer has been performed to the total requirements of the Contract Documents and is so certified by the Engineer. The terms Total Completion or Final Completion shall have the same meaning.

1.21 **Ultimate Recipient Agreement or "URA":** Ultimate Recipient Agreement between the Client and the Province of Saskatchewan, attached as Schedule B E2 – Ultimate Recipient Agreement.

1.22 **Value Added Taxes:** Value Added Taxes means such sums as levied upon fees and charges by a Federal, Provincial or Territorial Government and is computed as a percentage of the same and includes the Goods and Services Tax, the Harmonized Sales Tax, the Quebec Sales Tax, the Saskatchewan Sales Tax and any similar tax, the payment or collection of which is imposed by legislation.

1.23 **Work:** The totality of all labour, materials and equipment used or incorporated into the Project by the Contractor pursuant to the Contract Documents.

2. Client's Responsibilities

The Client shall give due consideration to all sketches, drawings, reports, bids, proposals and other information provided to the Client by the Engineer and shall render decisions in a timely manner so as not to delay the work of the Engineer.

The Client shall make available to the Engineer all relevant information or data pertinent to the Project which is required by the Engineer. The Engineer shall be entitled to rely upon the accuracy and completeness of all information and data furnished by the Client, including information and data originating with the Client's Consultants, whether such Consultants are engaged at the request of the Engineer or otherwise. Where such information or data originates either with the Client or with the Client's Consultants, then the Engineer shall not be responsible to the Client for any consequences of any error or omission contained therein.

The Client shall arrange and make provision for the Engineer's entry and ready access to public and/or private property as well as to the Project site, as necessary to enable the Engineer to perform the Services of this Agreement.

The Client shall designate in writing an individual to act as the Client's representative, such person to have complete and exclusive authority to transmit instructions to and receive information from the Engineer.

The Client shall give prompt written notice to the Engineer whenever the Client or the Client's representative becomes aware of any defects or deficiencies in the Work or in the Contract Documents.

The Client shall obtain required approvals, licenses and permits from municipal, governmental or other authorities having jurisdiction over the Project so as to not delay the Engineer in the performance of the Services being rendered under this Agreement.

The Client shall expressly undertake not to enter into contracts in connection with the Project with Contractors or Consultants (or with the Owner, when the Client is not the Owner) which describe duties and responsibilities of the Engineer which are inconsistent with the duties and responsibilities of the Engineer provided for in this Agreement, without first obtaining the Engineer's written agreement thereto.

Where the work to be rendered by the Engineer under this Agreement is for discipline work on a building project designed by others, the Client shall provide electronic drawing files of all applicable building and structural elements, in AutoCAD® format and metric configuration, finalized as to design layout and suitable for use as a reference, prior to the Engineer commencing design Services under this Agreement. Revisions, changes or re-work required to be done by the Engineer as a result of subsequent changes to the finalized design layout, for reasons beyond the Engineer's control, will be deemed Additional Services and, as such, will be at the Client's expense.

In accordance with Canadian anti-spam legislation, the Client consents to the Engineer and its Subconsultants contacting the Client and its personnel through electronic messages relating to the Engineer's Services and other matters of interest to the Client. After the completion of this Agreement, the Client may withdraw any such consent by contacting the Engineer at unsubscribe@ae.ca.

3. Payment of Engineer's Fee

The Client shall pay the Engineer as provided in this Agreement. The CONTRACT PRICE is all-inclusive except for value added tax or sales tax.

The Engineer's invoices are due and payable when presented. Accounts unpaid by the Client thirty
(30) days after presentation are subject to monthly interest charges at the rate of 12.0% per annum.

No deduction, holdback or set-off shall be made by the Client from the fee payable to the Engineer.

4. Additional Services

If the Client authorizes the Engineer to do additional work over and above that contemplated in this Agreement, including re-work of plans and specifications for reasons beyond the Engineer's control, the Engineer shall be additionally compensated based on the time basis fee rate schedule annexed hereto or, lacking such a schedule, such other fee rates as mutually agreed between the Client and the Engineer prior to the commencement of such Additional Services.

5. Construction Emergencies

In the event of any construction emergency which, in the opinion of the Engineer, requires immediate action in the Client's interests, the Engineer shall have authority to issue such orders on behalf of and at the expense of the Client as he may deem necessary or expedient.

6. Variations in Design

The Engineer is empowered to make such deviations, alterations, additions and omissions in carrying out the Services, as the Engineer may reasonably consider desirable in the Client's interests, provided that no additions to the costs of the Contract are caused thereby, and no additional charge is made in the design of the work.

7. Field Services

The level of Field Services to be provided by the Engineer shall be as detailed elsewhere in this Agreement and the schedules annexed thereto.

8. Documents

All documents and drawings prepared by the Engineer, or by others on behalf of the Engineer, in connection with this Project are instruments of professional service for the execution of the Project. The Engineer retains the property and copyright in these documents and drawings, whether the Project is executed or not. These documents and drawings may not be used on any other project or for any other purpose without the prior written agreement of the Engineer.

9. Standard of Care

The standard of care for all services performed by the Engineer pursuant to this Agreement shall be the care and skill ordinarily used by members of the design profession practicing under similar conditions at the same time and locality as the Project. The Engineer makes no warranties, express or implied, under this Agreement or otherwise, in connection with Services.

10. Insurance, Damages & Liability of the Engineer

10.1 The Engineer shall provide and maintain, at its own expense, standard Automobile Liability insurance on all vehicles owned, operated or licensed in the name of the Engineer in an amount not less than $1,000,000.00 inclusive for bodily injury and/or property damage.
The Engineer shall, at its own expense and without limiting its liabilities herein, insure its operations under a policy of Comprehensive or Commercial General Liability, with an insurer licensed in the Province or Territory where the Project is located, in an amount not less than $2,000,000.00 per occurrence, insuring against bodily injury, personal injury, and property damage including loss of use thereof. Such insurance shall include blanket contractual liability.

The Engineer shall provide and maintain, at its own expense, Professional Liability Insurance in an amount not less than $1,000,000.00 per claim. Such insurance shall be applicable to the Services.

10.2 Prior to the date of the execution of this Agreement, if the Client wishes to increase the amount of the coverage, or to obtain other special insurance coverage for this Project, then the Engineer shall cooperate with the Client to obtain such increased or special insurance coverage at the Client's expense.

10.3 In consideration of the provision of the Services rendered by the Engineer to the Client under this Agreement, the Client agrees that any and all claims which the Client has or hereafter may have against the Engineer, the Engineer's servants, employees, subconsultants or representatives, in respect of the Services, howsoever arising, whether in contract or in tort, shall be absolutely limited to:

10.3.1 A period of six years from the date of the Certificate of Substantial Performance or the date of the termination or suspension of the Engineer's Services, or within such shorter period as may be prescribed by any limitation statute in the Province or Territory where the Project is located.

10.3.2 The lesser of the total amount of the Engineer's fee paid by the Client under the terms of this Agreement or $250,000.00.

10.4 If for any reason the Engineer's Professional Liability Insurance is not available or does not apply to any claim made by the Client against the Engineer in respect of the Services, then the liability of the Engineer to the Client under this Agreement shall be absolutely limited to the re-performance at the Engineer's own cost of those Services which are proven at law to constitute errors, omissions or negligent acts on the part of the Engineer or anyone for whom the Engineer may be responsible at law.

The Engineer's liability with respect to any claims arising out of this Agreement shall be absolutely limited to direct damages arising out of the Services, and the Engineer shall bear no liability whatsoever for any consequential loss, injury or damages incurred by the Client, including but not limited to loss of profit, revenue, production, business, contracts or opportunity and increased cost of capital, financing or overhead.

10.5 It is further agreed that the Engineer shall not be liable for damages, interest, costs or any other expense arising out of the failure of any manufactured product or any manufactured or factory assembled system or components to perform in accordance with the manufacturer's specifications, advertising, product literature or written documentation on which the Engineer reasonably relied during the preparation of the design or the Contract Documents.

10.6 In those instances where the Engineer makes use of third-party software and other intellectual property in the course of providing the Services, the limitation of liability that exists between the third party provider and the Engineer shall, with the necessary changes, apply equally between the Engineer and the Client.

10.7 For the purposes of the limitation provisions contained in the Agreement of the Parties herein, the Client expressly agrees that it has entered into this Agreement with the Engineer, both on its own behalf and as an agent on behalf of its employees and principals. The Client expressly agrees that the Engineer's employees and principals shall have no personal liability to the Client in respect of a claim, whether in contract, tort and/or any other cause of action in law. Accordingly, the Client expressly agrees that it will bring no proceedings and take no action in any court of law against any of the Engineer's employees or principals in their personal capacity.

10.8 Where the Client is any form of municipal, local, provincial or federal government or agency, the Client expressly agrees that if the services provided by the Engineer or its principals, employees and subconsultants are the type that if provided by the officers or employees of the Client would bring into play statutory indemnification protection for the benefit of the Client or its officers and employees, the Client will indemnify the Engineer and its principals and employees to the same extent and under the same circumstances as the statutory indemnification would extend to the Client and its officers and employees. Examples of the services that are to be covered by this provision include but are not limited to the following:

(i) review of rezoning applications;
(ii) review of land use plans;
(iii) review of subdivision submissions;
(iv) review of building permit applications;

(v) review for building code compliance;
(vi) review of stormwater management, flood routing, or drainage plans; and
(vii) review of environment management plans.

11. Occupational Health and Safety Act

11.1 The Engineer acknowledges that the Engineer is an employer as defined in the Occupational Health and Safety Act, and will, as a condition of this Agreement, comply with the Occupational Health and Safety Act of the authority having jurisdiction and the regulations thereto in relation to the Engineer's own employees.

11.2 It is agreed that the Engineer shall not be responsible for the Contractor's means, methods, techniques, sequences, procedures or the safety and coordination of the Work. The Contractor shall be solely responsible for ensuring that any and all Occupational Health and Safety Acts and regulations are complied with. In particular, the Engineer shall not be required to accept the role or obligations of Prime Contractor with respect to such Acts.

12. Termination or Suspension by the Client

If the Engineer is shown to be in default in the performance of any of the Engineer's material obligations as set forth in this Agreement, then the Client may, by written notice to the Engineer, require such default to be corrected. If, within 30 days of receipt of such notice, such default has not been corrected or reasonable steps to correct such default have not been taken, the Client may, without limiting any other right or remedy the Client may have, immediately terminate this Agreement and make such settlement for the cost of the Services rendered and disbursements incurred by the Engineer pursuant to this Agreement and remaining unpaid as of the effective date of such termination.

12.1 If the Client is unable or unwilling to proceed with the Project, the Client may suspend or terminate this Agreement by giving 30 days written notice to the Engineer. Upon receipt of such written notice, the Engineer shall perform no further Services other than those reasonably necessary to suspend or close out the Project. In such event, the Engineer shall be paid by the Client for all Services performed and for all disbursements incurred pursuant to this Agreement, plus expenses incurred by the Engineer which are directly attributable to termination or suspension, including expenses reasonably and necessarily incurred in winding down the Engineer's Services under this Agreement.

12.2 If the Project or any part thereof is abandoned at any stage or if any stage of the Engineer's Services is unduly delayed for reasons beyond his control, or if the contracts for the construction and installation of the Work are not awarded within 60 days after the completion of the drawings and specifications, the Engineer shall be entitled to payment as called for in this Agreement, including, if applicable, termination expenses.

13. Termination by the Engineer

If the Client is shown to be in default in the performance of any of the Client's material obligations set forth in this Agreement, including payment of the Engineer's fee as required herein, then the Engineer may, by written notice to the Client, require such default to be corrected. If, within 30 days after receipt of such notice, such default has not been corrected, the Engineer may, without limiting any other right or remedy he may have, immediately terminate this Agreement. In such an event, the Engineer shall not be liable for delay or damages as a result of the suspension or termination and the Client shall pay the Engineer for all Services performed and for all disbursements incurred by the Engineer pursuant to this Agreement and remaining unpaid as of the effective date of such termination, plus expenses incurred by the Engineer which are directly attributable to termination or suspension, including expenses reasonably and necessarily incurred in winding down the Engineer's Services under this Agreement, in addition to any other rights or remedies the Engineer may have.

If the Engineer's Services are suspended by the Client for any time for more than 30 cumulative consecutive or non-consecutive days through no fault of the Engineer, then the Engineer shall have the right at any time until such suspension is lifted by the Client, without limiting any other right or remedy the Engineer may have, to terminate this Agreement upon written notice thereof to the Client. In such an event, the Client shall pay the Engineer for all Services performed and for all disbursements incurred by the Engineer pursuant to this Agreement and remaining unpaid as of the effective date of such suspension, plus expenses incurred by the Engineer which are directly attributable to suspension, including expenses reasonably and necessarily incurred in winding down the Engineer's Services under this Agreement.

14. Dispute Resolution

In the event of a dispute arising the Client and the Engineer shall first use their best efforts to resolve the dispute or difference of opinion under or in connection with this Agreement by good faith amicable negotiations on a "without prejudice" basis, and shall provide frank, candid and timely disclosure of all relevant facts, information and documents to facilitate negotiations.

If a claim, dispute or controversy cannot be resolved by the project personnel, senior executives of the Client and Engineer, upon the request of either party, shall meet as soon as conveniently possible, but in no case later than thirty (30) days after such a request is made, to attempt to resolve such claim, dispute or controversy. If after meeting the senior executives determine that the claim, dispute or controversy cannot be resolved on terms satisfactory to both parties, the parties shall submit the claim, dispute or controversy for the legal remedy.

15. Notices

All notices required by this Agreement to be given by either Party shall be deemed to be properly given and received within three business days if made in writing to either Party by certified mail, facsimile or personal delivery, addressed to the regular business address of such other Party. Notices sent by email shall not be deemed properly given and received unless proof of receipt can be furnished by the sender.

16. Successors and Assignment

This Agreement shall inure to the benefit of and be binding upon the Parties hereto, and except as hereinafter otherwise provided, their executors, administrators, and successors and permitted assigns.

If a Party to this Agreement who is an individual should desire to bring in a partner or partners, or if a Party which is a partnership should desire to bring in a new partner or partners to share the benefit and burden of this Agreement, he or they may do so provided the additional parties covenant directly in writing with the other parties to be bound by the provisions of this Agreement.

Except as aforesaid, neither Party may assign this Agreement without the consent in writing of the other.

17. Joint and Several Liability

Where the Client is a joint venture, partnership or consortium each member of such joint venture, partnership or consortium shall be jointly and severally liable for the obligations of the Client under this Agreement.

18. Pollutants and Hazardous Wastes

The Client recognizes that projects involving pollutants and hazardous wastes, as defined below, create extraordinary risks. In consideration of said extraordinary risks and in consideration of the Engineer providing Services to the Client on a Project which involves pollutants and hazardous materials or waste, the Client agrees that the Engineer's liability to the Client with respect to any matter in any way arising out of the Engineer's involvement with pollutants and hazardous wastes associated with this Agreement shall be limited to or otherwise protected against as provided herein.

18.1 The Engineer’s liability to the Client in connection with pollutants and hazardous wastes is absolutely limited, both in contract and in tort, for any and all claims arising out of or in conjunction with the Project to a total aggregate amount not to exceed the cost of re-performance of the Services at the sole cost of the Engineer for that portion of the Services proven to be in error. This limitation is irrespective of the liability of the Engineer to the Client, which may otherwise be provided under this Agreement for claims unrelated to pollutants and hazardous wastes.

In further consideration of the Engineer providing Services to the Client on a Project involving pollutants and hazardous wastes, the Client agrees that in connection with incidents and claims initiated by third parties involving pollutants and hazardous wastes, the Client (to the extent that the Engineer is not covered by insurance in respect thereof) shall indemnify, defend and hold harmless the Engineer of and from any and all suits, actions, legal, administrative or arbitration proceedings, claims, demands, damages, penalties, fines, losses, costs and expenses of whatsoever kind or character, arising or alleged to arise out of the Services of the Engineer to the Client or any claims against the Engineer arising or alleged to arise from acts, omissions or work of others. Such indemnification shall apply to the fullest extent permitted by law, regardless of fault or breach of contract by the Engineer and shall include the fees and charges of lawyers in defending or advising the Engineer as to such claims under the Agreement. Without limiting the generality of the foregoing, such indemnity extends to claims which arise out of the actual or threatened dispersal, discharge, escape, release or saturation (whether sudden or gradual) of any pollutant or hazardous waste in or into the atmosphere, or on, on to, upon, in or into the surface or subsurface soils, water or water courses, persons, objects or other tangible matter.

Nothing herein shall relieve the Engineer from obligations to provide the Services required by this Agreement, and generally as required by standard engineering practice, current as of the date of the performance of the Services. Nothing herein shall apply to claims, damages, losses or expenses which are finally proven to result from the Engineer’s intentionally wrongful acts.

For the purposes of this Agreement, “pollutants and hazardous wastes” shall mean any solid, liquid, gaseous or thermal irritant or contaminant, including without limitation, smoke, vapour, soot, fumes, acids, alkalis, chemicals and waste, pollutants and hazardous or special wastes as defined in any federal, provincial, territorial or municipal laws.

SCHEDULE B
PROJECT DESCRIPTION

B.1 Objective and Purpose

The main objective of this project is to increase the water treatment capacity and water quality of the Resort Village of Elk Ridge 's water treatment plant in order to meet provincial drinking water quality standards for current and future community population of the Resort Village of Elk Ridge.

The project output includes replacement of the existing filtration equipment with treatment technology better suited for the raw water source, including modifications to the existing mechanical, electrical and control systems to suit. Raw water supply capacity will also be improved by installation of new well pumps and a pre-filter unit to address present issues with sediment in the source water.

B.2 Project Start Date:

The start date for this project shall be no later than **January 10, 2025.**

B.3 Project Completion Date:

The completion date for this project shall be no later than **March 31, 2027.**

B.4 Approach to Project Execution

This Project shall be executed in the following two phases:

a) Phase I – Preliminary Design. The Preliminary Design Phase shall focus on defining the Project requirements and constraints, and selection of the best-value approach and technology for upgrading the water treatment plant, including the following components:
   - I. Assess and recommend raw water supply system improvements for sediment removal.
   - II. Assess and recommend new filtration equipment targeting ammonia, iron, and manganese, including:
     - i. Replacement of filter face piping and connections to existing process piping,
     - ii. Replacement of backwash pump(s), piping and connections,
     - iii. Implementation of instrumentation and control equipment, and
     - iv. Removal of existing filters (as required).
   - III. Assess and recommend repairs and modifications to water treatment plant building.
   - IV. Assess and recommend repairs and modifications to electrical and mechanical works.
   - V. Investigate and recommend temporary works to maintain water supply during construction.
   - VI. Investigate and recommend distribution pumping system improvements.
   - VII. Investigate and recommend treated water storage improvements to increase capacity.

b) Phase II – Detailed Design, Engineering, Procurement, and Construction ("EPC"). The EPC phase involves refining the initial concepts and creating comprehensive designs and specifications necessary for construction and operation, including:
   - i. Work associated with detailed design, engineering, procurement and expediting of requisite technologies, materials, equipment and construction services, project management and reporting, and operator training.

   Phase II is NOT included in the scope of this Agreement and will be added upon completed of Phase I, in accordance with Article 3 – Additional Services of Schedule A – General Conditions of Agreement.

The key activities and deliverables expected of the Engineer for each phase of the Project shall be prescribed in Schedule C – Scope of Services.

B.5 General Requirements Governing Project Execution

a) Compliance With Laws. The Project must be executed and completed in compliance with all statutes, regulations, codes and standards required by all governments and regulatory bodies that have authority on the Project or how the Work is performed.

b) Awarding of Contracts. All Contracts will be awarded in a way that is fair, transparent, competitive and consistent with value-for-money principles as specified in Appendix A - Investing in Canada Infrastructure Program Awarded Contract Policies and Procedures.

c) Operational Communications. Calls for tender, construction notices, precautionary boil water advisories, public safety notices, service disruption notices, shall be coordinated through the Resort Village of Elk Ridge. Where appropriate, communications about the project should include the following statement, “This project is funded in part by the Government of Saskatchewan and the Government of Canada.”

d) Periods of Construction to Minimize Service Disruptions. Best efforts should be made to mitigate the distribution of treated water to the consumers in the Resort Village of Elk Ridge. As such, the recommended period for execution of demolition, de-construction and construction work is between January 5 and March 31

.

SCHEDULE C
SCOPE OF SERVICES

C.1 General Requirements

The Resort Village of Elk Ridge is seeking a qualified provider for Engineering, Procurement and Project/Construction Management Services for Water Treatment and Distribution. The engineer must have offices in Saskatchewan. The Engineer shall appoint qualified personnel to the Project who are experienced in the following:

a) The design, engineering, planning and execution of Water Treatment and Distribution Projects in Saskatchewan and Canada
b) The operation of Water Treatment Plants (e.g. Class I, II, III, etc.)
c) The planning, project management, administration and execution of ICIP projects, in the province of Saskatchewan
d) Who are current on the latest performance trends and technologies of water treatment
e) Available and competent to execute and deliver the outcomes, activities and deliverables prescribed and implied in Schedule B – Project Description, and Schedule C – Scope of Services.

C.2 Scope of Services Pertaining to Phase 1: Preliminary Design

The Preliminary Design Phase shall focus on defining the Project requirements and constraints, and selection of the best-value approach and technology for water treatment.

a) Key Activities: The Engineer's Work during this phase include, but are not limited to the following key activities:

   i. Conducting preliminary assessments (site analysis, environmental impact studies, etc.)
   ii. Evaluating best-value option and technology for water treatment
   iii. Engaging Resort Village stakeholders for input and requirements
   iv. Evaluating potential technologies and methods for water treatment, including recommendation of the best-value option for resolving sediment issue in raw water supply and water treatment
   v. Defining and recommendation a final design and scope of work
   vi. Developing initial cost estimates, for final design and scope of work, including a breakdown of which components are "eligible" and "non-eligible" for ICIP funding.
   vii. Creating a project schedule
   viii. Identifying regulatory and permitting requirements

b) Deliverables: During this phase, the Engineer agrees to produce the following deliverables:

   i. **Draft Preliminary Design Report**: A draft Preliminary Design Report shall be submitted to the Resort Village of Elk Ridge ("Report"). The Report shall be based on the Engineers best advice and include the following elements:
      - Design Basis. The Report shall recommend the design basis in consideration of the following:
         - Appendix B - Technical Statement of Work, including it's attached reference documents to Appendix B, which are listed as the following exhibits:
            - Apdx B E1-Oct 3. 2022 BCL Water Treatment Assessment Report
            - Apdx B E2A-2022 ICIP Application
            - Apdx B E2B-Ultimate Recipient Agreement
            - Apdx B E3-Description of Groundworks for Well PW7-2014
            - Apdx B E4-2014 Beckie Hydrogeologist Report (Page 7 only)
            - Apdx B E5- 2023 Treated Water Certificate of Analysis Report
            - Apdx B E6- 2023 PW6-2011 Well Raw Water Certificate of Analysis Report
            - Apdx B E7-2024 Gaudet Greensand Bench Test Report
            - Apdx B E8-2024 Drop Solutions Biological Filtration Study Project Report
         - The design basis shall also consider factors and data collected from an onsite visit, historical performance data and insights provided by staff, best practices for plant control and automation, and stakeholder interviews.
      - Drawings and Sketches. The Report shall include preliminary sketches, such as a site plan, water treatment plant floor plan, and process flow diagram, to depict the design basis described in the Report.
      - Priorities. The Report shall identify those priority items which are necessary and eligible within the budget of the ICIP grant funding.
      - Schedule. The Report should present a schedule to complete the proposed work and include an assumed timeline for completion of Phase II activities, to provide an understanding of the project timelines relative to the ICIP grant funding deadlines (March 31, 2027).

SCHEDULE C
SCOPE OF SERVICES

- Report Exclusions. The Report should exclude repeating information already provided in Appendix B or any of the reference technical exhibits attached to Appendix B, unless requested to do so by the Resort Village or if deemed necessary. To be clear, the Engineer should avoid spending person-hours repeating work or incurring cost for work already performed in other technical studies, unless deemed necessary.
- Cost Breakdown. An opinion of probable costs is required, as well as opportunities and risks associated with ongoing operating and maintenance costs. The opinion of probable costs should consider Section 5 of Apdx B E2A – 2022 ICIP Application, and the Engineer should consider the cost as a constraint on the scope, excluding escalation of costs experienced between 2022 and 2026 for which adjustments are expected. In 2022, the total Project costs were estimated to be $1,100,000 and the ICIP eligible costs were estimated to be $1,085,000. Paragraph 9 estimates the cost breakdown as:
    - Design/Engineering: $95,000
    - Construction/Materials: $770,000
    - Contingency: $195,000
    - Project Planning: $25,000

  The cost breakdown shall include an opinion of probable costs for construction as well as a breakdown of all the Engineer's costs associated with producing each of the deliverables outlined in Phase II of the Project. This information is necessary to refine the Engineer's scope for Phase II. For example, some elements such as Procurement Work, Bidding Packages, etc. may be performed by other parties. The cost escalation factors, and forecast should be provided in the updated estimate.
- Variances to Exhibit 2A-2022 ICIP Application. All variations in proposed scope or estimated costs in Section 5 of Exhibit 2A will require explanation in the Report, which may require the Engineer to make its own opinion of the assumptions in the Exhibit 1 – 2022 BCL Water System Assessment, the Project and the Exhibit 2A-2022 ICIP Application.

ii. **Stakeholder Meetings.** Meeting with stakeholders, including an onsite meeting with the utility staff, and a final meeting with Resort Village Council to review and approve, amend recommendations in the draft Report. Request that Resort Village be given ten days' notice for any onsite visits.

iii. **Final Preliminary Design Report.** Upon receiving comments and hearing decisions by the Resort Village as to the scope of design and construction of Phase II of the Project, the Engineer will revise, produce and submit a final copy of the Report.

iv. **Amended Contract.** An updated form of Agreement between the Resort Village and Engineer for completing Phase II of the Project.

v. **Progress Reports.** Upon request of the Chief Administrator Officer, the Engineer shall provide a progress report on the ICIP project, which shall contain the following information:
- Canada's contribution funding to the Project by Fiscal Year;
- Construction start and end dates (forecasted/actual);
- Progress tracker (e.g., percent completed);
- Risks and mitigation strategies, as required;
- Confirmation that the Project is on-track to achieve expected results (e.g. sediment removal, water quality, capacity, etc.)

vi. **Regulatory Approvals.** If required, the Engineer will identify any necessary regulatory approvals and permits required during this phase and provide the information and documents necessary to the Resort Village to facilitate approval from the applicable agency.

SCHEDULE D
FEE BASIS

The Client agrees to pay the Engineer an all-inclusive lump sum fee of $70,000.00, except for Value Added Taxes and sales tax. Additional fees for the project will be determined based on the attached Rate Schedule, General Conditions of Agreement, and scope of work.

In accordance with the terms of the Kinetic GPO agreement, the rate schedule will be reviewed and adjusted annually on January 1st of each year, starting on January 1st, 2026. Rates listed here are effective as of the date of this agreement.

ASSOCIATED ENGINEERING (SASK.) LTD.

Saskatchewan/Manitoba Operation

CLASSIFICATION RATE SCHEDULE

Rates Effective Until January 1, 2026

Level	Engineer (E)	Landscape Architect (Z)	Planner (N)	Geologist / Geoscientist (P)	Biologist / Agrologist / Environmental Scientist (C)	Technician / Technologist (T)	Specialist Consultant (R)	Project Administrator / Support (S)	Limited License (L)
0	$105	$100		$100	$100	$87			
1	$140	$131	$103	$125	$125	$109		$84	
2	$160	$152	$115	$153	$153	$128		$95	
3	$187	$183	$139	$188	$188	$139	$206	$106	
4	$220	$216	$157	$225	$225	$160	$250	$124	
5	$258	$247	$168	$257	$257	$172	$305	$128	
6	$278	$297	$192	$283	$283	$197	$345		
7	$305	$322	$212	$320	$320	$212			

NOTES:

1. These rates conform generally with guidelines published by ACEC Saskatchewan and Manitoba.
2. Overtime for professional staff will be billed at straight time; overtime for technicians and support staff will be billed at straight time rates plus twenty percent (20%). Overtime is calculated for hours worked beyond the regular hours per day.
3. Rates in effect to the earlier of project completion or December 31, 2025
4. Disbursements for reproduction, communications, local transportation (within one-hour radius of office) and computer charges will be billed at five percent (5%) of labour fees. Other disbursements such as travel expenses, accommodations and meals will be billed at invoiced cost additional to the 5% base disbursement fee.
5. Subconsultants retained by Associated Engineering (Sask.) Ltd. will be billed at cost plus a mark-up of ten percent (10%) to cover costs of handling, financing and liability insurance.
6. Federal Government Goods and Services tax will be applied in addition to the charge-out rates.
7. Invoices are due and payable upon receipt. Overdue invoices will accrue interest at eighteen percent (18%) per annum, calculated monthly or as stipulated in the Client/Engineer Agreement.

APPENDIX A
INVESTING IN CANADA INFRASTRUCTURE PROGRAM AWARDED CONTRACT POLICIES AND PROCEDURES

Investing in Canada Infrastructure Program Awarded Contract Policies and Procedures

POLICY:

As outlined in Section 7 of the Investing in Canada Infrastructure Program (ICIP) Ultimate Recipient Agreement, the Ultimate Recipient will ensure that Contracts will be awarded in a way that is fair, transparent, competitive and consistent with value-for-money principles, or in a manner otherwise acceptable to Saskatchewan, and if applicable, in accordance with international and domestic trade agreements. These trade agreements, include, but are not limited to: *the Canadian Free Trade Agreement, the New West Partnership Trade Agreement*, and *the Canada-European Union Comprehensive Economic and Trade Agreement*.

For information on procurement and trade obligations, please contact:

- Carl Macdonald, Procurement Advisor with the Saskatchewan Urban Municipalities Association (SUMA) at 306-525-4395 or munprocurement@suma.org
- Amanda Kozak, Member Purchasing Advisor with the Saskatchewan Association of Rural Municipalities at 306-761-3722 or akozak@sarm.ca
- Information on procurement policies and procedures can be found on the Priority Saskatchewan website at www.saskbuilds.ca (refer to Priority Saskatchewan tab at top of page).

Records may be requested in support of inspection and audit as outlined in Section 10 d) of the Ultimate Recipient Agreement. Records that may be requested include, but are not limited to, tendering documents, bid proposals, and procurement policies.

This Awarded Contract Policies and Procedures document should be given to your engineers and/or contractors so they are fully aware of the conditions.

REQUIREMENT:

A completed Awarded Contract Checklist must be submitted to the Ministry of Government Relations for contractors and suppliers that will provide **total estimated goods and/or services of $30,000 or more** on your project prior to the reimbursement of costs claimed on a Request for Payment. The checklist must be signed by the Mayor, Reeve, CEO, Administrator, or any authorized delegate.

Please note that the checklist is only required one time for each contractor/supplier.

OTHER INFORMATION:

Sole Sourcing:

Non-competitive contracts that fall under the following criteria are eligible and **do not** require approval from Infrastructure Canada (INFC):

- Costs are related to ineligible activities or are otherwise not included in the Total Eligible Costs for a project;
- Contract is for construction or goods and is $40,000 or less; or
- Contract is for service and is $100,000 or less.

Sole sourcing for the following must be **approved in advance** by INFC:

- The contract is for less than $500,000;
- The contract is with a public sector entity;
- The contract can only be performed by one person or entity;
- The contract is entered into by an Indigenous ultimate recipient;
- The contract is entered into with an Indigenous organization/governing body, and there is a benefit to an Indigenous community; or
- The contract addresses a state of emergency that has been declared.

Non-competitive contracts that do not fall within any of the above will require federal Treasury Board approval. Obtaining Treasury Board approval is a lengthy and resource intensive process that may take several months and will require a strong rationale for the non-competitive procurement process as well as more complex and in-depth information requirements.

Advanced Contract Award Notice:

Instead of Sole Sourcing, recipients can post an Advanced Contract Award Notice (ACAN). The ACAN must be posted on SaskTenders for a period of no less than 10 business days. ACAN is a practice that is accepted by Canada and is also a less administratively heavy and quicker option with less risk of delays or rejection. Information is available on the federal government's website regarding this practice: Chapter 3 - Procurement strategy | CanadaBuys.

Group Purchasing Order:

Kinetic/Central Source is a Group Purchasing Organization (GPO) that SUMA has an agreement with for its membership. It is a standing offer, that has been tendered according to provincial and national procurement standards, that municipalities can acquire services from.

INFC has reviewed and accepts this specific procurement process and does not consider it a sole source contract as:

- The work is not carried out by the Group Purchasing Organization but is contracted out by the company.
- Requests for work are publicly tendered requests for Standing Offers, which have been determined to be eligible.
- Requests for work follow similar procedures as RFPs, with seeking a minimum threshold for quality, service, experience. The only discernable difference is that a 3-year contract is signed with the successful applicants, instead of on a per-project basis. This allows for easier and cheaper completion of infrastructure projects in the community.

Own Force Labour:

Own-force labour costs require pre-approval from INFC. In requesting to use Own-Force Labour, the recipient needs to demonstrate the following to INFC:

- The Own-Force Labour costs are not otherwise ineligible under the program.
- The employee is engaged in work that would otherwise have been contracted out by the recipient for a project.

- The requested costs are Incremental:
    - Costs are associated with extra hours worked by an employee as a result of the project (e.g. overtime).
    - Costs are associated with backfilling the position of an employee who is assigned to the project or hiring a new employee.
- Due to unique circumstances, it is not economically feasible to tender a contract for the work:
    - There is a lack of private sector capacity to undertake the work (e.g. in a very remote community).
    - The work involves proprietary or specialized infrastructure or equipment that requires specific knowledge or skill.

If there are any questions relating to these policies or procedures, please contact the Ministry of Government Relations.

APPENDIX B
TECHNICAL STATEMENT OF WORK

1) Purpose of Document

This document provides key information believed to be necessary to achieve the key outcomes, answers and results required by the Resort Village of Elk Ridge that the Engineer is expected to achieve through the development of the Preliminary Design Report, as outlined in Phase 1, in Schedule C – Scope of Services.

2) Overview of Water Treatment Process

The current water treatment plant was commissioned in 2000 with fire suppression upgrades being installed in 2007 and reservoir bypass upgrades in 2018. Figure 1 below shows an overview of the current Water Treatment and Distribution Process. Details about each sub-system in the process can be found in the attached Exhibit 1-2022 BCL Water Treatment Assessment.

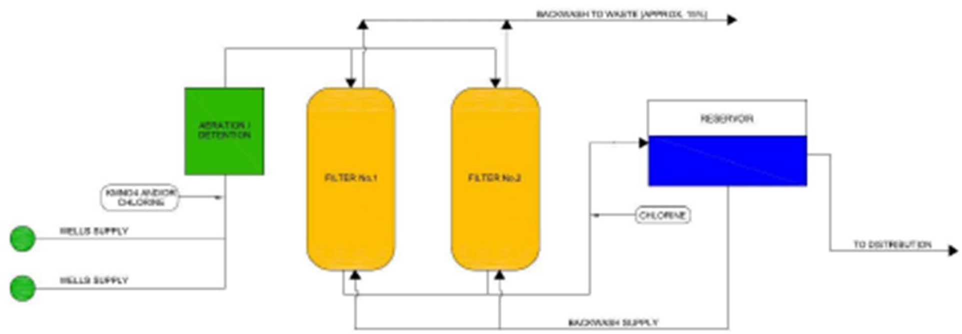


Figure 1: Overview of Resort Village of Elk Ridge Water Systems and Subsystems. Filters contain Greensand Plus media.

3) Priority 1: Resolve Entrained Sand in Raw Water Supply

a) **Baseline Situation.** Currently there are two raw water production wells named Well PW6-2011 and PW7-2014. Each well is designed and licensed to produced 58 imp. gallons/minute each and cannot be operated at the same time nor operated continuously. Well, PW7-2014 has been deemed by utility staff as “unusable” due to its high sediment production which significantly reduces the effectiveness and efficiency of downstream treatment processes. This also places a constraint on raw water supply and increases the risk of the have no raw water supply in the event of pump failure. In 2024, plant staff took steps to procure a pre-screen filter and containment tank, however, other equipment and materials to construct a pre-screen filter are outstanding.

b) **ICIP Eligibility.** It is the Resort Villages’ understanding that new well-pumps and pre-treatment unit is eligible for ICIP funding. It is unclear as to whether drilling and construction of a new well would be eligible for ICIP funding.

c) **Statement of Work.** Determine whether best value approach to dealing with the entrained sand.

   i. Based on Apdx B Exhibits 1,2A, 2B the Project called for the design and installation of a pre-filter system to deal with the sediment from the raw water supply. Recently, the utility staff have procured a pre-screen filter and containment tank but have yet to fully install the pre-filter unit.

ii. Is the current direction t hat the utility operators are taking for pre-filtering the sediment adequate for current and upgraded design? Will the planned and purchased unit fully integrate within the future upgraded water treatment process design?

iii. What is the risk level with the current raw water supply infrastructure? Does the Resort Village have adequate water supply with the two wells? Should a new well be drilled and constructed, and if so, when?

iv. Confirm as to whether drilling and construction of a new well would be eligible for ICIP funding.

4) Priority 2A: Verify Water Treatment Capacity

a) **Baseline Situation.** In the 2022, Water Treatment Assessment, the current population was estimated at 300 persons. The estimated future population was forecasted 480 persons (Year 2042) and the growth rate per year was assumed to be 2.4%. The current treatment flow capacity is 3.8 L/sec and the design capacity for the future was calculated to be 6.1 L/sec. (see Apdx B Exhibit 1 – 2022 BCL Water System Assessment)

The 2019 Elk Ridge Municipal Community Census reported that there were 122 Permanent Residents, 371 Seasonal Residents, and 203 temporary residents who occupied rental properties with the rental accommodations. (i.e. 696 total permanent + seasonal + temporary residents). Since, the 2019 Census there has been approximately 11 residential home builds, 1 rental cottage, and 67 seasonal RV lots established. In future, it is forecasted by 2044 that 1 municipal office building will be established, a 36-unit condo building, a general store, and 41 residential home-builds, and 42 additional RV lots may be added.

b) **ICIP Eligibility**. It is the Resort Villages' understanding that increased water treatment capacity is eligible for ICIP funding.

c) **Statement of Work.** It is unknown whether the future design capacity in the 2022 Water System Assessment adequately considered the seasonality impacts of water demand (i.e. peak demand due to seasonality population increases in the summer). It is requested the Engineer review the historical water supply and demand data with the utility staff and provide an opinion as to the adequacy of the forecasted design capacity requirements as specified in Apdx B E1.

5) Priority 2B: Upgrade Water Filtration Capacity and Improve Water Quality Performance

a) **Baseline Situation.**

i. <u>Detention Process.</u> Raw water entering the plant is metered and dosed with sodium hypochlorite prior to entering a detention tank. The tank is 1.22 min diameter by 1.52 min height, with an approximate volume of 1,800 L. The detention time is estimated to be in the order of 8 minutes. Due to the lengthy oxidization reaction time of manganese, the detention process is not likely to provide any significant improvement to the removal of this constituent.

ii. Greensand Plus Filtration Treatment. Following detention, raw water flows through two Greensand plus pressure filters operated in parallel. The filters are 1.22 min diameter by 2.13 m tall, operated at a rate of 1.9 Lis each (3.8 Lis total). For raw water of poor to fair quality, the recommended operating flux for manganese greensand filters is 1.0 - 1.6 L/s/m2, which equates to 1.2 - 1.9 Lis each (2.4- 3.8 Lis total). Therefore, the filters are operating at the high end of the recommended range, considering the raw water quality. Operations personnel report deteriorating treated water quality when operating above this rate. In addition, new greensand filtration media was installed in the spring of 2024. Operators report that after the media replacement a significant improvement in the treatment of manganese and iron was observed, but they are still experiencing elevated levels of ammonia, which often creates challenges with balancing the correct dosages of chlorine.

The filters are backwashed based on pressure differential, typically producing approximately 180 m3 of treated water between backwash cycles. The backwash process is conducted manually, with a dedicated backwash pump, consisting of 15 minutes per filter at a rate of 11 Lis. No air scour is provided. This equates to a backwash consumption rate in the order of 10% of total water use. The filters are regenerated every few months. The Operators avoid using well PW7, as the sediments from the source quickly build up in the filters and drastically reduce filtration rates.

iii. Chemical Treatment and Dosage. Following filtration, clarified water is dosed with additional sodium hypochlorite for disinfection followed by deposition to the treated water storage reservoirs. The only chemical used for treatment is a 12% liquid sodium hypochlorite solution (Hypochlor-12 by ClearTech Industries), which is dosed prior to detention and following filtration. The Operators vary the dosing rates frequently in response to daily free chlorine residual levels. Based on the daily records, the dosing rates ranged from 7 - 15 mg/L prior to detention and 0.5 - 3 mg/L following filtration, for a total dosage rate in the order of 7.5 - 18 mg/L. This is below the maximum use rate of 103 mg/L for this product, as per NSF60 standards for drinking water chemical use. The frequent variability of the dosing rates suggests that a constituent in the raw water, such as ammonia or organic material, is reacting with the chemical. The greensand media was replaced in the spring of 2024. Operators report that after the media replacement a significant improvement in the treatment of manganese and iron was observed, but they are still experiencing elevated levels of ammonia, which often creates challenges with balancing the correct dosages of chlorine.

iv. Bio-Filtration Pilot Study. A bio-filtration pilot was conducted between November 2023 to March 2024. The report of the study and findings is attached as Apdx B E8-2024 Drop Solutions Biological Filtration Study Project Report. The feasibility and value of bio-filtration as a capacity and quality upgrade for water treatment is questionable. As a result, a bench test and quality study was subsequently conducted by Gaudet Scientific as Apdx B E7-2024 Gaudet Greensand Bench Test Report. Biofiltration as a solution still remains as an economic means to achieving the upgrade objectives remains in question.

b) **ICIP Eligibility.** It is the Resort Villages' understanding that water treatment capacity improvements and quality improvements are eligible for ICIP funding.

c) **Statement of Work.**

i. Consider the future of the detention tank and process in the future design. Should it be upgraded, remain "as-is" or removed from the treatment process?

ii. Upgrade capacity and optimize the treatment process, as the current capacity of the filtration process is at its upper limits and will not be sufficient for future population growth. Consider expansion of existing greensand technology or alternative treatment technologies and avoid extensive study of biofiltration, unless it's the Engineer's opinion from the provided reports that biofiltration is the best-value approach. Minimize backwash frequency and waste, if possible and consider requirements for increased raw water supply if necessary. Consider pre-treatment of sediments from wells or drill a new well. Consider replacing manual processes with automation. Holistically, assess best value for community needs. Avoid any further pilots unless absolutely necessary.

iii. Assess and optimize WSA standards and targets for water quality. The upgraded water treatment solution should achieve parity of current water quality performance or improve the water quality and improve the efficiency of the chemical treatment process. Holistically, assess best value for community needs.

6) Priority 3: Provide Recommendations for Water Storage and Distribution

a) **Baseline Situation.** Storage of treated water is provided by two subgrade concrete reservoirs and a pump well. The pump well is located under the water treatment plant and has storage capacity of approximately 34,000 L. Reservoir #1 is also located under the water treatment plant building and has a storage capacity of approximately 155,000 L. Access to the pump well and reservoir #1 is provided by a raised hatch located within the building. Reservoir #2 is located immediately southwest of the plant and has a storage capacity of 222,000 L. A raised access hatch with lockable cover is provided. Total facility storage volume is 411,000 L. Well pumps are less than ten years old. The well-pump assembly suspends the pump motor from the end of a drop pipe, below the suction inlet of the pump. Therefore, the suction inlet is approximately 1.2 m above the pump well floor, rendering all water below the inlet elevation unusable. For this reason, the effective storage volumes of the pump well and reservoirs are reduced to approximately 23,000 L, 103,000 L, and 138,000 L, respectively, for a total effective storage volume of 264,000 L. If the reservoirs are operated at a lower level in order to improve the circulation rate, the effective storage volume would be further reduced. Under normal operation treated water is deposited to reservoir #2 and then flows via transfer pipe to reservoir #1, followed by the pump well for distribution. Water storage capacity is anticipated to be a constraint within the next ten years. Because the current pumps are less than ten years old, the upgrade/replacement strategy for replacing the existing suspended pumps with vertical turbine pumps is "run-to-fail".

b) **ICIP Eligibility.** It is the Resort Villages' understanding that water storage and distribution upgrades are NOT eligible for ICIP funding.

c) **Statement of Work.** The Resort Village is interested in is a design for future water storage and an assessment of the following:

i. The location and footprint of a future water storage. Does existing plant and land footprint accommodate, if not what are the feasible options?

ii. Determine whether the forecasted constraints in water storage are complimentary to the current "run-to-fail" strategy on the submersible pumps. Is there a requirement to replace the suspended pumps with vertical turbine pumps earlier than the forecasted constraints? What is the recommended replacement strategy?

iii. Determine whether there are opportunities to realize financial or construction synergies for the engineering and construction of increased water storage capacity during execution of the ICIP Water Treatment Upgrade

7) Other Reference Materials

The following exhibits are provided to the Engineer to assist in the development of deliverables for all phases of the Project.

1. Apdx B E1-2022 BCL Water Treatment Assessment
2. Apdx B E2A-2022 ICIP Application
3. Apdx B E2B-Ultimate Recipient Agreement
4. Apdx B E3-Description of Groundworks for Well PW7-2014
5. Apdx B E4-2014 Beckie Hydrogeologist Report (Page 7 only)
6. Apdx B E5- 2023 Treated Water Certificate of Analysis Report
7. Apdx B E6- 2023 PW6-2011 Well Raw Water Certificate of Analysis Report
8. Apdx B E7-2024 Gaudet Greensand Bench Test Report
9. Apdx B E8-2024 Drop Solutions Biological Filtration Study Project Report

October 3, 2022
File #364.01-2

Elk Ridge Utility
Box 182
Waskesiu, SK
S0J 2Y0

Attention: Mr. Dennis Paddock, P.Eng., President

Re: Elk Ridge Utility
Water Treatment Plant Facility

As requested, BCL is pleased to provide the following assessment report for the Elk Ridge Utility's Water Treatment Plant facility. The intent of this report is to provide an assessment of the existing infrastructure and recommendations for addressing any issues identified.

1. BACKGROUND

Raw Water Supply

Raw water for the community is provided by two groundwater wells, located in close proximity to the treatment facility. The primary well (PW6-BHL) was installed in 2011, with a depth of 100 m and a typical pumping rate of 3.8 L/s. The well is equipped with a 7.5 hp submersible well pump and supplies water to the treatment plant through a dedicated 50 mm HDPE raw water supply line.

An additional well (PW7-BHL) was installed in 2014, with a similar depth and pumping rate as PW6. This well replaced the original well (PW5-BHL), which was installed in 2000, but now serves as an observation well. PW7 is equipped with a 7.5 hp submersible well pump and supplies water to the treatment plant through a dedicated raw water supply line ranging from 38 mm to 50 mm.

Operations personnel report that PW7 produces high quantities of fine silt and sediment, causing rapid buildup and plugging of the filters. In previous seasons, PW7 pumped over 10,000 m^3 to waste, in an unsuccessful effort to exhaust the sediment source. For this reason, the Utility has operated primarily with PW6, using PW7 as backup supply.

Additional testing was conducted by Beckie Hydrogeologists Ltd. (BHL) in summer of 2022 to determine the concentrations and pumping characteristics of the entrained sediment coming from PW7. The well was pumped at a rate of 3.8 L/s through filter socks to capture and measure sediment quantities over various time intervals. The testing results are summarized as follows.

PW7 Entrained Sediment Testing					
Pumping Time					
Interval Duration (minutes)	5	5	20	30	235
Total Elapsed Time (minutes)	5	10	30	60	295
Concentration					
Interval Average (mg/L)	107	138	114	17	2.6
Overall Average (mg/L)	107	123	117	67	16
Total Sediment					
Interval Amount (kg)	0.1	0.2	0.5	0.1	0.1
Total Amount (kg)	0.1	0.3	0.8	0.9	1.1

Over a 1 hour period, the well yielded an average sediment concentration of approximately 67 mg/L, for a total of 0.9 kg. Concentrations exceeded 100 mg/L for the first 30 minutes before declining to less than 20 mg/L the remainder of the test. The well was pumped for approximately 4 hours following the initial 1 hour period, yielding a concentration of 2.6 mg/L for this period, for a total of 1.1 kg.

Treatment

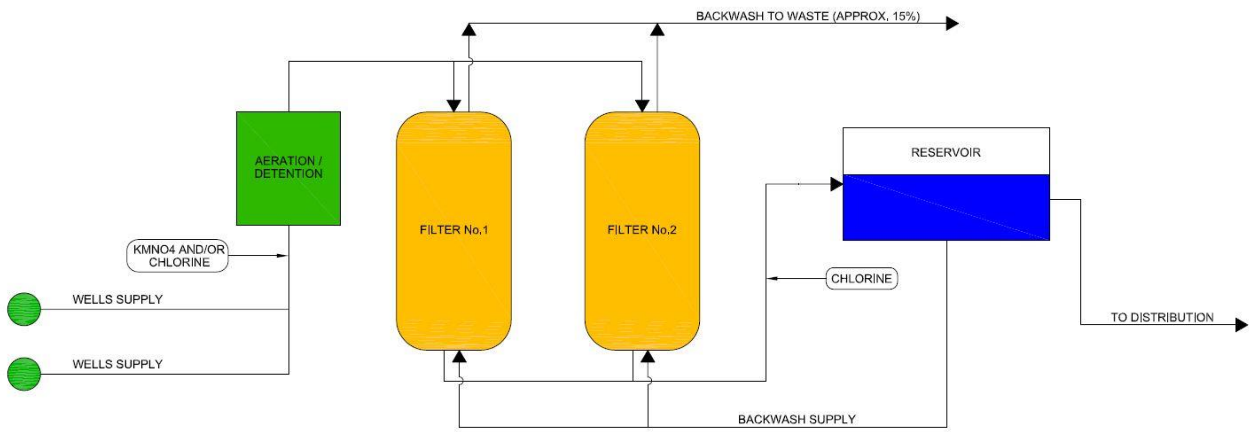
The water treatment facility was constructed in 2000, with mechanical upgrades completed in 2007.

Raw water entering the plant is metered and dosed with sodium hypochlorite prior to entering a detention tank. The tank is 1.22 m in diameter by 1.52 m in height, with an approximate volume of 1,800 L. The detention time is estimated to be in the order of 8 minutes. Due to the lengthy oxidization reaction time of manganese, the detention process is not likely to provide any significant improvement to the removal of this constituent.

Following detention, raw water flows through two manganese greensand pressure filters operated in parallel. The filters are 1.22 m in diameter by 2.13 m tall, operated at a rate of 1.9 L/s each (3.8 L/s total). For raw water of poor to fair quality, the recommended operating flux for manganese greensand filters is 1.0 - 1.6 L/s/m^2, which equates to 1.2 – 1.9 L/s each (2.4 – 3.8 L/s total). Therefore, the filters are operating at the high end of the recommended range, considering the raw water quality. Operations personnel report deteriorating treated water quality when operating above this rate.

The filters are backwashed based on pressure differential, typically producing approximately 180 m^3 of treated water between backwash cycles. The backwash process is conducted manually, with a dedicated backwash pump, consisting of 15 minutes per filter at a rate of 11 L/s. No air scour is provided. This equates to a backwash consumption rate in the order of 10% of total water use. The filters are regenerated every few months. The Operators avoid using well PW7, as the sediments from the source quickly build up in the filters and drastically reduce filtration rates.

Following filtration, clarified water is dosed with additional sodium hypochlorite for disinfection followed by deposition to the treated water storage reservoirs. The existing manganese greensand process schematic is shown below for reference.



MANGANESE GREENSAND

Chemical Dosage

The only chemical used for treatment is a 12% liquid sodium hypochlorite solution (Hypochlor-12 by ClearTech Industries), which is dosed prior to detention and following filtration. The Operators vary the dosing rates frequently in response to daily free chlorine residual levels. Based on the daily records, the dosing rates ranged from 7 - 15 mg/L prior to detention and 0.5 - 3 mg/L following filtration, for a total dosage rate in the order of 7.5 - 18 mg/L. This is below the maximum use rate of 103 mg/L for this product, as per NSF60 standards for drinking water chemical use. The frequent variability of the dosing rates suggests that a constituent in the raw water, such as ammonia or organic material, is reacting with the chemical.

Treated Water Storage

Storage of treated water is provided by two subgrade concrete reservoirs and a pump well. The pump well is located under the water treatment plant and has storage capacity of approximately 34,000 L. Reservoir #1 is also located under the water treatment plant building and has a storage capacity of approximately 155,000 L. Access to the pump well and reservoir #1 is provided by a raised hatch located within the building. Reservoir #2 is located immediately southwest of the plant and has a storage capacity of 222,000 L. A raised access hatch with lockable cover is provided. Total facility storage volume is 411,000 L.

As discussed in the following section, the plant uses submersible well pumps for distribution. Well pump assembly suspends the pump motor from the end of a drop pipe, below the suction inlet of the pump. Therefore, the suction inlet is approximately 1.2 m above the pump well floor, rendering all water below the inlet elevation unusable. For this reason, the effective storage volumes of the pump well and reservoirs are reduced to approximately 23,000 L, 103,000 L, and 138,000 L, respectively, for a total effective storage volume of 264,000 L. If the reservoirs are operated at a lower level in order to improve the circulation rate, the effective storage volume would be further reduced.

Under normal operation treated water is deposited to reservoir #2 and then flows via transfer pipe to reservoir #1, followed by the pump well for distribution.

Distribution

Distribution system pressure is provided by three submersible well pumps drawing from the pump well, each with a rated capacity of approximately 21 L/s at 46 m TDH. The pumps are driven by 20 hp, 600 V, 3 phase submersible motors, controlled by variable frequency drives to maintain a typical distribution pressure of 65 psi. Each pump has sufficient capacity to meet typical demand, with the lag pumps providing redundancy or additional flow in high demand scenarios.

Two distribution pumps draw from the pump well, while the third is installed in reservoir #1 to provide distribution in the event that the pump well is unavailable due to maintenance or other issues. The distribution header is equipped with valves for isolation and backflow prevention, a pressure relief valve that discharges to the pump well, and an electromagnetic flow meter. A pressure tank is connected to the system to mitigate excessive start and stop of the pumps during periods of low flow.

Controls and Electrical

The raw water supply, treatment, and distribution process all have automated components. The well pumps and chemical pumps are started and stopped based on level condition in the pump well, as monitored by an ultrasonic level transducer. The distribution pumps are controlled by a pressure transducer on the header, which communicates with the pump drives to maintain the set pressure. Manually controlled processes in the plant include filter backwash.

The plant is equipped with an autodialler call-out device, which notifies operations personnel of conditions such as low distribution pressure and low reservoir conditions.

Electrical service to the building is provided by a 600 V, three phase connection. Electrical components are typically individual surface mount type. The facility is equipped with a 100 kW, natural gas fuelled emergency power generator to maintain distribution in the event of a power outage. The generator is equipped with an automatic power transfer switch.

Facility

The water plant building is a timber-framed structure, totalling roughly 75 m^2 in area. The building is situated on top of the concrete reservoir foundation. The exterior finishes consist of stucco, wood and pre-finished metal trim, and asphalt shingles. The interior finishes consist of pre-finished metal cladding on the walls and ceiling, and exposed concrete floors.

The building is equipped with a small water heater and sink for domestic water use. Building heat is provided by a natural gas fired unit heater. Building ventilation is provided by a dedicated exhaust fan and intake damper. Lighting is provided by fluorescent fixtures.

2. EXISTING DEMAND

Annual water consumption records from 2007-2021 were reviewed to determine historical water consumption by the community. The following table provides a summary of treated water distribution since the inaugural development.

Year	Treated Distribution (m^3)	Operational Notes
2021	34,996	Leaking fixture in pavilion all summer.
2020	15,001	Resort closed April to November (Covid-19).
2019	29,496	
2018	32,524	Early fall.
2017	32,595	
2016	34,530	Cottages opened in late summer.
2015	31,753	Forest fires June and July.
2014	33,700	
2013	29,148	
2012	25,564	Early winter.
2011	29,040	
2010	26,989	
2009	23,892	Resort hotel opened.
2008	15,261	
2007	10,735	

With the exception of 2020, consumption has been relatively consistent since 2014, with an average annual distribution of approximately 32,800 m^3. Since the opening of the resort hotel, the consumption rate has increased intermittently, typically corresponding to further development within the community. Disregarding the years prior to the resort hotel opening, the average annual increase in consumption is in the order of 2.4%.

Daily water records from 2015 to 2021 were available and reviewed to determine more detailed usage data, as shown in the following table. Data from 2020 was discounted due to low facility use during the Covid-19 pandemic.

Year	Consumption (m^3)		Daily Peak Factor
	Avg day	Peak day	
2021	96	267	2.8
2020	-	-	-
2019	81	208	2.6
2018	89	304	3.4
2017	89	299	3.3
2016	95	271	2.9
2015	87	304	3.5
Average	**90**	**275**	**3.1**

The average daily consumption is in the order of 90 m^3 with a typical peak day of approximately three times that amount. It should be noted that this peak day factor is typical for communities of this size due to the seasonal nature of the community population.

It should be noted that total raw water consumption is recorded in addition to distributed water. The difference between the raw and treated totals typically provides an indication of backwash and waste volumes generated by the treatment process. Based on the raw water totals, backwash and waste amount to less than 5% of the total raw water usage. This is considered quite low for a manganese greensand process, particularly for treatment of lower quality raw water where backwash and waste rates in the order of 10 - 15% are typical. It is likely that the existing raw water meter readings contain some error. Treated distribution is metered by an electromagnetic flow meter which provide improved accuracy compared with older style meters. This should be taken into account when assessing total water consumption.

3. FUTURE DEMAND

The rate of water consumption varies widely during different periods of the year and hours of the day. However, two characteristic demand periods are normally recognized as being critical factors in the design and operation of a water system. These factors are the peak day (the day of highest consumption during any one year) and the peak hour (the hour of highest consumption during any one day) demand. A peak day factor of 3.1, as derived from the actual water consumption records, will be used for the peak day flow. A peak hour factor of 4.0 times the average day is typical for a community of this size and as such, will be used to determine water pumping capacities.

Applying the assumptions described, the following table summarizes the current and expected demand from the community.

Demand Projection 2022-2042					
Demand	**2022**	**2027**	**2032**	**2037**	**2042**
Average Day (raw; L/s)	1.22	1.38	1.55	1.74	1.96
Peak Day (raw; L/s; P.F. = 3.1)	3.79	4.27	4.80	5.41	6.08
Average Day (treated; L/s)	1.04	1.17	1.32	1.48	1.67
Peak Hour (treated; L/s; P.F. = 4.0)	4.16	4.68	5.27	5.93	6.67

Applying the future water demand projection, system component requirements for the current treatment process is shown in the following table below (bolded items highlight that there is a shortfall in capacity).

Infrastructure Requirements 2022 – 2042						
	Existing	**2022**	**2027**	**2035**	**2037**	**2042**
Raw Water Supply (L/s; P.F. = 3.1)	3.8	**3.8**	**4.3**	**4.8**	**5.4**	**6.1**
Water Treatment (L/s; P.F. = 3.1)	3.8	**3.8**	**4.3**	**4.8**	**5.4**	**6.1**
Distribution Pumping (L/s; P.F. = 4.0)	21.0	4.14	4.68	5.27	5.93	6.67
Treated Water Storage (L; 2 x avg. day)	264,000 / 411,000	210,470	237,941	**267,766**	**301,330**	**339,101**

As indicated, the current water treatment equipment has difficulty producing quality water at sufficient rate during peak periods. Increased treatment capacity will also require an increase to raw water supply. It is important to note that the existing water treatment facility is relatively small and does not have sufficient space for additional water treatment equipment.

The existing reservoir capacity is adequate to meet the 20 year projected requirements. However, the effective storage is reduced due to the current pumping arrangement and is anticipated to encounter a shortfall within 10 years. Therefore, it is recommended that an alternative pumping arrangement be explored prior to reaching this threshold.

It is understood that there is an RV Park in development that will increase demand within the next two years. Such development is accounted for by the long term growth rate applied to the annual water consumption. However, growth rates may be slightly higher in the short term due to this development. Therefore, the five year projected requirements may be realized more rapidly.

4. WATER QUALITY

The raw water source for the Elk Ridge Utility is classified as poor to fair, with high concentrations of ammonia, total dissolved solids, and moderate overall hardness. Metals are present in levels consistent with true groundwater, with arsenic, iron and manganese concentrations exceeding guidelines.

Treated water is sampled and tested for quality every two years. A brief summary of constituents of interest for the raw and treated water is summarized in the table below. Bolded values are those that are nearing or exceeding the Saskatchewan or Canadian Drinking Water Quality Guidelines.

Constituent	Raw Sept. 17, 2014	Treated Oct. 15, 2015	Treated July 7, 2017	Treated Feb. 5, 2019	Treated Feb. 22, 2021	SK Guideline	Canadian Guideline
Arsenic	**0.027**	0.0015	0.0025	0.0013	0.0016	0.01	0.01
Iron (mg/L)	**1.88**	-	0.107	0.03	0.017	0.3	0.3
Manganese (mg/L)	**0.13**	-	**0.0468**	0.0114	0.0008	0.05	0.02
Ammonia (mg/L)	0.71			0.75		-	-
Alkalinity (mg/L)	**538**	**501**	**497**	**486**	**494**	500	-
TDS (mg/L)	**848**	**842**	**530**	**519**	-	1,500	500
Hardness (mg/L)	446	434	450	440	432	800	200

A description of each of the raw and treated water constituents in excess of the Canadian or Saskatchewan Drinking Water Standards are as follows (unless noted as *, write ups are from SRC Analytical – *Water Analysis Information Sheet*):

Arsenic
Natural sources, such as the dissolution of arsenic-containing bedrock, often contribute significantly to the arsenic content of drinking water and groundwater. A number of disorders have been associated with the intake of arsenic in drinking water; however, there is no evidence of any specific illness related to the ingestion of water containing arsenic at the maximum acceptable concentration of 0.01 mg/L. Treated water test results have not approached the regulatory limits to date.

Iron
At levels above 0.3 mg/L, iron can stain laundry and plumbing fixtures, as well as cause an undesirable taste. The precipitation of excessive iron causes a reddish-brown colour in the water and may also encourage the growth of iron bacteria, leaving a slimy coating in piping. The presences of iron bacteria can also cause a rotten egg odour and a sheen on the surface of the water. The aesthetic objectives for both Saskatchewan and Canada are set at 0.3 mg/L.

Manganese
Manganese can cause staining of plumbing and laundry and undesirable tastes in beverages. Also, it may lead to the accumulation of bacterial growth in piping. The aesthetic objective for Saskatchewan is set at a maximum of 0.05 mg/L. Health Canada recently lowered the aesthetic objective to 0.02 mg/L and implemented a maximum acceptable concentration of 1.2 mg/L. Laboratory test results have exceeded the guidelines on one occasion. However, review of daily manganese testing conducted at the plant with a bench top unit indicated that manganese concentrations in the treated water routinely exceed 0.02 mg/L.

Ammonia*
Though not considered an immediate health or aesthetic concern, high ammonia in a raw water source can have deleterious affects on treatment processes. Ammonia reacts readily with sodium hypochlorite (chlorine), which is used for oxidization of iron and manganese, as well as for disinfection. This greatly increases chlorine consumption and inhibits the oxidization and disinfection processes, reducing the effectiveness of iron and manganese removal and potentially resulting in inadequately disinfected drinking water. The effects of ammonia on water treatment are well known and documented in the Water Security Agency's EPB 431. Recent testing indicates ammonia concentrations of 0.75 mg/L, which is considered moderately high.

Alkalinity
Alkalinity is a water's acid-neutralizing capacity and is primarily a function of carbonate, bicarbonate and hydroxide content. Excessive alkalinity levels may cause scale formation. The Saskatchewan aesthetic objective is set at a maximum of 500 mg/L. Recent testing results have approached and exceeded this limit.

Total Dissolved Solids or Specific Conductivity
Specific conductivity is a measure of the ability of water to carry an electric current. This ability depends on the presence of ions and therefore is an indication of the concentration of ions (i.e. dissolved solids) in the water. Waters with high dissolved solids generally are of inferior palatability and are likely to leave a white film on dishes, etc. The provincial aesthetic objective for total dissolved solids is 1,500 mg/L. The federal objective is more stringent, at 500 mg/L. Recent testing indicates concentrations exceeding 500 mg/L.

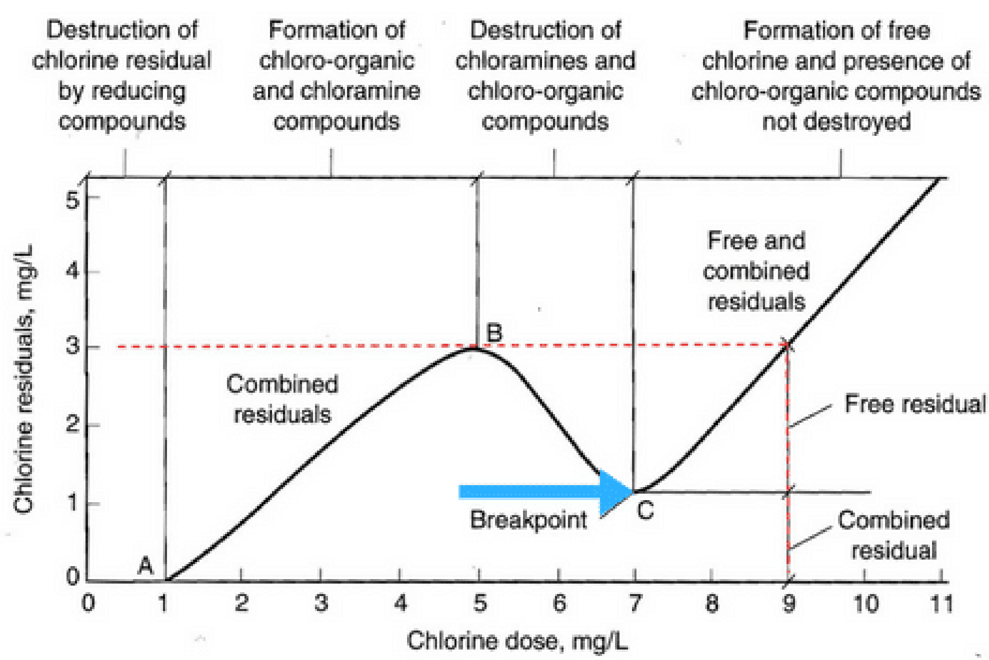
Total Hardness
Water hardness is mainly caused by the presence of calcium and magnesium and is expressed as the equivalent quantity of calcium carbonate. Scale formation and excessive soap consumption are the main concerns with hardness. When heated, hard waters have a tendency to form scale deposits. Depending on the interaction with other factors, such as pH and alkalinity, hardness levels between 80 and 100 mg/L are considered to provide an acceptable balance between corrosion and incrustation. Water supplies with a hardness greater than 200 mg/L are considered poor, but tolerable; those in excess of 500 mg/L are unacceptable for most domestic purposes. The aesthetic objective in Saskatchewan is 800 mg/L. Recent water quality records note total

hardness concentrations approaching 500 mg/L.

5. DISINFECTION

Disinfection is a critical part of the water treatment process, ensuring that water intended for human consumption is free of harmful viruses and pathogens. Chlorine is a powerful oxidant and is commonly used for disinfection of drinking water in Saskatchewan. To ensure adequate disinfection is achieved, free chlorine residuals are monitored daily at the water treatment plant. However, the presence of ammonia in the water interferes with the disinfection process by reacting with the available chlorine. To overcome this, chlorine dosage must be increased until all ammonia has reacted, and sufficient free chlorine residual is achieved. This process is referred to as 'breakpoint chlorination'.

A typical break point chlorination chart is shown below.



Fluctuating raw water ammonia levels require frequent adjustment to chlorine dosage rates and often result in over or under-dosage of the chemical. This is evidenced by the daily water plant records, which show highly variable free chlorine residuals, ranging from 0.15 to 1.5 mg/L. Operator notes indicate frequent dosage rate changes.

Review of sodium hypochlorite dosage indicates that the operation does not approach the NSF61 maximum use limit for use of this chemical in drinking water. However, the ammonia interference increases the overall chemical consumption at increased cost to the Utility. Further, ammonia can inactivate all available chlorine, reducing the effectiveness of the oxidization process, manganese greensand regeneration, and overall iron and manganese removal. This is likely a factor in the treatment process' difficulty in removing manganese below regulatory limits.

6. WATER TREATMENT CONSIDERATIONS

The existing manganese greensand filtration process is generally capable of meeting the regulatory requirements for arsenic, iron and manganese. However, the system must be operated at low flux rates to achieve adequate treatment. As indicated by the infrastructure requirement projections, the filters are currently operating at peak capacity and will not be capable of meeting peak demands of future development. Ammonia interference compounds the iron and manganese removal issues and results in excess chemical use. Further, the treatment system is not capable of achieving the recommended water quality objectives for the aesthetic constituents such as ammonia, alkalinity, hardness, and total dissolved solids.

Considering the characteristics of the raw water, several treatment considerations / processes may be required to meet the water quality objectives of the community. The following table highlights some of the key parameters and appropriate technologies for their removal.

Key Parameters and Appropriate Technologies		
Parameters	**Appropriate Technologies**	**Comments**
Arsenic	Greensand, Biological. Membrane.	The existing system is typically successful in removing arsenic.
Iron	Greensand, Biological, Membrane	The existing system is typically successful in removing iron.
Manganese	Greensand, Biological, Membrane	The existing system is often unsuccessful in removing manganese, due to filtration rate and ammonia interference.
Ammonia	Biological, Membrane	Greensand filtration will not remove ammonia. Biological filtration is very effective in ammonia removal. Membranes are typically effective, depending on the chemical state of the ammonia.
Alkalinity	Membrane	Greensand filtration and biological filtration by themselves do not reduce alkalinity. Membrane filtration is required to reduce alkalinity to below recommended limits.
TDS	Membrane	Greensand filtration and biological filtration, by themselves do not reduce TDS. Membrane filtration is required to reduce TDS to below regulated limits.
Hardness	Membrane	Greensand filtration and biological filtration, by themselves do not reduce hardness. Membrane filtration is required to reduce hardness to below recommended limits.

Both manganese greensand and biological filtration are considered suitable technologies for the removal of arsenic, iron and manganese. However, in order to meet all federal and provincial treatment regulations and aesthetic objectives, implementation of a membrane treatment system would be required. Membrane filtration consists of forcing water through a membrane barrier at high pressure. The use of membranes results in a treated water that is lower in all constituents, including organics, hardness, iron, manganese, and total dissolved solids. Membranes also provide a positive barrier against giardia and cryptosporidium.

It should be noted that a direct-feed membrane system is not recommended due to the high concentrations of iron and manganese. Though capable of iron and manganese removal, without a pre-treatment system the membranes would require frequent cleaning and replacement. The high ammonia concentrations present in the raw water suggest that a biological and membrane filtration combination would provide optimal treatment.

In addition to dissolved constituents, the treatment process also encounters entrained sediments in the source water when operating PW7. Conventional greensand filtration is capable of filtering out small concentrations (<10 mg/L) of suspended solids, expelling the sediments during the backwash process. However, the concentrations of entrained sediment observed during the recent testing far exceed this amount. Sediment buildup in the filters would be rapid and cause plugging, requiring frequent backwashing, reducing treatment effectiveness, and increasing maintenance requirements. Entrained sediments would present even greater issue for the biological filtration process, which typically uses a lesser backwash rate than conventional greensand filtration. Regardless of treatment process, additional measures will be required to mitigate this issue.

7. TREATMENT OPTIONS

Overall, the existing water treatment facility is in good condition, but is presenting several issues regarding capacity and capability in meeting current standards and objectives for water treatment. It must be noted that most options for improving the treatment process require additional equipment, which is constrained by the physical size of the existing building. Considering this, the following options have been identified.

Option 1 – Manganese Greensand Media Replacement

The plant currently uses typical manganese greensand media, which is a silicate mineral coated with manganese dioxide. The greensand is topped with a layer of anthracite media which acts as a physical filter for precipitated iron, manganese, and other larger particulates. The anthracite material has been replenished periodically, as it is gradually lost during the backwash process. However, the greensand media is believed to be the original material. Over time, greensand material can degrade through abrasion (reduced surface area), physical loss of media during backwashing, and possibly reduced adsorption ability over time. Therefore, it is possible that replacing the greensand media could improve treatment performance. Estimated cost to replace the media is as follows:

Greensand Media Replacement	
Item	**Estimated Cost**
Greensand Media Replacement	$40,000

It is important to note that treatment issues, particularly regarding manganese removal, have been observed for more than 10 years and are not isolated to recent occurrences. There does not appear to be a discernable trend of reducing manganese removal within this timeframe. It is more likely that the treatment issues stem from the rate of operation and inadequate oxidization time than from media degradation or loss. Therefore, media replacement is not guaranteed to realize increased treatment performance.

Alternatively, modified media types are available that can reportedly increase the flux capacity of the existing tanks. Alternative media options typically include a variation of the type of mineral coated with greensand or a solid manganese dioxide mineral media. Manufacturers report improved iron and manganese adsorption rates; however, limited data is available by which to evaluate these claims. Estimated cost to replace with an alternative media is as follows:

Alternative Media Replacement	
Item	**Estimated Cost**
Alternative Media Replacement	$75,000

Chemically, the process for iron and manganese removal is the same for all media types using the greensand approach. Therefore, improved removal requires a substantial increase in oxidization and adsorption of dissolved iron and manganese. A large factor in successful oxidization, particularly for manganese, is the oxidization time and the pH level of the raw water. Manganese is typically harder to remove as the oxidization reaction time is significantly slower than that of iron, particularly at the pH level present in the raw water. It is important to note that alternative media will do nothing to increase the contact time with the oxidizing agent and media. By increasing filtration rates to meet demand, media contact time will actually be reduced. Further, the presence of elevated ammonia concentrations in the raw water is likely inhibiting the oxidization process. This too would not be mitigated by alternative media types.

For these reasons, the alternative media options are not guaranteed to achieve treatment at the filtration rates required to meet future growth in the community. Though some improvement may be realized at the current operating rate, it is anticipated that these returns will diminish at increased filtration rates. The better alternative for continued use of the manganese greensand process is to simply add more filters or replace the existing ones with larger tanks. Physically, it may be possible to accommodate the additional equipment but working space would be significantly reduced. An air scour process is also recommended. Such a project would require the following:

- replacement of existing media;
- installation of two additional filters;
- installation of air scour system and piping;
- plant and piping modifications.

Estimated costs to design, construct, and implement this work are as follows:

Greensand Process Expansion	
Item	**Estimated Cost**
Filter Media Replacement	$75,000
Additional Filters	150,000
Air Scour System	50,000
Existing Building / Reservoir Modifications	25,000
Process Piping Modifications	90,000
Instrumentation	20,000
Subtotal - Construction	**$410,000**
Contingency (15%)	60,000
Engineering (15%)	60,000
Total Estimated Cost	**$530,000**

Installing additional filters will increase production ability of the plant. However, some difficulty in manganese removal is likely to continue due to inadequate contact time and ammonia interference. Increasing the size of the detention tank would not be possible due to physical constraints of the plant.

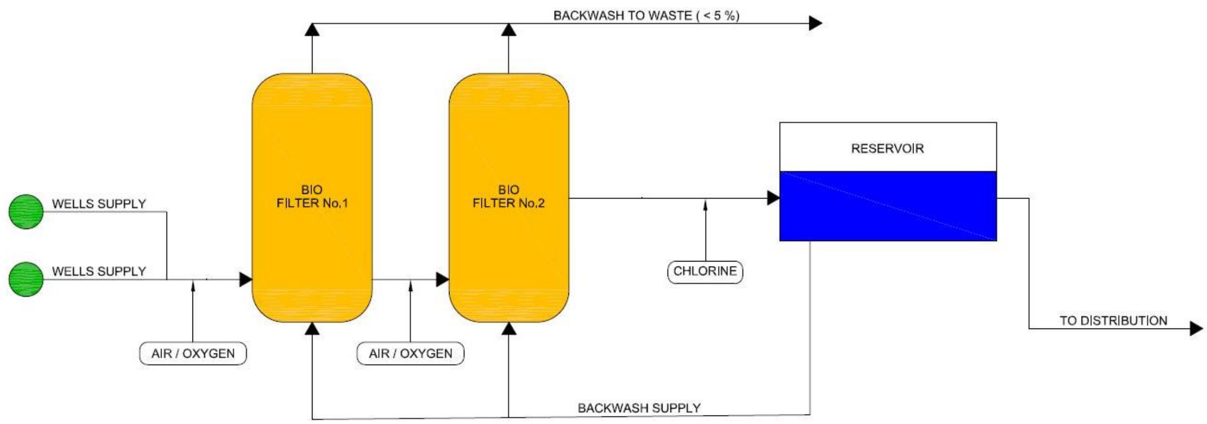
Option 2 – Biological Filtration Conversion

Biological filtration provides several advantages over conventional manganese greensand filtration. This process has been implemented at many locations throughout Saskatchewan over the last 10 years, replacing manganese greensand processes in many instances. Biological filtration typically realizes slightly improved iron removal and significantly improved manganese removal, compared to manganese greensand filtration. Biological filtration can also remove ammonia whereas manganese greensand has no ammonia removal ability. Due to the ability to remove ammonia and the elimination of oxidization prior to filtration, the biological process would greatly reduce chlorine usage at the plant. Backwash requirements would also be reduced.

The existing filter tanks are in good condition and are suitable for conversion to a biological process. Based on the filter sizing and projected demand, two additional tanks of equivalent size would likely be required. The existing detention tank could be removed for this process. Confirmation of filter sizing would be required by the treatment process vendor. Such a project would require the following:

- 4 to 6 week pilot testing process;
- replacement of the existing filter media;
- installation of additional filters;
- 4 week bio-seeding process;
- installation of compressor and blower system equipment;
- instrumentation equipment.

A typical biological filtration schematic is shown for reference:



BIOLOGICAL

It should be noted that the existing treatment process would not be available during the 4 week seeding process. Therefore, direct distribution of unfiltered water with chemical disinfection would be required during this time. It is possible that the bio-filters could begin use before the end of this period with gradually improving treatment.

Estimated costs to design, construct and implement this work are as follows:

Biological Filtration Conversion	
Item	**Estimated Cost**
Pilot Process	$25,000
Filter Media Replacement	40,000
New Filters	150,000
Air System	75,000
Existing Building / Reservoir Modifications	25,000
Process Piping Modifications	90,000
Instrumentation	25,000
Subtotal - Construction	**$430,000**
Contingency (15%)	65,000
Engineering (15%)	65,000
Total Estimated Cost	**$560,000**

The addition of biological filtration would provide benefit to operations by reducing chemical usage and backwash requirements. Water quality would be improved by reduced iron and manganese concentrations, as well as ammonia removal. However, as discussed herein, biological filtration will not remove other dissolved solids. Therefore, alkalinity, water hardness and total dissolved solid concentrations will not be improved. Additional treatment process equipment is required to address these constituents.

Option 3 – Membrane Filtration Addition

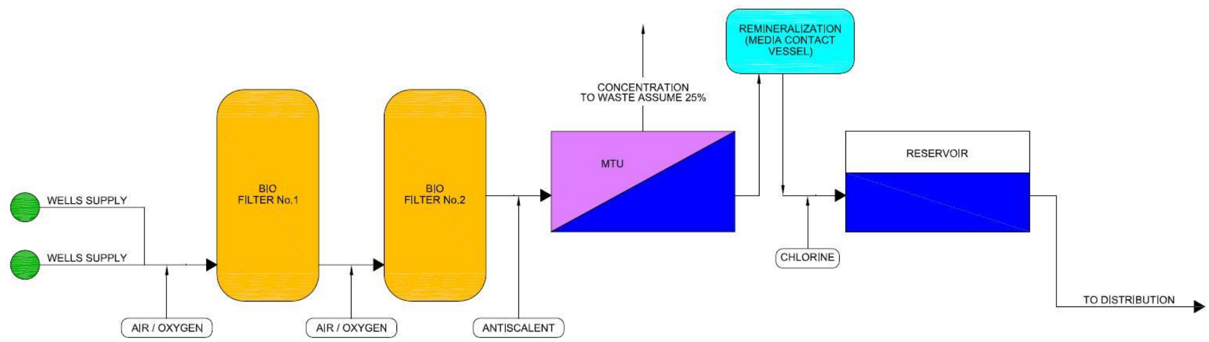
The manganese greensand and biological filtration processes are suitable for iron and manganese removal, but are incapable of removing other dissolved minerals and lowering hardness. It was reported that many residences employ water softeners and small-scale, point-of-use reverse osmosis filters to address this. Membrane filtration is capable of removing dissolved solids from water and can produce a 'bottled water' quality product. Should the Utility wish to remove these constituents to meet all regulations and aesthetic quality objectives, a membrane system would be required. However, due to the high concentrations of dissolved solids in the raw water at Elk Ridge, a 'direct-feed' membrane system would be prone to membrane fouling and frequent replacement at substantial cost. Therefore, a two stage treatment process would be recommended, consisting of greensand or biological filtration for iron, manganese and ammonia removal, followed by membrane filtration for removal of remaining constituents.

Therefore, Option 3 would be added to the greensand or biological filtration process as discussed in Options 1 and 2. Option 3 could be considered concurrently or for upgrade in the future.

Spatial constraints of the existing plant would require construction of a new space to house the additional equipment. This could likely be accomplished by construction of a new building using the existing external reservoir as a foundation. In general, the project would require the following:

- 4 to 6 week pilot testing process;
- construction of a new building;
- installation of membrane filtration equipment;
- modifications to the existing process piping and building;
- instrumentation and integration into controls and monitoring systems.

A typical biological membrane filtration schematic is shown for reference:



BIOLOGICAL / MEMBRANE

Estimated costs to design, construct and implement this work are as follows:

Membrane / Building Addition	
Item	**Estimated Cost**
Pilot Process	$25,000
Building Construction	475,000
Membrane Process Equipment	600,000
Process Piping	150,000
Existing Building / Reservoir Modifications	90,000
Existing Process Modifications	50,000
Instrumentation and Controls	250,000
Subtotal - Construction	**$1,640,000**
Contingency (15%)	245,000
Engineering (15%)	245,000
Total Estimated Cost	**$2,130,000**

It should be noted that these costs would be in addition to Option 1 or 2. Further, these estimates do not include upgrading the existing well capacity, should it be required to meet the additional water supply necessary for the membrane filtration option.

8. ADDITIONAL IMPROVEMENTS

In addition to the treated water quality and capacity issues, several other items were noted during the inspection of the facilities.

Raw Water Supply

The capacity of the existing raw water supply is approximately 3.8 L/s. Therefore, increased raw water pumping capacity will be required to realize any increase to the treatment capacity. This is most easily achieved by replacement of the existing well pumps with larger units. Preliminary well analysis suggests that the existing well construction and aquifer are sufficient for increased pumping rates.

Well Pump Replacement	
Item	**Estimated Cost**
Well Pump and Motors	$35,000
Total Estimated Cost	**$35,000**

In addition to capacity, PW7 also has issues with entrained sediment, which will pose a problem to any treatment process upgrades. As a result, PW7 has been operated as a back-up well, only used in case of issues with PW6. BHL suggested several options for mitigating this issue in their 2018 letter report. One option was to pump the well to waste in an effort to exhaust the source of the sediment, which was done without success in 2021.

Another option listed in the BHL report was to install a screen insert with smaller slot openings and finer screening sand within the well to prevent the sediment infiltration. A reduced screen opening size and the accumulation of fine sediment around the well will increase the drawdown level of the well, affecting pumping capacity. Therefore, a larger pump may be required for PW7 to achieve equivalent capacity to PW6. Additional analysis would be required to determine whether this assembly would be sufficient for increased pumping rates. It should be noted that the installation of a screen would also make it more difficult to service and rehabilitate the well in the future.

Well Screen Installation	
Item	**Estimated Cost**
Well Screen Installation	$70,000
Total Estimated Cost	**$70,000**

Rather than addressing the issue at the source, there is also an option to filter out and remove the entrained sediments as a part of the treatment process. This could be accomplished through addition of a self-cleaning filter within the plant, installed prior to the filter tanks. These units remove suspended solid particles, automatically flushing them to waste intermittently or continuously, without interrupting filter operation. This option would require piping modifications and additional floor space within the plant. The filter discharge would direct sediment to the sanitary sewer system, including the nearby pumping station and ultimately, the lagoon. The sediments observed to date have been relatively fine and are not anticipated to pose a problem to the sanitary sewer system but may increase wear on sewage pumping equipment.

Pre-Filter Installation	
Item	**Estimated Cost**
Pre-Filter Installation	$35,000
Piping Modifications	5,000
Electrical	5,000
Total Estimated Cost	**$45,000**

Long term, the best option would be design and installation of a new well with increased capacity and adjusted screen sizing to prevent infiltration of finer sediments. However, capital costs for well development are significant and would also include the cost of construction of a new supply main to connect well to treatment plant.

Estimated costs for the options discussed herein are as follows:

Well Development	
Item	**Estimated Cost**
Well Drilling	$170,000
Well Completion	50,000
Pump and Motor	40,000
Raw Water Supply Main	50,000
Total Estimated Cost	**$310,000**

Distribution Pumping

As discussed, the plant currently uses submersible well pumps for distribution of treated water. The pumps are of adequate capacity to meet current and future demands but present operational issues due to the installation arrangement. The pumps are installed vertically within the reservoir and consist of a motor and pump end suspended from a drop pipe. The motor hangs below the suction inlet of the pump, positioning the inlet approximately 1.2m above the reservoir floor. Therefore, the bottom 1.2 m of treated water are inaccessible, effectively reducing storage capacity by approximately 147,000 m^3.

The effective storage volume is sufficient to meet current demand rates but will realize a shortfall in approximately 10 years. However, if the utility reduces the operating level of the reservoirs during winter months, the effective storage may dip below current requirements.

Vertical turbine pumps are considered industry standard for treated water distribution and feature a suction inlet extending to the base of a reservoir to utilize the full storage volume. It is recommended that vertical turbine pumps be installed when storage capacity becomes critical. Estimated cost to replace the distribution pumps with vertical turbine pumps are as follows:

Distribution Pumping	
Item	**Estimated Cost**
Vertical Turbine Pumps	$180,000
Header Piping Modifications	10,000
Total Estimated Cost	**$190,000**

9. RECOMMENDATIONS AND CONCLUSION

As discussed, the ERU water treatment plant is currently faced with several immediate operational issues.

Water Treatment Quality / Capacity
Recommendation: Conversion to Biological Filtration System

The existing system requires media replacement and installation of additional filters to increase treatment capacity and quality. Even with additional filters, insufficient oxidization time may result in continued difficulty with removal of manganese. The presence of ammonia in the raw water would continue to interfere with the oxidization process and require excess chlorine dosage. Conversion of the filters to a biological filtration system would realize significantly improved manganese removal, as well as ammonia removal, with reduced chemical dosing. The bio process has no oxidization requirement and therefore would eliminate the detention tank, reducing spatial requirement of the process. Costs for these upgrades are not expected to differ significantly from greensand option.

Raw Water Supply Capacity
Recommendation: Well Pump Replacement

The wells are currently run at full, or near full, capacity during normal operation. Increasing treatment capacity will require increased supply capacity to suit. Preliminary well analysis suggests the well construction and aquifer should be sufficient for increased pumping rates. Therefore, installation of larger capacity well pumps would achieve the required supply increase.

PW7 Entrained Sediments
Recommendation: Pre-Filter Installation

The entrained sediment produced by PW7 pose a problem to the operation of the existing treatment process as well as the future process upgrades. Therefore, sediment removal is required by installation of a screen sleeve within the well or a self-cleaning pre-filter within the plant. Installation of a well screen would accomplish the task but may reduce well efficiency, which is problematic for increasing the aforementioned raw water supply capacity. The screen would also make rehabilitation work on PW7 impossible, effectively limiting the remaining lifespan of the well. A pre-filter unit within the plant would have a spatial requirement but would be more cost effective to install and easily serviceable. Further, the pre-filter could provide benefit to both existing wells as well as any future wells should further sediment issues crop up.

Immediate Recommendations Cost Summary	
Item	**Estimated Cost**
Biological Filtration Process Upgrade	$430,000
Well Pump Replacement	35,000
Sediment Pre-Filter Unit	45,000
Subtotal – Construction	**$510,000**
Contingency (15%)	75,000
Engineering (15%)	75,000
Total Estimated Cost	**$660,000**

Please note that all costs provided in this report are preliminary in nature and subject to change based on economic conditions, market timing, contractor and material availability.

Long term, the ERU should consider additional upgrades as discussed within this report, including:

- replacement of the existing distribution pumps with vertical turbine style pumps in order to realize full reservoir capacity;
- should the community wish to pursue further improvements to water treatment to meet all treatment guidelines and objectives, a membrane filter could be added to the proposed biofilter upgrades. This would require a building expansion to fit this equipment;
- the ERU should plan for new well construction in the event that PW7 experiences further issues.

We trust this information meets your needs at this time. If you have any questions or require further information, please do not hesitate to contact our office.

Yours truly,

BCL ENGINEERING LTD.

T. T. Braun, P. Eng.

ICIP - Green Infrastructure Stream - 2022-23

2. Project Eligibility

CONFIRMATION OF PROJECT ELIGIBILITY

I have reviewed the ICIP eligibility information, and to the best of my knowledge confirm that my project will meet program requirements.

3. Project Characteristics

1. Project Title:

Elk Ridge - Water Treatment Plant Upgrades

2. Project Description:

The main objective of this project is to increase the water treatment capacity and water quality of the Elk Ridge Utility water treatment plant in order to meet provincial drinking water quality standards for current and future community population of the Resort Village of Elk Ridge. The project output includes replacement of the existing filtration equipment with treatment technology better suited for the raw water source, including modifications to the existing mechanical/electrical to suit. Raw water supply capacity will also be improved by installation of new well pumps and a pre-filter unit to address present issues with sediment in the source water.

3. Will the highest published applicable energy efficiency standards in the jurisdiction be met or exceeded?

Yes

4. Does the project involve a public facing infrastructure (i.e., can be accessed by public when completed)?

No

a) Please explain how it will incorporate the principles of universal design and meet the highest published provincial accessibility standards in effect at the time the Building Permit is issued?

4. Ultimate Recipient

If you (the project owner) are a municipality, please select the name of your community from the list below. If this does not apply, please select 'Project Owner Is Not Municipal'.

Project Owner: : Project Owner Is Not Municipal

If you (the project owner) are an Indigenous community, please select the name of your community from the list below. If this does not apply please choose 'Project Owner Is Not Indigenous'.

Project Owner: : Project Owner Is Not Indigenous

If you (the project owner) are not municipal or Indigenous, please insert your organization's name in the text box below. If you are municipal or Indigenous please select 'Project owner is municipal or Indigenous'

Project owner:: Elk Ridge Utility Ltd. / Resort Village (pending)

Street Address/Number or P.O. Box Number:

Box 182

City/Town:

Waskesiu

Postal Code

S0J2Y0

Primary Project Contact Name:

Dennis Paddock

Primary Project Contact Position/Title

President

Primary Project Contact Email Address

dkpaddock@hotmail.com

Verify the Primary Project Contact Email address:

dkpaddock@hotmail.com

Primary Project Contact Phone Number:

6395713933

Primary Project Contact Phone Number (Cell):

6395713933

Alternate Project Contact Name:

Gren Smith-Windsor

Alternate Project Contact Position/Title:

Secretary

Alternate Project Contact Email Address:

gsmithwindsor@gmail.com

Verify the Alternate Project Contact Email Address:

gsmithwindsor@gmail.com

Alternate Project Contact Phone Number:

3066635744

Alternate Project Contact Phone Number (Cell):

3069609974

If you have a Project Engineer, please provide the contact information details, i.e., name, company, phone number, and email:

Tyrel Braun, P.Eng.
BCL Engineering Ltd.
(306) 477-2822
tbraun@bcl-eng.ca

5. Project Applicant Type

A private sector body, including for-profit organizations and not-for-profit organizations. In the case of for-profit organizations, they will need to work in collaboration with one or more of the entities referred to above or one of the Indigenous Ultimate Recipients listed below.

5. Project Finances

6. Are sources of funding secured for the Total Project Costs (eligible+ineligible)?

No

a) If no, please explain how, when, and from what source(s) funding will be secured for the project?

Assuming the Utility is successful in the grant application, the Utility's savings / reserves are sufficient to cover the Utility's portion of project costs.

7. Based on your Detailed Cost Estimate, please provide the Total Project Costs:

1100000

8. Based on your Detailed Cost Estimate, please provide the Total Eligible Project Costs:

1085000

9. Using the details from the cost estimate, provide the following information:

II. Design/Engineering : 95000
III. Construction/Materials : 770000
V. Contingency : 195000
I. Project Planning : 25000
Total : 1085000

10. Will the project have the cooperation and/or financial support of two or more communities?

Yes

a) If yes, please list the eligible recipients that will be part of the project, including the level of involvement, and indicate the financial contribution of each community or entity.

	Name of the entity that will receive service	Level of involvement (check all that apply)				Financial contribution ($)
		Letter of Support	Financial Contributor	Partner in Operations	Partner in Ownership	
1.	Resort Village of Elk Ridge	X		X		
2.	Elk Ridge Utility Ltd.		X	X	X	350000
3.						
4.						
5.						

11. Is there a formal agreement in place between the project partners? (Please choose not applicable if there are no partners to this project)

No

12. Fiscal Year Breakdown – Total Eligible Project Costs (April 1 to March 31)

2023-24 : 570000
2024-25 : 515000
Total : 1085000

13. Have any costs been incurred or contracts awarded for the project?

Yes

14. Please select what the estimated project costs are based on

Class D: Estimates at the "Conceptual Design" stage / +/- 20% to 30%

15. When was the cost estimate provided or last updated?

Less than six months ago

16. Please indicate the funding sources for the Applicant's portion of the total project costs.

a) Reserves / Savings: 360000

b-1) What is the estimated date that borrowing will be secured?

b-2) What is the term of borrowing?

b-3) How will borrowing be secured?

b-4) Is outside approval required to borrow? (i.e., from Saskatchewan Municipal Board)

b-5) What is the status of your application with the Saskatchewan Municipal Board?

c) Are those fees and/or levies new or existing?

d) How much has been fundraised to date?

e) Please indicate the project number for your Canada Community-Building Fund (formerly Gas Tax Fund) provided on your acknowledgement of receipt letter, or if not yet submitted enter '0000-000000'

f) What other government funding programs have you applied to and/or received approval for? Please provide program name, amount, and status.

h) If you have selected "other", please elaborate on what other sources of funding you will be utilizing.

6. Nature of the Project

17. What is the nature of the project? Please indicate the percentage of project work in each of the categories below.

Other % : 100%
Total : 100%

a) If "Other", please describe:

Process/capacity upgrades to meet water quality objectives and increase capacity

18. Will the Ultimate Recipient own and operate the asset?

No

a) If you selected 'No', please provide additional information regarding asset ownership & operation. This must include the name, the type of entity, and a brief description of the arrangement.

The Elk Ridge Utility Ltd. (ERU) will own and operate the asset in the immediate term. However, the ERU is in the early stages of transitioning ownership and operation of infrastructure assets to the recently incorporated Resort Village of Elk Ridge (municipality).

7. Location

19. Please enter your project's location.

Latitude

53.895383

Longitude

-105.991622

a) Please enter all the legal land descriptions associated with your project location:

Legal Land Description

Blk/Par EU Plan No. 102323944 Ext 0

20. Have you conducted engagement and/or consultation with the Indigenous communities surrounding your proposed project?

No, we did not conduct any engagement with the surrounding Indigenous communities.

a) If yes, please provide a summary of the feedback you received, the persons contacted etc.

8. Project Schedule

21. Has the project planning started?

Yes

a) If you selected 'Yes', what is the estimated amount of sole source contract?

a) If yes, what percentage of the project <u>design</u> has been completed?

Up to 25%
i.e. Conceptual Design In-Progress or Complete

22. Has project construction started?

No

a) If yes, please describe the construction work that has occurred to date.

23. What is the forecasted construction start date?

09/01/2023

24. What is the forecasted construction end date?

06/30/2024

9. Procurement

25. Will a sole source procurement be used?

No

1. If you answered yes in response to question 25, please add the details of the sole source contract:

a) Estimated amount of the sole source contract

b) Are the contract details known?

c) Indicate the nature of the work:

d) If you selected other, please provide details on the nature of work:

e) What is the justification for sole source contracting?

10. Outcomes and Indicators

26. What category does your project fall under

Drinking Water

Federal Outcome – Project must meet the federal outcome associated with the program to be eligible.

Specifically explain how the project will meet this federal outcome including how it will increase structural capacity to adapt to climate change impacts, natural disasters and extreme weather events.

Specifically explain how the project will meet this federal outcome including how it will increase natural capacity to adapt to climate change impacts, natural disasters and extreme weather events.

Federal Outcome – Project must meet the federal outcome associated with the program to be eligible.

27. Federal Outcome – Project must meet the federal outcome associated with the program to be eligible.

Increased access to potable water (drinking water)

Specifically, explain how the project will meet this federal outcome including how it will increase the capacity to treat and manage wastewater and/or stormwater.

28. Specifically, explain how the project will meet this federal outcome including how it will increase access to potable water.

The existing treatment utilized by the Utility is provided by a small detention tank and two manganese greensand pressure filters. The filters are currently operated above recommended flow rates in order to meet demand of the growing community. The process is unable to achieve provincial and federal drinking water quality standards, particularly regarding manganese removal. The process also has no ability to remove elevated ammonia concentrations from the raw water, which interferes with treatment and disinfection effectiveness. Biofiltration is an improved treatment technology capable of producing drinking water meeting provincial and federal standards, as well as achieving ammonia removal. The replacement process would be designed with capacity to serve current and future population growth of the community.

The existing raw water well pumps will also be replaced to increase supply capacity to match treatment rates. Due to high sediment production, the Utility's backup well is currently unusable, limiting operational flexibility. A pre-filter unit is proposed to address this issue and prevent the sediment from interfering with the treatment process. This will restore use of the backup well, providing the necessary redundancy for the supply system.

29. Will the project result in drinking water that will meet or exceed the relevant provincial or territorial standards following project completion?

Yes

Please select all that apply to your project.

30. Please select all that apply to your project.

Ground water wells
Treatment process, filters, pumps, chemical injection systems, back up power source, monitoring equipment

Currently, is there an environmental risk related to wastewater quality issue in this system, such as potential downstream environmental health or failure to meet effluent quality standards?

If No, what is the objective of the project?

If Yes, please describe.

31. Has the provincial and/or a federal regulator given a notice that the facility must be upgraded?

No

If Yes, please describe.

If Yes, what is the issued deadline(s) to comply with the federal/provincial regulations?

Please explain how the project will achieve compliance with federal/provincial regulations?

Does the proposed project (E.g., wastewater treatment upgrade) discharge into fish-bearing water?

If No, please describe the method for effluent discharge. (i.e. irrigation, surface water discharge)

If Yes, has a downstream use and impact study (DUIS) been conducted?

Has the DUIS study been reviewed and approved by the regulator?

If Yes, please attach the DUIS.

If No, what is the status of the DUIS?

If applicable to your project, please list effluent limits that the project will meet based on the recent *Wastewater Systems Effluent Regulations (WSER)* and *The Waterworks and Sewage Works Regulations.*

32. Describe how the project incorporates sustainable environmental practices?

The existing greensand filtration process requires high chemical dosage to combat ammonia interference and oxidize dissolved iron and manganese. The filters are backwashed frequently in effort to improve treatment and backwashing is longer in duration due to lack of air scour. Issues with entrained sediment in the source water also increase backwash requirements. Poor treatment of iron and manganese causes damage to household appliances, dishes, and laundry promoting waste. As a result, many users implement water softeners and point-of-use membrane filters, which are known to be inefficient and generate high wastewater volumes.

Biological treatment does not require oxidization to remove iron and manganese and is capable of removing ammonia, reducing overall chemical use significantly. This system also requires reduced backwash volumes, saving water and reducing energy consumption through backwash pump usage. Further, vastly improved removal rates of iron, and manganese will extend the lifespan of household appliances and fixtures, reducing waste. Improved treatment would negate the need for household treatment units, which are significantly less efficient than large scale systems in terms of wastewater generation. Installation of a pre-filter unit ahead of the treatment process will address the entrained sediment issues, reducing backwash requirements further and regaining use of our existing backup well. Restoring the existing infrastructure circumvents the need for construction of a new source well altogether.

33. Will this project result in expanded water or wastewater services to households, industries, commercial establishments, and institutions?

No

If Yes, how many?

	Current Number	Future Anticipated Number
Households		
Small and Medium Businesses		
Industries		
Institutions		

34. Please state the current/future growth, design flow upon which the infrastructure is based.

Current population and year (e.g., 480 people, year: 2020) : 300 (2022)
Future design population and year (e.g., 630 people, year: 2051) : 480 (2042)
Growth Rate (e.g., 3%) : 2.4%
Current flow capacity (e.g., 240 m3) : 3.8 L/s
Future design flow capacity (e.g., 315 m3) : 6.1 L/s

35. Are there any capacity issues in the system to meet current and/or future needs?

Yes

36. If Yes, please explain how the project will address this capacity issue to meet current and/or future needs.

The existing greensand filters must be operated above recommended flow rates in attempt to meet demand from the growing community. This compounds the poor treatment capability of the filters. Even when operations are reduced to recommended rates, the process has difficulty in achieving provincial and federal drinking water quality standards, particularly regarding manganese removal. The new treatment system will be designed with sufficient capacity to serve the 20-year population projection. Installation of new well pumps will increase supply capacity to match the required treatment increase. Installation of the pre-filter to address the entrained sediment issue will restore use of our backup well to provide required redundancy.

If No, please describe the capacity of the system to show it can meet the needs of the community.

37. What is the life expectancy of the proposed system or component?

20

38. Does the community require a parallel growth agreement from the Water Security Agency (WSA)?

Not applicable

If Yes, please upload supporting documentation from the WSA and/or describe the status of the agreement in the comments box.

Comments:

If No, please explain why.

39. Does the project involve any new technology?

No

If Yes, please describe the new technology implemented in the project.

If Yes, has it been approved by a provincial regulator?

40. Have you considered other options or alternative approaches/technology that would result in similar project outcomes?

Yes

41. If Yes, please explain what other options were considered and the reason for going forward with the chosen option.

Several conventional treatment processes were considered, including continued use of manganese greensand filtration (with increased capacity). The existing manganese greensand process has proven ineffective at removing manganese for many years, largely due to ammonia interference and insufficient detention time / water characteristics for oxidization reaction. Biological filtration technology is capable of removing iron and manganese in the dissolved state and is also capable of ammonia removal. Therefore, these processes are ideal for addressing the primary concerns present in the raw water. Final treatment selection will be determined through pilot testing.

If No, please explain why other options or alternative approaches/technology were not considered.

42. Does the project implement any water or energy conservation measures?

Yes

43. If Yes, please explain

The existing greensand filtration process requires frequent and sustained backwashing, resulting in high wastewater generation and pump use. Due to poor treatment, distributed water is high in manganese and minerals, prompting users to implement point-of-use treatment, such as water softeners and household membrane filters. Point-of-use filters are known to be much less efficient than large scale systems in terms of wastewater generation. Implementation of the new treatment system would realize reduced backwash requirements and improved treatment quality, eliminating need for point-of-use treatment. Installation of a pre-filter unit to address entrained sand in the source water will lower backwash requirements further by preventing this material from interfering with the treatment process. Variable frequency or soft-start technology will be included with well pump upgrades to reduce power consumption.

If No, please explain why water or energy conservation measures were not considered.

44. Have you applied for permits related to the project?

No

If Yes, please list all the permits required and state the status of each permit

45. If No, please list the permits that will be required and state the estimated time frame in which you would be applying for the permit(s).*

Permit to construct - Water Security Agency
This permit will be applied for upon completion of design drawings to ensure compliance with provincial standards for municipal infrastructure.

46. Will the project result in a change to the system's operator classification?

No

If Yes, please describe the current system's operator classification requirement and explain how the new classification requirement will be met.

Indicators

	Qty/Length	Physical Condition before Investment	Physical Condition after Investment	Nature of Project Work				Nature of Project Work (%)
				New	Expansion	Rehab	Upgrade	
Treatment plant								
Lagoon systems								
Wastewater pump stations								
Wastewater lift station								
Wastewater storage tank								
Linear wastewater assets (in meters)								

51. Compliance with federal effluent regulations.

Will the project achieve compliance with federal effluent regulations?

What is the risk level of the facility in relation to federal effluent regulations?

Indicators

	Qty/Length	Physical Condition before Investment	Physical Condition after Investment	Nature of Project Work				Nature of Project Work (%)
				New	Expansion	Rehab	Upgrade	
Drainage pump stations								
Management facilities: ponds and water wetlands								
Management facilities: all other permitted end-of-pipe facilities								
Linear stormwater features (in meters)								

Stormwater assets

	Before investment	After Investment
Volume of materials diverted (in liters)		
Capacity to dispose of materials (in liters)		

47. Is there an exceedance in maximum allowable concentration (MAC) or Aesthetic Objective (AO) as outlined in Saskatchewan's Drinking Water Quality standards and objectives?

Yes

48. If Yes, please describe.

Treated water has exceeded the AO for manganese, alkalinity, and total dissolved solids in past laboratory testing. Daily testing conducted by the operators indicates that the process frequently exceeds the AO and occasionally the MAC for manganese, particularly during peak demand periods. It is anticipated that the AO for manganese will be reduced to 0.02 mg/L in near future, following suit with federal standards.

If No, what is the objective of the project?

49. Has the community been put on Boil/Precautionary Drinking Water Advisory (PDWA) lasting more than 12 months?

No

If Yes, please describe the reason behind the PDWA.

If Yes, how will the project resolve the issue which resulted in the PDWA?

50. If No, explain the nature, dates, and duration of any shorter-term drinking water advisories that have recently affected the community and how the project will resolve the issue?

There have been no recent boil water advisories.

51. Please list the water quality data before and after the treatment process (raw and treated), if applicable.

Parameter - Raw value (Treated value) (all units mg/L)

Ammonia - 0.71 (0.75)
Arsenic - 0.027 (0.0025)
Alkalinity - 538 (501)
Iron - 1.88 (0.02-0.1 typical in plant, 0.12 laboratory)
Manganese - 0.13 (0.02-0.08 typical +0.2 occasional in plant, 0.05 laboratory)
Total dissolved solids - 538 (530)
Hardness - 446 (450)

52. Does this project increase wastewater generation (especially for membrane treatment systems)?

No

If Yes, will the community wastewater system have the capacity for potable water system upgrades?

If Yes, briefly describe the wastewater infrastructure to show it has the capacity to meet the needs of the upgrades.

53. Does the proposed project discharge into fish-bearing water?

No

54. If No, please explain where the effluent will be discharged.

Any waste generated at the water treatment plant is discharged to the sanitary sewer system and ultimately to the lagoon. Net wastewater generation is not anticipated to increase due to implementation of the new treatment process.

If Yes, has a Downstream Use and Impact Study (DUIS) been conducted?

If Yes, please attach the DUIS.

If No, what is the status of the DUIS?

55. Please attach a feasibility study completed by a Professional Engineer licensed to practice in Saskatchewan:

36401ElkRidge.rpt22.pdf

56. Provincial or territorial drinking water standards will be met or exceeded.

Yes

57. Indicators

	Quantity/Length	Physical Condition before Investment	Physical Condition after Investment	Nature of Project Work				Nature of Project Work (%)
				New	Expansion	Rehabilitation	Upgrade	
Water treatment facilities	1	Very Poor	Very Good				X	100
Reservoir								
Pump stations								
Local water pipes (in meters)								
Transmission pipes (in meters)								

What category does your project fall under?

Please indicate how the proposed project will meet provincial/federal regulations. Attach documentation if applicable(e.g., engineering reports).

Attach documents.

Please provide information that demonstrates that major social, physical, or economic risks exist and have been considered. Please attach available study reports for this project.

Attach study reports

Have any risk assessments and/or mitigation plans been developed in support of your project?

If Yes, please describe the findings of the risk assessments and/or mitigation plans.

If No, please describe why not.

Has public consultation been held regarding the project?

Please state the outcome of the public consultation.

Please explain why no public consultation was held.

84. Describe the project assets that will improve structural capacityto adapt to climate change impacts, natural disasters and extreme weather events.

Description of the Asset

Quantity

Physical condition of the asset - Before Investment

Physical condition of the asset - At project conclusion

Adaptation Purpose (select all that apply)

Description of the Asset

Quantity

Physical condition of the asset - Before Investment

Physical condition of the asset - At project conclusion

Adaptation Purpose (select all that apply)

Description of the Asset

Quantity

Physical condition of the asset - Before Investment

Physical condition of the asset - At project conclusion

Adaptation Purpose (select all that apply)

85. Describe the project assets that will improve natural capacityto adapt to climate change impacts, natural disasters and extreme weather events.

Type of Asset

Quantity

Physical condition of the asset - Before investment

Physical condition of the asset - At project conclusion

Adaptation Purpose (select all that apply)

58. Is the proposed project part of your asset management plan?

No

If Yes, please upload a copy of your asset management plan.

11. Project Risks and Mitigation Strategies

59. Select all applicable project risks below and indicate what measures will be taken to mitigate the selected risks.

Project Complexity

No risk identified

Project Readiness

No risk identified

Public Sensitivity

No risk identified

Ultimate Recipient Risk

No risk identified

12. Environmental Assessment and Consultations and Climate Lens

60. Please confirm you have completed the Federal Aboriginal Consultation and Environmental Assessment smart form.

I confirm that I have completed the form.

Please confirm you have completed the mandatory Climate Lens required for the Green Infrastructure-Adaptation, Resilience and Disaster Mitigation sub-stream.

13. Upload of Mandatory Documents

Please upload the Climate Lens

Please upload the document supporting land ownership/control (e.g., certificate of title, long-term lease, etc.)

Land_Title.pdf

Please upload the council resolution

Village_&_Board_Resolution.pdf

Please upload the completed detailed cost estimate using the template provided.

ICIP-Detailed-Cost-Estimate-Template.xlsx

Please upload the site plan/map (including the .kml file).

ERU_WTP_kml_file.docx

Please upload the completed Federal Aboriginal Consultation and Environmental Assessment smart form (ACEA).

Aboriginal-Consultation-and-EA-Smart-Form_V8.7.pdf

Please upload any engineering reports you have completed or additional documents in support of your project.

36401ElkRidge.rpt22.pdf

Please upload any permits, licenses or approvals you have obtained to complete your project.

Please upload documentation in support of your regional project.

14. Attestation/Authorization

Attestation/Declaration:

I attest that I have reviewed the information in this application, and, to the best of my knowledge:

the information provided in this project application is complete and accurate; and
if approved, federal and provincial funding will support only eligible expenditures.

I understand that if approved, the project:

will be required to meet the requirements of the Investing in Canada Infrastructure Program (ICIP); and
will be governed under the terms of an ICIP Ultimate Recipient Agreement.

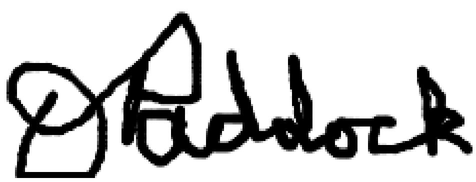
I further authorize:

the Ministry of Government Relations to request information about the Applicant or the Applicant's project from any federal or provincial government department or agency, or from any third party including, but not limited to, Saskatchewan Water Security Agency, Saskatchewan Municipal Board, Saskatchewan Ministry of Environment, Saskatchewan Ministry of Parks, Culture and Sport, SaskBuilds and SaskWater and to disclose any information contained in this application or provided in relation to the Applicant, to any such department, agency or third party for the purposes of processing this application or administering the Investing in Canada Infrastructure Program;
any department, agency or third party mentioned above, who is requested to verify or provide information, to disclose that information to the Ministry of Government Relations; and
the Ministry of Government Relations to disclose information in relation to the Applicant or the Applicant's project to any department, agency or third party for the purpose of making application to a complimentary grant program (the applicant will be notified by the Ministry of Government Relations in the event this occurs).

Title/Position

President

Signature



Signature of: Dennis K. Paddock

Date

11/28/2022

SASKATCHEWAN - RESORT VILLAGE OF ELK RIDGE

ULTIMATE RECIPIENT AGREEMENT FOR THE

INVESTING IN CANADA INFRASTRUCTURE PROGRAM

This Agreement is made as of the date of last signature

BETWEEN:

HIS MAJESTY THE KING IN RIGHT OF SASKATCHEWAN, as represented by the Minister of Government Relations ("Saskatchewan") and

RESORT VILLAGE OF ELK RIDGE, in the Province of Saskatchewan (hereinafter referred to as the "Ultimate Recipient").

individually referred to as a "Party" and collectively referred to as the "Parties".

AUTHORIZATION

WHEREAS the Government of Canada and the Government of Saskatchewan entered into the Canada - Saskatchewan IBA Investing in Canada Infrastructure Program (ICIP) signed the 17th day of October, 2018 (the "IBA");

WHEREAS Saskatchewan is administering the Integrated Bilateral Agreement (IBA) with respect to the contributions made by Canada and Saskatchewan under the ICIP;

WHEREAS the Minister is authorized to enter into an Agreement to provide financial assistance to the Ultimate Recipient for this purpose under the authority granted by section 18 of *The Executive Government Administration Act,* and *The Crown Corporations Act* and O.C. 550/2012, amended by O.C. 539/2018;

WHEREAS the Ultimate Recipient has submitted a proposal under the IBA to Saskatchewan and this Project has been approved for funding by Saskatchewan and Canada.

NOW THEREFORE, the Parties agree as follows:

1. INTERPRETATION

1.1 DEFINITIONS

"Agreement" means this Ultimate Recipient Agreement and all schedules, as may be amended from time to time, between Saskatchewan and the Ultimate Recipient whereby a financial contribution is made to an approved project.

"Agreement End Date" means the date this Agreement will terminate as set out in Schedule A.

"Asset" means any real or personal property, or immovable or movable asset, acquired, purchased, constructed, rehabilitated or improved, in whole or in part, with contribution funding provided under the terms and conditions of this Agreement.

"Asset Disposal Period" means the period ending five (5) years after the Project Completion Date.

"Canada" means the federal Minister or their delegate.

"Communications Activity" or "Communications Activities" means, but is not limited to, public or media events or ceremonies including key milestone events, news releases, reports, web and social media products or postings, blogs, news conferences, public notices, physical and digital signs, publications, success stories and vignettes, photos, videos, multi-media content, advertising campaigns, awareness campaigns, editorials, multi-media products and all related communication materials under this Agreement.

"Contract" means an Agreement between the Ultimate Recipient and a Third Party whereby the latter agrees to supply a product or service to a Project in return for financial consideration.

"Contribution" means the financial contribution that Canada and Saskatchewan will pay to the Ultimate Recipient under the terms of this Agreement as detailed in Schedule A, Section A.5.

"Effective Date" means the date of last signature of this Agreement.

"Eligible Expenditures" mean those costs Incurred and eligible for payment by Saskatchewan as set out in Schedule B.

"Final Claim Date" means the date as shown on Schedule A which is the date by which the final claim for the Project must be submitted to Saskatchewan for review.

"Fiscal Year" means the period beginning on April 1st of a calendar year and ending on March 31st of the following calendar year.

"Incurred" means an event or transaction has taken place for which an obligation to pay exists, even if an invoice has not been received.

"Ineligible Expenditures" means those expenditures incurred that are ineligible for reimbursement by Saskatchewan as set out in Schedule B.

"Infrastructure" means publicly or privately-owned capital assets in Saskatchewan for public use or benefit**.**

"Integrated Bilateral Agreement" ("IBA") means the Canada-Saskatchewan IBA for the ICIP and all its schedules, as may be amended from time to time.

"ICIP" means the Investing in Canada Infrastructure Program, under which this Ultimate Recipient Agreement is authorized.

"Joint Communications" means events, news releases, and signage that relate to this Agreement and are collaboratively developed and approved by Canada, Saskatchewan and the Ultimate Recipient and are not operational in nature.

"Oversight Committee" means the federal and provincial officials appointed as per the IBA.

"Project(s)" means one or more projects submitted by Saskatchewan and approved by Canada pursuant to section 9 (Project Submission, Approval and Changes) of the IBA and governed under this Agreement.

"Project Approval Date" means the date as set out in Schedule A on which the Project was authorized for funding under the IBA.

"Project Substantial Completion" means when a Project can be used for the purpose for which it was intended as declared in Schedule A.

"Project Completion Date" as listed on Schedule A means the date after which Eligible Expenditures can no longer be incurred.

"Substantial Completion" or "Substantially Completed" means, when referring to a Project, that the Project can be used for the purpose for which it was intended.

"Third Party" means any Person or legal entity, other than a Party or Ultimate Recipient, who provides goods and/or services under Contract and/or participates in the implementation of a Project by means of a Contract.

“Total Eligible Expenditures” means all Eligible Expenditures for the Project, as defined in Schedule B, Subsection B.1.

“Total Financial Assistance” means total Project funding from all sources including, but not limited to, funding from federal, provincial, territorial, municipal, regional, not-for-profit institution, debt financing, band council, and Indigenous government sources; private sources; and in-kind contributions.

1.2 ENTIRE AGREEMENT

This Agreement comprises the entire Agreement between the Parties in relation to the subject of the Agreement. No prior document, negotiation, provision, undertaking or agreement has legal effect, unless incorporated by reference into this Agreement. No representation or warranty express, implied or otherwise, is made by Saskatchewan to the Ultimate Recipient except as expressly set out in this Agreement.

In the case of a conflict between the IBA and this Agreement, the IBA shall take precedence.

1.3 TERM OF AGREEMENT

This Agreement will be effective as of the date of last signature of this Agreement and will terminate on the date as per Schedule A, subject to early termination in accordance with this Agreement.

1.4 SCHEDULE

The following schedules are attached to and form part of this Agreement:

Schedule A – Project Details
Schedule B – Program Details – Eligible and Ineligible Expenditures
Schedule C – Communications Protocol
Schedule D – Declaration of Completion

1.5 THE CONTRIBUTION

a) The Ultimate Recipient is eligible to receive a financial contribution upon incurring Eligible Expenditures for the Project as detailed in Schedule A and Schedule B.

b) For the purposes of Subsection a), Saskatchewan will make a Contribution to reimburse the Ultimate Recipient for Eligible Expenditures of the approved Project as per Section A.5 of Schedule A.

2. COMMITMENTS BY THE ULTIMATE RECIPIENT

2.1 GENERAL

a) The Ultimate Recipient will be responsible for the complete, diligent, and timely implementation of this Agreement, within the funding limits and deadlines specified in this Agreement and in accordance with the terms and conditions of this Agreement.

b) The Ultimate Recipient acknowledges that Saskatchewan will not be financially responsible for any ineligible expenditures or cost and schedule overruns for a Project.

c) The Ultimate Recipient will be responsible for any costs associated with a withdrawn or cancelled Project, and will repay to Saskatchewan any and all disallowed costs, surpluses, unexpended contributions, and overpayments made under and according to the terms and conditions of this Agreement.

d) The Ultimate Recipient will inform Saskatchewan immediately of any fact or event, of which the Ultimate Recipient is aware, that will compromise wholly, or in part, the completion of a Project.

e) The Ultimate Recipient shall comply with reporting requirements as outlined in this Agreement and any reporting requested by Saskatchewan (e.g., progress reports).

f) The Ultimate Recipient and any Third Party shall comply with all applicable legislation including without limiting the foregoing, all necessary licenses, permits, and approvals required for the Project by applicable legislation, regulations and by-laws.

g) The Ultimate Recipient will promptly inform Saskatchewan of any cancelled or withdrawn Projects.

h) For Projects which include the construction of buildings, the Ultimate Recipient must meet or exceed the highest energy efficiency and accessibility standards for buildings in Saskatchewan by complying with the minimum requirements in the National Energy Code of Canada, 2017 and the National Building Code of Canada, 2015, as amended from time to time. The Ultimate Recipient will provide Saskatchewan with copies of the building permit, the final inspection certificate or occupancy permit issued by a building official licensed in the classification appropriate for the Project.

3. CHANGES TO AN AGREEMENT

a) A written request for any changes to the agreement will be reviewed by Saskatchewan and may be approved or rejected. Approved changes will not be effective until the Parties execute an amendment to this Agreement.

b) The Project Completion Date and Final Claim Date may be altered by notice in writing by Saskatchewan.

c) The Ultimate Recipient agrees that any material changes to a Project will require Canada and Saskatchewan's written approval. Material changes to a Project includes the following:
   i. Any change to its location, scope or timing as laid out in Schedule A;
   ii. When applicable, any change that would trigger a further environmental assessment or duty to consult;
   iii. A decrease in the estimate for Total Eligible Expenditures to the extent that estimated Total Eligible Expenditures would be less than the total approved Eligible Expenditures;
   iv. Any changes that result in not achieving the targets laid out in the subsection A.7 of this agreement.

4. DEBT DUE TO SASKATCHEWAN

a) Any amount owed to Saskatchewan under this Agreement will constitute a debt due to Saskatchewan, which the Ultimate Recipient will reimburse forthwith, on demand, to Saskatchewan.

b) Without limiting the foregoing, the following shall be considered a debt due to Saskatchewan:
   i. Any portion of the Contribution paid to the Ultimate Recipient under this Agreement not used for Eligible Expenditures for approved Projects;
   ii. Any funds paid to the Ultimate Recipient under this Agreement that exceed the Contribution specified; and
   iii. Any funds paid to the Ultimate Recipient under this Agreement that exceeds the maximum Total Eligible Expenditures described in this Agreement.

c) In addition to any other right or remedy at law, Saskatchewan shall have the right of setoff to recover any overpayments made to the Ultimate Recipient on debts due to Saskatchewan under this Agreement.

5. ENVIRONMENTAL ASSESSMENT

No site preparation, vegetation removal or construction will occur for a Project and Canada and Saskatchewan's funding for a Project is conditional upon Canada and Saskatchewan being satisfied that the federal and provincial requirements under the *Impact Assessment Act, 2019* (IAA, 2019) and *The Environmental Assessment Act* and other applicable federal or provincial environmental assessment legislation that is or may come into force during the term of this Agreement are met and continue to be met.

6. ABORIGINAL CONSULTATION

a) No construction will occur for a Project and Canada and Saskatchewan's funding for a Project is conditional upon Canada and Saskatchewan's obligations, if any, to consult Aboriginal Peoples with respect to adverse impacts of the Project on Aboriginal groups, including, where appropriate, the accommodation of Aboriginal concerns, being met and continuing to be met.

b) Where Canada and Saskatchewan may have an obligation to consult, at Canada's and Saskatchewan's request, the Ultimate Recipient will provide to Canada and Saskatchewan, a summary of consultation that has occurred with Aboriginal groups, including the Aboriginal group's position, concerns and indication of how the concerns were addressed.

c) Where Canada and Saskatchewan have an obligation to consult, at Canada and Saskatchewan's request, the Ultimate Recipient will assist Canada and Saskatchewan to undertake the procedural aspects of consultation and implement measures to accommodate an Aboriginal group's concerns as appropriate, and these costs may be considered Eligible Expenditures as set out in Schedule B Eligible and Ineligible Expenditures.

7. AWARDING OF CONTRACTS

The Ultimate Recipient will ensure that Contracts will be awarded in a way that is fair, transparent, competitive and consistent with value-for-money principles, or in a manner otherwise acceptable to Saskatchewan, and if applicable, in accordance with international and domestic trade agreements. These trade agreements, include, but are not limited to: *the Canadian Free Trade Agreement, the New West Partnership Trade Agreement*, and *the Canada-European Union Comprehensive Economic and Trade Agreement*.

a) lf Saskatchewan determines that the Ultimate Recipient has awarded a Contract in a manner that is not in compliance with the foregoing, upon notification to the Ultimate Recipient, Saskatchewan may consider the expenditures associated with the Contract to be ineligible.

b) The Ultimate Recipient agrees that all Contracts will be awarded and managed in accordance with Saskatchewan's relevant policies and procedures.

c) All Contracts of the Ultimate Recipient made under the provisions of this Agreement shall be consistent with this Agreement.

8. REPORTING

8.1 PROGRESS REPORT

a) The Ultimate Recipient will submit progress reports to Saskatchewan at a timing and frequency determined by Saskatchewan but no less than twice a year. The first progress report under this Agreement must cover the period from the Project Approval Date.

b) Each Project progress report will include an attestation in a format acceptable to Saskatchewan, from a delegated official, that the information in the report is accurate.

c) The Project progress report will include the following updated information for each Project:
   - i. Canada's contribution funding to the Project by Fiscal Year;
   - ii. Construction start and end dates (forecasted/actual);
   - iii. Progress tracker (e.g., percent completed);
   - iv. Risks and mitigation strategies, as required;
   - v. Confirmation that the Project is on-track to achieve expected results, or if Substantially Completed, confirmation of actual results; and
   - vi. Confirmation of installed Project signage, if applicable.

d) The Ultimate Recipient will report annually, at a timing and frequency determined by Saskatchewan, through the Project progress report on expected and actual results related to community employment benefits for applicable Projects.

e) The Ultimate Recipient will complete all reporting requirements as defined under paragraphs a), b) and c) in this section for all Projects to the satisfaction of both Parties no later than the Agreement End Date as set out in Schedule A.4.

f) The Ultimate Recipient agrees and will ensure that Canada and Saskatchewan may use the information submitted by the Ultimate Recipient under this section to publicly report on Program results.

8.2 FINAL REPORT

The Ultimate Recipient will submit a final report to Saskatchewan in the form determined by Saskatchewan for approval no later than the Final Claim Date. The final report will include at least:

a) All information required under Section 8.1 Progress Report, covering the period from the last progress report to the Final Claim Date as outlined in Schedule A; and

b) A cumulative summary of the Project, which will include the following information:
   i. The Project's completed outcome and output results compared to the baseline established prior to the start of the Project as agreed to by all Parties;
   ii. Total expenditures for the Project;
   iii. Total Eligible Expenditures for the Project; and
   iv. Confirmation of the Total Financial Assistance received.

9. CLAIMS AND PAYMENTS

9.1 CLAIMS AND PAYMENTS

a) Saskatchewan shall make a payment to the Ultimate Recipient, for the purposes described in Schedule B, (Project and Program Details – Eligible and Ineligible Expenditures) upon receipt of a claim for Eligible Expenditures. The information to be provided on the claim is outlined below:
   i. A listing of invoices paid by the Ultimate Recipient for which the Ultimate Recipient has received goods and services for Eligible Expenditures.
   ii. The claim shall be made on the form and in the manner specified by Saskatchewan and may be submitted as frequently as once per month, or at least semi-annually, at a timing and frequency determined by Saskatchewan.
   iii. Final payment will be made upon the completion of the Project to the satisfaction of Saskatchewan and submission of a final claim which includes copies of the outstanding invoices for Eligible Expenditures actually incurred and paid, a Declaration of Completion form (Schedule D), a final report, as described in 8.2, copies of all required permits and any other applicable reporting in a form specified and if deemed necessary, by Saskatchewan. The Final Claim Date is listed in Schedule A; and
   iv. Saskatchewan may withhold interim or final payments of the Contribution for the Project pending satisfactory completion of a claim audit or where in the opinion of the Minister, the Ultimate Recipient has failed to comply with the provisions of this Agreement.

b) Completed Projects may be subject to a full audit of the Project, records and expenditures.

c) The Parties acknowledge that Saskatchewan's role is limited to providing funding to the Project and that Saskatchewan will have no involvement in the implementation of that Project or its operation. Saskatchewan is neither a decision-maker nor an administrator to the Project.

d) The Ultimate Recipient may receive additional funding from other provincial grant programs for any Project approved pursuant to this Agreement, provided that the Ultimate Recipient informs Saskatchewan promptly of any additional provincial financial assistance received in respect of the Eligible Expenditures of a Project, not to exceed total Project costs.

9.2 PAYMENT CONDITIONS

Saskatchewan will not:

a) Pay interest for failing to make a Contribution under this Agreement;

b) Pay capital costs for a Project until the requirements under Section 5 Environmental Assessment and Section 6 Aboriginal Consultation, if applicable, are, in Saskatchewan's opinion, satisfied to the extent possible at the date the claim is submitted to Saskatchewan;

c) Pay any claims until requirements under any audit requirements in section 10 (Audit) and any requirements outlined in Schedule C (Communications Protocol) are met; and

d) The Parties acknowledge that no payment will be provided until:
   i. The Legislative Assembly of Saskatchewan has appropriated funds out of which the financial assistance may be paid in the fiscal year in which the payment is to be made pursuant to this Agreement; and
   ii. The Ultimate Recipient has met the eligibility criteria with respect to the financial contribution as set out above and all other significant terms and conditions of the Agreement.

9.3 RETENTION OF CONTRIBUTION

Saskatchewan will retain a maximum of five percent (5%) of its contribution funding under this Agreement. The amount retained by Saskatchewan will be released by Saskatchewan when:

a) The Ultimate Recipient fulfils all of its obligations under this Agreement;

b) The Ultimate Recipient submits an attestation, from a delegated official and in a format acceptable to Saskatchewan, that the Project has been Substantially Completed and contribution funding under this Agreement has been spent on Eligible Expenditures; and

c) The Parties jointly carry out a final reconciliation of all claims and payments in respect of this Agreement and make any required adjustments.

10. AUDIT

a) The Ultimate Recipient agrees to inform Saskatchewan of any audit that has been conducted on the use of contribution funding under the IBA, provide Saskatchewan with all relevant audit reports, and ensure that prompt and timely corrective action is taken in response to any audit findings and recommendations. The Ultimate Recipient will submit to Saskatchewan in writing as soon as possible, but no later than sixty (60) days following receiving it, a report on follow-up actions taken to address recommendations and results of the audit.

b) Saskatchewan may undertake, at any time, any other audit in relation to this Agreement. All audits conducted by Saskatchewan will be at Saskatchewan’s expense.

c) The Ultimate Recipient will ensure proper and accurate financial accounts and records are kept, including but not limited to its Contracts, invoices, statements, receipts, and vouchers in respect of all Projects for at least six (6) years after the Agreement End Date, as per Schedule A.

d) All the Project’s records and accounts are available to Canada and Saskatchewan for inspection, at all reasonable times.

e) The Ultimate Recipient shall permit any authorized representative of the Oversight Committee reasonable access to the Ultimate Recipient's premises to inspect and assess the progress of the Project as well as to examine the Ultimate Recipient's books and records relating to the Project, and to make copies thereof. The Ultimate Recipient shall provide promptly information or documentation required to clarify any of its books and records.

f) The Ultimate Recipient agrees to abide by all deliverables and timelines of Ultimate Recipient audits as set by the Oversight Committee.

11. DISPUTE RESOLUTION

a) The Parties will keep each other informed of any issue that could be contentious.

b) If a contentious issue arises, the Parties will examine it and will, in good faith, attempt to resolve the contentious issue as soon as possible, and, in any event, within thirty (30) business days from the receipt of notice of such contentious issue. Where the Parties cannot agree on a resolution, the matter will be referred to the Oversight Committee for resolution. The Oversight Committee will provide a decision within ninety (90) business days from the date of referral to the Parties.

c) Any payments related to any contentious issue raised by any of the Parties may be suspended by Saskatchewan together with the obligations related to such issue, pending resolution.

d) The Parties agree that nothing in this section will affect, alter or modify the rights of the Parties to terminate this Agreement.

12. DEFAULT

12.1 EVENTS OF DEFAULT

The following event constitutes the "Event of Default" under this Agreement:

a) The Ultimate Recipient has not complied with one or more of the terms and conditions of this Agreement and the IBA.

12.2 DECLARATION OF DEFAULT

Saskatchewan may declare default if:

a) The Event of Default occurs;

b) Saskatchewan gives notice to the Ultimate Recipient of the event, which in Saskatchewan's opinion constitutes an Event of Default; and

c) The Ultimate Recipient has failed, within thirty (30) business days of receipt of the notice, either to remedy the Event of Default or to notify and demonstrate to the satisfaction of Saskatchewan that it has taken such steps as are necessary to remedy the Event of Default.

12.3 REMEDIES ON DEFAULT

In the event that Saskatchewan declares default under Section 12.2 (Declaration of Default), Saskatchewan may exercise one or more of the following remedies, without limiting any remedy available to it by law:

a) Suspend or terminate any obligation by Saskatchewan to contribute or continue to contribute funding to the Project, including any obligation to pay an amount owing prior to the date of such suspension or termination;

b) Suspend or terminate the approval of the Project;

c) Require the Ultimate Recipient to reimburse Saskatchewan all or part of the contribution paid by Saskatchewan to the Ultimate Recipient; or

d) Terminate this Agreement.

13. LIMITATION OF LIABILITY AND INDEMNIFICATION

13.1 LIMITATION OF LIABILITY

In no event will Canada, Saskatchewan, its officers, servants, employees or agents be held liable for any damages in contract, tort (including negligence) or otherwise, for:

a) Any injury to any Person, including, but not limited to, death, economic loss or infringement of rights;

b) Any damage to or loss or destruction of property of any Person; or

c) Any obligation of any Person, including, but not limited to, any obligation arising from a loan, capital lease or other long term obligation;

d) The performance of this Agreement or the breach of any term and condition of it by the Ultimate Recipient, its officers, servants, employees and agents, or by a Third Party, and any of its officers, servants, employees or agents; or

e) Any omission or other willful or negligent act of the Ultimate Recipient, a Third Party, and their respective officers, servants, employees or agents;

In relation to this Agreement or each of the Projects.

13.2 INDEMNIFICATION

The Ultimate Recipient will at all times indemnify and save harmless Canada, Saskatchewan, their officers, servants, employees or agents, from and against all actions, claims, demands, losses, costs, damages, suits or other proceedings, whether in contract, tort (including negligence)
or otherwise, by whomsoever brought or prosecuted in any manner based upon or occasioned by:

a) Any injury to any Person, including, but not limited to, death, economic loss or any infringement of rights;

b) Any damage to or loss or destruction of property of any Person; or

c) Any obligation of any Person, including, but not limited to, any obligation arising from a loan, capital lease or other long term obligation;

In relation to this Agreement or each of the Projects, except to the extent to which such actions, claims, demands, losses, costs, damages, suits or other proceedings are caused by the negligence or breach of the Agreement by an officer, servant, employee or agent of Canada or Saskatchewan in the performance of his or her duties.

14. ASSETS

14.1 DISPOSAL OF ASSETS

a) Unless otherwise agreed to by the Parties, Saskatchewan will require that the Ultimate Recipient maintain ongoing operations and will agree to retain title to and ownership of an Asset for the Asset Disposal Period.

b) If at any time within the Asset Disposal Period, the Ultimate Recipient sells, leases, or otherwise disposes of, directly or indirectly, any Asset purchased, acquired, constructed, rehabilitated or renovated, in whole or in part, under this Agreement, other than to Canada, Saskatchewan, a municipal or regional government as outlined in paragraph ii. a) of section A.1 a) (Ultimate Recipients) of the IBA, or with Saskatchewan’s consent, the Ultimate Recipient may be required to reimburse Saskatchewan, any federal or provincial funding received for the Project.

14.2 REVENUE FROM ASSETS

The Parties acknowledge that Canada and Saskatchewan's contribution to the Ultimate Recipient's Project is meant to accrue to the public benefit. The Ultimate Recipient will notify Saskatchewan in writing within ninety (90) business days of the end of a Fiscal Year if any Asset owned by a for-profit Ultimate Recipient as defined in paragraph ii. d) of section A.1 a) (Ultimate Recipients) of the IBA, is used in such a way that in the Fiscal Year revenues are generated from it that exceed its operating expenses. Saskatchewan may require the Ultimate Recipient to immediately pay to Canada, via Saskatchewan, a portion of the excess in the same proportion as the total cost of the Asset to not exceed Canada and Saskatchewan's contribution to the Project. This obligation will only apply during the Asset Disposal Period, and when it is determined by Saskatchewan that the Project no longer meets the requirement of public benefit.

14.3 REPAYABLE CONTRIBUTIONS

At Saskatchewan's request, the Ultimate Recipient shall repay any contribution funding provided by Canada and Saskatchewan under this Agreement that is intended for an Ultimate Recipient that is a for-profit private sector body where such funding is for the purpose of that Ultimate Recipient generating profits or increasing the value of its business. Any repayment by the Ultimate Recipient will be made in accordance with terms and conditions of repayment as determined by Saskatchewan at the time Saskatchewan approves a Project.

15. GENERAL

15.1 ACCOUNTING PRINCIPLES

All accounting terms will have the meanings assigned to them, all calculations will be made and all financial data to be submitted will be prepared, in accordance with the public sector accounting standards in effect in Canada.

15.2 SURVIVAL

The Parties' rights and obligations, which by their nature, extend beyond the termination of this Agreement, will survive any termination of this Agreement.

15.3 CONFLICT OF INTEREST

No current or former public servant or public office holder to whom any post-employment, ethics and conflict of interest legislation, guidelines, codes or policies of Saskatchewan applies will derive direct benefit from this Agreement unless the provision or receipt of such benefits is in compliance with such legislation, guidelines, policies or codes. The Ultimate Recipient will promptly inform Saskatchewan should it become aware of the existence of any such situation.

15.4 NO AGENCY, PARTNERSHIP, JOINT VENTURE, ETC.

No provision of this Agreement and no action by the Parties will establish or be deemed to establish a partnership, joint venture, principal-agent relationship or employer-employee relationship in any way or for any purpose whatsoever between Saskatchewan and an Ultimate Recipient or between Saskatchewan and a Third Party.

The Ultimate Recipient will not represent itself in any agreement with a Third Party, as a partner, employee or agent of Saskatchewan.

15.5 NO AUTHORITY TO REPRESENT

Nothing in this Agreement is to be construed as authorizing any Person, including a Third Party, to contract for or to incur any obligation on behalf of Saskatchewan or to act as an agent for Saskatchewan.

15.6 COUNTERPART SIGNATURE

This Agreement may be signed in counterpart, and the signed copies will, when attached, constitute an original Agreement.

15.7 SEVERABILITY

If for any reason a provision of this Agreement that is not a fundamental term of this Agreement between the Parties is found to be or becomes invalid or unenforceable, in whole or in part, and if the Parties agree, it will be deemed to be severable and will be deleted from this Agreement, but all the other terms and conditions of this Agreement will continue to be valid and enforceable.

15.8 ASSIGNMENT

a) The Ultimate Recipient will not transfer or assign its rights or obligations under this Agreement without the prior written consent of Saskatchewan. Any attempt by the Ultimate Recipient to assign any of the rights, duties or obligations of this Agreement without Saskatchewan’s express written consent is void.

b) Saskatchewan can transfer or assign its rights or obligations under this Agreement to any other Government of Saskatchewan organization at any time without prior consent of the Ultimate Recipient.

15.9 COMPLIANCE WITH LAWS

The Ultimate Recipient will comply with and ensure that the Project complies with all statutes, regulations, and other applicable laws governing Saskatchewan, the Ultimate Recipient and the Project under this Agreement, including all requirements of, and conditions imposed by, regulatory bodies having jurisdiction over the subject matter.

15.10 AMENDMENTS

This Agreement may be amended from time to time on written Agreement of the Parties.

15.11 WAIVER

A Party may waive any of its rights under this Agreement only in writing. Any tolerance or indulgence demonstrated by the Party will not constitute a waiver.

15.12 GOVERNING LAW

This Agreement is governed by the laws applicable in the Province of Saskatchewan.

15.13 SUCCESSORS AND ASSIGNS

This Agreement is binding upon the Parties and their respective successors and assigns.

15.14 NOTICE

Any notice provided for under this Agreement may be delivered in person, sent by email facsimile or mail addressed to:

for Saskatchewan:

Executive Director
Municipal Infrastructure and Finance Branch
Ministry of Government Relations
500-1855 Victoria Avenue
REGINA SK S4P 3T2
Email: infra@gov.sk.ca

or to such other address, email, or addressed to such other person as Saskatchewan may, from time to time, designate in writing to the Ultimate Recipient; and

for Resort Village of Elk Ridge:

P.O. Box 171
WASKESIU LAKE SK S0J 2Y0
Phone: 306-940-9052
Email: infoelkridge@sasktel.net

or such other address, email, or addressed to such other person as the Ultimate Recipient may, from time to time, designate in writing to Saskatchewan.

Such notice will be deemed to have been received, if sent by mail or email, when receipt is acknowledged by the other Party; and in person, when delivered.

15.15 TERMINATION

Either party may terminate this Agreement, without cause, by giving the other party at least 30 days' notice.

16. SIGNATURES

This Agreement has been executed by the Parties by their duly authorized officers on the day and year first written below.

For Saskatchewan:	For: Resort Village of Elk Ridge
Iryna Soloduk — Digitally signed by Iryna Soloduk Date: 2024.04.04 16:33:01 -06'00'	Michele Bonneau — Digitally signed by Michele Bonneau Date: 2024.04.04 08:23:29 -06'00'
Per:	Per:
4/4/24	4/4/24
Date	Date

SCHEDULE A: GREEN STREAM - PROJECT DETAILS

Program: Investing in Canada Infrastructure Program (ICIP)

Project #: 20220101

Project: **Elk Ridge - Water Treatment Plant Upgrades** for the **Resort Village of Elk Ridge** located at the following locations:

- 53.895383, -105.99162
    - Blk/Par EU Plan No. 102323944 Ext 0

A.1 Project Approval Date:

The Project Approval Date for this ICIP Project is **November 28, 2023.**

A.2 Project Completion Date:

The Project Completion Date for this ICIP Project is **March 31, 2027.**

A.3 Final Claim Date:

The deadline for final claim submission for this ICIP Project is **June 30, 2027.**

A.4 Agreement End Date:

This Agreement will terminate on the 31st day following the day of the last payment by Saskatchewan.

A.5 Contribution by Saskatchewan:

For the purpose of this Agreement, following the Effective Date of this Agreement, Saskatchewan will make a contribution to reimburse the Ultimate Recipient for Eligible Expenditures of the approved Project incurred and paid by the Ultimate Recipient.

a) The maximum Total Eligible Expenditures approved for this Project is **$1,085,000**. As per the IBA, the total financial Contribution is not to exceed **seventy-three and thirty three hundredths per cent (73.33%)** of the Total Eligible Expenditures up to a maximum of **$795,631**.

b) Saskatchewan's Contribution will not exceed **thirty three and thirty three hundredths per cent (33.33%)** of the Total Eligible Expenditures under ICIP.

c) Canada's contribution will not exceed **forty per cent (40%)** of the Total Eligible Expenditures under ICIP.

d) Any expenditure in excess of the maximum total financial Contribution in a) is the responsibility of the Ultimate Recipient.

e) The maximum federal funding to a Project, from all federal sources, will not exceed **forty per cent (40%)** of the total Eligible Expenditures for that Project. If the federal Crown's total contribution towards a Project exceeds **forty per cent (40%)** of that Project's total Eligible Expenditures or if the Total Financial Assistance received or due in respect of the total Project costs exceeds one hundred per cent (100%) thereof, Saskatchewan may recover the excess from the Ultimate Recipient or reduce its contribution by an amount equal to the excess. The Ultimate Recipient shall inform Saskatchewan promptly of any additional federal funding approved or received in respect of Eligible Expenditures of a Project and shall provide a detailed accounting of such funding.

f) If the Total Financial Assistance received or due in respect of the total Project costs exceeds one hundred per cent (100%) thereof, Saskatchewan may recover the excess from the Ultimate Recipient or reduce its contribution by an amount equal to the excess.

A.6 Project Description:

The main objective of this project is to increase the water treatment capacity and water quality of the Elk Ridge Utility water treatment plant in order to meet provincial drinking water quality standards for current and future community population of the Resort Village of Elk Ridge. The project output includes replacement of the existing filtration equipment with treatment technology better suited for the raw water source, including modifications to the existing mechanical/electrical to suit. Raw water supply capacity will also be improved by installation of new well pumps and a pre-filter unit to address present issues with sediment in the source water.

This Project involves the following components:

- raw water supply system improvements including sediment removal;
- new filtration equipment targeting ammonia, iron, and manganese;
- filter face piping and connections to existing process piping;
- backwash pump, piping and connections;
- analytical and instrumentation equipment;
- removal of existing filters;
- repairs and modifications to water treatment plant building as required;
- electrical and mechanical works to support;
- all temporary works to maintain water supply during construction; and
- engineering and associated work.

A.7 Expected Results:

Outcome(s)	Indicators	Baseline	Target	Actual Results
Increased access to potable water	Number of assets receiving investment	0	1	

SCHEDULE B – PROGRAM DETAILS – ELIGIBLE AND INELIGIBLE EXPENDITURES

B.1 Eligible Expenditures

B.1.1 Eligible Expenditures will include the following:

a) All costs considered to be direct and necessary for the successful implementation of an eligible project, in the opinion of Canada and Saskatchewan, excluding those identified under Section B.2 (Ineligible Expenditures);

b) The capital costs of constructing or renovating a tangible asset, as defined and determined according to generally accepted accounting principles in Canada;

c) All planning (including plans and specifications), assessment and design costs specified in the Agreement such as the costs of environmental planning, surveying, engineering, architectural supervision, testing and management consulting services;

d) Costs will only be eligible as of Project approval, except for the following costs which are eligible if incurred before a Project is approved by Canada for contribution funding under this Agreement, but can only be paid if and when that Project is approved by Canada:
   i. Costs associated with completing climate lens assessments as outlined in paragraph h) of Section 4 (Commitments by Saskatchewan) of IBA; and
   ii. Costs associated with Aboriginal consultation and engagement activities, which are retroactively eligible from February 15, 2018, for Projects approved after February 7, 2019.

e) The costs of engineering and environmental reviews, including environmental assessments and follow-up programs as defined in the *Impact Assessment Act 2019* and the costs of remedial activities, mitigation measures and follow-up identified in any environmental assessment;

f) The costs directly associated with joint federal and provincial communication activities (press releases, press conferences, translation, etc.) and with federal and provincial project signage;

g) The incremental costs of the Ultimate Recipient’s employees related to construction of the project may be included as eligible costs under the following conditions:
   i. The Ultimate Recipient is able to demonstrate that it is not economically feasible to tender a contract;
   ii. The employee or equipment is engaged directly in respect of the work that would have been the subject of the contract; and
   iii. The arrangement is approved in advance and in writing by the Province and by Canada.

B.1.2 Eligible costs are limited to the following:

a) Costs incurred between the Project Approval Date and the Project Completion Date set out in the Ultimate Recipient Agreement, except for costs associated with completing climate lens assessments and creating community employment benefit plans, which are eligible before project approval, but can only be paid if and when a project is approved by the Province and Canada and a signed Ultimate Recipient Agreement is in place.

B.2 Ineligible Expenditures

Ineligible expenditures for Projects will include the following:

a) Costs Incurred before the Project Approval Date, and any and all expenditures related to contracts signed prior to the Project Approval Date;

b) Costs Incurred before a Project is approved by Canada and any and all expenditures related to contracts signed prior to Canada's approval of a Project, except for:

    i. Costs associated with completing climate lens assessments as outlined in paragraph h) of section 4 (Commitments by Saskatchewan); and
    ii. Costs associated with Aboriginal consultation and engagement activities, which are retroactively eligible from February 15, 2018, for Projects approved after February 7, 2019.

c) Costs Incurred for cancelled Projects;

d) Costs of relocating entire communities;

e) Land acquisition;

f) Leasing land, buildings and other facilities; leasing equipment other than equipment directly related to the construction of the Project; real estate fees and related costs;

g) Any overhead costs, including salaries and other employment benefits of any employees of the Ultimate Recipient, any direct or indirect operating or administrative costs of Ultimate Recipients, and more specifically any costs related to planning, engineering, architecture, supervision, management and other activities normally carried out by the Ultimate Recipient's staff, except in accordance with Section B.1 d) (Eligible Expenditures);

h) Financing charges, legal fees, and loan interest payments, including those related to easements (e.g. surveys);

i) Any goods and services costs which are received through donations or in-kind;

j) Provincial sales tax, goods and services tax, or harmonized sales tax for which the Ultimate Recipient is eligible for a rebate, and any other costs eligible for rebates;

k) Costs associated with operating expenses and regularly scheduled maintenance work;

l) Cost related to furnishing and non-fixed assets which are not essential for the operation of the Asset/Project; and

m) All capital costs, including site preparation and construction costs, until federal environmental assessment(s) and Aboriginal consultation obligations as required, under sections 5 (Environmental Assessment) and 6 (Aboriginal Consultation) have been met and continue to be met.

SCHEDULE C - COMMUNICATIONS PROTOCOL

C.1 PURPOSE

a) This Communications Protocol outlines the roles and responsibilities of each of the Parties to this Agreement, as well as those of Canada, with respect to Communications Activities related to this Agreement and the Projects funded through it.

b) This Communications Protocol will guide the planning, development and implementation of all Communications Activities to ensure clear, consistent and coordinated communications to the Canadian public.

c) The provisions of this Communications Protocol apply to all Communications Activities related to this Agreement and any Projects funded under the IBA.

C.2 GUIDING PRINCIPLES

a) Public acknowledgement of financial assistance received from Canada and Saskatchewan is a condition of funding.

b) Communications Activities undertaken in accordance with this Communications Protocol should ensure that Canadians are informed of infrastructure investments made to help improve their quality of life and that they receive consistent information about funded Projects and their benefits.

c) The Ultimate Recipient is responsible for communicating the requirements and responsibilities outlined in this Communications Protocol and for ensuring their compliance to its third parties.

d) Saskatchewan will communicate to Ultimate Recipient any deficiencies and/or corrective actions identified by Canada or by the Oversight Committee.

C.3 GOVERNANCE

a) The Parties will designate communications contacts that will be responsible for preparing a communications plan, overseeing its implementation and reporting on its results to the Oversight Committee.

C.4 JOINT COMMUNICATIONS

a) Canada, Saskatchewan and the Ultimate Recipient will have Joint Communications about the funding of the Project(s).

b) Joint Communications related to Project(s) funded under this Agreement should not occur without the prior knowledge and agreement of all Parties, where applicable.

c) All Joint Communications material will be approved by Canada and Saskatchewan prior to release, and will recognize the funding of all Parties, including the Ultimate Recipient.

d) Each of the Parties may request Joint Communications to communicate to Canadians about the progress or completion of the Project(s). The requestor will provide at least 15 business days' notice to the other Parties. If the Communications Activity is an event, it will take place at a mutually agreed date and location.

e) The requestor of the Joint Communications will provide an equal opportunity for the other Parties or the Ultimate Recipient to participate and choose their own designated representative (in the case of an event).

f) Saskatchewan or the Ultimate Recipient will be responsible for providing onsite communications and logistics support. Any related costs are eligible for cost-sharing in accordance with the formula outlined in the funding Agreement.

g) Joint Communications products must be bilingual and include the Government of Saskatchewan logo and Canada or word mark. Canada has an obligation to communicate in English and French. Canada will provide the translation services and final approval on products.

h) The conduct of all Joint Communications will follow the *Table of Precedence for Canada*.

C.5 INDIVIDUAL COMMUNICATIONS

a) Notwithstanding Section C.4 of this Communications Protocol (Joint Communications), Canada and Saskatchewan retain the right to meet their obligations to communicate information to Canadians about the IBA and the use of funds through their own Communications Activities.

b) Canada, Saskatchewan and the Ultimate Recipient may each include general Program messaging and examples of Projects funded though the Agreement in their own Communications Activities. The authoring Party will not unreasonably restrict the use of such products or messaging by the other Parties; and if web or social-media based, from linking to it.

c) Where a website or web page is created to promote or communicate progress on a funded Project or Projects, it must recognize provincial and federal funding through the use of a digital sign or through the use of Government of Saskatchewan logo and the Canada wordmark and the following wording, “This project is funded in part by the Government of Canada.” and “This project is funded in part by the Government of Saskatchewan.” The Canada wordmark or digital sign must link to Infrastructure Canada’s website, at www.infrastructure.gc.ca. Canada will provide and publish guidelines for how this recognition is to appear and language requirements. The Saskatchewan logo or the text “Government of Saskatchewan” must link to the Government of Saskatchewan website at www.Saskatchewan.ca.

d) The Ultimate Recipient will be required to send a minimum of one photograph to each of the Parties of the construction in progress, or of the completed Project, for use in social media and other digital individual communications activities. Sending the photos will constitute permission to use and transfer of copyright. Photographs are to be sent to INFC.photos@canada.ca along with Project name and location.

C.6 OPERATIONAL COMMUNICATIONS

a) The Ultimate Recipient is solely responsible for operational communications with respect to Projects, including but not limited to: calls for tender, or construction and public safety notices. Operational communications as described above are not subject to the federal official language policy.

b) Saskatchewan does not need to be informed on operational communications. However, such products should include, where appropriate, the following statement, “This project is funded in part by the Government of Saskatchewan and the Government of Canada.” As appropriate, operational communications will also recognize the funding of Saskatchewan in a similar manner.

C.7 MEDIA RELATIONS

a) Canada, Saskatchewan and the Ultimate Recipient will share information promptly with the other Parties should significant media inquiries be received or emerging media or stakeholder issues arise to a Project or the overall fund.

C.8 SIGNAGE

a) Canada, Saskatchewan or the Ultimate Recipient may request a Project sign recognizing their funding contribution to a Project.

b) Where a physical sign is to be installed, unless otherwise agreed upon by Canada, it will be the Ultimate Recipient who will produce and install a joint physical sign that recognizes funding of each Party at each Project site in accordance with current federal signage guidelines.

c) The joint sign design, content, and installation guidelines will be provided by Canada.

d) The recognition of funding contributions of each of the Parties will be of equal prominence and visibility.

e) Digital signage may also be used in addition or in place of a physical sign in cases where a physical sign would not be appropriate due to project type, scope, location or duration.

f) Where the Ultimate Recipient decides to install a permanent plaque or other suitable marker with respect to a Project, it must recognize the federal and provincial contribution and be approved by Saskatchewan and Canada.

g) Saskatchewan and the Ultimate Recipient agree to inform Canada of sign installations through the Project progress reports referenced in Section 14 (Reporting) of the IBA.

h) Where a physical sign is being installed, signage should be installed at each Project site one (1) month prior to the start of construction, be visible for the duration of that Project, and remain in place until one (1) month after construction is completed and the infrastructure is fully operational or opened for public use.

i) Signage should be installed in a prominent and visible location that takes into consideration pedestrian and traffic safety and visibility.

C.9 COMMUNICATION BETWEEN CANADA AND ULTIMATE RECIPIENTS

a) Saskatchewan agrees to facilitate, as required, communications between Canada and the Ultimate Recipient for Communications Activities.

C.10 ADVERTISING CAMPAIGNS

Recognizing that advertising can be an effective means of communicating with the public, Canada and/or Saskatchewan and/or the Ultimate Recipient may, at their own cost, organize an advertising or public information campaign related to this Agreement or eligible Projects. However, such a campaign will respect the provisions of this Agreement. In the event of such a campaign, the sponsoring Party will inform the other Parties of its intention no less than twenty-one (21) business days prior to the campaign launch.

SCHEDULE D – DECLARATION OF COMPLETION

Applicant Name: Resort Village of Elk Ridge
Project Title: Elk Ridge - Water Treatment Plant Upgrades
Project Number: 20220101

In the matter of the Agreement concerning the Canada-Saskatchewan IBA ICIP, entered into between His Majesty the King in Right of Canada and Saskatchewan, as represented by the Minister of SaskBuilds ("Saskatchewan"), in the Province of Saskatchewan

I, ______________________(Name), of _____________________________________ (entity), in the Province of Saskatchewan, declare as follows:

1. I hold the position of ______________________ with ________________________(entity) and as such have knowledge of the matters set forth in this declaration and believe this declaration to be true.

2. a) I have received the following documents for the Elk Ridge - Water Treatment Plant Upgrades Project and have the following documents on file, if applicable:

   ☐ Certificate of Substantial Performance of subcontract as per the Saskatchewan Builder's Lien Regulation B-7.1 REG 1.
   ☐ Certificate of Substantial Performance of Contract as per the Saskatchewan Builder's Lien Regulation B-7.1 REG 1.
   ☐ Construction Completion Certificate for each output signed by engineer (e.g. wells, reservoir, water treatment process upgrades, wet well/dry well) responsible for the project.
   ☐ Letter of Good Standing and Clearances from Workers Compensation Board.
   ☐ Other – Please specify: ____.

   b) Based on the above documents and the representations made to me by the professionals identified in Section 2(a) above, I declare to the best of my knowledge and belief that this Project has met Project Substantial Completion on the _______ day of ____________ 20___.

3. All terms and conditions of the Agreement that are required to be met as of the date of this declaration have been met.

Declared at ______________________ (Location), in __________________________ (Province)

this ________ day of _________________, 20_____.

____
(Signature)

____
(Title)

Contact Number: ______________________________

Email: _______________________________________

Water Security Agency

Approval to Operate Works

File: E3/4966

Issued Pursuant to *The Water Security Agency Act* for the Operation of Ground Water Works.

Approval No. 4966 issued on April 8, 2015

ELK RIDGE UTILITY LTD. of **WASKESIU, SASKATCHEWAN**

hereinafter called the proponent, is hereby granted Approval to Operate Works in accordance with this Approval subject to the conditions and restrictions contained in *The Water Security Agency Act* and the regulations under that *Act,* each as amended or replaced from time to time.

A. Description of Ground Water Works

Well: PW7-2014: Approximately 94.35 m of 203 mm diameter PVC casing, with 7.62 m of 203 mm diameter stainless steel screens completed to a depth of 101.50 m below ground surface, and equipped with a submersible pump.

Pipeline: Approximately 15 m of 51 mm diameter HDPE pipeline connecting PW7-2014 to the water treatment plant as shown on the submitted plans.

B. Project Information

Source of Supply:	Glacial Deposits
Point of Diversion:	LSD 05-05-57-27 W2M (Blk/Par BB Plan 01PA06245 Ext 1)
Point of Delivery:	LSD 05-05-57-27 W2M (Blk/Par BB Plan 01PA06245 Ext 1)
Purpose:	Municipal (Urban Distribution)
Maximum Rate of Diversion:	4.4 litres per second (58 igpm)

This Approval does not negate the proponent's responsibility to comply with the requirements of any other relevant municipal, provincial and/or federal legislation.

This Approval issued and recorded at Moose Jaw, Saskatchewan is subject to the conditions listed on the following page(s).

WATER SECURITY AGENCY

for Water Security Agency

RG-106

6.0 Well and Aquifer Yield Analyses

From a hydrogeologic perspective, a developed aquifer system must be capable of supplying the average day raw water requirements of a user(s) on a sustained basis and the water supply well(s) should be capable of supplying the maximum day raw water requirements of a user(s) on an intermittent basis.

6.1 Estimated Average Day Aquifer Capacity

As noted in the 2012 BHL report prepared for Elk Ridge Utility, Catterall and Wright – Consulting Engineers had estimated that Elk Ridge has an average day water requirement of 125 cubic metres per day or 0.087 cubic metres per minute. Catterall and Wright also estimated that Elk Ridge has a maximum day (intermittent) raw water requirement of 200 cubic metres per day or 0.139 cubic metres per minute.

Since well PW7-2014 is a replacement/redundant well, the hydrogeologic scope of work approved for this project did not include a formal assessment of the average day (sustainable) capacity of the developed aquifer. However, based on the available hydrogeologic data, it appears that the static water level in the developed aquifer has remained relatively stable since at least 1997. A stable static water level over time indicates that an aquifer is being recharged at an average rate that equals or exceeds the total groundwater extraction volume(s) from the aquifer by all users and that the aquifer is being properly managed as a locally renewable resource.

It was previously concluded by BHL that the developed aquifer can supply Elk Ridge with their average day raw water requirement of 125 cubic metres per day on a sustainable basis. Continued collection and regular hydrogeologic analyses of water level and well(s) production data over time is required to confirm or revise this conclusion.

There are four (4) irrigation wells, two (2) of which were operational at the time of this project, installed around the pond and maintenance yard. These wells are operated by the Elk Ridge Golf Course and Conference Center and are developed in the same aquifer as the Elk Ridge Utility Wells. Historical production data from these wells was not available to BHL. Additional hydrogeologic testing and analyses is required to determine the combined effect of pumping the Elkridge utility and the Elkridge Golf water wells on the developed aquifer.

6.2 Estimated Maximum Day Well Capacity

The maximum day capacity of a water well is primarily dependant on the design characteristics of the intake screen and on the hydraulic properties of the aquifer into which the well is installed and does not necessarily represent the sustainable capacity of the developed aquifer.

PW7-2014 was designed, located and constructed to provide redundancy to existing well PW6-2011, but not to be operated simultaneously with well PW6-2011.

With well PW6-2011 shut off and assuming that the static water level in the developed aquifer remains stable and that the well efficiency is maintained through regular and effective rehabilitation work, it is estimated that well PW7-2014 is capable of a maximum day (intermittent) pumping rate 0.265 cubic metres per minute, which is the same rate as that previously recommended by BHL for well PW6-2011. The recommended individual maximum day well(s) capacities exceed the Elk Ridge Utility's estimated maximum day raw water requirement of 0.139 cubic metres per minute.

The service pump has been installed with the fluid intake at a depth of 77.87 metres below the top of the well casing (pitless adapter barrel). Assuming new well efficiency, this installation depth will accommodate the anticipated water level drawdown at a maximum day (intermittent) pumping rate of 0.265 cubic metres per minute.

It is normal for the efficiency and therefore the maximum day pumping capacity of a water well to decline with use over time as the openings in the well intake screen and/or the surrounding filter sand and aquifer sediments become partially plugged due to chemical, biological or mechanical processes. Therefore, BHL recommends that mechanical rehabilitation work be completed on municipal water wells every five (5) years, or more frequently if the specific capacity (pumping rate per unit of water level drawdown) declines by more than 25 percent of new condition. Timely and effective rehabilitation work will maintain the efficiency and maximum day pumping capacity of a water well and will also maximize the overall service life of the well.

7.0 Raw Water Quality Analyses

Water samples were collected from production well PW7-2014 near the conclusion of the pumping test. These samples were then sent to the Saskatchewan Research Council (SRC) laboratory for general chemical and chemical health and toxicity analyses.

The results from the water sample taken from well PW7-2014 are included in Appendix C, along with the water quality results from PW6-2011 and Obs PW5-2000 for comparative purposes. All three wells have also been plotted on a Piper Trilinear Graph shown on the next page.

The suitability of the water quality for municipal purposes, any addition water sampling requirements and any additional water treatment requirements should be assessed by an engineer that is qualified to provide consulting services in water treatment.

The piper trilinear graph shown below, allows a visual comparison of the overall chemical characteristics of the individual water sources. Based on the similar plotting position of the samples within the central diamond shaped portion of the graph, it was concluded by BHL that the water from all three wells is chemically the same.

CERTIFICATE OF ANALYSIS

Work Order	: **SK2300358**	Page	: 1 of 5
Client	: **Elk Ridge Utility Ltd.**	Laboratory	: Saskatoon - Environmental
Contact	: Russell Nelson	Account Manager	: Kimberley Head
Address	: Box 182 Waskesiu SK Canada S0J 2Y0	Address	: 819 58 Street East Saskatoon SK Canada S7K 6X5
Telephone	: 306 961 0637	Telephone	: +1 306 668 8370
Project	: ----	Date Samples Received	: 31-Jan-2023 09:35
PO	: ----	Date Analysis Commenced	: 31-Jan-2023
C-O-C number	: ----	Issue Date	: 06-Feb-2023 11:39
Sampler	: Terri		
Site	: ----		
Quote number	: ----		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Colby Bingham	Laboratory Supervisor	Inorganics, Saskatoon, Saskatchewan
Colby Bingham	Laboratory Supervisor	Metals, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Janiko Lindain	Laboratory Assistant	Metals, Saskatoon, Saskatchewan
Kimberly Hanson	Laboratory Analyst	Metals, Saskatoon, Saskatchewan
MaryJade Erederos	Laboratory Assistant	Administration, Saskatoon, Saskatchewan
Milad Khani	Laboratory Analyst	Inorganics, Saskatoon, Saskatchewan

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
μS/cm	microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
SFP	*Sample was filtered and preserved at the laboratory.*

Analytical Results

Sub-Matrix: Water
(Matrix: Water)

Analyte	CAS Number	Method	LOR	Unit	TREATED AT WATER PLANT	----	----	----	----
				Client sampling date / time	30-Jan-2023 13:30	----	----	----	----
					SK2300358-001	--------	--------	--------	--------
					Result	----	----	----	----
Field Tests									
Chlorine, free, field	7782-50-5	EF001	0.01	mg/L	0.13	----	----	----	----
Chlorine, total, field	7782-50-5	EF001	0.01	mg/L	1.17	----	----	----	----
Turbidity, field	----	EF001	0.01	NTU	0.14	----	----	----	----
Physical Tests									
Hardness (as CaCO3), dissolved	----	EC100	0.50	mg/L	433	----	----	----	----
Conductivity	----	E100	2.0	µS/cm	913	----	----	----	----
pH	----	E108	0.10	pH units	7.87	----	----	----	----
Alkalinity, bicarbonate (as HCO3)	71-52-3	E290	1.0	mg/L	592	----	----	----	----
Alkalinity, carbonate (as CO3)	3812-32-6	E290	1.0	mg/L	<1.0	----	----	----	----
Alkalinity, hydroxide (as OH)	14280-30-9	E290	1.0	mg/L	<1.0	----	----	----	----
Alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	485	----	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L	554	----	----	----	----
Anions and Nutrients									
Chloride	16887-00-6	E235.Cl	0.50	mg/L	17.4	----	----	----	----
Fluoride	16984-48-8	E235.F	0.020	mg/L	0.165	----	----	----	----
Nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L	0.056	----	----	----	----
Nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L	<0.020 DLDS	----	----	----	----
Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	17.8	----	----	----	----
Nitrate + Nitrite (as N)	----	EC235.N+N	0.0500	mg/L	0.0560	----	----	----	----
Ion Balance									
Anion sum	----	EC101	0.10	meq/L	10.6	----	----	----	----
Cation sum	----	EC101	0.10	meq/L	10.8	----	----	----	----
Ion balance (APHA)	----	EC101	0.01	%	0.93	----	----	----	----
Ion balance (cations/anions)	----	EC101	0.010	%	102	----	----	----	----
Total Metals									
Aluminum, total	7429-90-5	E420	0.0030	mg/L	<0.0030	----	----	----	----
Antimony, total	7440-36-0	E420	0.00010	mg/L	<0.00010	----	----	----	----
Arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00129	----	----	----	----
Barium, total	7440-39-3	E420	0.00010	mg/L	0.150	----	----	----	----

Analytical Results

Sub-Matrix: Water
(Matrix: Water)

Analyte	CAS Number	Method	LOR	Unit	TREATED AT WATER PLANT	----	----	----	----
Client sampling date / time					30-Jan-2023 13:30	----	----	----	----
					SK2300358-001	--------	--------	--------	--------
					Result	----	----	----	----
Total Metals									
Beryllium, total	7440-41-7	E420	0.000020	mg/L	<0.000020	----	----	----	----
Bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	----	----	----	----
Boron, total	7440-42-8	E420	0.010	mg/L	0.140	----	----	----	----
Cadmium, total	7440-43-9	E420	0.0000050	mg/L	<0.0000050	----	----	----	----
Calcium, total	7440-70-2	E420	0.050	mg/L	105	----	----	----	----
Cesium, total	7440-46-2	E420	0.000010	mg/L	<0.000010	----	----	----	----
Chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	----	----	----	----
Cobalt, total	7440-48-4	E420	0.00010	mg/L	0.00018	----	----	----	----
Copper, total	7440-50-8	E420	0.00050	mg/L	0.0745	----	----	----	----
Iron, total	7439-89-6	E420	0.010	mg/L	<0.010	----	----	----	----
Lead, total	7439-92-1	E420	0.000050	mg/L	0.000275	----	----	----	----
Lithium, total	7439-93-2	E420	0.0010	mg/L	0.0319	----	----	----	----
Magnesium, total	7439-95-4	E420	0.0050	mg/L	42.5	----	----	----	----
Manganese, total	7439-96-5	E420	0.00010	mg/L	0.00038	----	----	----	----
Molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.00714	----	----	----	----
Nickel, total	7440-02-0	E420	0.00050	mg/L	0.00072	----	----	----	----
Phosphorus, total	7723-14-0	E420	0.050	mg/L	<0.050	----	----	----	----
Potassium, total	7440-09-7	E420	0.050	mg/L	4.28	----	----	----	----
Rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00055	----	----	----	----
Selenium, total	7782-49-2	E420	0.000050	mg/L	<0.000050	----	----	----	----
Silicon, total	7440-21-3	E420	0.10	mg/L	10.7	----	----	----	----
Silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	----	----	----	----
Sodium, total	7440-23-5	E420	0.050	mg/L	46.4	----	----	----	----
Strontium, total	7440-24-6	E420	0.00020	mg/L	0.521	----	----	----	----
Sulfur, total	7704-34-9	E420	0.50	mg/L	6.69	----	----	----	----
Tellurium, total	13494-80-9	E420	0.00020	mg/L	<0.00020	----	----	----	----
Thallium, total	7440-28-0	E420	0.000010	mg/L	<0.000010	----	----	----	----
Thorium, total	7440-29-1	E420	0.00010	mg/L	<0.00010	----	----	----	----
Tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	----	----	----	----
Titanium, total	7440-32-6	E420	0.00030	mg/L	<0.00030	----	----	----	----

Analytical Results

Sub-Matrix: **Water**

(Matrix: **Water**)

				Client sample ID	TREATED AT WATER PLANT	----	----	----	----
				Client sampling date / time	30-Jan-2023 13:30	----	----	----	----
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*	**SK2300358-001**	--------	--------	--------	--------
					Result	----	----	----	----
Total Metals									
Tungsten, total	7440-33-7	E420	0.00010	mg/L	<0.00010	----	----	----	----
Uranium, total	7440-61-1	E420	0.000010	mg/L	0.000515	----	----	----	----
Vanadium, total	7440-62-2	E420	0.00050	mg/L	<0.00050	----	----	----	----
Zinc, total	7440-66-6	E420	0.0030	mg/L	0.115	----	----	----	----
Zirconium, total	7440-67-7	E420	0.00020	mg/L	<0.00020	----	----	----	----
Dissolved Metals									
Calcium, dissolved	7440-70-2	E421	0.050	mg/L	103	----	----	----	----
Iron, dissolved	7439-89-6	E421	0.030	mg/L	<0.030	----	----	----	----
Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	42.6	----	----	----	----
Manganese, dissolved	7439-96-5	E421	0.00500	mg/L	<0.00500	----	----	----	----
Potassium, dissolved	7440-09-7	E421	0.050	mg/L	4.16	----	----	----	----
Sodium, dissolved	7440-23-5	E421	0.050	mg/L	47.5	----	----	----	----
Dissolved metals filtration location	----	EP421	-	-	Laboratory [SFP]	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 914962

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Environmental Division
Saskatoon
Work Order Reference
SK2300358

Telephone : +1 306 668 8370

DE LABEL HERE
e only)

Report To — Contact and company name below will appear on the final report

Company:	Elk Ridge Utility LTD
Contact:	Russell Nelson
Phone:	1306 961 0637

Company address below will appear on the final report

Street:	Box 182
City/Province:	Waskesiu Lk, SK
Postal Code:	S0J 2Y0

Invoice To

Same as Report To ☑ YES ☐ NO

Copy of Invoice with Report ☑ YES ☐ NO

Company:

Contact:

Reports / Recipients

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax utility-manager@hotmail.com

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax utility_manager@hotmail.com

Email 2

Turnaround Time (T

☑ Routine [R] If received by 3pm M-F - n

☐ 4 day [P4] If received by 3pm M-F - 2(

☐ 3 day [P3] If received by 3pm M-F - 2

☐ 2 day [P2] If received by 3pm M-F - 5

☐ 1 day [E] If received by 3pm M-F - 10

☐ Same day [E2] If received by 10am M-S may apply to rush requests on weekends,

Date and Time Required for all E&

For all tests with

Project Information

ALS Account # / Quote #:	25885
Job #:	
PO / AFE:	
LSD:	STN: # SK05GG0003

ALS Lab Work Order # (ALS use only):

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: Kim Head | Sampler: Terri

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	General Chemical	Health general toxicity	FREE	TOTAL	NTU	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	TREATED AT WATER PLANT	30-01-23	1:30 pm	treated water	2	1	1	.13	1.17	.14			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☑ YES ☐ NO

Are samples for human consumption/ use? ☑ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C: 5.8

FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)

Released by: [signature] Date: Jan 30/23 Time: 2:00 pm

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by: ME3 Date: 31/1/23 Time: 9:35

FINAL SHIPMENT RECEPTION (ALS use only)

Received by: Date: Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

CERTIFICATE OF ANALYSIS

Work Order	:	**SK2301322**	Page	:	1 of 4
Client	:	**Elk Ridge Utility Ltd.**	Laboratory	:	Saskatoon - Environmental
Contact	:	Russell Nelson	Account Manager	:	Kimberley Head
Address	:	Box 182 Waskesiu SK Canada S0J 2Y0	Address	:	819 58 Street East Saskatoon SK Canada S7K 6X5
Telephone	:	306 961 0637	Telephone	:	+1 306 668 8370
Project	:	----	Date Samples Received	:	04-Apr-2023 08:55
PO	:	----	Date Analysis Commenced	:	04-Apr-2023
C-O-C number	:	----	Issue Date	:	11-Apr-2023 09:12
Sampler	:	Terri			
Site	:	----			
Quote number	:	----			
No. of samples received	:	1			
No. of samples analysed	:	1			

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Colby Bingham	Laboratory Supervisor	Inorganics, Saskatoon, Saskatchewan
Colby Bingham	Laboratory Supervisor	Metals, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Milad Khani	Laboratory Analyst	Inorganics, Saskatoon, Saskatchewan
Milad Khani	Laboratory Analyst	Metals, Saskatoon, Saskatchewan
Ruth Islas	Laboratory Assistant	Metals, Saskatoon, Saskatchewan

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
SFP	*Sample was filtered and preserved at the laboratory.*

Analytical Results

Sub-Matrix: Water
(Matrix: Water)

Analyte	CAS Number	Method	LOR	Unit	GENERAL CHEMISTRY 2011 Well	----	----	----	----
				Client sampling date / time	03-Apr-2023 12:00	----	----	----	----
					SK2301322-001	--------	--------	--------	--------
					Result	----	----	----	----
Physical Tests									
Hardness (as CaCO3), dissolved	----	EC100	0.50	mg/L	440	----	----	----	----
Conductivity	----	E100	2.0	µS/cm	869	----	----	----	----
pH	----	E108	0.10	pH units	8.03	----	----	----	----
Alkalinity, bicarbonate (as HCO3)	71-52-3	E290	1.0	mg/L	608	----	----	----	----
Alkalinity, carbonate (as CO3)	3812-32-6	E290	1.0	mg/L	<1.0	----	----	----	----
Alkalinity, hydroxide (as OH)	14280-30-9	E290	1.0	mg/L	<1.0	----	----	----	----
Alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	498	----	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L	538	----	----	----	----
Anions and Nutrients									
Chloride	16887-00-6	E235.Cl	0.50	mg/L	2.65	----	----	----	----
Fluoride	16984-48-8	E235.F	0.020	mg/L	0.179	----	----	----	----
Nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L	<0.040 DLDS	----	----	----	----
Nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L	<0.020 DLDS	----	----	----	----
Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	17.4	----	----	----	----
Nitrate + Nitrite (as N)	----	EC235.N+N	0.0500	mg/L	<0.0500	----	----	----	----
Ion Balance									
Anion sum	----	EC101	0.10	meq/L	10.4	----	----	----	----
Cation sum	----	EC101	0.10	meq/L	10.5	----	----	----	----
Ion balance (APHA)	----	EC101	0.01	%	0.48	----	----	----	----
Ion balance (cations/anions)	----	EC101	0.010	%	101	----	----	----	----
Dissolved Metals									
Calcium, dissolved	7440-70-2	E421	0.050	mg/L	105	----	----	----	----
Iron, dissolved	7439-89-6	E421	0.030	mg/L	<0.030	----	----	----	----
Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	43.3	----	----	----	----
Manganese, dissolved	7439-96-5	E421	0.00500	mg/L	0.0782	----	----	----	----
Potassium, dissolved	7440-09-7	E421	0.050	mg/L	4.42	----	----	----	----
Sodium, dissolved	7440-23-5	E421	0.050	mg/L	36.5	----	----	----	----
Dissolved metals filtration location	----	EP421	-	-	Laboratory SFP	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

ALS

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

COC Number 21 -

Page of

Canada Toll Free: 1 800 668 9878

Report To	Contact and company name below will appear on the final report
Company:	Elk Ridge Utility Ltd
Contact:	Russell Nelson
Phone:	13069610637
	Company address below will appear on the final report
Street:	Box 182
City/Province:	Waskesiu Lake, SK.
Postal Code:	S0J2Y0
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax utility_manager@hotmail.com

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax utility_manager@hotmail.com

Email 2

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm

☐ 2 day [P2] if received by 3pm

☐ 1 day [E] if received by 3pm

☐ Same day [E2] if received by

Additional fees

Date and Time Required

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Environmental Division
Saskatoon
Work Order Reference
SK2301322

Telephone : +1 306 668 8370

Project Information

Account 25885

Job #:

PO / AFE:

LSD: WSA STATION # SK: SK05GG0603; WSA PERMIT #: 00002164-05-00

Sample Notes (location, sample type, frequency, etc)

ALS Lab Work Order # (ALS use only):

ALS Contact: Kim Head | Sampler: Terri

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Reason for Bacteriological Analysis (Bacti type)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)	Number of Containers
	GENERAL CHEMISTRY 2001 well	~~Regular/Routine~~	3·04·23	12:00 NOON	RAW	1				1

Reason for Bacteriological Analysis	Bacti Type
Please choose the bacti type that best describes your bacteriological sample above	Regular/Routine Other Special Repeat

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☑ YES ☐ NO

Are samples for human consumption/ use? ☑ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

Report any Positive Bacteria Results immediately to and WSA

Daily Bacti

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C: 4.9°

FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by: [signature]	Date: April 3/23	Time: 12:15 pm	Received by: JSJ2	Date: 04/04/23	Time: 8:55	Received by: JSJ2	Date:	Time: 8:55

Gaudet's Sci Tech Services

SITE VISIT / REPORT

OWNER:	Elk Ridge Utility			REPORT NO.:	01
PROJECT:	Bench testing Greensand			SHEET:	1 of 6
COMPONENT:	Site Visit	DATE:			
LOCATION:	Water Treatment Plant, Elk Ridge	PROJ. MGR.:	Bertrand (Bert) Gaudet, A.Sc.T.		

OTHERS PRESENT: Terri Kowbel-Nesbitt – Operator
Russell Nelson - Operator

PROJECT REPORT Greensand Bench Testing

Overview

Gaudet's Sci Tech Services (GSTS) was asked to see if water quality can be improved at the water treatment plant using greensand technology as a treatment of the raw water.

Currently the addition of sodium hypochlorite (Cl), which is the chlorine addition, is above the maximum usage limit (MUL) set by the Saskatchewan Water Security Agency (WSA). Also the volume of water treated is just meeting demand.

GSTS used a bench scale greensand column to determine the possibilities.

The current process uses pre-chlorination to breakpoint using a contact tank. This water then enters into 2 greensand filters. Post chlorination is used to adjust for primary disinfection.

Testing

Breakpoint Determination

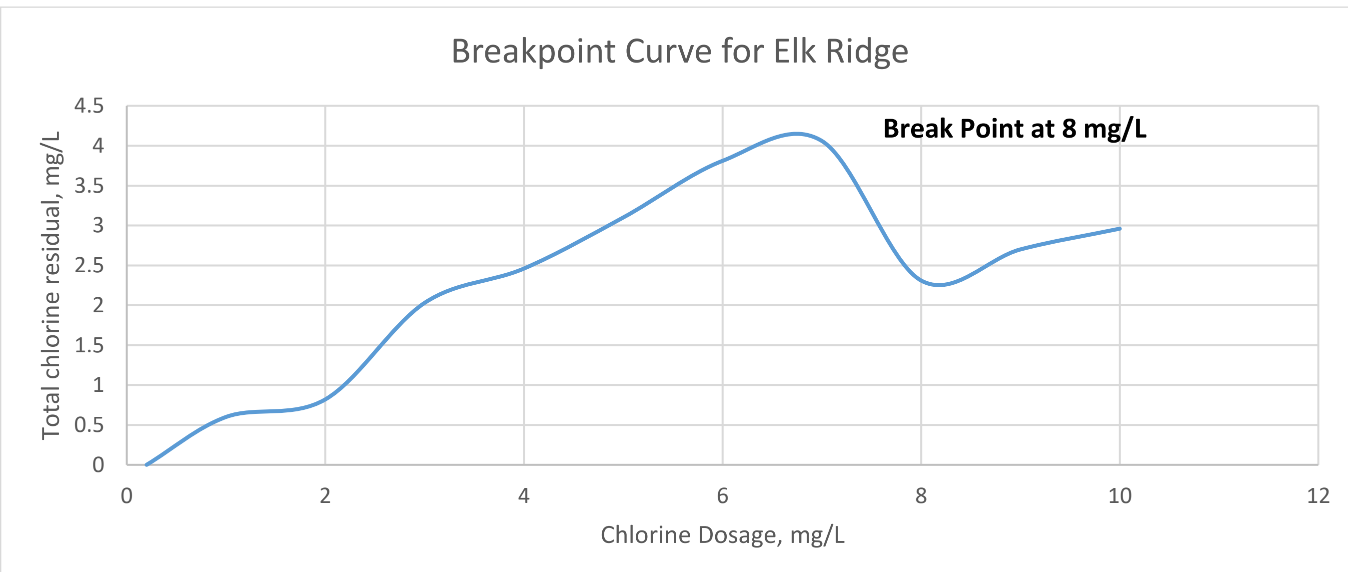
Chlorine, Oxidation								Chart one		
Dosage	T Cl	F Cl	Mono	F NH3	T NH3	T Fe	D Fe	T Mn	D Mn	
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
0.2	0	0	0	0.59	0.59	2.23	1.28	0.127	0.107	
1	0.6	0.04	0.55	0	0.71	2.1	2	0.09	0.068	
2	0.82	0	0.82	0.56	0.72	2.07	0.05	0.11	0.096	Fe Oxidation
3	2.03	0	1.93	0.32	0.7	2.14	0	0.069	0.056	
4	2.46	0	2.44	0.17	0.65	2.46	0	0.119	0.06	
5	3.1	0	2.59	0.12	0.63	2.35	0	0.095	0.057	
6	3.81	0	2.46	0	0.4	2.3	0	0.1	0.041	
7	4.06	0	2.42	0	0.38	2.18	0	0.087	0.046	
8	2.31	1.13	0.14	0	0	2.28	0	0.077	0.019	Breakpoint, NH3 removal
9	2.7	0.4	0.53	0	0.1	2.15	0	0.199	0.11	
10	2.96	2.25	0	0	0	2.24	0	0.049	0.043	Mn Oxidation

Where: T Cl = total chlorine, F Cl = free chlorine, Mono = Mono Chloramine, F NH3 = Free Ammonia, T Fe = total iron, D Fe = dissolved iron, T Mn = total manganese, D Mn = dissolved manganese

KMnO4 Oxidation									Chart two
Dosage	**A Colour**	**ORP**	**F Cl**	**T Fe**	**D Fe**	**T Mn**	**D Mn**	**UVT**	**DUVT**
mg/L	pt colour	mV	mg/L	mg/L	mg/L	mg/L	mg/L	%UVT	%UVT
0.5	130	314	0.75	2.11	0	>0.8	0.323	47.57	73.55
0.4	119	405	0.4	2.33	0	>0.8	0.224	48.08	75.51
0.3	244	361	0.35	2.3	0	0.752	0.241	39.48	72.28
0.2	398	312	0	2.17	0	0.758	0.169	49.68	73.79

Where: A Colour = apparent colour, ORP = oxidation reduction potential, UVT = ultraviolet transmission 254nm, DUVT = dissolved UVT.

Onsite Analysis



Bench test column, second pass from treated before post chlorination					Chart three
			Treated	Treated	
		Raw water	Before BW	After BW	2nd Pass
Loading	gpm/ft2				2
T UVT	%UVT	72.34	76.71	76.96	76.84
D UVT	%UVT		76.73	76.89	76.73
T Cl	mg/L		1.48	1.41	0.42
F CL	mg/L		0.92	0.84	0.13
Mono	mg/L		0.09	0.09	0
F NH3	mg/L		0.04	0	0
T NH3	mg/L	0.67	0.06	0	0
Temp	°C	4.5	5.5	7.3	12.8
pH	units	7.21	7.43	7.69	7.65
TDS	mg/L	619.1	631.3	632.8	622.6
Cond	mS/cm	906.9	927.7	930.2	918.3
ORP	mV	-29	533	557	446
T Fe	mg/L	2.25	0	0.07	0
D Fe	mg/L	2.16	0	0	0
T Mn	mg/L	0.123	0.039	0.006	0.038
D Mn	mg/L	0.119	0.008	0	0.003
Hardness	mg/L	462			

Where: Temp = temperature, TDS = total dissolved solids, Cond = conductivity

Bench Test column					Chart four
		Before	Treated	After	Treated
		Contactor	Column	Contactor	Column
Loading	gpm/ft2		2		2
T UVT	%UVT	48.09	76.12	49.16	75.41
D UVT	%UVT	73.04	76.36	74.35	76.48
T Cl	mg/L	6.01	0.42	2.97	0.39
F CL	mg/L	2.72	0.19	0.97	0.14
Mono	mg/L	1.35	0	0.97	0
F NH3	mg/L	0	0	0.37	0
T NH3	mg/L	0.27	0	0.07	0
Temp	oC	5.5	15.5	5.5	5.6
pH	units	7.64	7.56	7.69	7.71
TDS	mg/L	631.5	636.2	629.5	630.6
Cond	mS/cm	925.2	938.5	923.2	930.4
ORP	mV	581	479	556	425
T Fe	mg/L	1.86	0	2.06	0
D Fe	mg/L	0	0	0	0
T Mn	mg/L	0.189	0.018	0.06	0.01
D Mn	mg/L	0.037	0.011	0.002	0.004
Hardness	mg/L				

Summary

The current process is operating at peak efficiency.

From chart three we see the reduction of iron (Fe) and manganese (Mn) through the process before and after the filter backwash. The frequency of the backwash on the existing filters is providing potable water in regards to Fe and Mn. The current process is designed to remove only Fe and Mn. Chart three also shows that a second pass through a greensand would not improve the removal of Fe and Mn. On Chart four the dissolved Mn went from 0.037 mg/L before the contactor to 0.002 mg/L after the contactor. This indicates that the contactor has enough contact time to oxidize both the Fe and Mn.

The issue becomes the amount of ammonia in the water and the amount of Cl needed to reach break point. Chart one indicates that the Fe is readily oxidized at 2 mg/L of Cl. Then the ammonia (NH3) requires another 6 mg/L to bring us to a breakpoint of 8 mg/L. But to achieve the oxidation of Mn an additional 2 mg/L of Cl is need which will bring us to 10 mg/L for breakpoint. An additional 1 to 2 mg/L is then needed to satisfy primary disinfection and regenerating the greensand. This brings the total Cl to 11 or 12 mg/L. This requires additional treatment for NH3 removal.

Chart two was a trial using potassium permanganate ($KMnO_4$) as the primary oxidant. It indicates that it will oxidize the Fe and is inconclusive for Mn due to the test used for determination, the $KMnO_4$ has Mn in it so there is an interference.

The $KMnO_4$ is not as efficient as the Cl but could reduce the chlorine demand by reducing Fe and Mn before chlorine is added. Traditionally the greensand process utilized $KMnO_4$ as the primary oxidant which did oxidize and remove both Fe and Mn. The hazard of using $KMnO_4$ becomes an issue with most operators as it is messy to use.

Recommendations

The WTP has just recently had a bio-oxidation pilot done on the raw water by BrewNature, with the reduction of Fe only. Mn and ammonia were not reduced. This is unfortunate as this would have required no chemicals to achieve the end result needed, which is the removal of iron, manganese and ammonia.

The goal for this WTP would be to remove the Fe, Mn, NH_3 and to increase treated water flow from current to approximately 5 L/s (80 usgpm).

Method one:

Converting existing 4' filters to birm media filters would increase the loading rate to approximately 2 gpm/ft2. The current process has a lower loading rate (1.0 gpm/ft2) as the anthracite/greensand mixed media has a short run time for the removal of Mn. An air venturi would provide the oxidation of iron and filter out any turbidity that might precipitate from the air oxidation. This would be pre-treatment for a membrane treatment unit (MTU). The MTU would remove the Mn and ammonia in the water. It would also remove the mineral salts and hardness from the water. A disadvantage of a MTU is the need for chemicals; an antiscalelant to keep the Mn in solution and sodium hydroxide for pH control. Another disadvantage is allowing the Mn to pass into the MTU. It is a possibility that the membranes require changing more often (perhaps every 3 years), as an added operational cost. The existing 4' diameter filters could be replaced with 5' filters with an added air scour to help with the backwash.

Method two:

Install a larger diameter bio filter to accommodate the amount of water needed for the community. This will remove the Fe with no chemicals added. This would be pre-treatment for a membrane treatment unit (MTU). The MTU would remove the Mn and ammonia in the water. It would also remove the mineral salts and hardness from the water, with the same disadvantages as method one.

Method three:

Remove the existing filters and install bigger vessels to accommodate the amount of water need for the community (approximate 7' to 8' diameter, for 80 usgpm). Media would be a mixed bed of greensand and anthracite. The process would use $KMnO_4$ as the primary oxidant with a loading rate of 1 gpm/ft2. Install ultraviolet disinfection as the primary disinfection. The process would use the intrinsic NH_3 with added chlorine (approximately 4:1 ratio, chlorine to NH_3) for monochloramine as a secondary disinfection. Ultraviolet disinfection depends on the UVT and hardness of the water, which is borderline for this raw water.

Method four:

Remove the existing filters and install bigger vessels to accommodate the amount of water need for the community (approximate 7' to 8' diameter, for 80 usgpm with a loading rate of 1 gpm/ft2). Media would be a mixed bed of greensand and anthracite. The process would use chlorine as the primary oxidant to breakpoint as a pre-treatment to a MTU. There would have to be an added chemical to quench the excess chlorine before the MTU. This may increase the life of the membranes to 5 years.

All four methods have been tried at other water treatment plants with success. Using MTU may have some disadvantage but the advantages are great. The water will need less chlorine as a disinfectant, the removal of mineral salts (no more hardness) and no more residual left around the water fixtures are but a few. The technologies around the MTU has been improved over the years, but the membranes still need to be cleaned periodically probably every quarter to treat this raw water.

Any process change would have to be proven and reviewed by an engineering firm and meet approvals with the WSA.

Gaudet's Sci Tech Services thanks you for the opportunity to help your community and would like to offer further assistance to either bench scale or pilot any of the process that has been decided on for proof of concept.

Bert Gaudet, A.Sc.T.
Process Specialist, GSTS
306 961 4088

Biological Filtration Piloting Study at Village of Elk Ridge

Demonstration Project Summary

May 2024

Prepared By:

Babak Roshani, PhD, P. Eng.

Scott McKerracher, Engineer-in-Training

Reviewed By:

Dillon Petrucha, P. Eng.

Drop Solutions Inc.
(Drop Water Service)
306-344-1270
service@dropsolutions.ca

BrewNature Inc.
306-716-6551
info@brewnature.ca

Table of Contents

1. Problem Statement

Groundwater is a crucial water resource in the Canadian Prairies. Currently, Saskatchewan is a national leader in economic growth associated with natural resource development and industrial activities. There is a strong demand for securing clean water in a variety of public and industrial sectors. However, groundwater in the Canadian Prairies frequently contains unacceptably high levels of iron, manganese, ammonia, nitrate, arsenic and organic substances, and thus, does not meet drinking water quality standards. Considering future water consumption rates and water infrastructure costs, the development of cost-effective treatment technologies for the removal of contaminants from water has become increasingly urgent in the water treatment industry in the Canadian Prairies.

Various treatment technologies have been employed to enhance potable water quality by removing these inorganic contaminants. In the last two decades, research has focused on individual removal of ammonia, iron, and manganese by biological oxidation from polluted groundwater. However, the combined and simultaneous biological removal of the above contaminants is a difficult task since different conditions are necessary to activate the biological oxidation of each pollutant. Simultaneous biological removal of the above pollutants was studied using two or three treatment stages in order to achieve high removal rates and high-quality potable water that meets or surpasses Canadian Drinking Water standards.

The local groundwater (well water) source at the Village of Elk Ridge, Saskatchewan contains iron, ammonia, and manganese at concentrations higher than the drinking water standards (DWS). The groundwater source contains iron and manganese, at 1.84 and 0.13 mg/L, respectively. Therefore, a combination of a biological filtration process would be a potentially cost-effective option to treat this groundwater for domestic applications. The groundwater also contains a high level of ammonia (0.75 mg/L) which would require a high amount of chlorine to oxidize the ammonia to chloramines if it were not removed in the treatment process. The presence of 0.75 mg/L of ammonia nitrogen in the groundwater may require 6 to 8 mg/L of chlorine to achieve breakpoint chlorination. A high amount of chlorine may result in a high concentration of total chloramines that exceeds the MAC level of 3.0 mg/L set by Health Canada and interferes with the DPD (i.e. N, N-diethyl-p-phenylenediamine) test method for free chlorine. Trihalomethanes (THMs), halogenated acetic acids (HAAs), bromates, chlorates, and chlorides are other concerns associated with a high dosage of chlorine-based disinfectants. By applying biological filtration technology for biological iron, manganese, and ammonia removal from the groundwater, we can produce safe drinking water and considerably reduce the chlorine consumption for disinfection of treated water.

The biological filtration process, a fixed-film biological process, is a specific engineering design that supports the growth of microbial communities capable of metabolizing contaminants through mediating oxidation-reduction reactions. The oxidants (electron acceptors) are normally oxygen, nitrate, perchlorate, sulfate, and iron (III); the reductants (electron donors) include organic matter, trace organic compounds, ammonia, arsenic (III), iron (II), and manganese (II). In a fixed-film biological process, biofilms are developed on the filter media.

A biofilm process mainly consists of two simultaneous steps, substrate diffusion and biological reaction. Electron donors and acceptors diffuse from a bulk fluid into the biofilm and are metabolized by microbial cells. Diffusion profiles are caused to be parabolic by this process. Bio-filtration allows a combination of aerobic biodegradation and physical retention of suspended solids by filtration through the filter bed. The accumulation of a critical mass of micro-organisms, required to bring about the desired reactions, is key to any biological process.

2. Pilot Description

2.1. Pilot Setup

Figure 1: Pilot installation at Village of Elk Ridge.

Drop Water was requested to run a comprehensive pilot study at the Village of Elk Ridge to treat ground water. The 2-gpm pilot skid was provided, including biological filtration system equipment. The biological filtration system has a 2-stage filter vessel array to simulate the operation of the existing system with the required upgrades. This unit is designed to replicate a full-scale system and remove iron, manganese, and ammonia. The piloting study was started in November 2023 and continued until end-March 2024. Through this pilot study, we intended to test the validity of biological filtration as a cost-effective technology for removing iron, manganese, and ammonia at the Village of Elk Ridge. This pilot is specifically designed to perform pilot testing functions and serves as a base on which to further develop new technologies and optimize existing technologies for water treatment.

A pilot-scale biological filtration unit was installed at the Village of Elk Ridge in Saskatchewan. The pilot-scale biological filter consisted of a translucent PVC column, 150 cm high and 12 cm internal diameter. This pilot filter height is typical of a full-scale industrial filter. The height and diameter of the pilot were chosen to ensure enough of the filtrate is available for the bacteria to colonize. The pilot is a scaled-down version of a full biological filtration system, although offers the same filtration capacity for the 2.5 gpm/ft^2 capacity of water. The pilot skid also allows for pressurization of the vessel to closely emulate the conditions inside a full biological filtration system. Air injection is also necessary for the survival of the bacteria in the vessels. Air injection for the pilot skid is supplied by an air compressor that was installed with the pilot skid.

The pilot was running when the full-scale water treatment plant turned on to produce water. The groundwater was pumped directly through the biological filter columns. Ideally, the pilot was to operate 24 hours per day, although the configuration available at the Village of Elk Ridge only allowed for 4-6 hours of operation time, refer to Figure 2 for the graphic of Pilot operational hours. Due to the low run time, the pilot experienced warmer temperatures when not running. The impacts of low runtime and warmer static temperature will be discussed in pilot biofilter performance.

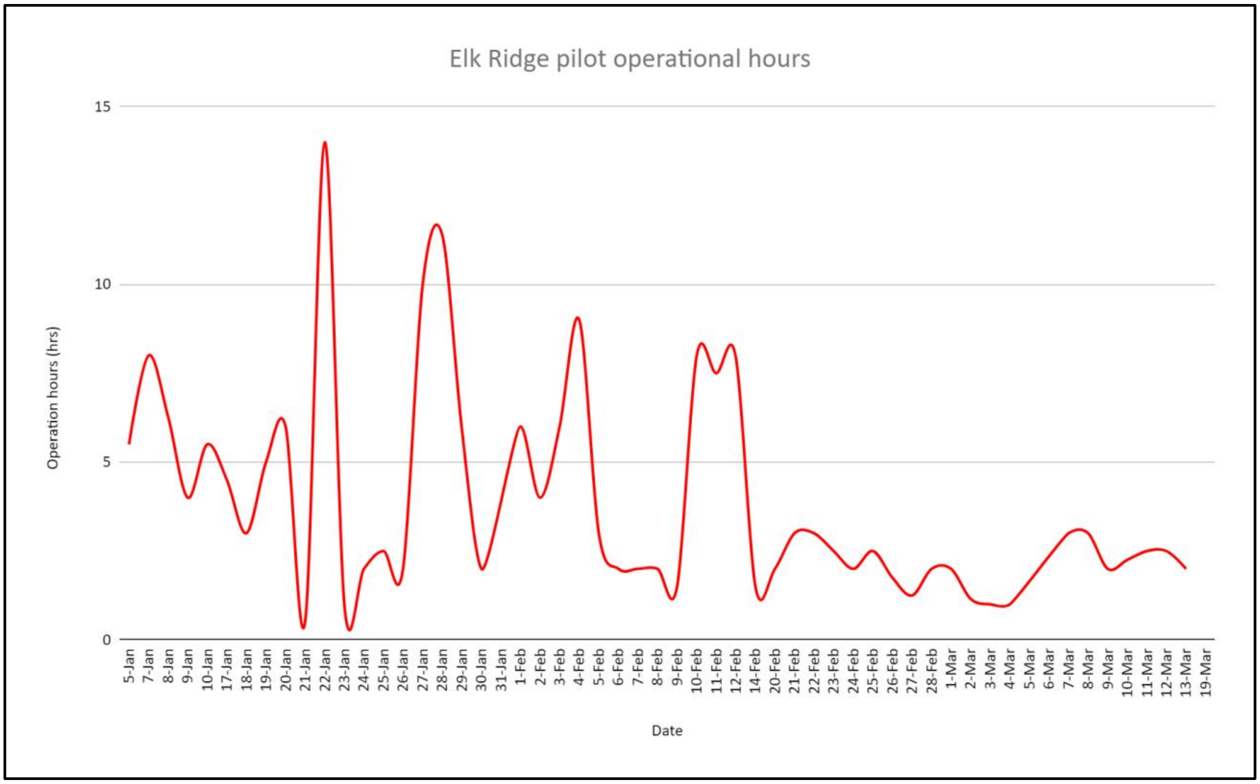


Figure 2: Elk Ridge pilot operational hours.

The groundwater quality parameters and characteristics of the groundwater treated by the biological filtration process are summarized in Table 1.

Table 1: Groundwater quality and treated water by biological filtration at the Village of Elk Ridge.

Parameter	Raw Water	SK Guideline
Ammonia-N (mg/L)	0.71	No guideline
Iron (mg/L)	1.84	<0.3
Manganese (mg/L)	0.13	<0.05
TDS (mg/L)	570	<1500
pH	7.96	7-10.5
Total Alkalinity (mg/L $CaCO_3$)	538	<500
Bicarbonate (mg/L)	656	No guideline
Carbonate (mg/L)	<1	No guideline
Hydroxide (mg/L)	<1	No guideline
Total Hardness (mg/L $CaCO_3$)	446	<800
Conductivity (uS/cm)	913	<2300
Calcium (mg/L)	108	No guideline
Magnesium (mg/L)	43	<200
Potassium (mg/L)	3.6	No guideline
Sodium (mg/L)	36	<300

For more information, please see the laboratory reports found in Appendix A

The key items to highlight in the groundwater samples are high levels of

- Iron
- Manganese
- Ammonia

It is expected that the first filter column will remove iron and part of the ammonia and the second filter column is primarily responsible for the removal of manganese, and remaining ammonia. In the first filter iron-oxidizing bacteria and nitrifying-bacteria (nitrification) are selectively enriched. Whereas, in the second filter a combination of nitrifying-bacteria (nitrification) and manganese-oxidizing bacteria are enriched. Depending on the bed height in the filter and the flux rate, there is a possibility there is a possibility to enrich these three groups of bacteria within a single column of a biofilter.

2.2. Design Criteria and Flux Rate

During the pilot operation at Village of Elk Ridge, following parameters in both filters were monitored on day-to-day basis:

- Iron
- Manganese
- Ammonia
- Flow rate
- Air Injection
- Operating Hours

In this pilot study, iron, manganese, and ammonia concentrations in groundwater and biofilter effluents were measured on a daily basis (The details of these results are explained in the below sections). The results of the previous pilot studies indicate that the filtration rate, or hydraulic loading, is the key design parameter for the filtration processes. The micro-organisms are normally present only in the upper layer of the bed, but as the filtration rate is increased the food supply to the bacteria is carried deeper into the medium. Under these conditions the bacteria adapt themselves to living at greater depths, but only to a limited extent. If the flow rate velocity becomes too high a break-through of ammonia, iron and manganese into the effluent may occur. A satisfactory way of assessing the filter depth and the proper filtration rate is to carry out experiments, either in the laboratory or a pilot-plant, filtering the actual groundwater to be treated through media of differing depth. During two months of piloting, the pilot biofilters were operating at a flux rate of 2.5 USgpm/ft^2 or (6 m^3/m^2/h).

2.3. Backwashing Information

The key to long-term operating success of biofilters is proper bed design and adequate bed cleaning during backwashing. Filters with inefficient backwashing tend to accumulate aggregates of sediments in the pores, increasing local velocities and having a potentially negative impact on filtrate efficiency and filter run time. During backwash, the filters are cleaned with water and gentle air scour in order to remove excess micro-organisms and built-up particulates or solids.

Generally, water used in backwashing must be unchlorinated and, in some cases, groundwater sources can be used. Biological filters often run for periods of one week to few months between backwashes, resulting in less wastewater than most other filtration technologies. The backwashing process essentially involves rinsing or flushing the biofilters. The low back wash rates, along with rapid filter ripening following backwash, increase the water production efficiency of the treatment plant. Micro-organisms remain attached to the filter media in the system even after backwashing, which allows the system to run continuously for an indefinite period of time, as long as backwashing is carried out on a regular basis and no biocides or harsh oxidants are introduced.

This pilot study at Elk Ridge resort, to remove iron, manganese, and ammonia from the local groundwater source, was conducted approximately for four months (15 Nov 2023 to 19 March 2024). During the piloting, approximately 28,800 gallons of groundwater was treated through the biofilter columns. And the biofilters were backwashed three times throughout the course of piloting, indicating a very low backwashing rate is required by using a biological filtration system. The biological filtration pilot was backwashed using the raw water. After backwashing, the system was ripened for 20 minutes at the lower flow rate till the turbidity became equal or below 0.1 NTU. Generally, the following parameters should be considered for backwash time and automation of the system:

- Backwash when the differential pressure reaches 5 PSI or accumulative water volume.
- Backwash when there are increasing Fe & Mn levels in the outlet of the filter; and
- Backwash when turbidity equal to or higher than 0.5 NTU.

The biofilter columns at the Elk Ridge were backwashed with a combination of air scour (rate = 0.5 scfm/ft^2) plus water (flow rate = 4-6 US gpm/ft^2). The media in the column experienced 25-30% bed expansion. Backwash water from the first filter which removes iron is orange in colour, whereas the water from the second filter which removes manganese is dark brown.

The Pilot underwent backwashing on three occasions:

- On January 19th, the first backwash of 2.5 gallons per minute (gpm) was conducted on filter one using raw water.
- On February 6th, both vessels underwent backwashing with air scour.
- The filters were reseeded with Leask Colony's backwashed water on February 14th.
- On February 23rd, filter 1 underwent air scour backwashing again.

For the duration of the pilot, the backwash water was captured and analyzed based on the colour from both vessels. Figures 3 and 4 are examples of the backwash water. Figure 3 shows the backwash from the first vessel after three months of operation. The distinct red-brown colour is expected from the first vessel because this colouring usually coincides with iron removal. The backwash water also was fairly opaque signifying lots of removal from the first filter. The red-brown colouring is created when the iron rusts due to the increases in oxygen present in the vessel, the iron then precipitates getting captured in the vessel's media.

Figure 3: Filter 1 backwashed water, February 6th.

The backwash from vessel 2 is consistent with the results found from testing. Figure 4 shows the backwash water from the second vessel after three months of operation. The backwash water was dark brown almost blue, this coloring is consistent with manganese removal. Although different from the backwash water from vessel 1, the vessel 2 backwash water was slightly transparent. Therefore vessel 2 does not have the same removal as vessel 1 was achieving.

Figure 4: Filter 2 backwash water, February 6th.

2.4. Dissolved Oxygen Consumption

Dissolved oxygen (DO) concentration strongly influences the performance of biological processes as it is necessary for micro-organism growth. The minimum dissolved oxygen content in the effluent of Filter 2 should not be allowed to fall below 5 mg/L. By controlling the DO level with sensors in the biological filter, we are able to provide a uniform and stable environment for the microorganisms, which reduces sludge production and energy costs. During biological filtration piloting at the Elk Ridge, the pilot was operating at a water flow rate of 0.3-0.5 USGPM, the air flow rate to the Filter-1 and Filter-2 was 0.035 SCFH and 0.07 SCFH, respectively. This is equal to the air flow of 2 SLPM for Filter-1 and 1 SLPM for Filter-2.

3. Pilot-scale Biofilter Performance

3.1. Iron Removal

Iron concentration in the local groundwater source at the Village of Elk Ridge ranged between 2.21 to 2.41 mg/L during the piloting period. Saskatchewan's guideline for iron in drinking water is ≤0.3 mg/L. The biological filtration pilot has shown conclusive evidence from this study that the iron concentrations in the groundwater can meet drinking water guidelines and can be consistent with biological removal. Time-dependent profiles of iron concentration and its removal efficiency over the two months of piloting are shown in Figures 5, and Figure 6, respectively. As shown in Figure 5 and 6, it is evident that the biological iron removal was rapid and was consistently below the standards over the course of operation, where iron removal efficiency was higher than 99%.

The sharp peak detailed in the figures around February 8th was due to a reconfiguration of the pilot's settings. On February 7th the inlet pressure was increased from 4 psi to 10 psi to test how the pilot operated at different pressures. The pilot was left at this increased pressure for the remainder of the piloting study. The pilot had also undergone an air scour and backwash on February 6th. The combination of the increased inlet pressure and a recent air scour and backwash would have caused the rapid decrease in performance in vessel 1, although vessel 1 responded quickly. The Iron removal in the effluent from vessel 1 returned to normal removal numbers after six days as the system naturally adapted. Throughout the spike, the effluent from vessel 2 maintained 99% iron removal.

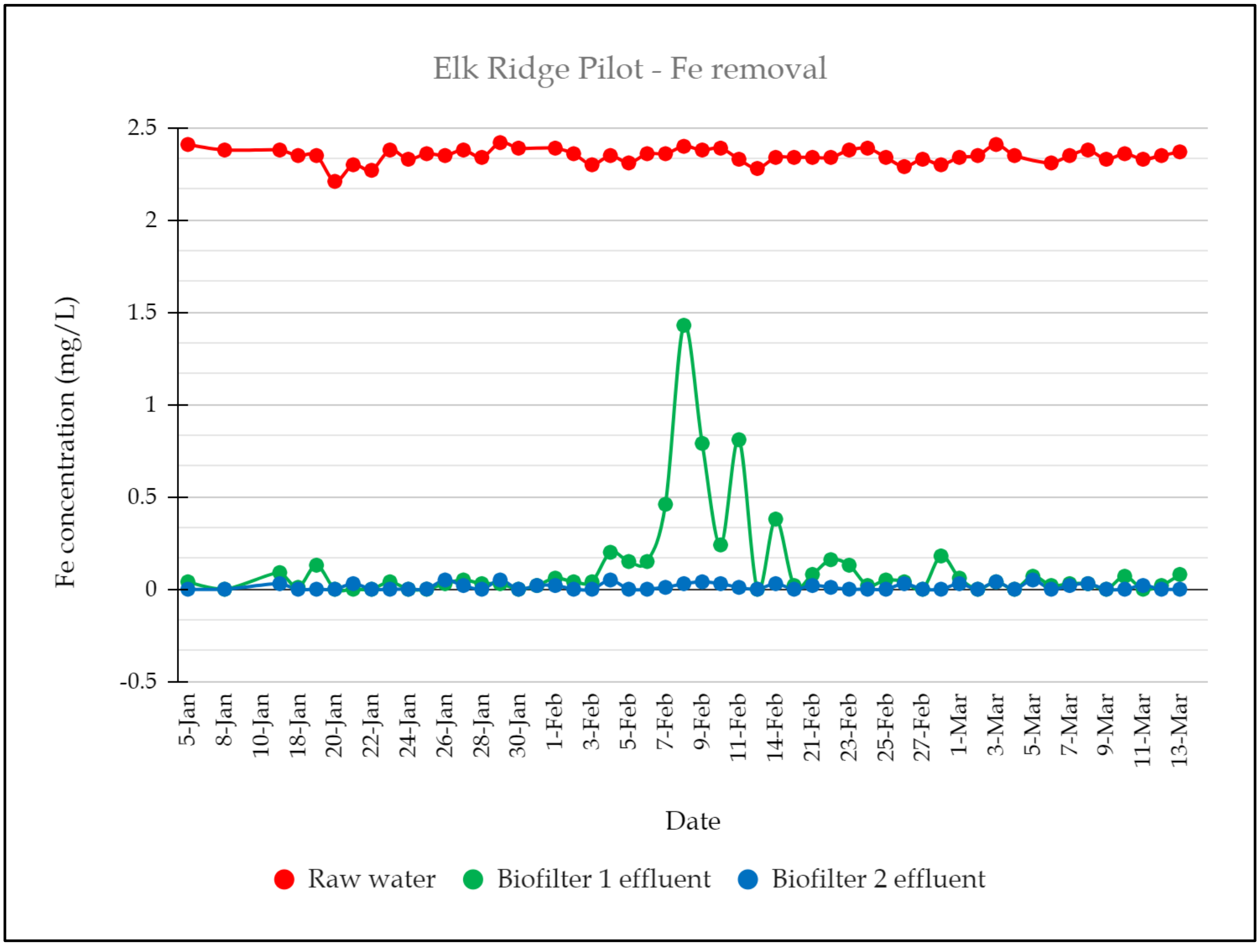


Figure 5: Profile of iron (Fe) concentration in the groundwater, Bio-1, and Bio-2 outlet for the Village of Elk Ridge.

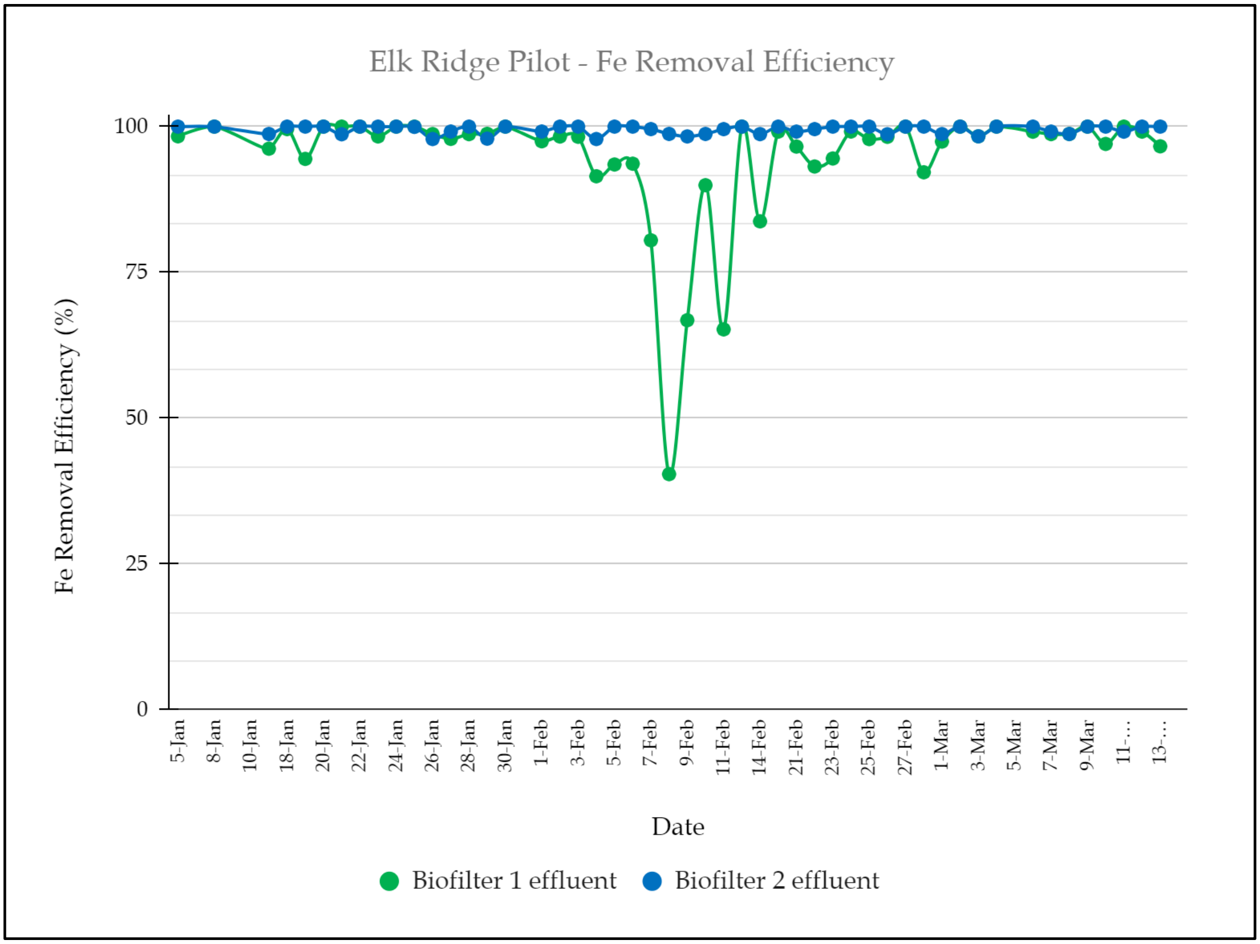


Figure 6: Profile of iron (Fe) removal efficiency in the Bio-1 outlet and Bio-2 outlet for the* Village of Elk Ridge*.

3.2. Manganese Removal

In this pilot study, along with iron, the potential of manganese removal by biological filtration was investigated. Manganese concentration in the local groundwater source at the Village of Elk Ridge varied between 0.029 to 0.123 mg/L during the duration of the pilot. Saskatchewan guideline for manganese in drinking water is ≤0.05 mg/L. For the given manganese concentration in local groundwater source, the biological filtration system had shown commendable performance in the biofilter effluent from the start of the pilot till around February 14th. After this date, we see a breakdown of the manganese removal shown in figure 7. In the early phases of biofilter operation, manganese removal was mainly promoted in the Filter-2 of the pilot.

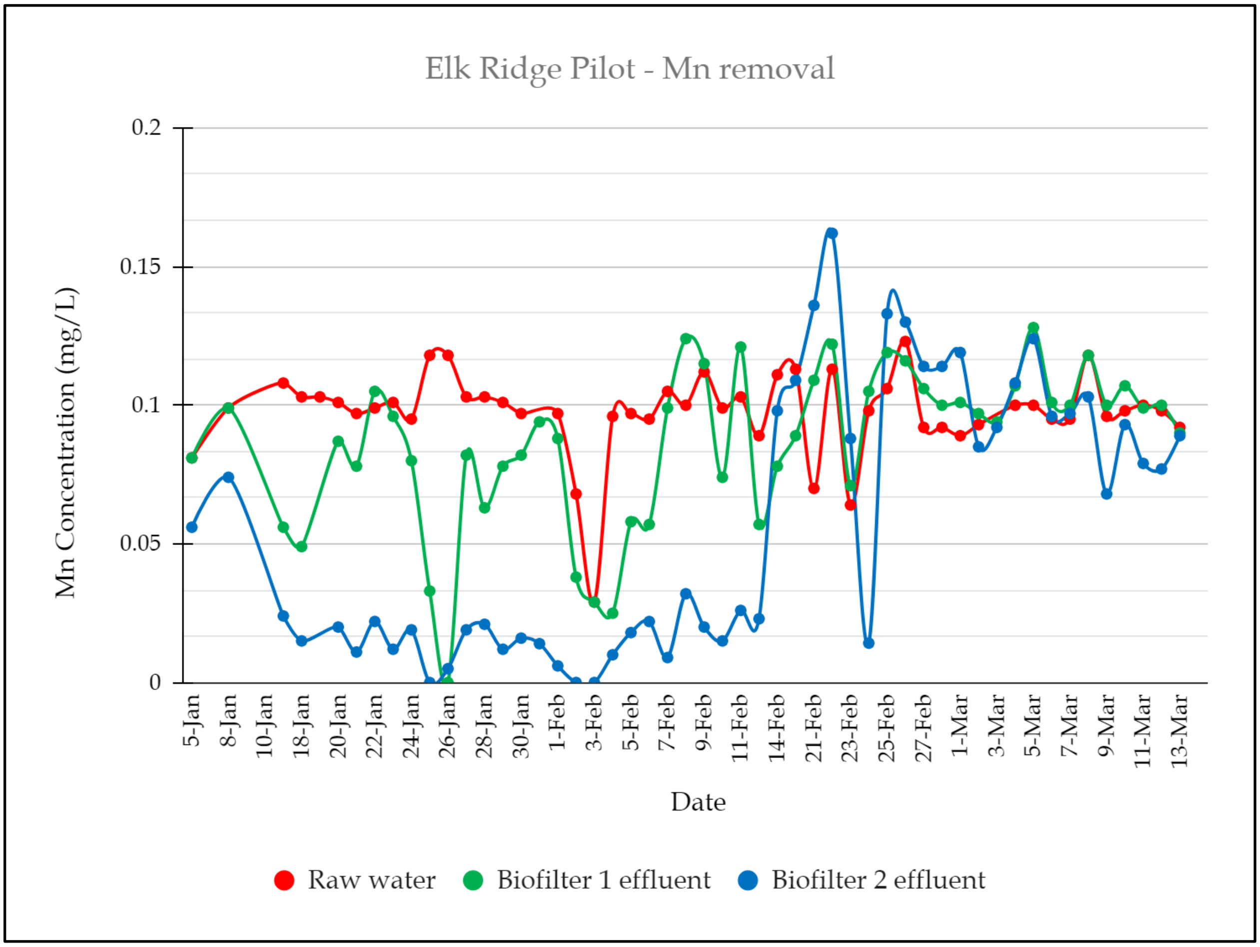


Figure 7: Profile of manganese (Mn) concentration in the groundwater, Bio-1, and Bio-2 outlet over the Pilot at the Village of Elk Ridge.

Time-dependent profiles of manganese concentration and its removal efficiency in the biofilter effluent over the two months of piloting were depicted in Figure 7, and Figure 8, respectively. Manganese concentration in the filter 2 outlet met SK standard after 15 days of operation and held under the 0.05 mg/L for 26 days.

The fluctuation in manganese concentration can be attributed in part to inconsistent operational hours. The variability in operation affects the bacterial population within the vessels, as warmer temperatures facilitate increased bacterial growth. This fluctuation in bacterial population may account for the inconsistencies observed from the beginning of the pilot study through mid-February. Subsequently, a significant reduction in pilot operation hours, as illustrated in Figure 2, resulted in inconsistent manganese removal.

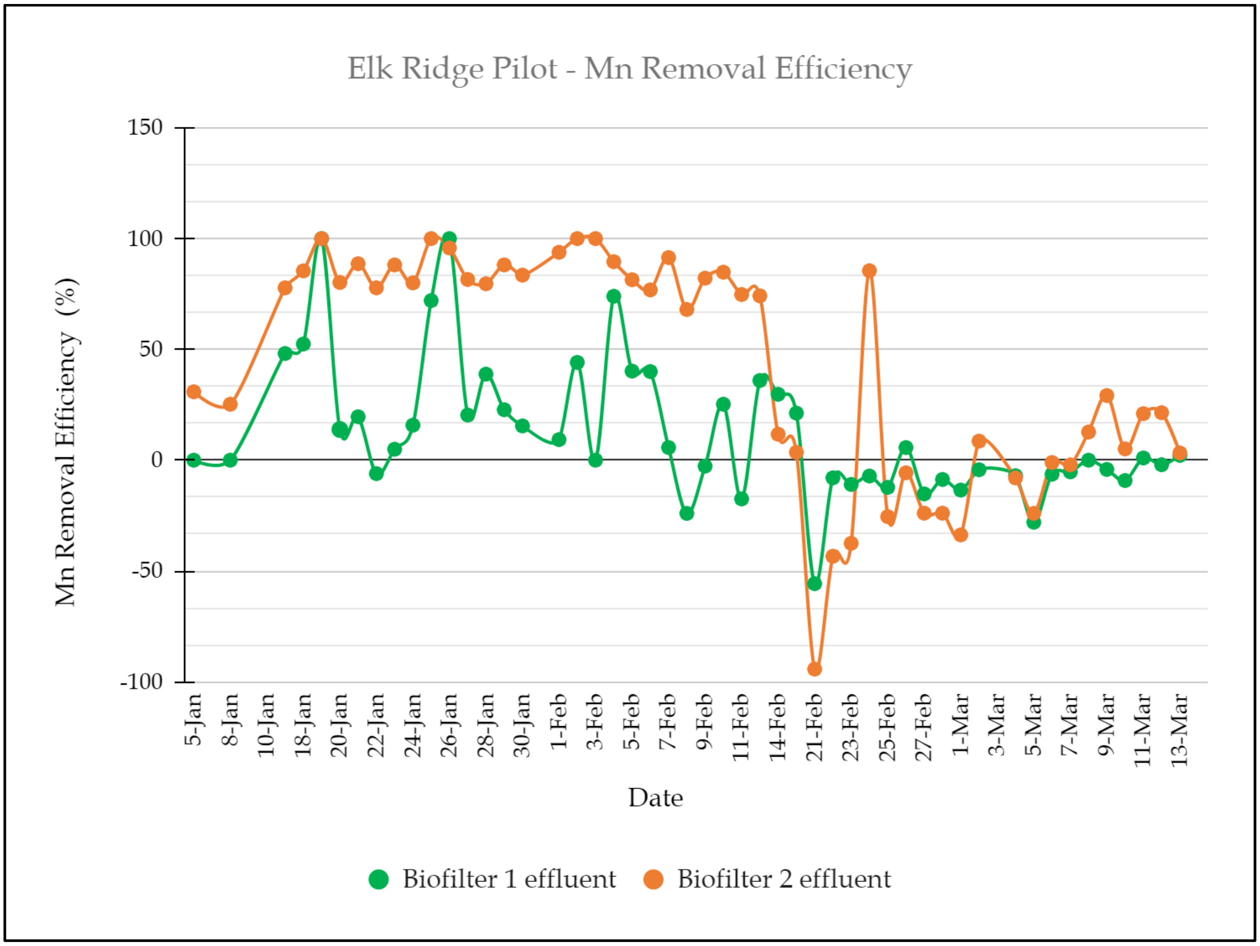


Figure 8: Profile of manganese (Mn) removal efficiency in the bio-1, and bio-2 outlet over the Pilot at the Village of Elk Ridge.

As depicted in Figure 8, during the initial stages of piloting, the manganese levels in the groundwater remained relatively constant. Throughout this phase, the Filter-2 effluent consistently exhibited an average removal rate of 81% for manganese. It is not believed that the operational times had a strong correlation with removal percentages, refer to section 3.4 for more analysis on operational times. After February 14, it is believed the void spaces in the filter media became filled with precipitated manganese. The precipitated manganese would then be added to the filtered water as it runs, leading to a negative removal efficiency of manganese leading to poor pilot performance from February 14th to the conclusion of the pilot. It is believed that this precipitation could be avoided in a full-scale biological filtration system. Typically, biological filtration is employed for manganese removal once ammonia has been removed prior. Based on the findings of this pilot project and previous pilots, the manganese would be able to be removed by a biological filtration system. The subsequent section on ammonia removal will elucidate why biological removal of ammonia was not achievable.

3.3. Ammonia Removal

3.3.1. Biological Ammonia Removal

Biological ammonia removal by bacteria needs very specific environmental conditions. To promote conditions for biological ammonia removal in a water/wastewater treatment process of a plant, an understanding of the processes and careful control of process conditions are required. Untreated groundwater can contain nitrogen in the form of organic nitrogen, ammonia (NH_3-N). Ammonia removal in biological filters involves oxidation of ammonia contained in the water to nitrate (NO_3-N) by nitrifying bacteria. This process is called nitrification. Nitrification is the two-step biological oxidation of ammonia (NH_3-N) to nitrate (NO_3-N). The oxidation is performed by aerobic autotrophic bacteria frequently called nitrifiers. The predominant species that are commonly encountered in water treatment plants for nitrification belong to genera *Nitrospira*, *Nitrobacters,* and *Nitrosomonas*. Equations describing the oxidation of NH_3-N to NO_2^--N and oxidation of NO_2^--N to NO_3^--N are presented as follows:

$$2NH_4^+ + 3O_2 \text{ -----> } 2NO_2^- + 2H_2O + 4H^+ + \text{New Cells}$$

$$2NO_2^- + O2 \quad \text{ -----> } 2NO_3^- + \text{New Cells}$$

Nitrification occurs only under aerobic conditions, so dissolved oxygen must be available to the bacteria in the treatment process. It requires approximately 4.6 kg of oxygen for every kg of ammonia converted to nitrate by the bacteria. Temperature, pH, and alkalinity are other factors which impact biological nitrification. Alkalinity is consumed at a rate of approximately 7.14 kg per kg of ammonia nitrified. During nitrification, this alkalinity reduction causes the pH of the water to drop. The rate of nitrification is dependent on pH, temperature and the water components. The optimum pH for nitrification is approximately 8.4. The rate of nitrification drops off rapidly at pH levels of less than 7.0. There is also a significant drop in nitrification rates at temperatures less than 15°C.

3.3.2. Ammonia Removal at Village of Elk Ridge Pilot

In addition to iron and manganese, biological filtration pilots at the Village of Elk Ridge have also shown poor and sporadic removal of ammonia through biological processes. Ammonia concentration in the local groundwater source at the Village of Elk Ridge ranged mainly between 0.60 to 0.92 mg/L throughout the pilot. Although there is no guideline for ammonia in drinking water, Saskatchewan Water Security Agency developed an operational guideline of ≤0.1 mg/L to minimize chlorine consumption. Within a few days of operation, the biological filtration pilot has shown complete removal of ammonia from groundwater source by biological process and has met process guidelines. Although this removal was short-lived because a couple days later there was minimal removal. The inconsistencies continued throughout the pilot's duration.

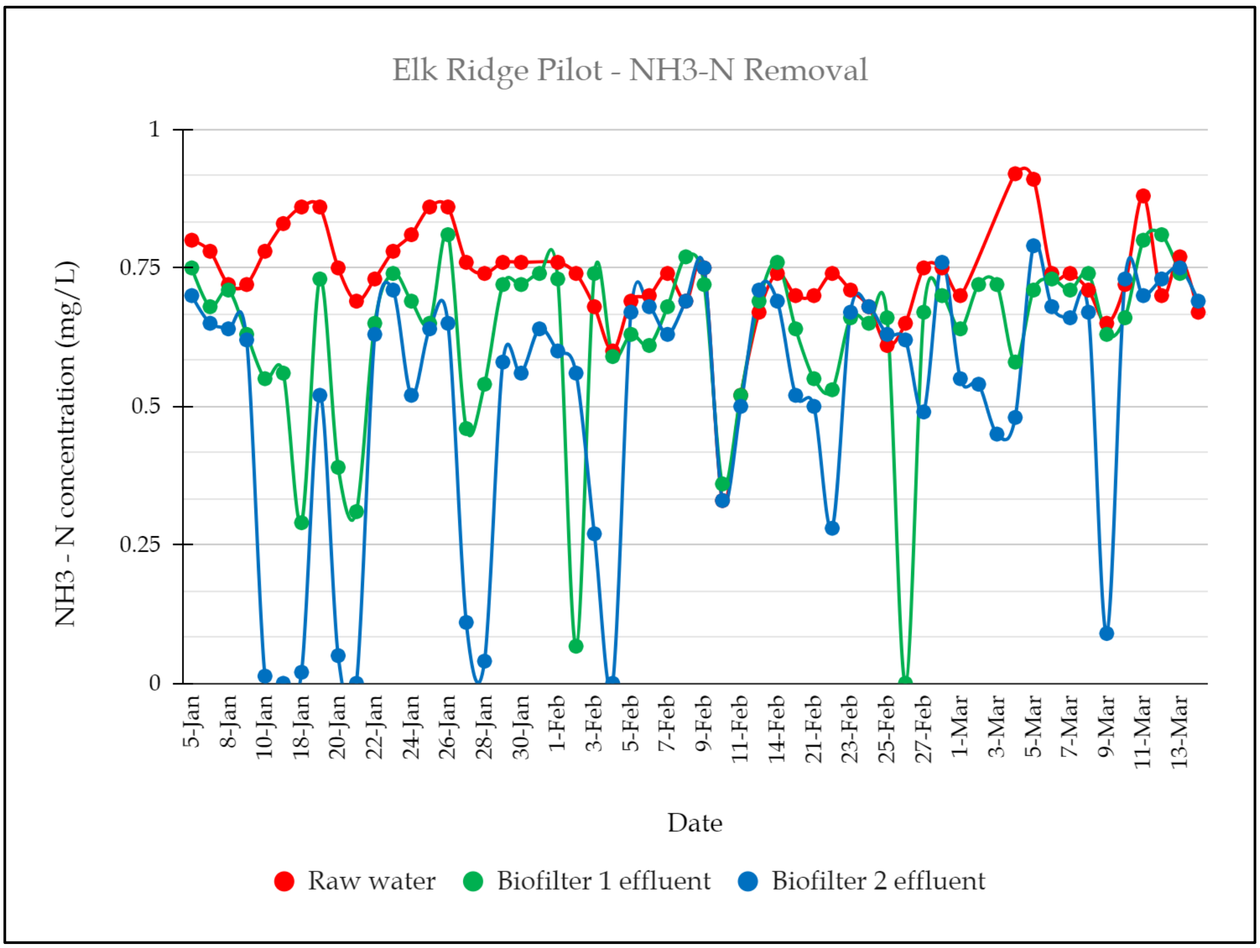


Figure 9: Profile of ammonia-N (NH_3-N) concentration in the groundwater, Filter-1 and Filter-2 outlet over the Pilot at the Village of Elk Ridge.

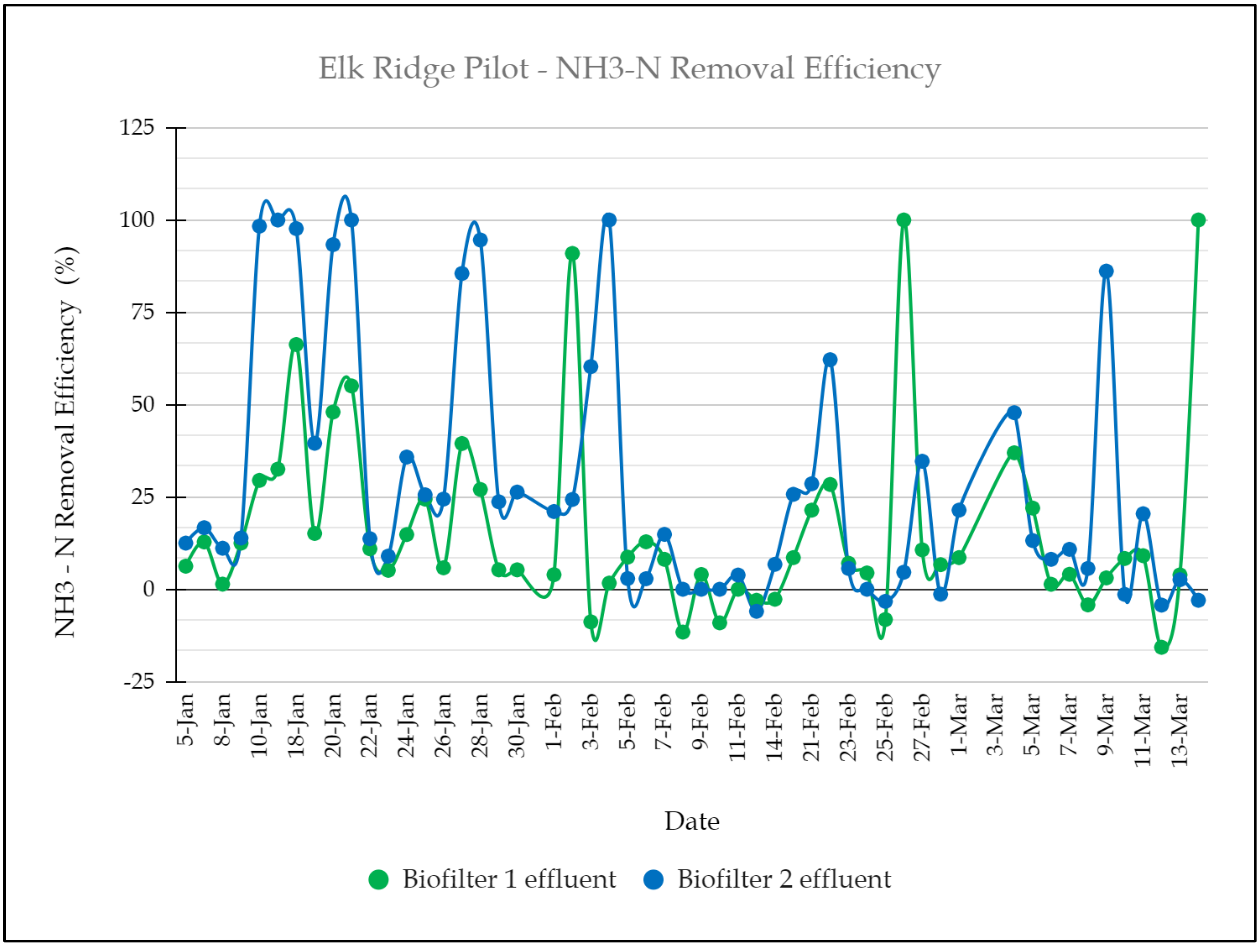


Figure 10: Profile of ammonia-N (NH_3-N) removal efficiency in the Filter-1, and Filter-2 outlet over the Pilot at the Village of Elk Ridge.

Figure 11 illustrates the operational hours of the pilot in red, measured on the left vertical axis, alongside the percentage of ammonia removal in orange, measured on the right vertical axis. This figure offers valuable insights into the relationship between operational time and ammonia removal. A noticeable trend from the graph suggests that extended operational periods, followed by shorter intervals of activity, result in higher percentages of ammonia removal due to increased bacteria count in the vessels. For instance, on January 22, the pilot was operational for 14 hours, followed by less than 3 hours of operation over the next four days. This pattern led to a substantial increase in ammonia removal on January 26th and 27th.

The trend continues from January 28th to February 3rd, where a large operation time followed by decreased activity sees a spike in ammonia removal. An explanation for this trend could be low nitrifying bacteria in the raw water. For example, when the pilot is run for long amounts of time, the vessels can build up nitrifying bacteria and their food source. Then, when the pilot is run for less time, the bacteria are given a chance to bolster populations in a warmer environment leading to more ammonia removal. For every 10°C the total micro-organism population doubles. The increased bacteria would lead to a small unsustainable peak of ammonia removal as seen in figure 10.

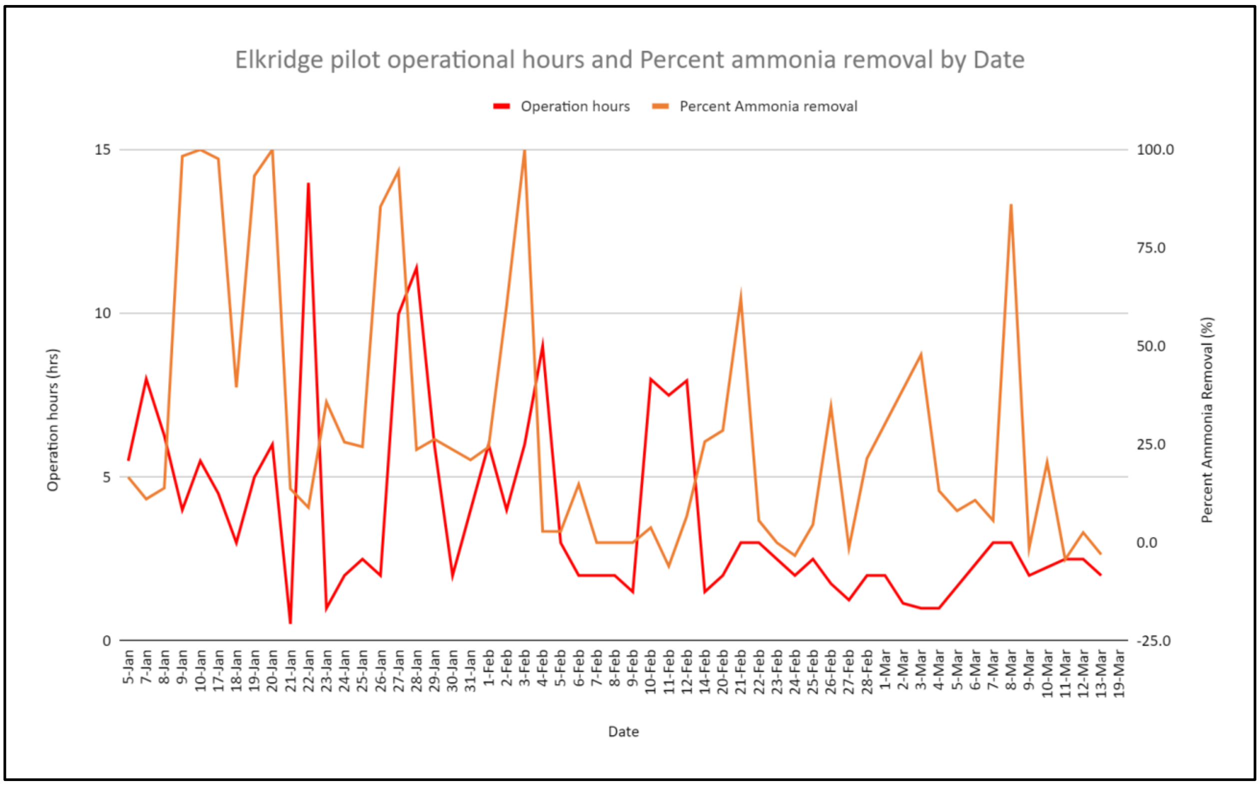


Figure 11: Elk Ridge pilot operation vs percent ammonia removal.

After conducting over three months of piloting at Elk Ridge and comparing it with previous piloting efforts in various locations, we made a significant observation regarding the depth of the well water. At Elk Ridge, the well water depth is exceptionally deep, averaging around 360 feet. This contrasts with our prior successful piloting experiences, where the well water depth typically did not exceed 200 feet. This variance in depth led us to speculate about the reason for the low indigenous nitrifying bacteria crucial for promoting ammonia removal.

Upon seeding the biofilter, we initially observed promising results in ammonia removal. However, this efficiency declined after a few days, which we attribute to an insufficient number of indigenous bacteria at such depths to maintain sufficient ammonia removal. Additionally, Elk Ridge's location within a federally protected area limits activities like farming and animal husbandry, which are typically sources of live organisms and bacteria in the soil. Which could also affect the amounts of nitrifying bacteria present in the well water. Consequently, the biological filtration system's efficacy is compromised due to the scarcity of these essential organisms.

We conclude that biological filtration systems are more feasible when fed from shallow wells rather than excessively deep ones like those found at Elk Ridge because of the higher likelihood of sufficient nitrifying bacteria. This insight underscores the importance of considering environmental factors, such as well depth and surrounding land use, when implementing such filtration systems for effective ammonia removal. It is possible to complete an HPCs test to validate low amounts of nitrifying bacteria. Heterotrophic plate counts (HPCs) are commonly used to assess the general microbiological quality of drinking water.

3.4. Correlation between Operational time and Percent removal

Due to the inconsistent run time of the pilot, it is necessary to analyse the correlation between pilot run time and the removal of manganese and ammonia from the water to ensure proper recommendations are made. Correlation is a statistical measurement of the relationship between two variables. The analysis will be done using a scatter plot graph with trend lines indicating possible correlations. The correlation coefficient value or r value will also be calculated throughout analysis. r value can range from 1 for a strong positive correlation meaning an increase of one variable leads to an increase of the other variable, to -1 a strong negative correlation where an increase of one variable leads to a decrease in the other. An r value of 0 indicates no correlation, meaning the variables do not have a relationship with each other. For this analysis the relationship between operational run time and percent removal will be calculated. A strong relationship, an r value close to 1, would mean the longer the pilot is run the better the removal percentage. No correlation or an r value close to 0 would mean that the operational time does not have a relationship with the removal percentage.

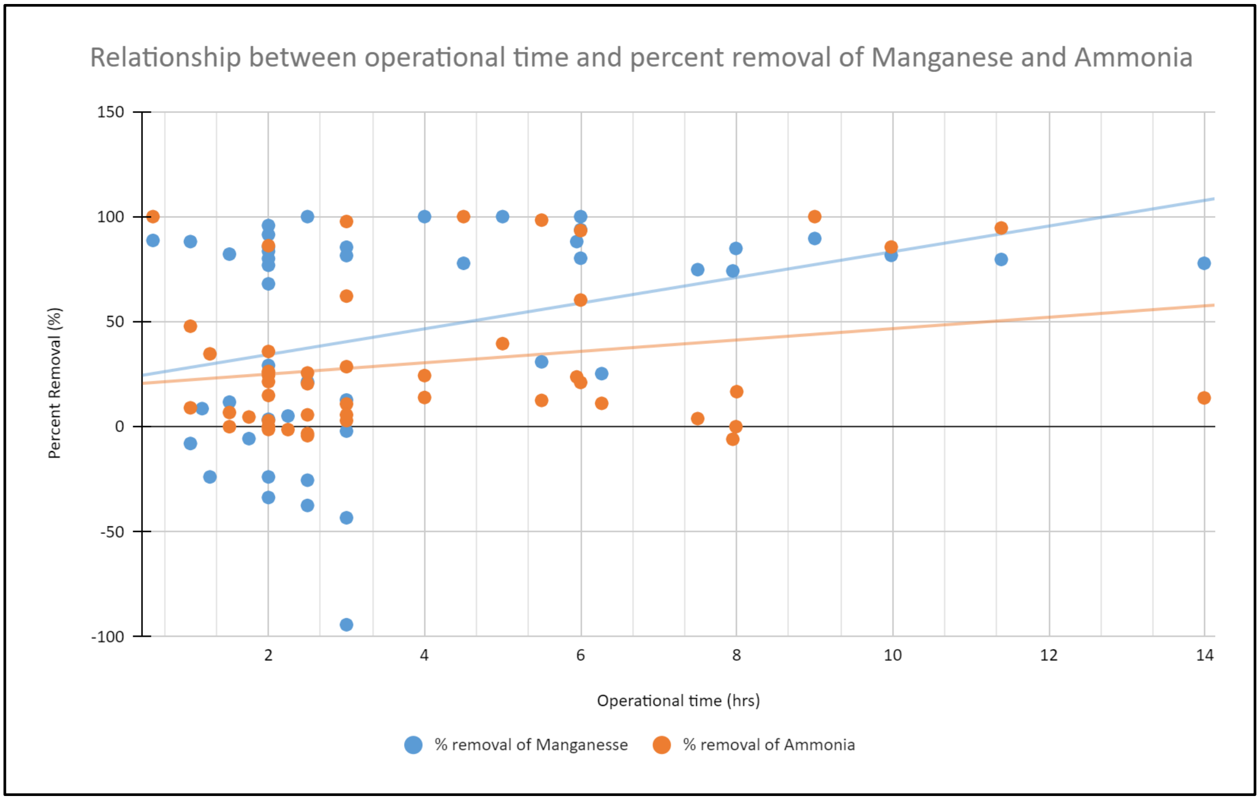


Figure 12: Relationship between operational time and percent removal of Manganese and Ammonia

The figure above displays the relationship between the Operational time of the pilot and the percent removal of manganese and ammonia. The left axis is for percent removal while the horizontal is for the operational hours of the pilot. The percent removal of manganese is displayed in blue, while ammonia is in orange. The linear slope is depicted for both relationships. Manganese removal has a higher slope than ammonia removal which indicates a stronger relationship between operational time and manganese removal than operational time and ammonia removal. Both slopes are positive, representing more operational time would lead to more percent removal. To determine the strength of the relationship the equation pictured below will be used where r_{xy} is the correlation coefficient, X_i is the x variable values, $\overline{X}$ is the mean value of the x variables, y_i is the y variable values, and

$\bar{y}$ is the mean of the y variables.

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Figure 13: Equation for calculating the correlation coefficient

The equation used over the data set correlation coefficient can be calculated for both relationships. The value for the relationship between the operational time and percent removal of manganese was calculated to be $r = 0.36$, therefore the relationship can be described as a weak relationship. The values of the relationship between operational time and the percent ammonia removal was calculated to be $r = 0.24$, therefore the relationship can be described as weak as well bordering on very weak/ no association. (These determinations were based on a table from Boston universities educational website, and the table will be included in the appendix) While both correlation coefficients are positive slopes, due to their low value operational time would not be the leading factor in affecting percent removal for both manganese and ammonia. Therefore, it is accurate to describe operational time as not having significant enough effect on percent removal of manganese and ammonia to invalidate our piloting project. It is still believed that low bacteria present in the raw water has the largest impact on the pilots poor inconsistent removal of Ammonia from the water.

4. Conclusions and Recommendations

The analysis reveals that Filter-1 effectively eliminates iron, while Filter-2 encountered challenges in removing both ammonia and manganese. Iron and manganese concentrations consistently adhered to drinking water and process standards. Conversely, the biofilter proved ineffective in removing ammonia due to the potentially low amounts of indigenous bacteria in the well water and the inconsistent operation of the pilot. In summary, the pilot study at the Elk Ridge WTP reveals conclusions in the following areas:

- Iron concentrations in the local groundwater source were effectively reduced by over 99% through biological filtration, all achieved without the need for chemical additives.
- Manganese concentrations in the groundwater underwent a reduction of over 80% via biological treatment, although the consistency of this reduction varied.
- Biological filtration resulted in an average 28% decrease in ammonia concentrations within the groundwater.
- Despite a prolonged acclimation period during the biological filtration pilot aimed at removing ammonia from the given groundwater source, the potential for a low number of indigenous bacteria and inconsistent operation hindered the ability to achieve full ammonia removal.
- A next step could be to ensure that the absence of nitrification bacteria is confirmed to eliminate it as a cause, then comp the pilot with more consistent run times and possibly add a third stage.
- The use biological filtration as primary treatment system to effectively eliminate iron and manganese, is possible and it is recommended that breakpoint chlorination for ammonia removal be employed at the outlet of the final biofilter to ensure targets are achieved. The main advantage of a biological filtration system will be less backwashing of the filters compared to greensand filters. Typical backwash requirements for the first biofilter is every two weeks and the second biofilter is every three months, comparing the greensand filters that must be backwashed every second day.

5. Acknowledgements

Drop Water would like to thank **Mr. Russel and Ms. Terri** for their assistance in measuring water parameters during the pilot study at the Elk Ridge WTP.

APPENDIX

Laboratory Results and Daily Log sheet and Correlation Coefficient table

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	FRIDAY	SAT	SUN	MON	Tuesday	Wed.
Date	Jan 5	Jan 6	Jan 7	Jan 8	Jan 9	Jan 10
Raw Water						
Operating (hr)	5.5		8 hrs	6.27	4.00	5.5
Iron (mg/L)	2.41			2.39		
Manganese (mg/L)	.081			.099		
NH3-N (mg/L)	.80		.78	.72	.72	.78
Outlet Filter 1						
Iron (mg/L)	.04			0.00		
Manganese (mg/L)	.081			.099 ~~.099~~		
NH3-N (mg/L)	.75		.68	.71 ~~.099~~	.63	1st .53 / 2nd .55
Inlet Press. (PSI)	.2		5	5	5	0
Outlet Press. (PSI)	3		5	5	5	0
Outlet Filter 2						
Iron (mg/L)	0.00			0.00		
Manganese (mg/L)	.056			.074		
NH3-N (mg/L)	.70		.65	.64	.62	0.00 / 2nd .015
Inlet Press. (PSI)	4		5	4	5	0
Outlet Press. (PSI)	4		5	4	4	0
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:

.3#/m

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	Wed	Thur	Frid	Sat	Sun	Mon	Tues
Date	Jan 17	18	19	20	21	22	23 (Startup)
Raw Water							
Operating (hr)	4.5	3	5	6	.52	13.99	(Snow) 1hr
Iron (mg/L)	2.38	2.35	2.35	2.21	2.30	~~13.99~~ 2.27	2.38
Manganese (mg/L)	.108	.103	.103	.101	.097	.099	.101
NH3-N (mg/L)	.83	.86	.86	.75	.69	.73	(.78) / .78
Outlet Filter 1							
Iron (mg/L)	.09	.01	.13	.00	.00	.00	.04
Manganese (mg/L)	.056	.049		.087	.078	.105	.096
NH3-N (mg/L)	.56	.29	.73	.39	.31	.65	(.41) / .74
Inlet Press. (PSI)	2	2	8	2	2	5	5
Outlet Press. (PSI)	2	2	8	2	2	7	5
Outlet Filter 2							
Iron (mg/L)	.03	.00	.00	.00	.03	.00	.00
Manganese (mg/L)	.024	.015		.020	.011	.022	.012
NH3-N (mg/L)	.00	.02	.52	.05	.00	.63	(.01) / .71
Inlet Press. (PSI)	2	2	7	2	2	5	5
Outlet Press. (PSI)	2	2	6	2	2	5	5
Air Scour (Bio 1 or 2)							5
Backwashing (Bio 1 or 2)			#1 - 5,595 gal				

Comments:

Taking 5 min run from well on warm / colder water

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	Wed	Thur	Fri	SAT	SUN	Mon
Date	Jan 24	25	26	27	28	29
Raw Water						
Operating (hr)	2 hrs cold	2.5	2	9.98	11.39	5.95
Iron (mg/L)	2.33	2.36	2.35	2.38	2.34	2.42
Manganese (mg/L)	.095	.118	.118	.108	.103	.101
NH3-N (mg/L)	.81	.86	.86	.76	.74	.76
Outlet Filter 1						
Iron (mg/L)	.00	.00	.03	.05	.03	.03
Manganese (mg/L)	.080	.033	.000	.082	.063	.078
NH3-N (mg/L)	.69	.65	.81	.46	.54	.72
Inlet Press. (PSI)	4	3	4	2	2	2
Outlet Press. (PSI)	4	3	4	2	2	4
Outlet Filter 2						
Iron (mg/L)	.00	.001	.05	.02	.00	.05
Manganese (mg/L)	.019	.000	.005	.019	.021	.012
NH3-N (mg/L)	.52	.64	.65	.11	.04	.58
Inlet Press. (PSI)	4	3	5	2	2	2
Outlet Press. (PSI)	4	3	5	2	2	4
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments: cold to test

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	Tue	Wed	Thurs	Fri	Sat	Sun
Date	Jan 30	31	Feb 1	Feb 2	Feb 3	Feb 4
Raw Water						
Operating (hr)	2 hrs		6	4	6	(bus all 9) raw well - 1 hr 45 min
Iron (mg/L)	2.39		2.39	2.36	2.30	2.35
Manganese (mg/L)	.097		.097	.068	.028	.096
NH3-N (mg/L)	.76		.76	.74	.68	.60
Outlet Filter 1						
Iron (mg/L)	.00	.02	.06	.04	.04	.20
Manganese (mg/L)	.082	.094	.088	.038	.029	.025
NH3-N (mg/L)	.72	.74	.73	.67	.74	.59
Inlet Press. (PSI)	4	6	10	8	9	5
Outlet Press. (PSI)	5	6	10	10	9	6
Outlet Filter 2						
Iron (mg/L)	.00	.02	.02	.00	.00	.05
Manganese (mg/L)	.016	.014	.006	.000	---	.010
NH3-N (mg/L)	.56	.64	.60	.56	.27	.00
Inlet Press. (PSI)	5	5	10	7	9	5
Outlet Press. (PSI)	5	6	10	9	9	6
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:

Jan 31 - Increase output pressure to 10 lbs Increase Filter 2 Air to 2 After Babock

did mang 2x
same
results

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	Feb						
Date	5	6	7	8	9	10	11
Raw Water		10 AM				Hr	Hr
Operating (hr)	3 act/run	2 hrs	2 hrs	2 hrs	1.5 hrs	7.99 (1.5)	7.5 (1
Iron (mg/L)	2.31	2.36	2.36	2.40	2.38	2.39	2.33
Manganese (mg/L)	.097	.095	.105	.100	.112	.099	.103
NH3-N (mg/L)	.69	.70	.74	.69	.75	.33	.52
Outlet Filter 1							
Iron (mg/L)	.15	15	.46	1.43	.79	.24	.01
Manganese (mg/L)	.058	.057	.099	~~.100~~ .124	.115	.074	.121
NH3-N (mg/L)	.63	.61	.68	.77	.72	.36	.52
Inlet Press. (PSI)	5	4	10	12	13	8	16
Outlet Press. (PSI)	7	5	10	11	12	8	16
Outlet Filter 2							
Iron (mg/L)	.00	.00	.01	.03	.04	.03	.01
Manganese (mg/L)	.018	.022	.009	.032	.020	.015	.026
NH3-N (mg/L)	.67	.68	.63	.69	.75	.33	.50
Inlet Press. (PSI)	5	4	10	10	10	7	13
Outlet Press. (PSI)	7	5	10	10	10	8	14
Air Scour (Bio 1 or 2)		yes @ 230 pm					
Backwashing (Bio 1 or 2)		yes					

Comments:

very cold
well ran long 3hr

Filter 1 has
air when
openning to
Sample
Wedid
Mang
raw .100
filter1 .124

@ Elk Ridge WTP

Elk Ridge Weekly Log						
Date	Feb 12	13	14	20	24	22
Raw Water	3		1.5			
Operating (hr)	7.95			2	3	3
Iron (mg/L)	2.28		2.34	2.34	2.34	2.34
Manganese (mg/L)	.089		.111	.113	.070	.113.
NH3-N (mg/L)	.67		.74	.70	.70	.74
Outlet Filter 1						
Iron (mg/L)	0.00		.38	.02	.08	.16
Manganese (mg/L)	.057		.078	.089	.109	.122
NH3-N (mg/L)	.69		.76	.64	.55	.53
Inlet Press. (PSI)	9	16	16	10	7	12
Outlet Press. (PSI)	9	15	15	12	10	13
Outlet Filter 2						
Iron (mg/L)	0.00		.03	.00	.02	.01
Manganese (mg/L)	.023		.098	.109	.136	.162
NH3-N (mg/L)	.71		.69	.52	.50	.28
Inlet Press. (PSI)	9	15	15	10	7	12
Outlet Press. (PSI)	8	15	15	11	8	12
Air Scour (Bio 1 or 2)						#1
Backwashing (Bio 1 or 2)						#1

Comments:

Feb 16
Scott added Bio
to filter 1+2
restart 20

BackWash #1 - 22nd

… @ Elk Ridge WTP

Elk Ridge Weekly Log						
Date Feb	23	24	25	26	27	28
Raw Water						
Operating (hr)	2½	2hrs	2.5hr	1.75	1.25	2.0
Iron (mg/L)	2.38	2.39	2.34	2.29	2.33	2.3
Manganese (mg/L)	.064	.098	.106	.123	.092	.092
NH3-N (mg/L)	.71	.68	.61	.65	.75	.75
Outlet Filter 1						
Iron (mg/L)	.13	.02	.05	.04	.00	.18
Manganese (mg/L)	.071	.105	.119	.116	.106	.100
NH3-N (mg/L)	.66	.65	.66	++	.67	.70
Inlet Press. (PSI)	14	12	9	9	4-5	5
Outlet Press. (PSI)	14	10	11	11	6	6
Outlet Filter 2						
Iron (mg/L)	.00	.00	.00	.03	.00	.00
Manganese (mg/L)	.088	.142	.133	.130	.114	.114
NH3-N (mg/L)	.67	.68	.63	.62	.49	.76
Inlet Press. (PSI)	11	10	10	9	5	5
Outlet Press. (PSI)	11	10	10	10	6	6
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:

took 2 pails out of filter 1 as per Mr B.

ran bio ran 2hrs. evening 6:30-8:30

ran 30 min AM

... @ Elk Ridge WTP

Elk Ridge Weekly Log						
Date	Mar 1	Mar 2	Mar 3	4	5	6
Raw Water						
Operating (hr)	2	1.15	1	1		
Iron (mg/L)	2.34	2.35	2.41	2.35	/	~~.095~~ 2.31
Manganese (mg/L)	.089	.093	/	.100	.100	.095
NH3-N (mg/L)	.70	/	/	.92	.91	.74
Outlet Filter 1				/		
Iron (mg/L)	.06	.00	.04	.06	.07	.02
Manganese (mg/L)	.101	.097	.094	.107	.128	.101
NH3-N (mg/L)	.64	.72	.72	.58	.71	.73
Inlet Press. (PSI)	9	5	5	9	12	9
Outlet Press. (PSI)	10	5	6	11	15	10
Outlet Filter 2				/		
Iron (mg/L)	.03	.00	.04	.00	.05	.00
Manganese (mg/L)	.119	.085	.092	.108	.124	.096
NH3-N (mg/L)	.55	.54	.45	.48	.79	.68
Inlet Press. (PSI)	8	5	5	9	10	10
Outlet Press. (PSI)	9	5	5	10	12	10
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:

@ Elk Ridge WTP

Elk Ridge Weekly Log						
Date	Mar 7/24	Mar 8	9	10	11	12
Raw Water						
Operating (hr)	3	3	2	2.25	2½	2.5
Iron (mg/L)	2.35	2.38	2.33	2.36	2.33	2.35
Manganese (mg/L)	.095	.118	.096	.098	.100	.98
NH3-N (mg/L)	.74	.71	.65	.72	.88	.70
Outlet Filter 1						
Iron (mg/L)	.03	.03	.00	.07	.00	.02
Manganese (mg/L)	.100	.118	.100	.107	.099	.100
NH3-N (mg/L)	.71	.74	.63	.66	.80	.81
Inlet Press. (PSI)	9	10	8	12	11	10
Outlet Press. (PSI)	10	11	10	14	12	10
Outlet Filter 2						
Iron (mg/L)	.02	.03	.00	.00	.02	.00
Manganese (mg/L)	.097	.103	.068	.93	.079	.077
NH3-N (mg/L)	.66	.67	.09	.73	.70	.73
Inlet Press. (PSI)	8	8	8	11	11	11
Outlet Press. (PSI)	10	10	10	14	14	10
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

Comments:

Date	Mar 13	Mar 19				
Raw Water						
Operating (hr)	2					
Iron (mg/L)	2.37					
Manganese (mg/L)	.092					
NH3-N (mg/L)	~~77~~	.67				
Outlet Filter 1						
Iron (mg/L)	.08					
Manganese (mg/L)	.090					
NH3-N (mg/L)	.74					
Inlet Press. (PSI)	15					
Outlet Press. (PSI)	15					
Outlet Filter 2						
Iron (mg/L)	.00					
Manganese (mg/L)	.089					
NH3-N (mg/L)	.75	.69				
Inlet Press. (PSI)	15					
Outlet Press. (PSI)	15					
Air Scour (Bio 1 or 2)	/					
Backwashing (Bio 1 or 2)	/					

Comments:

ELK RIDGE UTILITY LTD. - WATER QUALITY DATA

Source		PW7-2014	PW6-2011	PW6-2011	OBS PW5-2000	Sask / Canada Municipal Treated Water AO and MAC
Developed Aquifer		Un-named Aquifer	Un-named Aquifer	Un-named Aquifer	Un-named Aquifer	
Location		Elk Ridge Utility Ltd.	Elk Ridge Utility Ltd.	Elk Ridge Utility Ltd.	Elk Ridge Utility Ltd.	
Lab and Sample No.		SRC	SRC	Sask Disease Control	Sask Disease Control	
		29643	32460	1053954	1042983	
Date Sampled		Sep-17-14	22-Sep-11	22-May-14	Apr-2-13	
Well Completion Depth (metres)		101.50	100.81	100.81	N/A	
Major Constituents						
Bicarbonate, HCO_3	mg/L	656	619	608	608	no criteria
Calcium, *Ca*	mg/L	108	105	109	111	no criteria
Carbonate, CO_3	mg/L	<1	<1	0	0	no criteria
Chloride, *Cl*	mg/L	3	4	14.8	13.5	250
Hydroxide, *OH*	mg/L	<1	<1	0	0	no criteria
P. Alkalinity	mg/L	<1	<1	0	0	no criteria
Magnesium, *Mg*	mg/L	43	40	43	43	200
Potassium, *K*	mg/L	3.6	4.3	5	5	no criteria
Sodium, *Na*	mg/L	36	37	47	48	300 / 200
Sulphate, SO_4	mg/L	23	20	21	19	500
Sum of Ions (calc.)	mg/L	874	829			1500
Total Alkalinity	mg/L	538	507	498	498	500
Total Hardness	mg/L	446	426	449	454	800 / 200
Nutrients/Organics						
Ammonia, as N	mg/L	0.71	0.64			no criteria
Nitrate, NO_3	mg/L	<0.04	<0.04	<0.2	<0.2	45
Organic Carbon, *Total*	mg/L	7.2	8.5			no criteria
Organic Carbon, *Dissolved*	mg/L	7	8.5			no criteria
Trace Constituents						
Cyanide, total	ug/L					200
Fluoride, *F*	mg/L	0.21	0.22	0.21	0.4	1.5
Mercury, Hg	ug/L					1.0
Phosphorous, *P*	mg/L					no criteria
Selenium, *Se*	mg/L	<0.0001	<0.0001	<0.00096		0.01
Trace Metals						
Aluminum, *Al*	mg/L	0.16	<0.0005	<0.00214		no criteria
Arsenic, *As*	ug/L	27.0	23	1.4		25 / 10
Barium, *Ba*	mg/L	0.16	0.16	0.129		1.0
Boron, *Bo*	mg/L	0.13	0.12	0.1		
Cadmium, *Cd*	mg/L	<0.00002	<0.00001	<0.00056		0.005
Chromium, *Cr*	mg/L	<0.0005	<0.0005	0.0003		0.05
Copper, *Cu*	mg/L	0.0012	<0.0002	0.238		1
Iron, *Fe*	mg/L	1.84	1.88	<0.1	<0.1	0.3
Lead, *Pb*	mg/L	0.0004	<0.0001	0.9		0.01
Manganese, *Mn*	mg/L	0.13	0.084	<0.01	<0.01	0.05
Zinc, *Zn*	mg/L	0.0041	<0.0005	0.0851		5
Physical Properties						
Total Dissolved Solids, *TDS*	mg/L	570	546	848	848	1500 / 500
Total Suspended Solids, *TSS*	mg/L		<1			no criteria
Turbidity	NTU		0.1			no criteria
Sp. Conductivity	uS/cm	913	901	919	908	no criteria
pH of Water	pH units	7.96	7.7	7.6	7.6	6.5 - 9.0
Radiochemicals						
Uranium, *total*	ug/L	0.8	<0.0005	0.0006		20

Legend	
MAC - Maximum Acceptable Concentration	Exceeded Sask or Federal AO
AO - Aesthetic Objective	Exceeded Sask or Federal MAC
< Not detected at the concentration stated	

Correlation Coefficient (r)	Description (Rough Guideline)
+1.0	Perfect positive + association
+0.8 to 1.0	Very strong + association
+0.6 to 0.8	Strong + association
+0.4 to 0.6	Moderate + association
+0.2 to 0.4	Weak + association
0.0 to +0.2	Very weak + or no association
0.0 to -0.2	Very weak - or no association
-0.2 to – 0.4	Weak - association
-0.4 to -0.6	Moderate - association
-0.6 to -0.8	Strong - association
-0.8 to -1.0	Very strong - association
-1.0	Perfect negative association

Standard Form of Agreement Between Client and Engineer
(excluding membrane filtration)

STANDARD FORM OF AGREEMENT
BETWEEN
CLIENT AND ENGINEER

THIS AGREEMENT made in duplicate the ___________day of _____________________in the year _____________ by and between the Parties:

The Resort Village of Elk Ridge
211C Arne Petersen Way
Elk Ridge, SK S0J 0N0

hereinafter called the "Client"

and

Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive
Saskatoon, SK S7L 6X6

hereinafter called the "Engineer"

WHEREAS the Client desires that engineering services be rendered by the Engineer for the following project (the “Project”):

Water Treatment Plant Upgrades for the Resort Village of Elk Ridge

located at: 53.895383 N, -105.99162 W Blk/Par EU Plan No. 102323944 Ext 0

Investing in Canada Infrastructure Project Number: 20220101

and as detailed in Schedule B - Project Description, annexed hereto.

NOW THEREFORE, the Client and the Engineer, for the consideration and upon the terms and conditions hereinafter named, **agree as follows**:

ARTICLE I. GENERAL CONDITIONS OF AGREEMENT

The General Conditions of Agreement, annexed hereto in Schedule A, form a part of this Agreement.

ARTICLE II. ENGINEERING SERVICES

The Engineer will perform the services (the “Services”) described in Schedule C - Scope of Services, annexed hereto.

ARTICLE III. FEE

The Client agrees to pay the Engineer the fees and charges as detailed in Schedule D - Fee Basis, annexed hereto, for furnishing the engineering Services described in Article II. Value Added Taxes are not included in the fees and charges and are payable additional thereto.

ARTICLE IV. ENTIRE AGREEMENT

This Agreement, including Schedules A, B, C and D annexed hereto, constitutes the sole and entire agreement between the Client and Engineer relating to the Project. This Agreement may be amended only by written instrument signed by both the Client and the Engineer. This Agreement is for the exclusive benefit of the Parties signatory thereto. It does not create a contractual relationship with or exist for the benefit of any third party, including contractors, subcontractors and their sureties.

IN WITNESS WHEREOF the Parties hereto have duly executed this Agreement.

RESORT VILLAGE OF ELK RIDGE

Per: Marg Smith-Windsor

Authorized Signatory — Mayor

Per: Michele Bonneau

Witness — Chief Administration Officer

Associated Engineering (Sask.) Ltd.

Per:

Authorized Signatory — Title

Per:

Authorized Signatory — Title

SCHEDULE A
GENERAL CONDITIONS OF AGREEMENT

The following provisions, terms and conditions shall apply hereto:

1. DEFINITIONS

1.1 **Agreement:** This form; the Standard Form of Agreement between Client and Engineer, including any and all Schedules annexed hereto.

1.2 **Additional Services:** Services required of the Engineer, which are outside the scope of Services defined in this Agreement and for which the Engineer will be additionally compensated by the Client.

1.3 **CAO:** The Chief Administrative Officer of the Client.

1.4 **Consultant:** Registered professional engineers, architects and other technical specialists, other than the Engineer, engaged by the Client directly.

1.5 **Contractor:** The party contracting with the Client or Owner for the provision of labour, materials and equipment for the execution of the Work.

1.6 **Contract:** The agreement between the Client or Owner and the Contractor for the provision of labour, materials and equipment for the execution of the Work by the Contractor.

1.7 **Contract Documents:** All documents relating to the Work issued by or through the Engineer which are incorporated into the Contract, and all variations and modifications thereto issued by or approved by the Engineer.

1.8 **Contract Time:** The period from the notice to proceed with the Work to the projected completion date for the Contract as agreed between the Client or Owner and the Contractor in the Contract.

1.9 **Not used.**

1.10 **Field Services:** Shall mean making such periodic visits to the Project site at intervals appropriate to the stage of construction as the Engineer, in the Engineer's sole professional discretion, considers necessary to enable the Engineer to ascertain whether the Contractor is carrying out the Work in general conformity with the Contract Documents, or such other Field Services as are stipulated herein.

1.11 **ICIP:** Investing in Canada Infrastructure Program, under which the Ultimate Recipient Agreement between the Client and the Province of Saskatchewan is authorized.

1.12 **Owner:** Where different from the Client, Owner shall mean the party contracting with the Contractor for the execution of the Work, and the party providing the funding for the Project. In such a case, it is assumed and understood that the Client has a master agreement with the Owner authorizing the Client to act on the Owner's behalf in the provision of services or the execution of the work under this Agreement.

1.13 **Project:** The Project described in the recitals to the Agreement.

1.14 **Services:** The Engineer's Services as set forth in this Agreement and the attached schedules.

1.15 **Shop Drawings:** Drawings, diagrams, illustrations, schedules, performance charts and data, technical brochures and other data provided by the Contractor or other third parties to illustrate details of a component or portion of the Work.

1.16 **Statement of Work:** The key outcomes, answers and results required by the Client that the Engineer is expected to achieve through those deliverables as outlined in Scope of Services in Schedule C, and applicable appendices.

1.17 **Substantial Performance:** Shall have the meaning set out in lien legislation in effect at the place of the Work or, if such legislation does not contain a definition, it shall mean that point in time at which the Work is ready to be used or is being used for its intended purpose and is so certified by the Engineer. The term Substantial Completion, used in some jurisdictions, shall have the same meaning.

1.18 **Subconsultant:** Any registered/licensed professional engineer, architect or other technical specialist engaged directly by the Engineer in connection with the Project.

1.19 **Termination Expenses or Suspension Expenses:** Expenses incurred by the Engineer which are directly attributable to termination or suspension of the Services by the Client for reasons beyond the control of the Engineer and shall include the Engineer's expenses reasonably and necessarily incurred in winding down the Engineer's Services.

1.20 **Total Performance:** Shall mean that the Work as appraised by the Engineer has been performed to the total requirements of the Contract Documents and is so certified by the Engineer. The terms Total Completion or Final Completion shall have the same meaning.

1.21 **Ultimate Recipient Agreement or "URA":** Ultimate Recipient Agreement between the Client and the Province of Saskatchewan, attached as Schedule B E2 – Ultimate Recipient Agreement.

1.22 **Value Added Taxes:** Value Added Taxes means such sums as levied upon fees and charges by a Federal, Provincial or Territorial Government and is computed as a percentage of the same and includes the Goods and Services Tax, the Harmonized Sales Tax, the Quebec Sales Tax, the Saskatchewan Sales Tax and any similar tax, the payment or collection of which is imposed by legislation.

1.23 **Work:** The totality of all labour, materials and equipment used or incorporated into the Project by the Contractor pursuant to the Contract Documents.

2. Client's Responsibilities

The Client shall give due consideration to all sketches, drawings, reports, bids, proposals and other information provided to the Client by the Engineer and shall render decisions in a timely manner so as not to delay the work of the Engineer.

The Client shall make available to the Engineer all relevant information or data pertinent to the Project which is required by the Engineer. The Engineer shall be entitled to rely upon the accuracy and completeness of all information and data furnished by the Client, including information and data originating with the Client's Consultants, whether such Consultants are engaged at the request of the Engineer or otherwise. Where such information or data originates either with the Client or with the Client's Consultants, then the Engineer shall not be responsible to the Client for any consequences of any error or omission contained therein.

The Client shall arrange and make provision for the Engineer's entry and ready access to public and/or private property as well as to the Project site, as necessary to enable the Engineer to perform the Services of this Agreement.

The Client shall designate in writing an individual to act as the Client's representative, such person to have complete and exclusive authority to transmit instructions to and receive information from the Engineer.

The Client shall give prompt written notice to the Engineer whenever the Client or the Client's representative becomes aware of any defects or deficiencies in the Work or in the Contract Documents.

The Client shall obtain required approvals, licenses and permits from municipal, governmental or other authorities having jurisdiction over the Project so as to not delay the Engineer in the performance of the Services being rendered under this Agreement.

The Client shall expressly undertake not to enter into contracts in connection with the Project with Contractors or Consultants (or with the Owner, when the Client is not the Owner) which describe duties and responsibilities of the Engineer which are inconsistent with the duties and responsibilities of the Engineer provided for in this Agreement, without first obtaining the Engineer's written agreement thereto.

Where the work to be rendered by the Engineer under this Agreement is for discipline work on a building project designed by others, the Client shall provide electronic drawing files of all applicable building and structural elements, in AutoCAD® format and metric configuration, finalized as to design layout and suitable for use as a reference, prior to the Engineer commencing design Services under this Agreement. Revisions, changes or re-work required to be done by the Engineer as a result of subsequent changes to the finalized design layout, for reasons beyond the Engineer's control, will be deemed Additional Services and, as such, will be at the Client's expense.

In accordance with Canadian anti-spam legislation, the Client consents to the Engineer and its Subconsultants contacting the Client and its personnel through electronic messages relating to the Engineer's Services and other matters of interest to the Client. After the completion of this Agreement, the Client may withdraw any such consent by contacting the Engineer at unsubscribe@ae.ca.

3. Payment of Engineer’s Fee

The Client shall pay the Engineer as provided in this Agreement. The CONTRACT PRICE is all-inclusive except for value added tax or sales tax.

The Engineer’s invoices are due and payable when presented. Accounts unpaid by the Client thirty
(30) days after presentation are subject to monthly interest charges at the rate of 12.0% per annum.

No deduction, holdback or set-off shall be made by the Client from the fee payable to the Engineer.

4. Additional Services

If the Client authorizes the Engineer to do additional work over and above that contemplated in this Agreement, including re-work of plans and specifications for reasons beyond the Engineer’s control, the Engineer shall be additionally compensated based on the time basis fee rate schedule annexed hereto or, lacking such a schedule, such other fee rates as mutually agreed between the Client and the Engineer prior to the commencement of such Additional Services.

5. Construction Emergencies

In the event of any construction emergency which, in the opinion of the Engineer, requires immediate action in the Client's interests, the Engineer shall have authority to issue such orders on behalf of and at the expense of the Client as he may deem necessary or expedient.

6. Variations in Design

The Engineer is empowered to make such deviations, alterations, additions and omissions in carrying out the Services, as the Engineer may reasonably consider desirable in the Client's interests, provided that no additions to the costs of the Contract are caused thereby, and no additional charge is made in the design of the work.

7. Field Services

The level of Field Services to be provided by the Engineer shall be as detailed elsewhere in this Agreement and the schedules annexed thereto.

8. Documents

All documents and drawings prepared by the Engineer, or by others on behalf of the Engineer, in connection with this Project are instruments of professional service for the execution of the Project. The Engineer retains the property and copyright in these documents and drawings, whether the Project is executed or not. These documents and drawings may not be used on any other project or for any other purpose without the prior written agreement of the Engineer.

9. Standard of Care

The standard of care for all services performed by the Engineer pursuant to this Agreement shall be the care and skill ordinarily used by members of the design profession practicing under similar conditions at the same time and locality as the Project. The Engineer makes no warranties, express or implied, under this Agreement or otherwise, in connection with Services.

10. Insurance, Damages & Liability of the Engineer

10.1 The Engineer shall provide and maintain, at its own expense, standard Automobile Liability insurance on all vehicles owned, operated or licensed in the name of the Engineer in an amount not less than $1,000,000.00 inclusive for bodily injury and/or property damage.

The Engineer shall, at its own expense and without limiting its liabilities herein, insure its operations under a policy of Comprehensive or Commercial General Liability, with an insurer licensed in the Province or Territory where the Project is located, in an amount not less than $2,000,000.00 per occurrence, insuring against bodily injury, personal injury, and property damage including loss of use thereof. Such insurance shall include blanket contractual liability.

The Engineer shall provide and maintain, at its own expense, Professional Liability Insurance in an amount not less than $1,000,000.00 per claim. Such insurance shall be applicable to the Services.

10.2 Prior to the date of the execution of this Agreement, if the Client wishes to increase the amount of the coverage, or to obtain other special insurance coverage for this Project, then the Engineer shall cooperate with the Client to obtain such increased or special insurance coverage at the Client's expense.

10.3 In consideration of the provision of the Services rendered by the Engineer to the Client under this Agreement, the Client agrees that any and all claims which the Client has or hereafter may have against the Engineer, the Engineer's servants, employees, subconsultants or representatives, in respect of the Services, howsoever arising, whether in contract or in tort, shall be absolutely limited to:

10.3.1 A period of six years from the date of the Certificate of Substantial Performance or the date of the termination or suspension of the Engineer's Services, or within such shorter period as may be prescribed by any limitation statute in the Province or Territory where the Project is located.

10.3.2 The lesser of the total amount of the Engineer's fee paid by the Client under the terms of this Agreement or $250,000.00.

10.4 If for any reason the Engineer's Professional Liability Insurance is not available or does not apply to any claim made by the Client against the Engineer in respect of the Services, then the liability of the Engineer to the Client under this Agreement shall be absolutely limited to the re-performance at the Engineer's own cost of those Services which are proven at law to constitute errors, omissions or negligent acts on the part of the Engineer or anyone for whom the Engineer may be responsible at law.

The Engineer's liability with respect to any claims arising out of this Agreement shall be absolutely limited to direct damages arising out of the Services, and the Engineer shall bear no liability whatsoever for any consequential loss, injury or damages incurred by the Client, including but not limited to loss of profit, revenue, production, business, contracts or opportunity and increased cost of capital, financing or overhead.

10.5 It is further agreed that the Engineer shall not be liable for damages, interest, costs or any other expense arising out of the failure of any manufactured product or any manufactured or factory assembled system or components to perform in accordance with the manufacturer's specifications, advertising, product literature or written documentation on which the Engineer reasonably relied during the preparation of the design or the Contract Documents.

10.6 In those instances where the Engineer makes use of third-party software and other intellectual property in the course of providing the Services, the limitation of liability that exists between the third party provider and the Engineer shall, with the necessary changes, apply equally between the Engineer and the Client.

10.7 For the purposes of the limitation provisions contained in the Agreement of the Parties herein, the Client expressly agrees that it has entered into this Agreement with the Engineer, both on its own behalf and as an agent on behalf of its employees and principals. The Client expressly agrees that the Engineer's employees and principals shall have no personal liability to the Client in respect of a claim, whether in contract, tort and/or any other cause of action in law. Accordingly, the Client expressly agrees that it will bring no proceedings and take no action in any court of law against any of the Engineer's employees or principals in their personal capacity.

10.8 Where the Client is any form of municipal, local, provincial or federal government or agency, the Client expressly agrees that if the services provided by the Engineer or its principals, employees and subconsultants are the type that if provided by the officers or employees of the Client would bring into play statutory indemnification protection for the benefit of the Client or its officers and employees, the Client will indemnify the Engineer and its principals and employees to the same extent and under the same circumstances as the statutory indemnification would extend to the Client and its officers and employees. Examples of the services that are to be covered by this provision include but are not limited to the following:

(i) review of rezoning applications;
(ii) review of land use plans;
(iii) review of subdivision submissions;
(iv) review of building permit applications;

(v) review for building code compliance;
(vi) review of stormwater management, flood routing, or drainage plans; and
(vii) review of environment management plans.

11. Occupational Health and Safety Act

11.1 The Engineer acknowledges that the Engineer is an employer as defined in the Occupational Health and Safety Act, and will, as a condition of this Agreement, comply with the Occupational Health and Safety Act of the authority having jurisdiction and the regulations thereto in relation to the Engineer's own employees.

11.2 It is agreed that the Engineer shall not be responsible for the Contractor's means, methods, techniques, sequences, procedures or the safety and coordination of the Work. The Contractor shall be solely responsible for ensuring that any and all Occupational Health and Safety Acts and regulations are complied with. In particular, the Engineer shall not be required to accept the role or obligations of Prime Contractor with respect to such Acts.

12. Termination or Suspension by the Client

If the Engineer is shown to be in default in the performance of any of the Engineer's material obligations as set forth in this Agreement, then the Client may, by written notice to the Engineer, require such default to be corrected. If, within 30 days of receipt of such notice, such default has not been corrected or reasonable steps to correct such default have not been taken, the Client may, without limiting any other right or remedy the Client may have, immediately terminate this Agreement and make such settlement for the cost of the Services rendered and disbursements incurred by the Engineer pursuant to this Agreement and remaining unpaid as of the effective date of such termination.
12.1 If the Client is unable or unwilling to proceed with the Project, the Client may suspend or terminate this Agreement by giving 30 days written notice to the Engineer. Upon receipt of such written notice, the Engineer shall perform no further Services other than those reasonably necessary to suspend or close out the Project. In such event, the Engineer shall be paid by the Client for all Services performed and for all disbursements incurred pursuant to this Agreement, plus expenses incurred by the Engineer which are directly attributable to termination or suspension, including expenses reasonably and necessarily incurred in winding down the Engineer's Services under this Agreement.
12.2 If the Project or any part thereof is abandoned at any stage or if any stage of the Engineer's Services is unduly delayed for reasons beyond his control, or if the contracts for the construction and installation of the Work are not awarded within 60 days after the completion of the drawings and specifications, the Engineer shall be entitled to payment as called for in this Agreement, including, if applicable, termination expenses.

13. Termination by the Engineer

If the Client is shown to be in default in the performance of any of the Client's material obligations set forth in this Agreement, including payment of the Engineer's fee as required herein, then the Engineer may, by written notice to the Client, require such default to be corrected. If, within 30 days after receipt of such notice, such default has not been corrected, the Engineer may, without limiting any other right or remedy he may have, immediately terminate this Agreement. In such an event, the Engineer shall not be liable for delay or damages as a result of the suspension or termination and the Client shall pay the Engineer for all Services performed and for all disbursements incurred by the Engineer pursuant to this Agreement and remaining unpaid as of the effective date of such termination, plus expenses incurred by the Engineer which are directly attributable to termination or suspension, including expenses reasonably and necessarily incurred in winding down the Engineer's Services under this Agreement, in addition to any other rights or remedies the Engineer may have.

If the Engineer's Services are suspended by the Client for any time for more than 30 cumulative consecutive or non-consecutive days through no fault of the Engineer, then the Engineer shall have the right at any time until such suspension is lifted by the Client, without limiting any other right or remedy the Engineer may have, to terminate this Agreement upon written notice thereof to the Client. In such an event, the Client shall pay the Engineer for all Services performed and for all disbursements incurred by the Engineer pursuant to this Agreement and remaining unpaid as of the effective date of such suspension, plus expenses incurred by the Engineer which are directly attributable to suspension, including expenses reasonably and necessarily incurred in winding down the Engineer's Services under this Agreement.

14. Dispute Resolution

In the event of a dispute arising the Client and the Engineer shall first use their best efforts to resolve the dispute or difference of opinion under or in connection with this Agreement by good faith amicable negotiations on a "without prejudice" basis, and shall provide frank, candid and timely disclosure of all relevant facts, information and documents to facilitate negotiations.

If a claim, dispute or controversy cannot be resolved by the project personnel, senior executives of the Client and Engineer, upon the request of either party, shall meet as soon as conveniently possible, but in no case later than thirty (30) days after such a request is made, to attempt to resolve such claim, dispute or controversy. If after meeting the senior executives determine that the claim, dispute or controversy cannot be resolved on terms satisfactory to both parties, the parties shall submit the claim, dispute or controversy for the legal remedy.

15. Notices

All notices required by this Agreement to be given by either Party shall be deemed to be properly given and received within three business days if made in writing to either Party by certified mail, facsimile or personal delivery, addressed to the regular business address of such other Party. Notices sent by email shall not be deemed properly given and received unless proof of receipt can be furnished by the sender.

16. Successors and Assignment

This Agreement shall inure to the benefit of and be binding upon the Parties hereto, and except as hereinafter otherwise provided, their executors, administrators, and successors and permitted assigns.

If a Party to this Agreement who is an individual should desire to bring in a partner or partners, or if a Party which is a partnership should desire to bring in a new partner or partners to share the benefit and burden of this Agreement, he or they may do so provided the additional parties covenant directly in writing with the other parties to be bound by the provisions of this Agreement.

Except as aforesaid, neither Party may assign this Agreement without the consent in writing of the other.

17. Joint and Several Liability

Where the Client is a joint venture, partnership or consortium each member of such joint venture, partnership or consortium shall be jointly and severally liable for the obligations of the Client under this Agreement.

18. Pollutants and Hazardous Wastes

The Client recognizes that projects involving pollutants and hazardous wastes, as defined below, create extraordinary risks. In consideration of said extraordinary risks and in consideration of the Engineer providing Services to the Client on a Project which involves pollutants and hazardous materials or waste, the Client agrees that the Engineer's liability to the Client with respect to any matter in any way arising out of the Engineer's involvement with pollutants and hazardous wastes associated with this Agreement shall be limited to or otherwise protected against as provided herein.

18.1 The Engineer's liability to the Client in connection with pollutants and hazardous wastes is absolutely limited, both in contract and in tort, for any and all claims arising out of or in conjunction with the Project to a total aggregate amount not to exceed the cost of re-performance of the Services at the sole cost of the Engineer for that portion of the Services proven to be in error. This limitation is irrespective of the liability of the Engineer to the Client, which may otherwise be provided under this Agreement for claims unrelated to pollutants and hazardous wastes.

In further consideration of the Engineer providing Services to the Client on a Project involving pollutants and hazardous wastes, the Client agrees that in connection with incidents and claims initiated by third parties involving pollutants and hazardous wastes, the Client (to the extent that the Engineer is not covered by insurance in respect thereof) shall indemnify, defend and hold harmless the Engineer of and from any and all suits, actions, legal, administrative or arbitration proceedings, claims, demands, damages, penalties, fines, losses, costs and expenses of whatsoever kind or character, arising or alleged to arise out of the Services of the Engineer to the Client or any claims against the Engineer arising or alleged to arise from acts, omissions or work of others. Such indemnification shall apply to the fullest extent permitted by law, regardless of fault or breach of contract by the Engineer and shall include the fees and charges of lawyers in defending or advising the Engineer as to such claims under the Agreement. Without limiting the generality of the foregoing, such indemnity extends to claims which arise out of the actual or threatened dispersal, discharge, escape, release or saturation (whether sudden or gradual) of any pollutant or hazardous waste in or into the atmosphere, or on, on to, upon, in or into the surface or subsurface soils, water or water courses, persons, objects or other tangible matter.

Nothing herein shall relieve the Engineer from obligations to provide the Services required by this Agreement, and generally as required by standard engineering practice, current as of the date of the performance of the Services. Nothing herein shall apply to claims, damages, losses or expenses which are finally proven to result from the Engineer's intentionally wrongful acts.

For the purposes of this Agreement, “pollutants and hazardous wastes” shall mean any solid, liquid, gaseous or thermal irritant or contaminant, including without limitation, smoke, vapour, soot, fumes, acids, alkalis, chemicals and waste, pollutants and hazardous or special wastes as defined in any federal, provincial, territorial or municipal laws.

SCHEDULE B
PROJECT DESCRIPTION

B.1 Objective and Purpose

The main objective of this project is to increase the water treatment capacity and water quality of the Resort Village of Elk Ridge 's water treatment plant in order to meet provincial drinking water quality standards for current and future community population of the Resort Village of Elk Ridge.

The project output includes replacement of the existing filtration equipment with treatment technology better suited for the raw water source, including modifications to the existing mechanical, electrical and control systems to suit. Raw water supply capacity will also be improved by installation of new well pumps and a pre-filter unit to address present issues with sediment in the source water.

B.2 Project Start Date:

The start date for this project shall be no later than **January 10, 2025.**

B.3 Project Completion Date:

The completion date for this project shall be no later than **March 31, 2027.**

B.4 Approach to Project Execution

This Project shall be executed in the following two phases:

a) Phase I – Preliminary Design. The Preliminary Design Phase shall focus on defining the Project requirements and constraints, and selection of the best-value approach and technology for upgrading the water treatment plant, including the following components:
   - I. Assess and recommend raw water supply system improvements for sediment removal.
   - II. Assess and recommend new filtration equipment (excluding membrane filtration) targeting ammonia, iron, and manganese, including:
     - i. Replacement of filter face piping and connections to existing process piping,
     - ii. Replacement of backwash pump(s), piping and connections,
     - iii. Implementation of instrumentation and control equipment, and
     - iv. Removal of existing filters (as required).
   - III. Assess and recommend repairs and modifications to water treatment plant building.
   - IV. Assess and recommend repairs and modifications to electrical and mechanical works.
   - V. Investigate and recommend temporary works to maintain water supply during construction.
   - VI. Investigate and recommend distribution pumping system improvements.
   - VII. Investigate and recommend treated water storage improvements to increase capacity.

b) Phase II – Detailed Design, Engineering, Procurement, and Construction (“EPC”). The EPC phase involves refining the initial concepts and creating comprehensive designs and specifications necessary for construction and operation, including:
   - i. Work associated with detailed design, engineering, procurement and expediting of requisite technologies, materials, equipment and construction services, project management and reporting, and operator training.

   Phase II is NOT included in the scope of this Agreement and will be added upon completed of Phase I, in accordance with Article 3 – Additional Services of Schedule A – General Conditions of Agreement.

The key activities and deliverables expected of the Engineer for each phase of the Project shall be prescribed in Schedule C – Scope of Services.

B.5 General Requirements Governing Project Execution

a) Compliance With Laws. The Project must be executed and completed in compliance with all statutes, regulations, codes and standards required by all governments and regulatory bodies that have authority on the Project or how the Work is performed.

b) Awarding of Contracts. All Contracts will be awarded in a way that is fair, transparent, competitive and consistent with value-for-money principles as specified in Appendix A - Investing in Canada Infrastructure Program Awarded Contract Policies and Procedures.

c) Operational Communications. Calls for tender, construction notices, precautionary boil water advisories, public safety notices, service disruption notices, shall be coordinated through the Resort Village of Elk Ridge. Where appropriate, communications about the project should include the following statement, “This project is funded in part by the Government of Saskatchewan and the Government of Canada.”

d) Periods of Construction to Minimize Service Disruptions. Best efforts should be made to mitigate the distribution of treated water to the consumers in the Resort Village of Elk Ridge. As such, the recommended period for execution of demolition, de-construction and construction work is between January 5 and March 31

.

SCHEDULE C
SCOPE OF SERVICES

C.1 General Requirements

The Resort Village of Elk Ridge is seeking a qualified provider for Engineering, Procurement and Project/Construction Management Services for Water Treatment and Distribution. The engineer must have offices in Saskatchewan. The Engineer shall appoint qualified personnel to the Project who are experienced in the following:

a) The design, engineering, planning and execution of Water Treatment and Distribution Projects in Saskatchewan and Canada
b) The operation of Water Treatment Plants (e.g. Class I, II, III, etc.)
c) The planning, project management, administration and execution of ICIP projects, in the province of Saskatchewan
d) Who are current on the latest performance trends and technologies of water treatment
e) Available and competent to execute and deliver the outcomes, activities and deliverables prescribed and implied in Schedule B – Project Description, and Schedule C – Scope of Services.

C.2 Scope of Services Pertaining to Phase 1: Preliminary Design

The Preliminary Design Phase shall focus on defining the Project requirements and constraints, and selection of the best-value approach and technology for water treatment.

a) Key Activities: The Engineer's Work during this phase include, but are not limited to the following key activities:

   i. Conducting preliminary assessments (site analysis, environmental impact studies, etc.)
   ii. Evaluating best-value option and technology for water treatment
   iii. Engaging Resort Village stakeholders for input and requirements
   iv. Evaluating potential technologies and methods for water treatment other than membrane filtration, including recommendation of the best-value option for resolving sediment issue in raw water supply and water treatment
   v. Defining and recommendation a final design and scope of work
   vi. Developing initial cost estimates, for final design and scope of work, including a breakdown of which components are "eligible" and "non-eligible" for ICIP funding.
   vii. Creating a project schedule
   viii. Identifying regulatory and permitting requirements

b) Deliverables: During this phase, the Engineer agrees to produce the following deliverables:

   i. **Draft Preliminary Design Report**: A draft Preliminary Design Report shall be submitted to the Resort Village of Elk Ridge ("Report"). The Report shall be based on the Engineers best advice and include the following elements:
      - Design Basis. The Report shall recommend the design basis in consideration of the following:
         - Appendix B - Technical Statement of Work, including it's attached reference documents to Appendix B, which are listed as the following exhibits:
            - Apdx B E1-Oct 3. 2022 BCL Water Treatment Assessment Report
            - Apdx B E2A-2022 ICIP Application
            - Apdx B E2B-Ultimate Recipient Agreement
            - Apdx B E3-Description of Groundworks for Well PW7-2014
            - Apdx B E4-2014 Beckie Hydrogeologist Report (Page 7 only)
            - Apdx B E5- 2023 Treated Water Certificate of Analysis Report
            - Apdx B E6- 2023 PW6-2011 Well Raw Water Certificate of Analysis Report
            - Apdx B E7-2024 Gaudet Greensand Bench Test Report
            - Apdx B E8-2024 Drop Solutions Biological Filtration Study Project Report
         - The design basis shall also consider factors and data collected from an onsite visit, historical performance data and insights provided by staff, best practices for plant control and automation, and stakeholder interviews.
      - Drawings and Sketches. The Report shall include preliminary sketches, such as a site plan, water treatment plant floor plan, and process flow diagram, to depict the design basis described in the Report.
      - Priorities. The Report shall identify those priority items which are necessary and eligible within the budget of the ICIP grant funding.
      - Schedule. The Report should present a schedule to complete the proposed work and include an assumed timeline for completion of Phase II activities, to provide an understanding of the project timelines relative to the ICIP grant funding deadlines (March 31, 2027).

- Report Exclusions. The Report should exclude repeating information already provided in Appendix B or any of the reference technical exhibits attached to Appendix B, unless requested to do so by the Resort Village or if deemed necessary. To be clear, the Engineer should avoid spending person-hours repeating work or incurring cost for work already performed in other technical studies, unless deemed necessary.
- Cost Breakdown. An opinion of probable costs is required, as well as opportunities and risks associated with ongoing operating and maintenance costs. The opinion of probable costs should consider Section 5 of Apdx B E2A – 2022 ICIP Application, and the Engineer should consider the cost as a constraint on the scope, excluding escalation of costs experienced between 2022 and 2026 for which adjustments are expected. In 2022, the total Project costs were estimated to be $1,100,000 and the ICIP eligible costs were estimated to be $1,085,000. Paragraph 9 estimates the cost breakdown as:
  - Design/Engineering: $95,000
  - Construction/Materials: $770,000
  - Contingency: $195,000
  - Project Planning: $25,000

  The cost breakdown shall include an opinion of probable costs for construction as well as a breakdown of all the Engineer's costs associated with producing each of the deliverables outlined in Phase II of the Project. This information is necessary to refine the Engineer's scope for Phase II. For example, some elements such as Procurement Work, Bidding Packages, etc. may be performed by other parties. The cost escalation factors, and forecast should be provided in the updated estimate.
- Variances to Exhibit 2A-2022 ICIP Application. All variations in proposed scope or estimated costs in Section 5 of Exhibit 2A will require explanation in the Report, which may require the Engineer to make its own opinion of the assumptions in the Exhibit 1 – 2022 BCL Water System Assessment, the Project and the Exhibit 2A-2022 ICIP Application.

ii. **Stakeholder Meetings.** Meeting with stakeholders, including an onsite meeting with the utility staff, and a final meeting with Resort Village Council to review and approve, amend recommendations in the draft Report. Request that Resort Village be given ten days' notice for any onsite visits.

iii. **Final Preliminary Design Report.** Upon receiving comments and hearing decisions by the Resort Village as to the scope of design and construction of Phase II of the Project, the Engineer will revise, produce and submit a final copy of the Report.

iv. **Amended Contract.** An updated form of Agreement between the Resort Village and Engineer for completing Phase II of the Project.

v. **Progress Reports.** Upon request of the Chief Administrator Officer, the Engineer shall provide a progress report on the ICIP project, which shall contain the following information:
   - Canada's contribution funding to the Project by Fiscal Year;
   - Construction start and end dates (forecasted/actual);
   - Progress tracker (e.g., percent completed);
   - Risks and mitigation strategies, as required;
   - Confirmation that the Project is on-track to achieve expected results (e.g. sediment removal, water quality, capacity, etc.)

vi. **Regulatory Approvals.** If required, the Engineer will identify any necessary regulatory approvals and permits required during this phase and provide the information and documents necessary to the Resort Village to facilitate approval from the applicable agency.

SCHEDULE D
FEE BASIS

The Client agrees to pay the Engineer an all-inclusive lump sum fee of $68,000.00, except for Value Added Taxes and sales tax. Additional fees for the project will be determined based on the attached Rate Schedule, General Conditions of Agreement, and scope of work.

In accordance with the terms of the Kinetic GPO agreement, the rate schedule will be reviewed and adjusted annually on January 1st of each year, starting on January 1st, 2026. Rates listed here are effective as of the date of this agreement.

ASSOCIATED ENGINEERING (SASK.) LTD.

Saskatchewan/Manitoba Operation

CLASSIFICATION RATE SCHEDULE

Rates Effective Until January 1, 2026

Level	Engineer (E)	Landscape Architect (Z)	Planner (N)	Geologist / Geoscientist (P)	Biologist / Agrologist / Environmental Scientist (C)	Technician / Technologist (T)	Specialist Consultant (R)	Project Administrator / Support (S)	Limited License (L)
0	$105	$100		$100	$100	$87			
1	$140	$131	$103	$125	$125	$109		$84	
2	$160	$152	$115	$153	$153	$128		$95	
3	$187	$183	$139	$188	$188	$139	$206	$106	
4	$220	$216	$157	$225	$225	$160	$250	$124	
5	$258	$247	$168	$257	$257	$172	$305	$128	
6	$278	$297	$192	$283	$283	$197	$345		
7	$305	$322	$212	$320	$320	$212			

NOTES:

1. These rates conform generally with guidelines published by ACEC Saskatchewan and Manitoba.
2. Overtime for professional staff will be billed at straight time; overtime for technicians and support staff will be billed at straight time rates plus twenty percent (20%). Overtime is calculated for hours worked beyond the regular hours per day.
3. Rates in effect to the earlier of project completion or December 31, 2025
4. Disbursements for reproduction, communications, local transportation (within one-hour radius of office) and computer charges will be billed at five percent (5%) of labour fees. Other disbursements such as travel expenses, accommodations and meals will be billed at invoiced cost additional to the 5% base disbursement fee.
5. Subconsultants retained by Associated Engineering (Sask.) Ltd. will be billed at cost plus a mark-up of ten percent (10%) to cover costs of handling, financing and liability insurance.
6. Federal Government Goods and Services tax will be applied in addition to the charge-out rates.
7. Invoices are due and payable upon receipt. Overdue invoices will accrue interest at eighteen percent (18%) per annum, calculated monthly or as stipulated in the Client/Engineer Agreement.

APPENDIX A
INVESTING IN CANADA INFRASTRUCTURE PROGRAM AWARDED CONTRACT POLICIES AND PROCEDURES

Investing in Canada Infrastructure Program Awarded Contract Policies and Procedures

POLICY:

As outlined in Section 7 of the Investing in Canada Infrastructure Program (ICIP) Ultimate Recipient Agreement, the Ultimate Recipient will ensure that Contracts will be awarded in a way that is fair, transparent, competitive and consistent with value-for-money principles, or in a manner otherwise acceptable to Saskatchewan, and if applicable, in accordance with international and domestic trade agreements. These trade agreements, include, but are not limited to: *the Canadian Free Trade Agreement, the New West Partnership Trade Agreement*, and *the Canada-European Union Comprehensive Economic and Trade Agreement*.

For information on procurement and trade obligations, please contact:

- Carl Macdonald, Procurement Advisor with the Saskatchewan Urban Municipalities Association (SUMA) at 306-525-4395 or munprocurement@suma.org
- Amanda Kozak, Member Purchasing Advisor with the Saskatchewan Association of Rural Municipalities at 306-761-3722 or akozak@sarm.ca
- Information on procurement policies and procedures can be found on the Priority Saskatchewan website at www.saskbuilds.ca (refer to Priority Saskatchewan tab at top of page).

Records may be requested in support of inspection and audit as outlined in Section 10 d) of the Ultimate Recipient Agreement. Records that may be requested include, but are not limited to, tendering documents, bid proposals, and procurement policies.

This Awarded Contract Policies and Procedures document should be given to your engineers and/or contractors so they are fully aware of the conditions.

REQUIREMENT:

A completed Awarded Contract Checklist must be submitted to the Ministry of Government Relations for contractors and suppliers that will provide **total estimated goods and/or services of $30,000 or more** on your project prior to the reimbursement of costs claimed on a Request for Payment. The checklist must be signed by the Mayor, Reeve, CEO, Administrator, or any authorized delegate.

Please note that the checklist is only required one time for each contractor/supplier.

OTHER INFORMATION:

Sole Sourcing:

Non-competitive contracts that fall under the following criteria are eligible and **do not** require approval from Infrastructure Canada (INFC):

- Costs are related to ineligible activities or are otherwise not included in the Total Eligible Costs for a project;
- Contract is for construction or goods and is $40,000 or less; or
- Contract is for service and is $100,000 or less.

Sole sourcing for the following must be **approved in advance** by INFC:

- The contract is for less than $500,000;
- The contract is with a public sector entity;
- The contract can only be performed by one person or entity;
- The contract is entered into by an Indigenous ultimate recipient;
- The contract is entered into with an Indigenous organization/governing body, and there is a benefit to an Indigenous community; or
- The contract addresses a state of emergency that has been declared.

Non-competitive contracts that do not fall within any of the above will require federal Treasury Board approval. Obtaining Treasury Board approval is a lengthy and resource intensive process that may take several months and will require a strong rationale for the non-competitive procurement process as well as more complex and in-depth information requirements.

Advanced Contract Award Notice:

Instead of Sole Sourcing, recipients can post an Advanced Contract Award Notice (ACAN). The ACAN must be posted on SaskTenders for a period of no less than 10 business days. ACAN is a practice that is accepted by Canada and is also a less administratively heavy and quicker option with less risk of delays or rejection. Information is available on the federal government's website regarding this practice: Chapter 3 - Procurement strategy | CanadaBuys.

Group Purchasing Order:

Kinetic/Central Source is a Group Purchasing Organization (GPO) that SUMA has an agreement with for its membership. It is a standing offer, that has been tendered according to provincial and national procurement standards, that municipalities can acquire services from.

INFC has reviewed and accepts this specific procurement process and does not consider it a sole source contract as:

- The work is not carried out by the Group Purchasing Organization but is contracted out by the company.
- Requests for work are publicly tendered requests for Standing Offers, which have been determined to be eligible.
- Requests for work follow similar procedures as RFPs, with seeking a minimum threshold for quality, service, experience. The only discernable difference is that a 3-year contract is signed with the successful applicants, instead of on a per-project basis. This allows for easier and cheaper completion of infrastructure projects in the community.

Own Force Labour:

Own-force labour costs require pre-approval from INFC. In requesting to use Own-Force Labour, the recipient needs to demonstrate the following to INFC:

- The Own-Force Labour costs are not otherwise ineligible under the program.
- The employee is engaged in work that would otherwise have been contracted out by the recipient for a project.

- The requested costs are Incremental:
  - Costs are associated with extra hours worked by an employee as a result of the project (e.g. overtime).
  - Costs are associated with backfilling the position of an employee who is assigned to the project or hiring a new employee.
- Due to unique circumstances, it is not economically feasible to tender a contract for the work:
  - There is a lack of private sector capacity to undertake the work (e.g. in a very remote community).
  - The work involves proprietary or specialized infrastructure or equipment that requires specific knowledge or skill.

If there are any questions relating to these policies or procedures, please contact the Ministry of Government Relations.

APPENDIX B
TECHNICAL STATEMENT OF WORK

1) Purpose of Document

This document provides key information believed to be necessary to achieve the key outcomes, answers and results required by the Resort Village of Elk Ridge that the Engineer is expected to achieve through the development of the Preliminary Design Report, as outlined in Phase 1, in Schedule C – Scope of Services.

2) Overview of Water Treatment Process

The current water treatment plant was commissioned in 2000 with fire suppression upgrades being installed in 2007 and reservoir bypass upgrades in 2018. Figure 1 below shows an overview of the current Water Treatment and Distribution Process. Details about each sub-system in the process can be found in the attached Exhibit 1-2022 BCL Water Treatment Assessment.

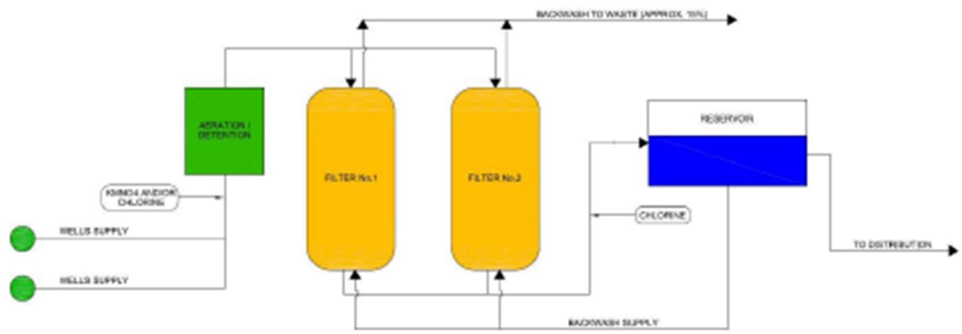


Figure 1: Overview of Resort Village of Elk Ridge Water Systems and Subsystems. Filters contain Greensand Plus media.

3) Priority 1: Resolve Entrained Sand in Raw Water Supply

a) **Baseline Situation.** Currently there are two raw water production wells named Well PW6-2011 and PW7-2014. Each well is designed and licensed to produced 58 imp. gallons/minute each and cannot be operated at the same time nor operated continuously. Well, PW7-2014 has been deemed by utility staff as “unusable” due to its high sediment production which significantly reduces the effectiveness and efficiency of downstream treatment processes. This also places a constraint on raw water supply and increases the risk of the have no raw water supply in the event of pump failure. In 2024, plant staff took steps to procure a pre-screen filter and containment tank, however, other equipment and materials to construct a pre-screen filter are outstanding.

b) **ICIP Eligibility.** It is the Resort Villages’ understanding that new well-pumps and pre-treatment unit is eligible for ICIP funding. It is unclear as to whether drilling and construction of a new well would be eligible for ICIP funding.

c) **Statement of Work.** Determine whether best value approach to dealing with the entrained sand.
   i. Based on Apdx B Exhibits 1,2A, 2B the Project called for the design and installation of a pre-filter system to deal with the sediment from the raw water supply. Recently, the utility staff have procured a pre-screen filter and containment tank but have yet to fully install the pre-filter unit.

ii. Is the current direction t hat the utility operators are taking for pre-filtering the sediment adequate for current and upgraded design? Will the planned and purchased unit fully integrate within the future upgraded water treatment process design?

iii. What is the risk level with the current raw water supply infrastructure? Does the Resort Village have adequate water supply with the two wells? Should a new well be drilled and constructed, and if so, when?

iv. Confirm as to whether drilling and construction of a new well would be eligible for ICIP funding.

4) Priority 2A: Verify Water Treatment Capacity

a) **Baseline Situation.** In the 2022, Water Treatment Assessment, the current population was estimated at 300 persons. The estimated future population was forecasted 480 persons (Year 2042) and the growth rate per year was assumed to be 2.4%. The current treatment flow capacity is 3.8 L/sec and the design capacity for the future was calculated to be 6.1 L/sec. (see Apdx B Exhibit 1 – 2022 BCL Water System Assessment)

The 2019 Elk Ridge Municipal Community Census reported that there were 122 Permanent Residents, 371 Seasonal Residents, and 203 temporary residents who occupied rental properties with the rental accommodations. (i.e. 696 total permanent + seasonal + temporary residents). Since, the 2019 Census there has been approximately 11 residential home builds, 1 rental cottage, and 67 seasonal RV lots established. In future, it is forecasted by 2044 that 1 municipal office building will be established, a 36-unit condo building, a general store, and 41 residential home-builds, and 42 additional RV lots may be added.

b) **ICIP Eligibility**. It is the Resort Villages' understanding that increased water treatment capacity is eligible for ICIP funding.

c) **Statement of Work.** It is unknown whether the future design capacity in the 2022 Water System Assessment adequately considered the seasonality impacts of water demand (i.e. peak demand due to seasonality population increases in the summer). It is requested the Engineer review the historical water supply and demand data with the utility staff and provide an opinion as to the adequacy of the forecasted design capacity requirements as specified in Apdx B E1.

5) Priority 2B: Upgrade Water Filtration Capacity and Improve Water Quality Performance

a) **Baseline Situation.**

i. <u>Detention Process.</u> Raw water entering the plant is metered and dosed with sodium hypochlorite prior to entering a detention tank. The tank is 1.22 min diameter by 1.52 min height, with an approximate volume of 1,800 L. The detention time is estimated to be in the order of 8 minutes. Due to the lengthy oxidization reaction time of manganese, the detention process is not likely to provide any significant improvement to the removal of this constituent.

ii. <u>Greensand Plus Filtration Treatment.</u> Following detention, raw water flows through two Greensand plus pressure filters operated in parallel. The filters are 1.22 min diameter by 2.13 m tall, operated at a rate of 1.9 Lis each (3.8 Lis total). For raw water of poor to fair quality, the recommended operating flux for manganese greensand filters is 1.0 - 1.6 L/s/m2, which equates to 1.2 - 1.9 Lis each (2.4- 3.8 Lis total). Therefore, the filters are operating at the high end of the recommended range, considering the raw water quality. Operations personnel report deteriorating treated water quality when operating above this rate. In addition, new greensand filtration media was installed in the spring of 2024. Operators report that after the media replacement a significant improvement in the treatment of manganese and iron was observed, but they are still experiencing elevated levels of ammonia, which often creates challenges with balancing the correct dosages of chlorine.

The filters are backwashed based on pressure differential, typically producing approximately 180 m3 of treated water between backwash cycles. The backwash process is conducted manually, with a dedicated backwash pump, consisting of 15 minutes per filter at a rate of 11 Lis. No air scour is provided. This equates to a backwash consumption rate in the order of 10% of total water use. The filters are regenerated every few months. The Operators avoid using well PW7, as the sediments from the source quickly build up in the filters and drastically reduce filtration rates.

iii. <u>Chemical Treatment and Dosage.</u> Following filtration, clarified water is dosed with additional sodium hypochlorite for disinfection followed by deposition to the treated water storage reservoirs. The only chemical used for treatment is a 12% liquid sodium hypochlorite solution (Hypochlor-12 by ClearTech Industries), which is dosed prior to detention and following filtration. The Operators vary the dosing rates frequently in response to daily free chlorine residual levels. Based on the daily records, the dosing rates ranged from 7 - 15 mg/L prior to detention and 0.5 - 3 mg/L following filtration, for a total dosage rate in the order of 7.5 - 18 mg/L. This is below the maximum use rate of 103 mg/L for this product, as per NSF60 standards for drinking water chemical use. The frequent variability of the dosing rates suggests that a constituent in the raw water, such as ammonia or organic material, is reacting with the chemical. The greensand media was replaced in the spring of 2024. Operators report that after the media replacement a significant improvement in the treatment of manganese and iron was observed, but they are still experiencing elevated levels of ammonia, which often creates challenges with balancing the correct dosages of chlorine.

iv. <u>Bio-Filtration Pilot Study</u>. A bio-filtration pilot was conducted between November 2023 to March 2024. The report of the study and findings is attached as Apdx B E8-2024 Drop Solutions Biological Filtration Study Project Report. The feasibility and value of bio-filtration as a capacity and quality upgrade for water treatment is questionable. As a result, a bench test and quality study was subsequently conducted by Gaudet Scientific as Apdx B E7-2024 Gaudet Greensand Bench Test Report. Biofiltration as a solution still remains as an economic means to achieving the upgrade objectives remains in question.

b) **ICIP Eligibility.** It is the Resort Villages' understanding that water treatment capacity improvements and quality improvements are eligible for ICIP funding.

c) **Statement of Work.**

i. Consider the future of the detention tank and process in the future design. Should it be upgraded, remain “as-is” or removed from the treatment process?

ii. Upgrade capacity and optimize the treatment process, as the current capacity of the filtration process is at its upper limits and will not be sufficient for future population growth. Consider expansion of existing greensand technology or alternative treatment technologies (excluding membrane filtration) and avoid extensive study of biofiltration, unless it’s the Engineer’s opinion from the provided reports that biofiltration is the best-value approach. Minimize backwash frequency and waste, if possible and consider requirements for increased raw water supply if necessary. Consider pre-treatment of sediments from wells or drill a new well. Consider replacing manual processes with automation. Holistically, assess best value for community needs. Avoid any further pilots unless absolutely necessary.

iii. Assess and optimize WSA standards and targets for water quality. The upgraded water treatment solution should achieve parity of current water quality performance or improve the water quality and improve the efficiency of the chemical treatment process. Holistically, assess best value for community needs.

6) Priority 3: Provide Recommendations for Water Storage and Distribution

a) **Baseline Situation.** Storage of treated water is provided by two subgrade concrete reservoirs and a pump well. The pump well is located under the water treatment plant and has storage capacity of approximately 34,000 L. Reservoir #1 is also located under the water treatment plant building and has a storage capacity of approximately 155,000 L. Access to the pump well and reservoir #1 is provided by a raised hatch located within the building. Reservoir #2 is located immediately southwest of the plant and has a storage capacity of 222,000 L. A raised access hatch with lockable cover is provided. Total facility storage volume is 411,000 L. Well pumps are less than ten years old. The well-pump assembly suspends the pump motor from the end of a drop pipe, below the suction inlet of the pump. Therefore, the suction inlet is approximately 1.2 m above the pump well floor, rendering all water below the inlet elevation unusable. For this reason, the effective storage volumes of the pump well and reservoirs are reduced to approximately 23,000 L, 103,000 L, and 138,000 L, respectively, for a total effective storage volume of 264,000 L. If the reservoirs are operated at a lower level in order to improve the circulation rate, the effective storage volume would be further reduced. Under normal operation treated water is deposited to reservoir #2 and then flows via transfer pipe to reservoir #1, followed by the pump well for distribution. Water storage capacity is anticipated to be a constraint within the next ten years. Because the current pumps are less than ten years old, the upgrade/replacement strategy for replacing the existing suspended pumps with vertical turbine pumps is “run-to-fail”.

b) **ICIP Eligibility.** It is the Resort Villages’ understanding that water storage and distribution upgrades are NOT eligible for ICIP funding.

c) **Statement of Work.** The Resort Village is interested in is a design for future water storage and an assessment of the following:

i. The location and footprint of a future water storage. Does existing plant and land footprint accommodate, if not what are the feasible options?

ii. Determine whether the forecasted constraints in water storage are complimentary to the current “run-to-fail” strategy on the submersible pumps. Is there a requirement to replace the suspended pumps with vertical turbine pumps earlier than the forecasted constraints? What is the recommended replacement strategy?

iii. Determine whether there are opportunities to realize financial or construction synergies for the engineering and construction of increased water storage capacity during execution of the ICIP Water Treatment Upgrade

7) Other Reference Materials

The following exhibits are provided to the Engineer to assist in the development of deliverables for all phases of the Project.

1. Apdx B E1-2022 BCL Water Treatment Assessment
2. Apdx B E2A-2022 ICIP Application
3. Apdx B E2B-Ultimate Recipient Agreement
4. Apdx B E3-Description of Groundworks for Well PW7-2014
5. Apdx B E4-2014 Beckie Hydrogeologist Report (Page 7 only)
6. Apdx B E5- 2023 Treated Water Certificate of Analysis Report
7. Apdx B E6- 2023 PW6-2011 Well Raw Water Certificate of Analysis Report
8. Apdx B E7-2024 Gaudet Greensand Bench Test Report
9. Apdx B E8-2024 Drop Solutions Biological Filtration Study Project Report

October 3, 2022
File #364.01-2

Elk Ridge Utility
Box 182
Waskesiu, SK
S0J 2Y0

Attention: Mr. Dennis Paddock, P.Eng., President

Re: Elk Ridge Utility
Water Treatment Plant Facility

As requested, BCL is pleased to provide the following assessment report for the Elk Ridge Utility's Water Treatment Plant facility. The intent of this report is to provide an assessment of the existing infrastructure and recommendations for addressing any issues identified.

1. BACKGROUND

Raw Water Supply

Raw water for the community is provided by two groundwater wells, located in close proximity to the treatment facility. The primary well (PW6-BHL) was installed in 2011, with a depth of 100 m and a typical pumping rate of 3.8 L/s. The well is equipped with a 7.5 hp submersible well pump and supplies water to the treatment plant through a dedicated 50 mm HDPE raw water supply line.

An additional well (PW7-BHL) was installed in 2014, with a similar depth and pumping rate as PW6. This well replaced the original well (PW5-BHL), which was installed in 2000, but now serves as an observation well. PW7 is equipped with a 7.5 hp submersible well pump and supplies water to the treatment plant through a dedicated raw water supply line ranging from 38 mm to 50 mm.

Operations personnel report that PW7 produces high quantities of fine silt and sediment, causing rapid buildup and plugging of the filters. In previous seasons, PW7 pumped over 10,000 m^3 to waste, in an unsuccessful effort to exhaust the sediment source. For this reason, the Utility has operated primarily with PW6, using PW7 as backup supply.

Additional testing was conducted by Beckie Hydrogeologists Ltd. (BHL) in summer of 2022 to determine the concentrations and pumping characteristics of the entrained sediment coming from PW7. The well was pumped at a rate of 3.8 L/s through filter socks to capture and measure sediment quantities over various time intervals. The testing results are summarized as follows.

PW7 Entrained Sediment Testing					
Pumping Time					
Interval Duration (minutes)	5	5	20	30	235
Total Elapsed Time (minutes)	5	10	30	60	295
Concentration					
Interval Average (mg/L)	107	138	114	17	2.6
Overall Average (mg/L)	107	123	117	67	16
Total Sediment					
Interval Amount (kg)	0.1	0.2	0.5	0.1	0.1
Total Amount (kg)	0.1	0.3	0.8	0.9	1.1

Over a 1 hour period, the well yielded an average sediment concentration of approximately 67 mg/L, for a total of 0.9 kg. Concentrations exceeded 100 mg/L for the first 30 minutes before declining to less than 20 mg/L the remainder of the test. The well was pumped for approximately 4 hours following the initial 1 hour period, yielding a concentration of 2.6 mg/L for this period, for a total of 1.1 kg.

Treatment

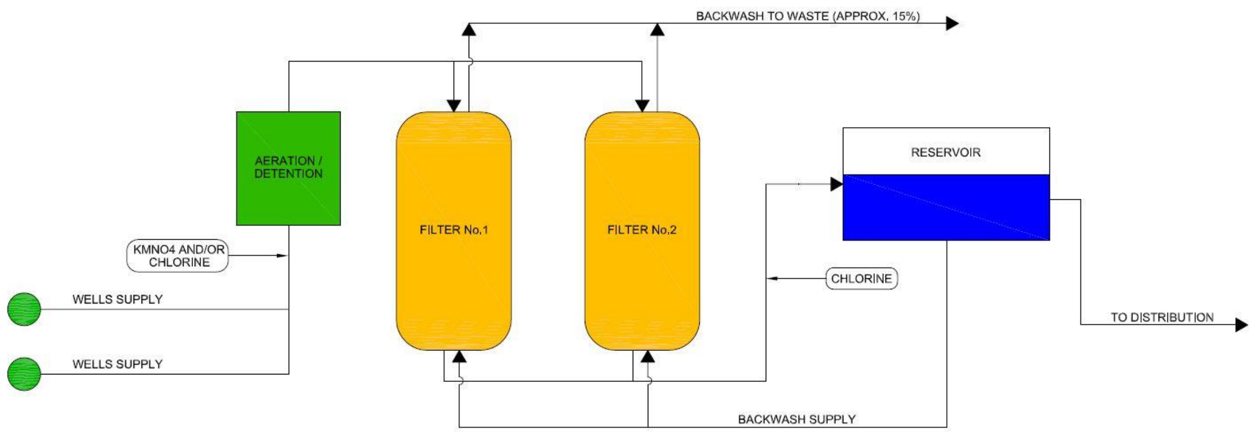
The water treatment facility was constructed in 2000, with mechanical upgrades completed in 2007.

Raw water entering the plant is metered and dosed with sodium hypochlorite prior to entering a detention tank. The tank is 1.22 m in diameter by 1.52 m in height, with an approximate volume of 1,800 L. The detention time is estimated to be in the order of 8 minutes. Due to the lengthy oxidization reaction time of manganese, the detention process is not likely to provide any significant improvement to the removal of this constituent.

Following detention, raw water flows through two manganese greensand pressure filters operated in parallel. The filters are 1.22 m in diameter by 2.13 m tall, operated at a rate of 1.9 L/s each (3.8 L/s total). For raw water of poor to fair quality, the recommended operating flux for manganese greensand filters is 1.0 - 1.6 L/s/m^2, which equates to 1.2 – 1.9 L/s each (2.4 – 3.8 L/s total). Therefore, the filters are operating at the high end of the recommended range, considering the raw water quality. Operations personnel report deteriorating treated water quality when operating above this rate.

The filters are backwashed based on pressure differential, typically producing approximately 180 m^3 of treated water between backwash cycles. The backwash process is conducted manually, with a dedicated backwash pump, consisting of 15 minutes per filter at a rate of 11 L/s. No air scour is provided. This equates to a backwash consumption rate in the order of 10% of total water use. The filters are regenerated every few months. The Operators avoid using well PW7, as the sediments from the source quickly build up in the filters and drastically reduce filtration rates.

Following filtration, clarified water is dosed with additional sodium hypochlorite for disinfection followed by deposition to the treated water storage reservoirs. The existing manganese greensand process schematic is shown below for reference.



MANGANESE GREENSAND

Chemical Dosage

The only chemical used for treatment is a 12% liquid sodium hypochlorite solution (Hypochlor-12 by ClearTech Industries), which is dosed prior to detention and following filtration. The Operators vary the dosing rates frequently in response to daily free chlorine residual levels. Based on the daily records, the dosing rates ranged from 7 - 15 mg/L prior to detention and 0.5 - 3 mg/L following filtration, for a total dosage rate in the order of 7.5 - 18 mg/L. This is below the maximum use rate of 103 mg/L for this product, as per NSF60 standards for drinking water chemical use. The frequent variability of the dosing rates suggests that a constituent in the raw water, such as ammonia or organic material, is reacting with the chemical.

Treated Water Storage

Storage of treated water is provided by two subgrade concrete reservoirs and a pump well. The pump well is located under the water treatment plant and has storage capacity of approximately 34,000 L. Reservoir #1 is also located under the water treatment plant building and has a storage capacity of approximately 155,000 L. Access to the pump well and reservoir #1 is provided by a raised hatch located within the building. Reservoir #2 is located immediately southwest of the plant and has a storage capacity of 222,000 L. A raised access hatch with lockable cover is provided. Total facility storage volume is 411,000 L.

As discussed in the following section, the plant uses submersible well pumps for distribution. Well pump assembly suspends the pump motor from the end of a drop pipe, below the suction inlet of the pump. Therefore, the suction inlet is approximately 1.2 m above the pump well floor, rendering all water below the inlet elevation unusable. For this reason, the effective storage volumes of the pump well and reservoirs are reduced to approximately 23,000 L, 103,000 L, and 138,000 L, respectively, for a total effective storage volume of 264,000 L. If the reservoirs are operated at a lower level in order to improve the circulation rate, the effective storage volume would be further reduced.

Under normal operation treated water is deposited to reservoir #2 and then flows via transfer pipe to reservoir #1, followed by the pump well for distribution.

Distribution
Distribution system pressure is provided by three submersible well pumps drawing from the pump well, each with a rated capacity of approximately 21 L/s at 46 m TDH. The pumps are driven by 20 hp, 600 V, 3 phase submersible motors, controlled by variable frequency drives to maintain a typical distribution pressure of 65 psi. Each pump has sufficient capacity to meet typical demand, with the lag pumps providing redundancy or additional flow in high demand scenarios.

Two distribution pumps draw from the pump well, while the third is installed in reservoir #1 to provide distribution in the event that the pump well is unavailable due to maintenance or other issues. The distribution header is equipped with valves for isolation and backflow prevention, a pressure relief valve that discharges to the pump well, and an electromagnetic flow meter. A pressure tank is connected to the system to mitigate excessive start and stop of the pumps during periods of low flow.

Controls and Electrical
The raw water supply, treatment, and distribution process all have automated components. The well pumps and chemical pumps are started and stopped based on level condition in the pump well, as monitored by an ultrasonic level transducer. The distribution pumps are controlled by a pressure transducer on the header, which communicates with the pump drives to maintain the set pressure. Manually controlled processes in the plant include filter backwash.

The plant is equipped with an autodialler call-out device, which notifies operations personnel of conditions such as low distribution pressure and low reservoir conditions.

Electrical service to the building is provided by a 600 V, three phase connection. Electrical components are typically individual surface mount type. The facility is equipped with a 100 kW, natural gas fuelled emergency power generator to maintain distribution in the event of a power outage. The generator is equipped with an automatic power transfer switch.

Facility
The water plant building is a timber-framed structure, totalling roughly 75 m^2 in area. The building is situated on top of the concrete reservoir foundation. The exterior finishes consist of stucco, wood and pre-finished metal trim, and asphalt shingles. The interior finishes consist of

pre-finished metal cladding on the walls and ceiling, and exposed concrete floors.

The building is equipped with a small water heater and sink for domestic water use. Building heat is provided by a natural gas fired unit heater. Building ventilation is provided by a dedicated exhaust fan and intake damper. Lighting is provided by fluorescent fixtures.

2. EXISTING DEMAND

Annual water consumption records from 2007-2021 were reviewed to determine historical water consumption by the community. The following table provides a summary of treated water distribution since the inaugural development.

Year	Treated Distribution (m^3)	Operational Notes
2021	34,996	Leaking fixture in pavilion all summer.
2020	15,001	Resort closed April to November (Covid-19).
2019	29,496	
2018	32,524	Early fall.
2017	32,595	
2016	34,530	Cottages opened in late summer.
2015	31,753	Forest fires June and July.
2014	33,700	
2013	29,148	
2012	25,564	Early winter.
2011	29,040	
2010	26,989	
2009	23,892	Resort hotel opened.
2008	15,261	
2007	10,735	

With the exception of 2020, consumption has been relatively consistent since 2014, with an average annual distribution of approximately 32,800 m^3. Since the opening of the resort hotel, the consumption rate has increased intermittently, typically corresponding to further development within the community. Disregarding the years prior to the resort hotel opening, the average annual increase in consumption is in the order of 2.4%.

Daily water records from 2015 to 2021 were available and reviewed to determine more detailed usage data, as shown in the following table. Data from 2020 was discounted due to low facility use during the Covid-19 pandemic.

Year	Consumption (m^3)		Daily Peak Factor
	Avg day	Peak day	
2021	96	267	2.8
2020	-	-	-
2019	81	208	2.6
2018	89	304	3.4
2017	89	299	3.3
2016	95	271	2.9
2015	87	304	3.5
Average	**90**	**275**	**3.1**

The average daily consumption is in the order of 90 m^3 with a typical peak day of approximately three times that amount. It should be noted that this peak day factor is typical for communities of this size due to the seasonal nature of the community population.

It should be noted that total raw water consumption is recorded in addition to distributed water. The difference between the raw and treated totals typically provides an indication of backwash and waste volumes generated by the treatment process. Based on the raw water totals, backwash and waste amount to less than 5% of the total raw water usage. This is considered quite low for a manganese greensand process, particularly for treatment of lower quality raw water where backwash and waste rates in the order of 10 - 15% are typical. It is likely that the existing raw water meter readings contain some error. Treated distribution is metered by an electromagnetic flow meter which provide improved accuracy compared with older style meters. This should be taken into account when assessing total water consumption.

3. FUTURE DEMAND

The rate of water consumption varies widely during different periods of the year and hours of the day. However, two characteristic demand periods are normally recognized as being critical factors in the design and operation of a water system. These factors are the peak day (the day of highest consumption during any one year) and the peak hour (the hour of highest consumption during any one day) demand. A peak day factor of 3.1, as derived from the actual water consumption records, will be used for the peak day flow. A peak hour factor of 4.0 times the average day is typical for a community of this size and as such, will be used to determine water pumping capacities.

Applying the assumptions described, the following table summarizes the current and expected demand from the community.

Demand Projection 2022-2042					
Demand	**2022**	**2027**	**2032**	**2037**	**2042**
Average Day (raw; L/s)	1.22	1.38	1.55	1.74	1.96
Peak Day (raw; L/s; P.F. = 3.1)	3.79	4.27	4.80	5.41	6.08
Average Day (treated; L/s)	1.04	1.17	1.32	1.48	1.67
Peak Hour (treated; L/s; P.F. = 4.0)	4.16	4.68	5.27	5.93	6.67

Applying the future water demand projection, system component requirements for the current treatment process is shown in the following table below (bolded items highlight that there is a shortfall in capacity).

Infrastructure Requirements 2022 – 2042						
	Existing	**2022**	**2027**	**2035**	**2037**	**2042**
Raw Water Supply (L/s; P.F. = 3.1)	3.8	**3.8**	**4.3**	**4.8**	**5.4**	**6.1**
Water Treatment (L/s; P.F. = 3.1)	3.8	**3.8**	**4.3**	**4.8**	**5.4**	**6.1**
Distribution Pumping (L/s; P.F. = 4.0)	21.0	4.14	4.68	5.27	5.93	6.67
Treated Water Storage (L; 2 x avg. day)	264,000 / 411,000	210,470	237,941	**267,766**	**301,330**	**339,101**

As indicated, the current water treatment equipment has difficulty producing quality water at sufficient rate during peak periods. Increased treatment capacity will also require an increase to raw water supply. It is important to note that the existing water treatment facility is relatively small and does not have sufficient space for additional water treatment equipment.

The existing reservoir capacity is adequate to meet the 20 year projected requirements. However, the effective storage is reduced due to the current pumping arrangement and is anticipated to encounter a shortfall within 10 years. Therefore, it is recommended that an alternative pumping arrangement be explored prior to reaching this threshold.

It is understood that there is an RV Park in development that will increase demand within the next two years. Such development is accounted for by the long term growth rate applied to the annual water consumption. However, growth rates may be slightly higher in the short term due to this development. Therefore, the five year projected requirements may be realized more rapidly.

4. WATER QUALITY

The raw water source for the Elk Ridge Utility is classified as poor to fair, with high concentrations of ammonia, total dissolved solids, and moderate overall hardness. Metals are present in levels consistent with true groundwater, with arsenic, iron and manganese concentrations exceeding guidelines.

Treated water is sampled and tested for quality every two years. A brief summary of constituents of interest for the raw and treated water is summarized in the table below. Bolded values are those that are nearing or exceeding the Saskatchewan or Canadian Drinking Water Quality Guidelines.

Constituent	Raw Sept. 17, 2014	Treated Oct. 15, 2015	Treated July 7, 2017	Treated Feb. 5, 2019	Treated Feb. 22, 2021	SK Guideline	Canadian Guideline
Arsenic	**0.027**	0.0015	0.0025	0.0013	0.0016	0.01	0.01
Iron (mg/L)	**1.88**	-	0.107	0.03	0.017	0.3	0.3
Manganese (mg/L)	**0.13**	-	**0.0468**	0.0114	0.0008	0.05	0.02
Ammonia (mg/L)	0.71			0.75		-	-
Alkalinity (mg/L)	**538**	**501**	**497**	**486**	**494**	500	-
TDS (mg/L)	**848**	**842**	**530**	**519**	-	1,500	500
Hardness (mg/L)	446	434	450	440	432	800	200

A description of each of the raw and treated water constituents in excess of the Canadian or Saskatchewan Drinking Water Standards are as follows (unless noted as *, write ups are from SRC Analytical – *Water Analysis Information Sheet*):

Arsenic
Natural sources, such as the dissolution of arsenic-containing bedrock, often contribute significantly to the arsenic content of drinking water and groundwater. A number of disorders have been associated with the intake of arsenic in drinking water; however, there is no evidence of any specific illness related to the ingestion of water containing arsenic at the maximum acceptable concentration of 0.01 mg/L. Treated water test results have not approached the regulatory limits to date.

Iron
At levels above 0.3 mg/L, iron can stain laundry and plumbing fixtures, as well as cause an undesirable taste. The precipitation of excessive iron causes a reddish-brown colour in the water and may also encourage the growth of iron bacteria, leaving a slimy coating in piping. The presences of iron bacteria can also cause a rotten egg odour and a sheen on the surface of the water. The aesthetic objectives for both Saskatchewan and Canada are set at 0.3 mg/L.

Manganese
Manganese can cause staining of plumbing and laundry and undesirable tastes in beverages. Also, it may lead to the accumulation of bacterial growth in piping. The aesthetic objective for Saskatchewan is set at a maximum of 0.05 mg/L. Health Canada recently lowered the aesthetic objective to 0.02 mg/L and implemented a maximum acceptable concentration of 1.2 mg/L. Laboratory test results have exceeded the guidelines on one occasion. However, review of daily manganese testing conducted at the plant with a bench top unit indicated that manganese concentrations in the treated water routinely exceed 0.02 mg/L.

Ammonia*
Though not considered an immediate health or aesthetic concern, high ammonia in a raw water source can have deleterious affects on treatment processes. Ammonia reacts readily with sodium hypochlorite (chlorine), which is used for oxidization of iron and manganese, as well as for disinfection. This greatly increases chlorine consumption and inhibits the oxidization and disinfection processes, reducing the effectiveness of iron and manganese removal and potentially resulting in inadequately disinfected drinking water. The effects of ammonia on water treatment are well known and documented in the Water Security Agency's EPB 431. Recent testing indicates ammonia concentrations of 0.75 mg/L, which is considered moderately high.

Alkalinity
Alkalinity is a water's acid-neutralizing capacity and is primarily a function of carbonate, bicarbonate and hydroxide content. Excessive alkalinity levels may cause scale formation. The Saskatchewan aesthetic objective is set at a maximum of 500 mg/L. Recent testing results have approached and exceeded this limit.

Total Dissolved Solids or Specific Conductivity
Specific conductivity is a measure of the ability of water to carry an electric current. This ability depends on the presence of ions and therefore is an indication of the concentration of ions (i.e. dissolved solids) in the water. Waters with high dissolved solids generally are of inferior palatability and are likely to leave a white film on dishes, etc. The provincial aesthetic objective for total dissolved solids is 1,500 mg/L. The federal objective is more stringent, at 500 mg/L. Recent testing indicates concentrations exceeding 500 mg/L.

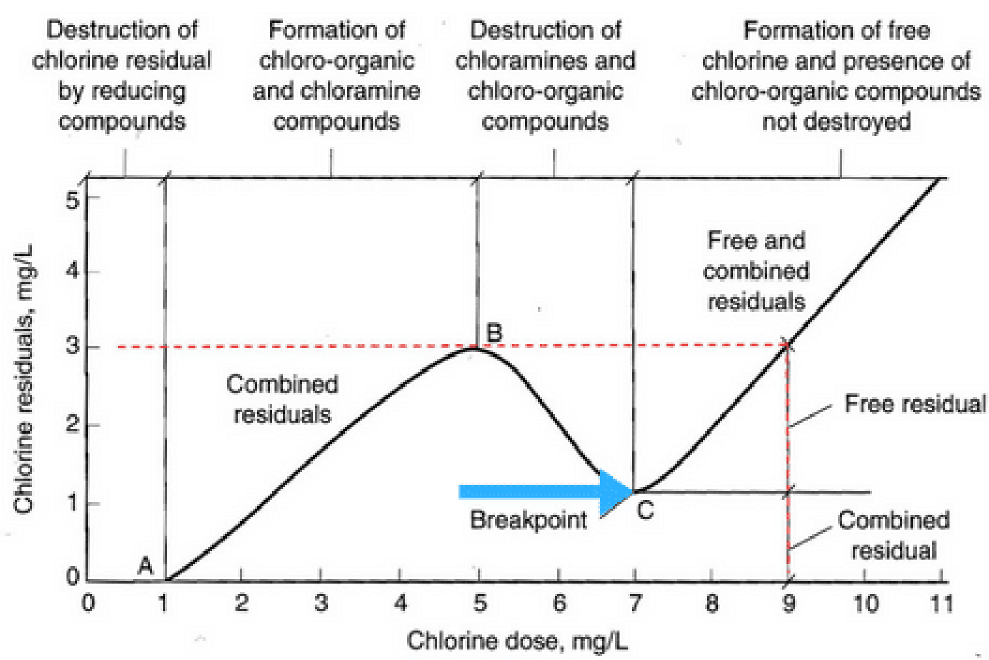
Total Hardness
Water hardness is mainly caused by the presence of calcium and magnesium and is expressed as the equivalent quantity of calcium carbonate. Scale formation and excessive soap consumption are the main concerns with hardness. When heated, hard waters have a tendency to form scale deposits. Depending on the interaction with other factors, such as pH and alkalinity, hardness levels between 80 and 100 mg/L are considered to provide an acceptable balance between corrosion and incrustation. Water supplies with a hardness greater than 200 mg/L are considered poor, but tolerable; those in excess of 500 mg/L are unacceptable for most domestic purposes. The aesthetic objective in Saskatchewan is 800 mg/L. Recent water quality records note total

hardness concentrations approaching 500 mg/L.

5. DISINFECTION

Disinfection is a critical part of the water treatment process, ensuring that water intended for human consumption is free of harmful viruses and pathogens. Chlorine is a powerful oxidant and is commonly used for disinfection of drinking water in Saskatchewan. To ensure adequate disinfection is achieved, free chlorine residuals are monitored daily at the water treatment plant. However, the presence of ammonia in the water interferes with the disinfection process by reacting with the available chlorine. To overcome this, chlorine dosage must be increased until all ammonia has reacted, and sufficient free chlorine residual is achieved. This process is referred to as 'breakpoint chlorination'.

A typical break point chlorination chart is shown below.



Fluctuating raw water ammonia levels require frequent adjustment to chlorine dosage rates and often result in over or under-dosage of the chemical. This is evidenced by the daily water plant records, which show highly variable free chlorine residuals, ranging from 0.15 to 1.5 mg/L. Operator notes indicate frequent dosage rate changes.

Review of sodium hypochlorite dosage indicates that the operation does not approach the NSF61 maximum use limit for use of this chemical in drinking water. However, the ammonia interference increases the overall chemical consumption at increased cost to the Utility. Further, ammonia can inactivate all available chlorine, reducing the effectiveness of the oxidization process, manganese greensand regeneration, and overall iron and manganese removal. This is likely a factor in the treatment process' difficulty in removing manganese below regulatory limits.

6. WATER TREATMENT CONSIDERATIONS

The existing manganese greensand filtration process is generally capable of meeting the regulatory requirements for arsenic, iron and manganese. However, the system must be operated at low flux rates to achieve adequate treatment. As indicated by the infrastructure requirement projections, the filters are currently operating at peak capacity and will not be capable of meeting peak demands of future development. Ammonia interference compounds the iron and manganese removal issues and results in excess chemical use. Further, the treatment system is not capable of achieving the recommended water quality objectives for the aesthetic constituents such as ammonia, alkalinity, hardness, and total dissolved solids.

Considering the characteristics of the raw water, several treatment considerations / processes may be required to meet the water quality objectives of the community. The following table highlights some of the key parameters and appropriate technologies for their removal.

Key Parameters and Appropriate Technologies		
Parameters	**Appropriate Technologies**	**Comments**
Arsenic	Greensand, Biological. Membrane.	The existing system is typically successful in removing arsenic.
Iron	Greensand, Biological, Membrane	The existing system is typically successful in removing iron.
Manganese	Greensand, Biological, Membrane	The existing system is often unsuccessful in removing manganese, due to filtration rate and ammonia interference.
Ammonia	Biological, Membrane	Greensand filtration will not remove ammonia. Biological filtration is very effective in ammonia removal. Membranes are typically effective, depending on the chemical state of the ammonia.
Alkalinity	Membrane	Greensand filtration and biological filtration by themselves do not reduce alkalinity. Membrane filtration is required to reduce alkalinity to below recommended limits.
TDS	Membrane	Greensand filtration and biological filtration, by themselves do not reduce TDS. Membrane filtration is required to reduce TDS to below regulated limits.
Hardness	Membrane	Greensand filtration and biological filtration, by themselves do not reduce hardness. Membrane filtration is required to reduce hardness to below recommended limits.

Both manganese greensand and biological filtration are considered suitable technologies for the removal of arsenic, iron and manganese. However, in order to meet all federal and provincial treatment regulations and aesthetic objectives, implementation of a membrane treatment system would be required. Membrane filtration consists of forcing water through a membrane barrier at high pressure. The use of membranes results in a treated water that is lower in all constituents, including organics, hardness, iron, manganese, and total dissolved solids. Membranes also provide a positive barrier against giardia and cryptosporidium.

It should be noted that a direct-feed membrane system is not recommended due to the high concentrations of iron and manganese. Though capable of iron and manganese removal, without a pre-treatment system the membranes would require frequent cleaning and replacement. The high ammonia concentrations present in the raw water suggest that a biological and membrane filtration combination would provide optimal treatment.

In addition to dissolved constituents, the treatment process also encounters entrained sediments in the source water when operating PW7. Conventional greensand filtration is capable of filtering out small concentrations (<10 mg/L) of suspended solids, expelling the sediments during the backwash process. However, the concentrations of entrained sediment observed during the recent testing far exceed this amount. Sediment buildup in the filters would be rapid and cause plugging, requiring frequent backwashing, reducing treatment effectiveness, and increasing maintenance requirements. Entrained sediments would present even greater issue for the biological filtration process, which typically uses a lesser backwash rate than conventional greensand filtration. Regardless of treatment process, additional measures will be required to mitigate this issue.

7. TREATMENT OPTIONS

Overall, the existing water treatment facility is in good condition, but is presenting several issues regarding capacity and capability in meeting current standards and objectives for water treatment. It must be noted that most options for improving the treatment process require additional equipment, which is constrained by the physical size of the existing building. Considering this, the following options have been identified.

Option 1 – Manganese Greensand Media Replacement

The plant currently uses typical manganese greensand media, which is a silicate mineral coated with manganese dioxide. The greensand is topped with a layer of anthracite media which acts as a physical filter for precipitated iron, manganese, and other larger particulates. The anthracite material has been replenished periodically, as it is gradually lost during the backwash process. However, the greensand media is believed to be the original material. Over time, greensand material can degrade through abrasion (reduced surface area), physical loss of media during backwashing, and possibly reduced adsorption ability over time. Therefore, it is possible that replacing the greensand media could improve treatment performance. Estimated cost to replace the media is as follows:

Greensand Media Replacement	
Item	**Estimated Cost**
Greensand Media Replacement	$40,000

It is important to note that treatment issues, particularly regarding manganese removal, have been observed for more than 10 years and are not isolated to recent occurrences. There does not appear to be a discernable trend of reducing manganese removal within this timeframe. It is more likely that the treatment issues stem from the rate of operation and inadequate oxidization time than from media degradation or loss. Therefore, media replacement is not guaranteed to realize increased treatment performance.

Alternatively, modified media types are available that can reportedly increase the flux capacity of the existing tanks. Alternative media options typically include a variation of the type of mineral coated with greensand or a solid manganese dioxide mineral media. Manufacturers report improved iron and manganese adsorption rates; however, limited data is available by which to evaluate these claims. Estimated cost to replace with an alternative media is as follows:

Alternative Media Replacement	
Item	**Estimated Cost**
Alternative Media Replacement	$75,000

Chemically, the process for iron and manganese removal is the same for all media types using the greensand approach. Therefore, improved removal requires a substantial increase in oxidization and adsorption of dissolved iron and manganese. A large factor in successful oxidization, particularly for manganese, is the oxidization time and the pH level of the raw water. Manganese is typically harder to remove as the oxidization reaction time is significantly slower than that of iron, particularly at the pH level present in the raw water. It is important to note that alternative media will do nothing to increase the contact time with the oxidizing agent and media. By increasing filtration rates to meet demand, media contact time will actually be reduced. Further, the presence of elevated ammonia concentrations in the raw water is likely inhibiting the oxidization process. This too would not be mitigated by alternative media types.

For these reasons, the alternative media options are not guaranteed to achieve treatment at the filtration rates required to meet future growth in the community. Though some improvement may be realized at the current operating rate, it is anticipated that these returns will diminish at increased filtration rates. The better alternative for continued use of the manganese greensand process is to simply add more filters or replace the existing ones with larger tanks. Physically, it may be possible to accommodate the additional equipment but working space would be significantly reduced. An air scour process is also recommended. Such a project would require the following:

- replacement of existing media;
- installation of two additional filters;
- installation of air scour system and piping;
- plant and piping modifications.

Estimated costs to design, construct, and implement this work are as follows:

Greensand Process Expansion	
Item	**Estimated Cost**
Filter Media Replacement	$75,000
Additional Filters	150,000
Air Scour System	50,000
Existing Building / Reservoir Modifications	25,000
Process Piping Modifications	90,000
Instrumentation	20,000
Subtotal - Construction	**$410,000**
Contingency (15%)	60,000
Engineering (15%)	60,000
Total Estimated Cost	**$530,000**

Installing additional filters will increase production ability of the plant. However, some difficulty in manganese removal is likely to continue due to inadequate contact time and ammonia interference. Increasing the size of the detention tank would not be possible due to physical constraints of the plant.

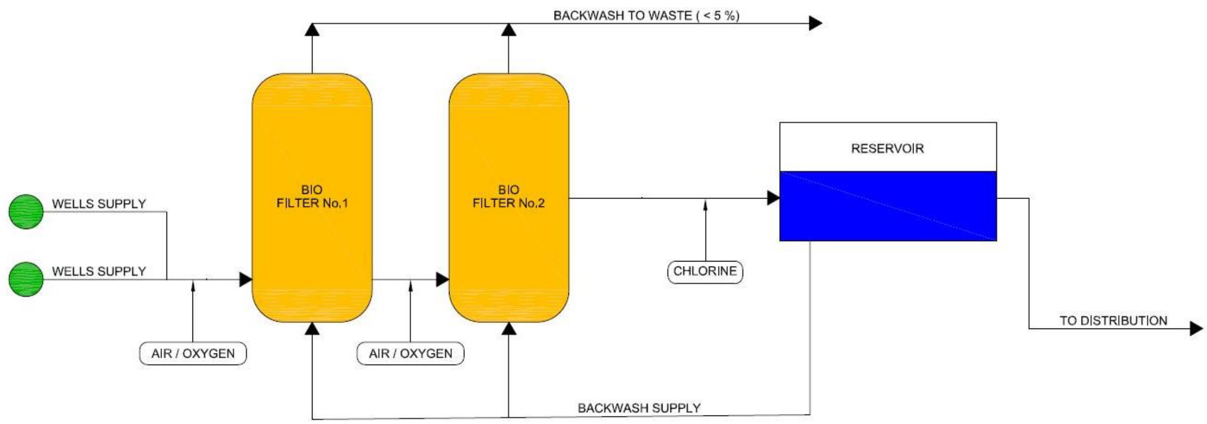
Option 2 – Biological Filtration Conversion

Biological filtration provides several advantages over conventional manganese greensand filtration. This process has been implemented at many locations throughout Saskatchewan over the last 10 years, replacing manganese greensand processes in many instances. Biological filtration typically realizes slightly improved iron removal and significantly improved manganese removal, compared to manganese greensand filtration. Biological filtration can also remove ammonia whereas manganese greensand has no ammonia removal ability. Due to the ability to remove ammonia and the elimination of oxidization prior to filtration, the biological process would greatly reduce chlorine usage at the plant. Backwash requirements would also be reduced.

The existing filter tanks are in good condition and are suitable for conversion to a biological process. Based on the filter sizing and projected demand, two additional tanks of equivalent size would likely be required. The existing detention tank could be removed for this process. Confirmation of filter sizing would be required by the treatment process vendor. Such a project would require the following:

- 4 to 6 week pilot testing process;
- replacement of the existing filter media;
- installation of additional filters;
- 4 week bio-seeding process;
- installation of compressor and blower system equipment;
- instrumentation equipment.

A typical biological filtration schematic is shown for reference:



BIOLOGICAL

It should be noted that the existing treatment process would not be available during the 4 week seeding process. Therefore, direct distribution of unfiltered water with chemical disinfection would be required during this time. It is possible that the bio-filters could begin use before the end of this period with gradually improving treatment.

Estimated costs to design, construct and implement this work are as follows:

Biological Filtration Conversion	
Item	**Estimated Cost**
Pilot Process	$25,000
Filter Media Replacement	40,000
New Filters	150,000
Air System	75,000
Existing Building / Reservoir Modifications	25,000
Process Piping Modifications	90,000
Instrumentation	25,000
Subtotal - Construction	**$430,000**
Contingency (15%)	65,000
Engineering (15%)	65,000
Total Estimated Cost	**$560,000**

The addition of biological filtration would provide benefit to operations by reducing chemical usage and backwash requirements. Water quality would be improved by reduced iron and manganese concentrations, as well as ammonia removal. However, as discussed herein, biological filtration will not remove other dissolved solids. Therefore, alkalinity, water hardness and total dissolved solid concentrations will not be improved. Additional treatment process equipment is required to address these constituents.

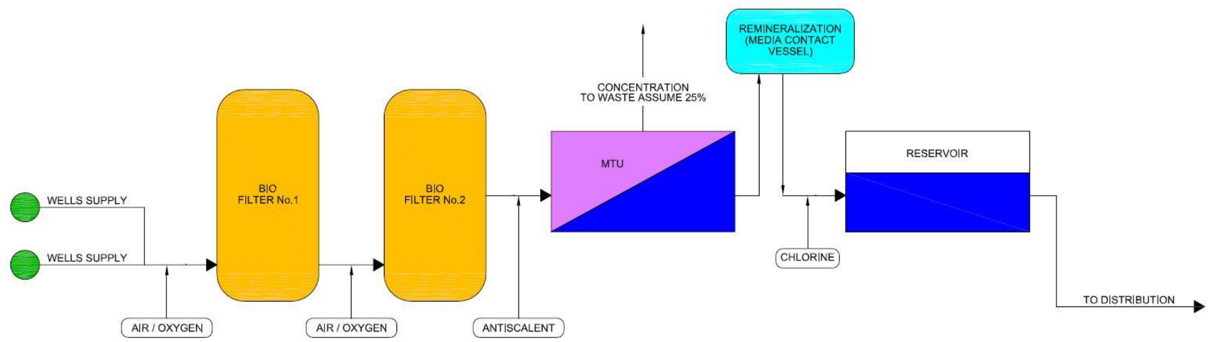
Option 3 – Membrane Filtration Addition
The manganese greensand and biological filtration processes are suitable for iron and manganese removal, but are incapable of removing other dissolved minerals and lowering hardness. It was reported that many residences employ water softeners and small-scale, point-of-use reverse osmosis filters to address this. Membrane filtration is capable of removing dissolved solids from water and can produce a 'bottled water' quality product. Should the Utility wish to remove these constituents to meet all regulations and aesthetic quality objectives, a membrane system would be required. However, due to the high concentrations of dissolved solids in the raw water at Elk Ridge, a 'direct-feed' membrane system would be prone to membrane fouling and frequent replacement at substantial cost. Therefore, a two stage treatment process would be recommended, consisting of greensand or biological filtration for iron, manganese and ammonia removal, followed by membrane filtration for removal of remaining constituents.

Therefore, Option 3 would be added to the greensand or biological filtration process as discussed in Options 1 and 2. Option 3 could be considered concurrently or for upgrade in the future.

Spatial constraints of the existing plant would require construction of a new space to house the additional equipment. This could likely be accomplished by construction of a new building using the existing external reservoir as a foundation. In general, the project would require the following:

- 4 to 6 week pilot testing process;
- construction of a new building;
- installation of membrane filtration equipment;
- modifications to the existing process piping and building;
- instrumentation and integration into controls and monitoring systems.

A typical biological membrane filtration schematic is shown for reference:



BIOLOGICAL / MEMBRANE

Estimated costs to design, construct and implement this work are as follows:

Membrane / Building Addition	
Item	**Estimated Cost**
Pilot Process	$25,000
Building Construction	475,000
Membrane Process Equipment	600,000
Process Piping	150,000
Existing Building / Reservoir Modifications	90,000
Existing Process Modifications	50,000
Instrumentation and Controls	250,000
Subtotal - Construction	**$1,640,000**
Contingency (15%)	245,000
Engineering (15%)	245,000
Total Estimated Cost	**$2,130,000**

It should be noted that these costs would be in addition to Option 1 or 2. Further, these estimates do not include upgrading the existing well capacity, should it be required to meet the additional water supply necessary for the membrane filtration option.

8. ADDITIONAL IMPROVEMENTS

In addition to the treated water quality and capacity issues, several other items were noted during the inspection of the facilities.

Raw Water Supply

The capacity of the existing raw water supply is approximately 3.8 L/s. Therefore, increased raw water pumping capacity will be required to realize any increase to the treatment capacity. This is most easily achieved by replacement of the existing well pumps with larger units. Preliminary well analysis suggests that the existing well construction and aquifer are sufficient for increased pumping rates.

Well Pump Replacement	
Item	**Estimated Cost**
Well Pump and Motors	$35,000
Total Estimated Cost	**$35,000**

In addition to capacity, PW7 also has issues with entrained sediment, which will pose a problem to any treatment process upgrades. As a result, PW7 has been operated as a back-up well, only used in case of issues with PW6. BHL suggested several options for mitigating this issue in their 2018 letter report. One option was to pump the well to waste in an effort to exhaust the source of the sediment, which was done without success in 2021.

Another option listed in the BHL report was to install a screen insert with smaller slot openings and finer screening sand within the well to prevent the sediment infiltration. A reduced screen opening size and the accumulation of fine sediment around the well will increase the drawdown level of the well, affecting pumping capacity. Therefore, a larger pump may be required for PW7 to achieve equivalent capacity to PW6. Additional analysis would be required to determine whether this assembly would be sufficient for increased pumping rates. It should be noted that the installation of a screen would also make it more difficult to service and rehabilitate the well in the future.

Well Screen Installation	
Item	**Estimated Cost**
Well Screen Installation	$70,000
Total Estimated Cost	**$70,000**

Rather than addressing the issue at the source, there is also an option to filter out and remove the entrained sediments as a part of the treatment process. This could be accomplished through addition of a self-cleaning filter within the plant, installed prior to the filter tanks. These units remove suspended solid particles, automatically flushing them to waste intermittently or continuously, without interrupting filter operation. This option would require piping modifications and additional floor space within the plant. The filter discharge would direct sediment to the sanitary sewer system, including the nearby pumping station and ultimately, the lagoon. The sediments observed to date have been relatively fine and are not anticipated to pose a problem to the sanitary sewer system but may increase wear on sewage pumping equipment.

Pre-Filter Installation	
Item	**Estimated Cost**
Pre-Filter Installation	$35,000
Piping Modifications	5,000
Electrical	5,000
Total Estimated Cost	**$45,000**

Long term, the best option would be design and installation of a new well with increased capacity and adjusted screen sizing to prevent infiltration of finer sediments. However, capital costs for well development are significant and would also include the cost of construction of a new supply main to connect well to treatment plant.

Estimated costs for the options discussed herein are as follows:

Well Development	
Item	**Estimated Cost**
Well Drilling	$170,000
Well Completion	50,000
Pump and Motor	40,000
Raw Water Supply Main	50,000
Total Estimated Cost	**$310,000**

Distribution Pumping

As discussed, the plant currently uses submersible well pumps for distribution of treated water. The pumps are of adequate capacity to meet current and future demands but present operational issues due to the installation arrangement. The pumps are installed vertically within the reservoir and consist of a motor and pump end suspended from a drop pipe. The motor hangs below the suction inlet of the pump, positioning the inlet approximately 1.2m above the reservoir floor. Therefore, the bottom 1.2 m of treated water are inaccessible, effectively reducing storage capacity by approximately 147,000 m^3.

The effective storage volume is sufficient to meet current demand rates but will realize a shortfall in approximately 10 years. However, if the utility reduces the operating level of the reservoirs during winter months, the effective storage may dip below current requirements.

Vertical turbine pumps are considered industry standard for treated water distribution and feature a suction inlet extending to the base of a reservoir to utilize the full storage volume. It is recommended that vertical turbine pumps be installed when storage capacity becomes critical. Estimated cost to replace the distribution pumps with vertical turbine pumps are as follows:

Distribution Pumping	
Item	**Estimated Cost**
Vertical Turbine Pumps	$180,000
Header Piping Modifications	10,000
Total Estimated Cost	**$190,000**

9. RECOMMENDATIONS AND CONCLUSION

As discussed, the ERU water treatment plant is currently faced with several immediate operational issues.

Water Treatment Quality / Capacity
Recommendation: Conversion to Biological Filtration System

The existing system requires media replacement and installation of additional filters to increase treatment capacity and quality. Even with additional filters, insufficient oxidization time may result in continued difficulty with removal of manganese. The presence of ammonia in the raw water would continue to interfere with the oxidization process and require excess chlorine dosage. Conversion of the filters to a biological filtration system would realize significantly improved manganese removal, as well as ammonia removal, with reduced chemical dosing. The bio process has no oxidization requirement and therefore would eliminate the detention tank, reducing spatial requirement of the process. Costs for these upgrades are not expected to differ significantly from greensand option.

Raw Water Supply Capacity
Recommendation: Well Pump Replacement

The wells are currently run at full, or near full, capacity during normal operation. Increasing treatment capacity will require increased supply capacity to suit. Preliminary well analysis suggests the well construction and aquifer should be sufficient for increased pumping rates. Therefore, installation of larger capacity well pumps would achieve the required supply increase.

PW7 Entrained Sediments
Recommendation: Pre-Filter Installation

The entrained sediment produced by PW7 pose a problem to the operation of the existing treatment process as well as the future process upgrades. Therefore, sediment removal is required by installation of a screen sleeve within the well or a self-cleaning pre-filter within the plant. Installation of a well screen would accomplish the task but may reduce well efficiency, which is problematic for increasing the aforementioned raw water supply capacity. The screen would also make rehabilitation work on PW7 impossible, effectively limiting the remaining lifespan of the well. A pre-filter unit within the plant would have a spatial requirement but would be more cost effective to install and easily serviceable. Further, the pre-filter could provide benefit to both existing wells as well as any future wells should further sediment issues crop up.

Immediate Recommendations Cost Summary	
Item	**Estimated Cost**
Biological Filtration Process Upgrade	$430,000
Well Pump Replacement	35,000
Sediment Pre-Filter Unit	45,000
Subtotal – Construction	**$510,000**
Contingency (15%)	75,000
Engineering (15%)	75,000
Total Estimated Cost	**$660,000**

Please note that all costs provided in this report are preliminary in nature and subject to change based on economic conditions, market timing, contractor and material availability.

Long term, the ERU should consider additional upgrades as discussed within this report, including:

- replacement of the existing distribution pumps with vertical turbine style pumps in order to realize full reservoir capacity;
- should the community wish to pursue further improvements to water treatment to meet all treatment guidelines and objectives, a membrane filter could be added to the proposed biofilter upgrades. This would require a building expansion to fit this equipment;
- the ERU should plan for new well construction in the event that PW7 experiences further issues.

We trust this information meets your needs at this time. If you have any questions or require further information, please do not hesitate to contact our office.

Yours truly,

BCL ENGINEERING LTD.

T. T. Braun, P. Eng.

ICIP - Green Infrastructure Stream - 2022-23

2. Project Eligibility

CONFIRMATION OF PROJECT ELIGIBILITY

I have reviewed the ICIP eligibility information, and to the best of my knowledge confirm that my project will meet program requirements.

3. Project Characteristics

1. Project Title:

Elk Ridge - Water Treatment Plant Upgrades

2. Project Description:

The main objective of this project is to increase the water treatment capacity and water quality of the Elk Ridge Utility water treatment plant in order to meet provincial drinking water quality standards for current and future community population of the Resort Village of Elk Ridge. The project output includes replacement of the existing filtration equipment with treatment technology better suited for the raw water source, including modifications to the existing mechanical/electrical to suit. Raw water supply capacity will also be improved by installation of new well pumps and a pre-filter unit to address present issues with sediment in the source water.

3. Will the highest published applicable energy efficiency standards in the jurisdiction be met or exceeded?

Yes

4. Does the project involve a public facing infrastructure (i.e., can be accessed by public when completed)?

No

a) Please explain how it will incorporate the principles of universal design and meet the highest published provincial accessibility standards in effect at the time the Building Permit is issued?

4. Ultimate Recipient

If you (the project owner) are a municipality, please select the name of your community from the list below. If this does not apply, please select 'Project Owner Is Not Municipal'.

Project Owner: : Project Owner Is Not Municipal

If you (the project owner) are an Indigenous community, please select the name of your community from the list below. If this does not apply please choose 'Project Owner Is Not Indigenous'.

Project Owner: : Project Owner Is Not Indigenous

If you (the project owner) are not municipal or Indigenous, please insert your organization's name in the text box below. If you are municipal or Indigenous please select 'Project owner is municipal or Indigenous'

Project owner:: Elk Ridge Utility Ltd. / Resort Village (pending)

Street Address/Number or P.O. Box Number:

Box 182

City/Town:

Waskesiu

Postal Code

S0J2Y0

Primary Project Contact Name:

Dennis Paddock

Primary Project Contact Position/Title

President

Primary Project Contact Email Address

dkpaddock@hotmail.com

Verify the Primary Project Contact Email address:

dkpaddock@hotmail.com

Primary Project Contact Phone Number:

6395713933

Primary Project Contact Phone Number (Cell):

6395713933

Alternate Project Contact Name:

Gren Smith-Windsor

Alternate Project Contact Position/Title:

Secretary

Alternate Project Contact Email Address:

gsmithwindsor@gmail.com

Verify the Alternate Project Contact Email Address:

gsmithwindsor@gmail.com

Alternate Project Contact Phone Number:

3066635744

Alternate Project Contact Phone Number (Cell):

3069609974

If you have a Project Engineer, please provide the contact information details, i.e., name, company, phone number, and email:

Tyrel Braun, P.Eng.
BCL Engineering Ltd.
(306) 477-2822
tbraun@bcl-eng.ca

5. Project Applicant Type

A private sector body, including for-profit organizations and not-for-profit organizations. In the case of for-profit organizations, they will need to work in collaboration with one or more of the entities referred to above or one of the Indigenous Ultimate Recipients listed below.

5. Project Finances

6. Are sources of funding secured for the Total Project Costs (eligible+ineligible)?

No

a) If no, please explain how, when, and from what source(s) funding will be secured for the project?

Assuming the Utility is successful in the grant application, the Utility's savings / reserves are sufficient to cover the Utility's portion of project costs.

7. Based on your Detailed Cost Estimate, please provide the Total Project Costs:

1100000

8. Based on your Detailed Cost Estimate, please provide the Total Eligible Project Costs:

1085000

9. Using the details from the cost estimate, provide the following information:

II. Design/Engineering : 95000
III. Construction/Materials : 770000
V. Contingency : 195000
I. Project Planning : 25000
Total : 1085000

10. Will the project have the cooperation and/or financial support of two or more communities?

Yes

a) If yes, please list the eligible recipients that will be part of the project, including the level of involvement, and indicate the financial contribution of each community or entity.

	Name of the entity that will receive service	Level of involvement (check all that apply)				Financial contribution ($)
		Letter of Support	Financial Contributor	Partner in Operations	Partner in Ownership	
1.	Resort Village of Elk Ridge	X		X		
2.	Elk Ridge Utility Ltd.		X	X	X	350000
3.						
4.						
5.						

11. Is there a formal agreement in place between the project partners? (Please choose not applicable if there are no partners to this project)

No

12. Fiscal Year Breakdown – Total Eligible Project Costs (April 1 to March 31)

2023-24 : 570000
2024-25 : 515000
Total : 1085000

13. Have any costs been incurred or contracts awarded for the project?

Yes

14. Please select what the estimated project costs are based on

Class D: Estimates at the "Conceptual Design" stage / +/- 20% to 30%

15. When was the cost estimate provided or last updated?

Less than six months ago

16. Please indicate the funding sources for the Applicant's portion of the total project costs.

a) Reserves / Savings: 360000

b-1) What is the estimated date that borrowing will be secured?

b-2) What is the term of borrowing?

b-3) How will borrowing be secured?

b-4) Is outside approval required to borrow? (i.e., from Saskatchewan Municipal Board)

b-5) What is the status of your application with the Saskatchewan Municipal Board?

c) Are those fees and/or levies new or existing?

d) How much has been fundraised to date?

e) Please indicate the project number for your Canada Community-Building Fund (formerly Gas Tax Fund) provided on your acknowledgement of receipt letter, or if not yet submitted enter '0000-000000'

f) What other government funding programs have you applied to and/or received approval for? Please provide program name, amount, and status.

h) If you have selected "other", please elaborate on what other sources of funding you will be utilizing.

6. Nature of the Project

17. What is the nature of the project? Please indicate the percentage of project work in each of the categories below.

Other % : 100%
Total : 100%

a) If "Other", please describe:

Process/capacity upgrades to meet water quality objectives and increase capacity

18. Will the Ultimate Recipient own and operate the asset?

No

a) If you selected 'No', please provide additional information regarding asset ownership & operation. This must include the name, the type of entity, and a brief description of the arrangement.

The Elk Ridge Utility Ltd. (ERU) will own and operate the asset in the immediate term. However, the ERU is in the early stages of transitioning ownership and operation of infrastructure assets to the recently incorporated Resort Village of Elk Ridge (municipality).

7. Location

19. Please enter your project's location.

Latitude

53.895383

Longitude

-105.991622

a) Please enter all the legal land descriptions associated with your project location:

Legal Land Description

Blk/Par EU Plan No. 102323944 Ext 0

20. Have you conducted engagement and/or consultation with the Indigenous communities surrounding your proposed project?

No, we did not conduct any engagement with the surrounding Indigenous communities.

a) If yes, please provide a summary of the feedback you received, the persons contacted etc.

8. Project Schedule

21. Has the project planning started?

Yes

a) If you selected 'Yes', what is the estimated amount of sole source contract?

a) If yes, what percentage of the project design has been completed?

Up to 25%
i.e. Conceptual Design In-Progress or Complete

22. Has project construction started?

No

a) If yes, please describe the construction work that has occurred to date.

23. What is the forecasted construction start date?

09/01/2023

24. What is the forecasted construction end date?

06/30/2024

9. Procurement

25. Will a sole source procurement be used?

No

1. If you answered yes in response to question 25, please add the details of the sole source contract:

a) Estimated amount of the sole source contract

b) Are the contract details known?

c) Indicate the nature of the work:

d) If you selected other, please provide details on the nature of work:

e) What is the justification for sole source contracting?

10. Outcomes and Indicators

26. What category does your project fall under

Drinking Water

Federal Outcome – Project must meet the federal outcome associated with the program to be eligible.

Specifically explain how the project will meet this federal outcome including how it will increase structural capacity to adapt to climate change impacts, natural disasters and extreme weather events.

Specifically explain how the project will meet this federal outcome including how it will increase natural capacity to adapt to climate change impacts, natural disasters and extreme weather events.

Federal Outcome – Project must meet the federal outcome associated with the program to be eligible.

27. Federal Outcome – Project must meet the federal outcome associated with the program to be eligible.

Increased access to potable water (drinking water)

Specifically, explain how the project will meet this federal outcome including how it will increase the capacity to treat and manage wastewater and/or stormwater.

28. Specifically, explain how the project will meet this federal outcome including how it will increase access to potable water.

The existing treatment utilized by the Utility is provided by a small detention tank and two manganese greensand pressure filters. The filters are currently operated above recommended flow rates in order to meet demand of the growing community. The process is unable to achieve provincial and federal drinking water quality standards, particularly regarding manganese removal. The process also has no ability to remove elevated ammonia concentrations from the raw water, which interferes with treatment and disinfection effectiveness. Biofiltration is an improved treatment technology capable of producing drinking water meeting provincial and federal standards, as well as achieving ammonia removal. The replacement process would be designed with capacity to serve current and future population growth of the community.

The existing raw water well pumps will also be replaced to increase supply capacity to match treatment rates. Due to high sediment production, the Utility's backup well is currently unusable, limiting operational flexibility. A pre-filter unit is proposed to address this issue and prevent the sediment from interfering with the treatment process. This will restore use of the backup well, providing the necessary redundancy for the supply system.

29. Will the project result in drinking water that will meet or exceed the relevant provincial or territorial standards following project completion?

Yes

Please select all that apply to your project.

30. Please select all that apply to your project.

Ground water wells
Treatment process, filters, pumps, chemical injection systems, back up power source, monitoring equipment

Currently, is there an environmental risk related to wastewater quality issue in this system, such as potential downstream environmental health or failure to meet effluent quality standards?

If No, what is the objective of the project?

If Yes, please describe.

31. Has the provincial and/or a federal regulator given a notice that the facility must be upgraded?

No

If Yes, please describe.

If Yes, what is the issued deadline(s) to comply with the federal/provincial regulations?

Please explain how the project will achieve compliance with federal/provincial regulations?

Does the proposed project (E.g., wastewater treatment upgrade) discharge into fish-bearing water?

If No, please describe the method for effluent discharge. (i.e. irrigation, surface water discharge)

If Yes, has a downstream use and impact study (DUIS) been conducted?

Has the DUIS study been reviewed and approved by the regulator?

If Yes, please attach the DUIS.

If No, what is the status of the DUIS?

If applicable to your project, please list effluent limits that the project will meet based on the recent *Wastewater Systems Effluent Regulations (WSER)* and *The Waterworks and Sewage Works Regulations.*

32. Describe how the project incorporates sustainable environmental practices?

The existing greensand filtration process requires high chemical dosage to combat ammonia interference and oxidize dissolved iron and manganese. The filters are backwashed frequently in effort to improve treatment and backwashing is longer in duration due to lack of air scour. Issues with entrained sediment in the source water also increase backwash requirements. Poor treatment of iron and manganese causes damage to household appliances, dishes, and laundry promoting waste. As a result, many users implement water softeners and point-of-use membrane filters, which are known to be inefficient and generate high wastewater volumes.

Biological treatment does not require oxidization to remove iron and manganese and is capable of removing ammonia, reducing overall chemical use significantly. This system also requires reduced backwash volumes, saving water and reducing energy consumption through backwash pump usage. Further, vastly improved removal rates of iron, and manganese will extend the lifespan of household appliances and fixtures, reducing waste. Improved treatment would negate the need for household treatment units, which are significantly less efficient than large scale systems in terms of wastewater generation. Installation of a pre-filter unit ahead of the treatment process will address the entrained sediment issues, reducing backwash requirements further and regaining use of our existing backup well. Restoring the existing infrastructure circumvents the need for construction of a new source well altogether.

33. Will this project result in expanded water or wastewater services to households, industries, commercial establishments, and institutions?

No

If Yes, how many?

	Current Number	Future Anticipated Number
Households		
Small and Medium Businesses		
Industries		
Institutions		

34. Please state the current/future growth, design flow upon which the infrastructure is based.

Current population and year (e.g., 480 people, year: 2020) : 300 (2022)
Future design population and year (e.g., 630 people, year: 2051) : 480 (2042)
Growth Rate (e.g., 3%) : 2.4%
Current flow capacity (e.g., 240 m3) : 3.8 L/s
Future design flow capacity (e.g., 315 m3) : 6.1 L/s

35. Are there any capacity issues in the system to meet current and/or future needs?

Yes

36. If Yes, please explain how the project will address this capacity issue to meet current and/or future needs.

The existing greensand filters must be operated above recommended flow rates in attempt to meet demand from the growing community. This compounds the poor treatment capability of the filters. Even when operations are reduced to recommended rates, the process has difficulty in achieving provincial and federal drinking water quality standards, particularly regarding manganese removal. The new treatment system will be designed with sufficient capacity to serve the 20-year population projection. Installation of new well pumps will increase supply capacity to match the required treatment increase. Installation of the pre-filter to address the entrained sediment issue will restore use of our backup well to provide required redundancy.

If No, please describe the capacity of the system to show it can meet the needs of the community.

37. What is the life expectancy of the proposed system or component?

20

38. Does the community require a parallel growth agreement from the Water Security Agency (WSA)?

Not applicable

If Yes, please upload supporting documentation from the WSA and/or describe the status of the agreement in the comments box.

Comments:

If No, please explain why.

39. Does the project involve any new technology?

No

If Yes, please describe the new technology implemented in the project.

If Yes, has it been approved by a provincial regulator?

40. Have you considered other options or alternative approaches/technology that would result in similar project outcomes?

Yes

41. If Yes, please explain what other options were considered and the reason for going forward with the chosen option.

Several conventional treatment processes were considered, including continued use of manganese greensand filtration (with increased capacity). The existing manganese greensand process has proven ineffective at removing manganese for many years, largely due to ammonia interference and insufficient detention time / water characteristics for oxidization reaction. Biological filtration technology is capable of removing iron and manganese in the dissolved state and is also capable of ammonia removal. Therefore, these processes are ideal for addressing the primary concerns present in the raw water. Final treatment selection will be determined through pilot testing.

If No, please explain why other options or alternative approaches/technology were not considered.

42. Does the project implement any water or energy conservation measures?

Yes

43. If Yes, please explain

The existing greensand filtration process requires frequent and sustained backwashing, resulting in high wastewater generation and pump use. Due to poor treatment, distributed water is high in manganese and minerals, prompting users to implement point-of-use treatment, such as water softeners and household membrane filters. Point-of-use filters are known to be much less efficient than large scale systems in terms of wastewater generation. Implementation of the new treatment system would realize reduced backwash requirements and improved treatment quality, eliminating need for point-of-use treatment. Installation of a pre-filter unit to address entrained sand in the source water will lower backwash requirements further by preventing this material from interfering with the treatment process. Variable frequency or soft-start technology will be included with well pump upgrades to reduce power consumption.

If No, please explain why water or energy conservation measures were not considered.

44. Have you applied for permits related to the project?

No

If Yes, please list all the permits required and state the status of each permit

45. If No, please list the permits that will be required and state the estimated time frame in which you would be applying for the permit(s).*

Permit to construct - Water Security Agency
This permit will be applied for upon completion of design drawings to ensure compliance with provincial standards for municipal infrastructure.

46. Will the project result in a change to the system's operator classification?

No

If Yes, please describe the current system's operator classification requirement and explain how the new classification requirement will be met.

Indicators

	Qty/Length	Physical Condition before Investment	Physical Condition after Investment	Nature of Project Work				Nature of Project Work (%)
				New	Expansion	Rehab	Upgrade	
Treatment plant								
Lagoon systems								
Wastewater pump stations								
Wastewater lift station								
Wastewater storage tank								
Linear wastewater assets (in meters)								

51. Compliance with federal effluent regulations.

Will the project achieve compliance with federal effluent regulations?

What is the risk level of the facility in relation to federal effluent regulations?

Indicators

	Qty/Length	Physical Condition before Investment	Physical Condition after Investment	Nature of Project Work				Nature of Project Work (%)
				New	Expansion	Rehab	Upgrade	
Drainage pump stations								
Management facilities: ponds and water wetlands								
Management facilities: all other permitted end-of-pipe facilities								
Linear stormwater features (in meters)								

Stormwater assets

	Before investment	After Investment
Volume of materials diverted (in liters)		
Capacity to dispose of materials (in liters)		

47. Is there an exceedance in maximum allowable concentration (MAC) or Aesthetic Objective (AO) as outlined in Saskatchewan's Drinking Water Quality standards and objectives?

Yes

48. If Yes, please describe.

Treated water has exceeded the AO for manganese, alkalinity, and total dissolved solids in past laboratory testing. Daily testing conducted by the operators indicates that the process frequently exceeds the AO and occasionally the MAC for manganese, particularly during peak demand periods. It is anticipated that the AO for manganese will be reduced to 0.02 mg/L in near future, following suit with federal standards.

If No, what is the objective of the project?

49. Has the community been put on Boil/Precautionary Drinking Water Advisory (PDWA) lasting more than 12 months?

No

If Yes, please describe the reason behind the PDWA.

If Yes, how will the project resolve the issue which resulted in the PDWA?

50. If No, explain the nature, dates, and duration of any shorter-term drinking water advisories that have recently affected the community and how the project will resolve the issue?

There have been no recent boil water advisories.

51. Please list the water quality data before and after the treatment process (raw and treated), if applicable.

Parameter - Raw value (Treated value) (all units mg/L)

Ammonia - 0.71 (0.75)
Arsenic - 0.027 (0.0025)
Alkalinity - 538 (501)
Iron - 1.88 (0.02-0.1 typical in plant, 0.12 laboratory)
Manganese - 0.13 (0.02-0.08 typical +0.2 occasional in plant, 0.05 laboratory)
Total dissolved solids - 538 (530)
Hardness - 446 (450)

52. Does this project increase wastewater generation (especially for membrane treatment systems)?

No

If Yes, will the community wastewater system have the capacity for potable water system upgrades?

If Yes, briefly describe the wastewater infrastructure to show it has the capacity to meet the needs of the upgrades.

53. Does the proposed project discharge into fish-bearing water?

No

54. If No, please explain where the effluent will be discharged.

Any waste generated at the water treatment plant is discharged to the sanitary sewer system and ultimately to the lagoon. Net wastewater generation is not anticipated to increase due to implementation of the new treatment process.

If Yes, has a Downstream Use and Impact Study (DUIS) been conducted?

If Yes, please attach the DUIS.

If No, what is the status of the DUIS?

55. Please attach a feasibility study completed by a Professional Engineer licensed to practice in Saskatchewan:

36401ElkRidge.rpt22.pdf

56. Provincial or territorial drinking water standards will be met or exceeded.

Yes

57. Indicators

	Quantity/Length	Physical Condition before Investment	Physical Condition after Investment	Nature of Project Work				Nature of Project Work (%)
				New	Expansion	Rehabilitation	Upgrade	
Water treatment facilities	1	Very Poor	Very Good				X	100
Reservoir								
Pump stations								
Local water pipes (in meters)								
Transmission pipes (in meters)								

What category does your project fall under?

Please indicate how the proposed project will meet provincial/federal regulations. Attach documentation if applicable(e.g., engineering reports).

Attach documents.

Please provide information that demonstrates that major social, physical, or economic risks exist and have been considered. Please attach available study reports for this project.

Attach study reports

Have any risk assessments and/or mitigation plans been developed in support of your project?

If Yes, please describe the findings of the risk assessments and/or mitigation plans.

If No, please describe why not.

Has public consultation been held regarding the project?

Please state the outcome of the public consultation.

Please explain why no public consultation was held.

84. Describe the project assets that will improve structural capacityto adapt to climate change impacts, natural disasters and extreme weather events.

Description of the Asset

Quantity

Physical condition of the asset - Before Investment

Physical condition of the asset - At project conclusion

Adaptation Purpose (select all that apply)

Description of the Asset

Quantity

Physical condition of the asset - Before Investment

Physical condition of the asset - At project conclusion

Adaptation Purpose (select all that apply)

Description of the Asset

Quantity

Physical condition of the asset - Before Investment

Physical condition of the asset - At project conclusion

Adaptation Purpose (select all that apply)

85. Describe the project assets that will improve natural capacityto adapt to climate change impacts, natural disasters and extreme weather events.

Type of Asset

Quantity

Physical condition of the asset - Before investment

Physical condition of the asset - At project conclusion

Adaptation Purpose (select all that apply)

58. Is the proposed project part of your asset management plan?

No

If Yes, please upload a copy of your asset management plan.

11. Project Risks and Mitigation Strategies

59. Select all applicable project risks below and indicate what measures will be taken to mitigate the selected risks.

Project Complexity

No risk identified

Project Readiness

No risk identified

Public Sensitivity

No risk identified

Ultimate Recipient Risk

No risk identified

12. Environmental Assessment and Consultations and Climate Lens

60. Please confirm you have completed the Federal Aboriginal Consultation and Environmental Assessment smart form.

I confirm that I have completed the form.

Please confirm you have completed the mandatory Climate Lens required for the Green Infrastructure-Adaptation, Resilience and Disaster Mitigation sub-stream.

13. Upload of Mandatory Documents

Please upload the Climate Lens

Please upload the document supporting land ownership/control (e.g., certificate of title, long-term lease, etc.)

Land_Title.pdf

Please upload the council resolution

Village_&_Board_Resolution.pdf

Please upload the completed detailed cost estimate using the template provided.

ICIP-Detailed-Cost-Estimate-Template.xlsx

Please upload the site plan/map (including the .kml file).

ERU_WTP_kml_file.docx

Please upload the completed Federal Aboriginal Consultation and Environmental Assessment smart form (ACEA).

Aboriginal-Consultation-and-EA-Smart-Form_V8.7.pdf

Please upload any engineering reports you have completed or additional documents in support of your project.

36401ElkRidge.rpt22.pdf

Please upload any permits, licenses or approvals you have obtained to complete your project.

Please upload documentation in support of your regional project.

14. Attestation/Authorization

Attestation/Declaration:

I attest that I have reviewed the information in this application, and, to the best of my knowledge:

the information provided in this project application is complete and accurate; and
if approved, federal and provincial funding will support only eligible expenditures.

I understand that if approved, the project:

will be required to meet the requirements of the Investing in Canada Infrastructure Program (ICIP); and
will be governed under the terms of an ICIP Ultimate Recipient Agreement.

I further authorize:

the Ministry of Government Relations to request information about the Applicant or the Applicant's project from any federal or provincial government department or agency, or from any third party including, but not limited to, Saskatchewan Water Security Agency, Saskatchewan Municipal Board, Saskatchewan Ministry of Environment, Saskatchewan Ministry of Parks, Culture and Sport, SaskBuilds and SaskWater and to disclose any information contained in this application or provided in relation to the Applicant, to any such department, agency or third party for the purposes of processing this application or administering the Investing in Canada Infrastructure Program;

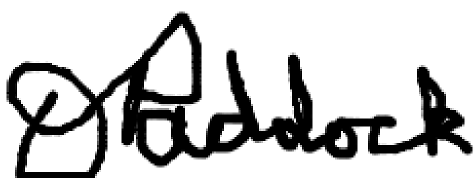
any department, agency or third party mentioned above, who is requested to verify or provide information, to disclose that information to the Ministry of Government Relations; and

the Ministry of Government Relations to disclose information in relation to the Applicant or the Applicant's project to any department, agency or third party for the purpose of making application to a complimentary grant program (the applicant will be notified by the Ministry of Government Relations in the event this occurs).

Title/Position

President

Signature



Signature of: Dennis K. Paddock

Date

11/28/2022

SASKATCHEWAN - RESORT VILLAGE OF ELK RIDGE

ULTIMATE RECIPIENT AGREEMENT FOR THE

INVESTING IN CANADA INFRASTRUCTURE PROGRAM

This Agreement is made as of the date of last signature

BETWEEN:

HIS MAJESTY THE KING IN RIGHT OF SASKATCHEWAN, as represented by the Minister of Government Relations ("Saskatchewan") and

RESORT VILLAGE OF ELK RIDGE, in the Province of Saskatchewan (hereinafter referred to as the "Ultimate Recipient").

individually referred to as a "Party" and collectively referred to as the "Parties".

AUTHORIZATION

WHEREAS the Government of Canada and the Government of Saskatchewan entered into the Canada - Saskatchewan IBA Investing in Canada Infrastructure Program (ICIP) signed the 17th day of October, 2018 (the "IBA");

WHEREAS Saskatchewan is administering the Integrated Bilateral Agreement (IBA) with respect to the contributions made by Canada and Saskatchewan under the ICIP;

WHEREAS the Minister is authorized to enter into an Agreement to provide financial assistance to the Ultimate Recipient for this purpose under the authority granted by section 18 of *The Executive Government Administration Act,* and *The Crown Corporations Act* and O.C. 550/2012, amended by O.C. 539/2018;

WHEREAS the Ultimate Recipient has submitted a proposal under the IBA to Saskatchewan and this Project has been approved for funding by Saskatchewan and Canada.

NOW THEREFORE, the Parties agree as follows:

1. INTERPRETATION

1.1 DEFINITIONS

"Agreement" means this Ultimate Recipient Agreement and all schedules, as may be amended from time to time, between Saskatchewan and the Ultimate Recipient whereby a financial contribution is made to an approved project.

"Agreement End Date" means the date this Agreement will terminate as set out in Schedule A.

"Asset" means any real or personal property, or immovable or movable asset, acquired, purchased, constructed, rehabilitated or improved, in whole or in part, with contribution funding provided under the terms and conditions of this Agreement.

"Asset Disposal Period" means the period ending five (5) years after the Project Completion Date.

"Canada" means the federal Minister or their delegate.

"Communications Activity" or "Communications Activities" means, but is not limited to, public or media events or ceremonies including key milestone events, news releases, reports, web and social media products or postings, blogs, news conferences, public notices, physical and digital signs, publications, success stories and vignettes, photos, videos, multi-media content, advertising campaigns, awareness campaigns, editorials, multi-media products and all related communication materials under this Agreement.

"Contract" means an Agreement between the Ultimate Recipient and a Third Party whereby the latter agrees to supply a product or service to a Project in return for financial consideration.

"Contribution" means the financial contribution that Canada and Saskatchewan will pay to the Ultimate Recipient under the terms of this Agreement as detailed in Schedule A, Section A.5.

"Effective Date" means the date of last signature of this Agreement.

"Eligible Expenditures" mean those costs Incurred and eligible for payment by Saskatchewan as set out in Schedule B.

"Final Claim Date" means the date as shown on Schedule A which is the date by which the final claim for the Project must be submitted to Saskatchewan for review.

“Fiscal Year” means the period beginning on April 1st of a calendar year and ending on March 31st of the following calendar year.

“Incurred” means an event or transaction has taken place for which an obligation to pay exists, even if an invoice has not been received.

“Ineligible Expenditures” means those expenditures incurred that are ineligible for reimbursement by Saskatchewan as set out in Schedule B.

“Infrastructure” means publicly or privately-owned capital assets in Saskatchewan for public use or benefit**.**

“Integrated Bilateral Agreement” (“IBA”) means the Canada-Saskatchewan IBA for the ICIP and all its schedules, as may be amended from time to time.

“ICIP” means the Investing in Canada Infrastructure Program, under which this Ultimate Recipient Agreement is authorized.

“Joint Communications” means events, news releases, and signage that relate to this Agreement and are collaboratively developed and approved by Canada, Saskatchewan and the Ultimate Recipient and are not operational in nature.

“Oversight Committee” means the federal and provincial officials appointed as per the IBA.

“Project(s)” means one or more projects submitted by Saskatchewan and approved by Canada pursuant to section 9 (Project Submission, Approval and Changes) of the IBA and governed under this Agreement.

“Project Approval Date” means the date as set out in Schedule A on which the Project was authorized for funding under the IBA.

“Project Substantial Completion” means when a Project can be used for the purpose for which it was intended as declared in Schedule A.

“Project Completion Date” as listed on Schedule A means the date after which Eligible Expenditures can no longer be incurred.

“Substantial Completion” or “Substantially Completed” means, when referring to a Project, that the Project can be used for the purpose for which it was intended.

“Third Party” means any Person or legal entity, other than a Party or Ultimate Recipient, who provides goods and/or services under Contract and/or participates in the implementation of a Project by means of a Contract.

"Total Eligible Expenditures" means all Eligible Expenditures for the Project, as defined in Schedule B, Subsection B.1.

"Total Financial Assistance" means total Project funding from all sources including, but not limited to, funding from federal, provincial, territorial, municipal, regional, not-for-profit institution, debt financing, band council, and Indigenous government sources; private sources; and in-kind contributions.

1.2 ENTIRE AGREEMENT

This Agreement comprises the entire Agreement between the Parties in relation to the subject of the Agreement. No prior document, negotiation, provision, undertaking or agreement has legal effect, unless incorporated by reference into this Agreement. No representation or warranty express, implied or otherwise, is made by Saskatchewan to the Ultimate Recipient except as expressly set out in this Agreement.

In the case of a conflict between the IBA and this Agreement, the IBA shall take precedence.

1.3 TERM OF AGREEMENT

This Agreement will be effective as of the date of last signature of this Agreement and will terminate on the date as per Schedule A, subject to early termination in accordance with this Agreement.

1.4 SCHEDULE

The following schedules are attached to and form part of this Agreement:

Schedule A – Project Details
Schedule B – Program Details – Eligible and Ineligible Expenditures
Schedule C – Communications Protocol
Schedule D – Declaration of Completion

1.5 THE CONTRIBUTION

a) The Ultimate Recipient is eligible to receive a financial contribution upon incurring Eligible Expenditures for the Project as detailed in Schedule A and Schedule B.

b) For the purposes of Subsection a), Saskatchewan will make a Contribution to reimburse the Ultimate Recipient for Eligible Expenditures of the approved Project as per Section A.5 of Schedule A.

2. COMMITMENTS BY THE ULTIMATE RECIPIENT

2.1 GENERAL

a) The Ultimate Recipient will be responsible for the complete, diligent, and timely implementation of this Agreement, within the funding limits and deadlines specified in this Agreement and in accordance with the terms and conditions of this Agreement.

b) The Ultimate Recipient acknowledges that Saskatchewan will not be financially responsible for any ineligible expenditures or cost and schedule overruns for a Project.

c) The Ultimate Recipient will be responsible for any costs associated with a withdrawn or cancelled Project, and will repay to Saskatchewan any and all disallowed costs, surpluses, unexpended contributions, and overpayments made under and according to the terms and conditions of this Agreement.

d) The Ultimate Recipient will inform Saskatchewan immediately of any fact or event, of which the Ultimate Recipient is aware, that will compromise wholly, or in part, the completion of a Project.

e) The Ultimate Recipient shall comply with reporting requirements as outlined in this Agreement and any reporting requested by Saskatchewan (e.g., progress reports).

f) The Ultimate Recipient and any Third Party shall comply with all applicable legislation including without limiting the foregoing, all necessary licenses, permits, and approvals required for the Project by applicable legislation, regulations and by-laws.

g) The Ultimate Recipient will promptly inform Saskatchewan of any cancelled or withdrawn Projects.

h) For Projects which include the construction of buildings, the Ultimate Recipient must meet or exceed the highest energy efficiency and accessibility standards for buildings in Saskatchewan by complying with the minimum requirements in the National Energy Code of Canada, 2017 and the National Building Code of Canada, 2015, as amended from time to time. The Ultimate Recipient will provide Saskatchewan with copies of the building permit, the final inspection certificate or occupancy permit issued by a building official licensed in the classification appropriate for the Project.

3. CHANGES TO AN AGREEMENT

a) A written request for any changes to the agreement will be reviewed by Saskatchewan and may be approved or rejected. Approved changes will not be effective until the Parties execute an amendment to this Agreement.

b) The Project Completion Date and Final Claim Date may be altered by notice in writing by Saskatchewan.

c) The Ultimate Recipient agrees that any material changes to a Project will require Canada and Saskatchewan's written approval. Material changes to a Project includes the following:
   i. Any change to its location, scope or timing as laid out in Schedule A;
   ii. When applicable, any change that would trigger a further environmental assessment or duty to consult;
   iii. A decrease in the estimate for Total Eligible Expenditures to the extent that estimated Total Eligible Expenditures would be less than the total approved Eligible Expenditures;
   iv. Any changes that result in not achieving the targets laid out in the subsection A.7 of this agreement.

4. DEBT DUE TO SASKATCHEWAN

a) Any amount owed to Saskatchewan under this Agreement will constitute a debt due to Saskatchewan, which the Ultimate Recipient will reimburse forthwith, on demand, to Saskatchewan.

b) Without limiting the foregoing, the following shall be considered a debt due to Saskatchewan:
   i. Any portion of the Contribution paid to the Ultimate Recipient under this Agreement not used for Eligible Expenditures for approved Projects;
   ii. Any funds paid to the Ultimate Recipient under this Agreement that exceed the Contribution specified; and
   iii. Any funds paid to the Ultimate Recipient under this Agreement that exceeds the maximum Total Eligible Expenditures described in this Agreement.

c) In addition to any other right or remedy at law, Saskatchewan shall have the right of setoff to recover any overpayments made to the Ultimate Recipient on debts due to Saskatchewan under this Agreement.

5. ENVIRONMENTAL ASSESSMENT

No site preparation, vegetation removal or construction will occur for a Project and Canada and Saskatchewan's funding for a Project is conditional upon Canada and Saskatchewan being satisfied that the federal and provincial requirements under the *Impact Assessment Act, 2019* (IAA, 2019) and *The Environmental Assessment Act* and other applicable federal or provincial environmental assessment legislation that is or may come into force during the term of this Agreement are met and continue to be met.

6. ABORIGINAL CONSULTATION

a) No construction will occur for a Project and Canada and Saskatchewan's funding for a Project is conditional upon Canada and Saskatchewan's obligations, if any, to consult Aboriginal Peoples with respect to adverse impacts of the Project on Aboriginal groups, including, where appropriate, the accommodation of Aboriginal concerns, being met and continuing to be met.

b) Where Canada and Saskatchewan may have an obligation to consult, at Canada's and Saskatchewan's request, the Ultimate Recipient will provide to Canada and Saskatchewan, a summary of consultation that has occurred with Aboriginal groups, including the Aboriginal group's position, concerns and indication of how the concerns were addressed.

c) Where Canada and Saskatchewan have an obligation to consult, at Canada and Saskatchewan's request, the Ultimate Recipient will assist Canada and Saskatchewan to undertake the procedural aspects of consultation and implement measures to accommodate an Aboriginal group's concerns as appropriate, and these costs may be considered Eligible Expenditures as set out in Schedule B Eligible and Ineligible Expenditures.

7. AWARDING OF CONTRACTS

The Ultimate Recipient will ensure that Contracts will be awarded in a way that is fair, transparent, competitive and consistent with value-for-money principles, or in a manner otherwise acceptable to Saskatchewan, and if applicable, in accordance with international and domestic trade agreements. These trade agreements, include, but are not limited to: *the Canadian Free Trade Agreement, the New West Partnership Trade Agreement*, and *the Canada-European Union Comprehensive Economic and Trade Agreement*.

a) lf Saskatchewan determines that the Ultimate Recipient has awarded a Contract in a manner that is not in compliance with the foregoing, upon notification to the Ultimate Recipient, Saskatchewan may consider the expenditures associated with the Contract to be ineligible.

b) The Ultimate Recipient agrees that all Contracts will be awarded and managed in accordance with Saskatchewan's relevant policies and procedures.

c) All Contracts of the Ultimate Recipient made under the provisions of this Agreement shall be consistent with this Agreement.

8. REPORTING

8.1 PROGRESS REPORT

a) The Ultimate Recipient will submit progress reports to Saskatchewan at a timing and frequency determined by Saskatchewan but no less than twice a year. The first progress report under this Agreement must cover the period from the Project Approval Date.

b) Each Project progress report will include an attestation in a format acceptable to Saskatchewan, from a delegated official, that the information in the report is accurate.

c) The Project progress report will include the following updated information for each Project:
    i. Canada's contribution funding to the Project by Fiscal Year;
    ii. Construction start and end dates (forecasted/actual);
    iii. Progress tracker (e.g., percent completed);
    iv. Risks and mitigation strategies, as required;
    v. Confirmation that the Project is on-track to achieve expected results, or if Substantially Completed, confirmation of actual results; and
    vi. Confirmation of installed Project signage, if applicable.

d) The Ultimate Recipient will report annually, at a timing and frequency determined by Saskatchewan, through the Project progress report on expected and actual results related to community employment benefits for applicable Projects.

e) The Ultimate Recipient will complete all reporting requirements as defined under paragraphs a), b) and c) in this section for all Projects to the satisfaction of both Parties no later than the Agreement End Date as set out in Schedule A.4.

f) The Ultimate Recipient agrees and will ensure that Canada and Saskatchewan may use the information submitted by the Ultimate Recipient under this section to publicly report on Program results.

8.2 FINAL REPORT

The Ultimate Recipient will submit a final report to Saskatchewan in the form determined by Saskatchewan for approval no later than the Final Claim Date. The final report will include at least:

a) All information required under Section 8.1 Progress Report, covering the period from the last progress report to the Final Claim Date as outlined in Schedule A; and

b) A cumulative summary of the Project, which will include the following information:
    i. The Project's completed outcome and output results compared to the baseline established prior to the start of the Project as agreed to by all Parties;
    ii. Total expenditures for the Project;
    iii. Total Eligible Expenditures for the Project; and
    iv. Confirmation of the Total Financial Assistance received.

9. CLAIMS AND PAYMENTS

9.1 CLAIMS AND PAYMENTS

a) Saskatchewan shall make a payment to the Ultimate Recipient, for the purposes described in Schedule B, (Project and Program Details – Eligible and Ineligible Expenditures) upon receipt of a claim for Eligible Expenditures. The information to be provided on the claim is outlined below:
    i. A listing of invoices paid by the Ultimate Recipient for which the Ultimate Recipient has received goods and services for Eligible Expenditures.
    ii. The claim shall be made on the form and in the manner specified by Saskatchewan and may be submitted as frequently as once per month, or at least semi-annually, at a timing and frequency determined by Saskatchewan.
    iii. Final payment will be made upon the completion of the Project to the satisfaction of Saskatchewan and submission of a final claim which includes copies of the outstanding invoices for Eligible Expenditures actually incurred and paid, a Declaration of Completion form (Schedule D), a final report, as described in 8.2, copies of all required permits and any other applicable reporting in a form specified and if deemed necessary, by Saskatchewan. The Final Claim Date is listed in Schedule A; and
    iv. Saskatchewan may withhold interim or final payments of the Contribution for the Project pending satisfactory completion of a claim audit or where in the opinion of the Minister, the Ultimate Recipient has failed to comply with the provisions of this Agreement.

b) Completed Projects may be subject to a full audit of the Project, records and expenditures.

c) The Parties acknowledge that Saskatchewan's role is limited to providing funding to the Project and that Saskatchewan will have no involvement in the implementation of that Project or its operation. Saskatchewan is neither a decision-maker nor an administrator to the Project.

d) The Ultimate Recipient may receive additional funding from other provincial grant programs for any Project approved pursuant to this Agreement, provided that the Ultimate Recipient informs Saskatchewan promptly of any additional provincial financial assistance received in respect of the Eligible Expenditures of a Project, not to exceed total Project costs.

9.2 PAYMENT CONDITIONS

Saskatchewan will not:

a) Pay interest for failing to make a Contribution under this Agreement;

b) Pay capital costs for a Project until the requirements under Section 5 Environmental Assessment and Section 6 Aboriginal Consultation, if applicable, are, in Saskatchewan's opinion, satisfied to the extent possible at the date the claim is submitted to Saskatchewan;

c) Pay any claims until requirements under any audit requirements in section 10 (Audit) and any requirements outlined in Schedule C (Communications Protocol) are met; and

d) The Parties acknowledge that no payment will be provided until:
    i. The Legislative Assembly of Saskatchewan has appropriated funds out of which the financial assistance may be paid in the fiscal year in which the payment is to be made pursuant to this Agreement; and
    ii. The Ultimate Recipient has met the eligibility criteria with respect to the financial contribution as set out above and all other significant terms and conditions of the Agreement.

9.3 RETENTION OF CONTRIBUTION

Saskatchewan will retain a maximum of five percent (5%) of its contribution funding under this Agreement. The amount retained by Saskatchewan will be released by Saskatchewan when:

a) The Ultimate Recipient fulfils all of its obligations under this Agreement;

b) The Ultimate Recipient submits an attestation, from a delegated official and in a format acceptable to Saskatchewan, that the Project has been Substantially Completed and contribution funding under this Agreement has been spent on Eligible Expenditures; and

c) The Parties jointly carry out a final reconciliation of all claims and payments in respect of this Agreement and make any required adjustments.

10. AUDIT

a) The Ultimate Recipient agrees to inform Saskatchewan of any audit that has been conducted on the use of contribution funding under the IBA, provide Saskatchewan with all relevant audit reports, and ensure that prompt and timely corrective action is taken in response to any audit findings and recommendations. The Ultimate Recipient will submit to Saskatchewan in writing as soon as possible, but no later than sixty (60) days following receiving it, a report on follow-up actions taken to address recommendations and results of the audit.

b) Saskatchewan may undertake, at any time, any other audit in relation to this Agreement. All audits conducted by Saskatchewan will be at Saskatchewan's expense.

c) The Ultimate Recipient will ensure proper and accurate financial accounts and records are kept, including but not limited to its Contracts, invoices, statements, receipts, and vouchers in respect of all Projects for at least six (6) years after the Agreement End Date, as per Schedule A.

d) All the Project's records and accounts are available to Canada and Saskatchewan for inspection, at all reasonable times.

e) The Ultimate Recipient shall permit any authorized representative of the Oversight Committee reasonable access to the Ultimate Recipient's premises to inspect and assess the progress of the Project as well as to examine the Ultimate Recipient's books and records relating to the Project, and to make copies thereof. The Ultimate Recipient shall provide promptly information or documentation required to clarify any of its books and records.

f) The Ultimate Recipient agrees to abide by all deliverables and timelines of Ultimate Recipient audits as set by the Oversight Committee.

11. DISPUTE RESOLUTION

a) The Parties will keep each other informed of any issue that could be contentious.

b) If a contentious issue arises, the Parties will examine it and will, in good faith, attempt to resolve the contentious issue as soon as possible, and, in any event, within thirty (30) business days from the receipt of notice of such contentious issue. Where the Parties cannot agree on a resolution, the matter will be referred to the Oversight Committee for resolution. The Oversight Committee will provide a decision within ninety (90) business days from the date of referral to the Parties.

c) Any payments related to any contentious issue raised by any of the Parties may be suspended by Saskatchewan together with the obligations related to such issue, pending resolution.

d) The Parties agree that nothing in this section will affect, alter or modify the rights of the Parties to terminate this Agreement.

12. DEFAULT

12.1 EVENTS OF DEFAULT

The following event constitutes the “Event of Default” under this Agreement:

a) The Ultimate Recipient has not complied with one or more of the terms and conditions of this Agreement and the IBA.

12.2 DECLARATION OF DEFAULT

Saskatchewan may declare default if:

a) The Event of Default occurs;

b) Saskatchewan gives notice to the Ultimate Recipient of the event, which in Saskatchewan’s opinion constitutes an Event of Default; and

c) The Ultimate Recipient has failed, within thirty (30) business days of receipt of the notice, either to remedy the Event of Default or to notify and demonstrate to the satisfaction of Saskatchewan that it has taken such steps as are necessary to remedy the Event of Default.

12.3 REMEDIES ON DEFAULT

In the event that Saskatchewan declares default under Section 12.2 (Declaration of Default), Saskatchewan may exercise one or more of the following remedies, without limiting any remedy available to it by law:

a) Suspend or terminate any obligation by Saskatchewan to contribute or continue to contribute funding to the Project, including any obligation to pay an amount owing prior to the date of such suspension or termination;

b) Suspend or terminate the approval of the Project;

c) Require the Ultimate Recipient to reimburse Saskatchewan all or part of the contribution paid by Saskatchewan to the Ultimate Recipient; or

d) Terminate this Agreement.

13. LIMITATION OF LIABILITY AND INDEMNIFICATION

13.1 LIMITATION OF LIABILITY

In no event will Canada, Saskatchewan, its officers, servants, employees or agents be held liable for any damages in contract, tort (including negligence) or otherwise, for:

a) Any injury to any Person, including, but not limited to, death, economic loss or infringement of rights;

b) Any damage to or loss or destruction of property of any Person; or

c) Any obligation of any Person, including, but not limited to, any obligation arising from a loan, capital lease or other long term obligation;

d) The performance of this Agreement or the breach of any term and condition of it by the Ultimate Recipient, its officers, servants, employees and agents, or by a Third Party, and any of its officers, servants, employees or agents; or

e) Any omission or other willful or negligent act of the Ultimate Recipient, a Third Party, and their respective officers, servants, employees or agents;

In relation to this Agreement or each of the Projects.

13.2 INDEMNIFICATION

The Ultimate Recipient will at all times indemnify and save harmless Canada, Saskatchewan, their officers, servants, employees or agents, from and against all actions, claims, demands, losses, costs, damages, suits or other proceedings, whether in contract, tort (including negligence)
or otherwise, by whomsoever brought or prosecuted in any manner based upon or occasioned by:

a) Any injury to any Person, including, but not limited to, death, economic loss or any infringement of rights;

b) Any damage to or loss or destruction of property of any Person; or

c) Any obligation of any Person, including, but not limited to, any obligation arising from a loan, capital lease or other long term obligation;

In relation to this Agreement or each of the Projects, except to the extent to which such actions, claims, demands, losses, costs, damages, suits or other proceedings are caused by the negligence or breach of the Agreement by an officer, servant, employee or agent of Canada or Saskatchewan in the performance of his or her duties.

14. ASSETS

14.1 DISPOSAL OF ASSETS

a) Unless otherwise agreed to by the Parties, Saskatchewan will require that the Ultimate Recipient maintain ongoing operations and will agree to retain title to and ownership of an Asset for the Asset Disposal Period.

b) If at any time within the Asset Disposal Period, the Ultimate Recipient sells, leases, or otherwise disposes of, directly or indirectly, any Asset purchased, acquired, constructed, rehabilitated or renovated, in whole or in part, under this Agreement, other than to Canada, Saskatchewan, a municipal or regional government as outlined in paragraph ii. a) of section A.1 a) (Ultimate Recipients) of the IBA, or with Saskatchewan's consent, the Ultimate Recipient may be required to reimburse Saskatchewan, any federal or provincial funding received for the Project.

14.2 REVENUE FROM ASSETS

The Parties acknowledge that Canada and Saskatchewan's contribution to the Ultimate Recipient's Project is meant to accrue to the public benefit. The Ultimate Recipient will notify Saskatchewan in writing within ninety (90) business days of the end of a Fiscal Year if any Asset owned by a for-profit Ultimate Recipient as defined in paragraph ii. d) of section A.1 a) (Ultimate Recipients) of the IBA, is used in such a way that in the Fiscal Year revenues are generated from it that exceed its operating expenses. Saskatchewan may require the Ultimate Recipient to immediately pay to Canada, via Saskatchewan, a portion of the excess in the same proportion as the total cost of the Asset to not exceed Canada and Saskatchewan's contribution to the Project. This obligation will only apply during the Asset Disposal Period, and when it is determined by Saskatchewan that the Project no longer meets the requirement of public benefit.

14.3 REPAYABLE CONTRIBUTIONS

At Saskatchewan's request, the Ultimate Recipient shall repay any contribution funding provided by Canada and Saskatchewan under this Agreement that is intended for an Ultimate Recipient that is a for-profit private sector body where such funding is for the purpose of that Ultimate Recipient generating profits or increasing the value of its business. Any repayment by the Ultimate Recipient will be made in accordance with terms and conditions of repayment as determined by Saskatchewan at the time Saskatchewan approves a Project.

15. GENERAL

15.1 ACCOUNTING PRINCIPLES

All accounting terms will have the meanings assigned to them, all calculations will be made and all financial data to be submitted will be prepared, in accordance with the public sector accounting standards in effect in Canada.

15.2 SURVIVAL

The Parties' rights and obligations, which by their nature, extend beyond the termination of this Agreement, will survive any termination of this Agreement.

15.3 CONFLICT OF INTEREST

No current or former public servant or public office holder to whom any post-employment, ethics and conflict of interest legislation, guidelines, codes or policies of Saskatchewan applies will derive direct benefit from this Agreement unless the provision or receipt of such benefits is in compliance with such legislation, guidelines, policies or codes. The Ultimate Recipient will promptly inform Saskatchewan should it become aware of the existence of any such situation.

15.4 NO AGENCY, PARTNERSHIP, JOINT VENTURE, ETC.

No provision of this Agreement and no action by the Parties will establish or be deemed to establish a partnership, joint venture, principal-agent relationship or employer-employee relationship in any way or for any purpose whatsoever between Saskatchewan and an Ultimate Recipient or between Saskatchewan and a Third Party.

The Ultimate Recipient will not represent itself in any agreement with a Third Party, as a partner, employee or agent of Saskatchewan.

15.5 NO AUTHORITY TO REPRESENT

Nothing in this Agreement is to be construed as authorizing any Person, including a Third Party, to contract for or to incur any obligation on behalf of Saskatchewan or to act as an agent for Saskatchewan.

15.6 COUNTERPART SIGNATURE

This Agreement may be signed in counterpart, and the signed copies will, when attached, constitute an original Agreement.

15.7 SEVERABILITY

If for any reason a provision of this Agreement that is not a fundamental term of this Agreement between the Parties is found to be or becomes invalid or unenforceable, in whole or in part, and if the Parties agree, it will be deemed to be severable and will be deleted from this Agreement, but all the other terms and conditions of this Agreement will continue to be valid and enforceable.

15.8 ASSIGNMENT

a) The Ultimate Recipient will not transfer or assign its rights or obligations under this Agreement without the prior written consent of Saskatchewan. Any attempt by the Ultimate Recipient to assign any of the rights, duties or obligations of this Agreement without Saskatchewan's express written consent is void.

b) Saskatchewan can transfer or assign its rights or obligations under this Agreement to any other Government of Saskatchewan organization at any time without prior consent of the Ultimate Recipient.

15.9 COMPLIANCE WITH LAWS

The Ultimate Recipient will comply with and ensure that the Project complies with all statutes, regulations, and other applicable laws governing Saskatchewan, the Ultimate Recipient and the Project under this Agreement, including all requirements of, and conditions imposed by, regulatory bodies having jurisdiction over the subject matter.

15.10 AMENDMENTS

This Agreement may be amended from time to time on written Agreement of the Parties.

15.11 WAIVER

A Party may waive any of its rights under this Agreement only in writing. Any tolerance or indulgence demonstrated by the Party will not constitute a waiver.

15.12 GOVERNING LAW

This Agreement is governed by the laws applicable in the Province of Saskatchewan.

15.13 SUCCESSORS AND ASSIGNS

This Agreement is binding upon the Parties and their respective successors and assigns.

15.14 NOTICE

Any notice provided for under this Agreement may be delivered in person, sent by email facsimile or mail addressed to:

for Saskatchewan:

Executive Director
Municipal Infrastructure and Finance Branch
Ministry of Government Relations
500-1855 Victoria Avenue
REGINA SK S4P 3T2
Email: infra@gov.sk.ca

or to such other address, email, or addressed to such other person as Saskatchewan may, from time to time, designate in writing to the Ultimate Recipient; and

for Resort Village of Elk Ridge:

P.O. Box 171
WASKESIU LAKE SK S0J 2Y0
Phone: 306-940-9052
Email: infoelkridge@sasktel.net

or such other address, email, or addressed to such other person as the Ultimate Recipient may, from time to time, designate in writing to Saskatchewan.

Such notice will be deemed to have been received, if sent by mail or email, when receipt is acknowledged by the other Party; and in person, when delivered.

15.15 TERMINATION

Either party may terminate this Agreement, without cause, by giving the other party at least 30 days' notice.

16. SIGNATURES

This Agreement has been executed by the Parties by their duly authorized officers on the day and year first written below.

For Saskatchewan:	For: Resort Village of Elk Ridge
Iryna Soloduk — Digitally signed by Iryna Soloduk Date: 2024.04.04 16:33:01 -06'00'	Michele Bonneau — Digitally signed by Michele Bonneau Date: 2024.04.04 08:23:29 -06'00'
Per:	Per:
4/4/24	4/4/24
Date	Date

SCHEDULE A: GREEN STREAM - PROJECT DETAILS

Program: Investing in Canada Infrastructure Program (ICIP)

Project #: 20220101

Project: Elk Ridge - Water Treatment Plant Upgrades for the **Resort Village of Elk Ridge** located at the following locations:

- 53.895383, -105.99162
    - Blk/Par EU Plan No. 102323944 Ext 0

A.1 Project Approval Date:

The Project Approval Date for this ICIP Project is **November 28, 2023.**

A.2 Project Completion Date:

The Project Completion Date for this ICIP Project is **March 31, 2027.**

A.3 Final Claim Date:

The deadline for final claim submission for this ICIP Project is **June 30, 2027.**

A.4 Agreement End Date:

This Agreement will terminate on the 31st day following the day of the last payment by Saskatchewan.

A.5 Contribution by Saskatchewan:

For the purpose of this Agreement, following the Effective Date of this Agreement, Saskatchewan will make a contribution to reimburse the Ultimate Recipient for Eligible Expenditures of the approved Project incurred and paid by the Ultimate Recipient.

a) The maximum Total Eligible Expenditures approved for this Project is **$1,085,000**. As per the IBA, the total financial Contribution is not to exceed **seventy-three and thirty three hundredths per cent (73.33%)** of the Total Eligible Expenditures up to a maximum of **$795,631**.

b) Saskatchewan's Contribution will not exceed **thirty three and thirty three hundredths per cent (33.33%)** of the Total Eligible Expenditures under ICIP.

c) Canada's contribution will not exceed **forty per cent (40%)** of the Total Eligible Expenditures under ICIP.

d) Any expenditure in excess of the maximum total financial Contribution in a) is the responsibility of the Ultimate Recipient.

e) The maximum federal funding to a Project, from all federal sources, will not exceed **forty per cent (40%)** of the total Eligible Expenditures for that Project. If the federal Crown's total contribution towards a Project exceeds **forty per cent (40%)** of that Project's total Eligible Expenditures or if the Total Financial Assistance received or due in respect of the total Project costs exceeds one hundred per cent (100%) thereof, Saskatchewan may recover the excess from the Ultimate Recipient or reduce its contribution by an amount equal to the excess. The Ultimate Recipient shall inform Saskatchewan promptly of any additional federal funding approved or received in respect of Eligible Expenditures of a Project and shall provide a detailed accounting of such funding.

f) If the Total Financial Assistance received or due in respect of the total Project costs exceeds one hundred per cent (100%) thereof, Saskatchewan may recover the excess from the Ultimate Recipient or reduce its contribution by an amount equal to the excess.

A.6 Project Description:

The main objective of this project is to increase the water treatment capacity and water quality of the Elk Ridge Utility water treatment plant in order to meet provincial drinking water quality standards for current and future community population of the Resort Village of Elk Ridge. The project output includes replacement of the existing filtration equipment with treatment technology better suited for the raw water source, including modifications to the existing mechanical/electrical to suit. Raw water supply capacity will also be improved by installation of new well pumps and a pre-filter unit to address present issues with sediment in the source water.

This Project involves the following components:

- raw water supply system improvements including sediment removal;
- new filtration equipment targeting ammonia, iron, and manganese;
- filter face piping and connections to existing process piping;
- backwash pump, piping and connections;
- analytical and instrumentation equipment;
- removal of existing filters;
- repairs and modifications to water treatment plant building as required;
- electrical and mechanical works to support;
- all temporary works to maintain water supply during construction; and
- engineering and associated work.

A.7 Expected Results:

Outcome(s)	Indicators	Baseline	Target	Actual Results
Increased access to potable water	Number of assets receiving investment	0	1	

SCHEDULE B – PROGRAM DETAILS – ELIGIBLE AND INELIGIBLE EXPENDITURES

B.1 Eligible Expenditures

B.1.1 Eligible Expenditures will include the following:

a) All costs considered to be direct and necessary for the successful implementation of an eligible project, in the opinion of Canada and Saskatchewan, excluding those identified under Section B.2 (Ineligible Expenditures);

b) The capital costs of constructing or renovating a tangible asset, as defined and determined according to generally accepted accounting principles in Canada;

c) All planning (including plans and specifications), assessment and design costs specified in the Agreement such as the costs of environmental planning, surveying, engineering, architectural supervision, testing and management consulting services;

d) Costs will only be eligible as of Project approval, except for the following costs which are eligible if incurred before a Project is approved by Canada for contribution funding under this Agreement, but can only be paid if and when that Project is approved by Canada:
   i. Costs associated with completing climate lens assessments as outlined in paragraph h) of Section 4 (Commitments by Saskatchewan) of IBA; and
   ii. Costs associated with Aboriginal consultation and engagement activities, which are retroactively eligible from February 15, 2018, for Projects approved after February 7, 2019.

e) The costs of engineering and environmental reviews, including environmental assessments and follow-up programs as defined in the *Impact Assessment Act 2019* and the costs of remedial activities, mitigation measures and follow-up identified in any environmental assessment;

f) The costs directly associated with joint federal and provincial communication activities (press releases, press conferences, translation, etc.) and with federal and provincial project signage;

g) The incremental costs of the Ultimate Recipient's employees related to construction of the project may be included as eligible costs under the following conditions:
   i. The Ultimate Recipient is able to demonstrate that it is not economically feasible to tender a contract;
   ii. The employee or equipment is engaged directly in respect of the work that would have been the subject of the contract; and
   iii. The arrangement is approved in advance and in writing by the Province and by Canada.

B.1.2 Eligible costs are limited to the following:

a) Costs incurred between the Project Approval Date and the Project Completion Date set out in the Ultimate Recipient Agreement, except for costs associated with completing climate lens assessments and creating community employment benefit plans, which are eligible before project approval, but can only be paid if and when a project is approved by the Province and Canada and a signed Ultimate Recipient Agreement is in place.

B.2 Ineligible Expenditures

Ineligible expenditures for Projects will include the following:

a) Costs Incurred before the Project Approval Date, and any and all expenditures related to contracts signed prior to the Project Approval Date;

b) Costs Incurred before a Project is approved by Canada and any and all expenditures related to contracts signed prior to Canada's approval of a Project, except for:
   i. Costs associated with completing climate lens assessments as outlined in paragraph h) of section 4 (Commitments by Saskatchewan); and
   ii. Costs associated with Aboriginal consultation and engagement activities, which are retroactively eligible from February 15, 2018, for Projects approved after February 7, 2019.

c) Costs Incurred for cancelled Projects;

d) Costs of relocating entire communities;

e) Land acquisition;

f) Leasing land, buildings and other facilities; leasing equipment other than equipment directly related to the construction of the Project; real estate fees and related costs;

g) Any overhead costs, including salaries and other employment benefits of any employees of the Ultimate Recipient, any direct or indirect operating or administrative costs of Ultimate Recipients, and more specifically any costs related to planning, engineering, architecture, supervision, management and other activities normally carried out by the Ultimate Recipient's staff, except in accordance with Section B.1 d) (Eligible Expenditures);

h) Financing charges, legal fees, and loan interest payments, including those related to easements (e.g. surveys);

i) Any goods and services costs which are received through donations or in-kind;

j) Provincial sales tax, goods and services tax, or harmonized sales tax for which the Ultimate Recipient is eligible for a rebate, and any other costs eligible for rebates;

k) Costs associated with operating expenses and regularly scheduled maintenance work;

l) Cost related to furnishing and non-fixed assets which are not essential for the operation of the Asset/Project; and

m) All capital costs, including site preparation and construction costs, until federal environmental assessment(s) and Aboriginal consultation obligations as required, under sections 5 (Environmental Assessment) and 6 (Aboriginal Consultation) have been met and continue to be met.

SCHEDULE C - COMMUNICATIONS PROTOCOL

C.1 PURPOSE

a) This Communications Protocol outlines the roles and responsibilities of each of the Parties to this Agreement, as well as those of Canada, with respect to Communications Activities related to this Agreement and the Projects funded through it.

b) This Communications Protocol will guide the planning, development and implementation of all Communications Activities to ensure clear, consistent and coordinated communications to the Canadian public.

c) The provisions of this Communications Protocol apply to all Communications Activities related to this Agreement and any Projects funded under the IBA.

C.2 GUIDING PRINCIPLES

a) Public acknowledgement of financial assistance received from Canada and Saskatchewan is a condition of funding.

b) Communications Activities undertaken in accordance with this Communications Protocol should ensure that Canadians are informed of infrastructure investments made to help improve their quality of life and that they receive consistent information about funded Projects and their benefits.

c) The Ultimate Recipient is responsible for communicating the requirements and responsibilities outlined in this Communications Protocol and for ensuring their compliance to its third parties.

d) Saskatchewan will communicate to Ultimate Recipient any deficiencies and/or corrective actions identified by Canada or by the Oversight Committee.

C.3 GOVERNANCE

a) The Parties will designate communications contacts that will be responsible for preparing a communications plan, overseeing its implementation and reporting on its results to the Oversight Committee.

C.4 JOINT COMMUNICATIONS

a) Canada, Saskatchewan and the Ultimate Recipient will have Joint Communications about the funding of the Project(s).

b) Joint Communications related to Project(s) funded under this Agreement should not occur without the prior knowledge and agreement of all Parties, where applicable.

c) All Joint Communications material will be approved by Canada and Saskatchewan prior to release, and will recognize the funding of all Parties, including the Ultimate Recipient.

d) Each of the Parties may request Joint Communications to communicate to Canadians about the progress or completion of the Project(s). The requestor will provide at least 15 business days' notice to the other Parties. If the Communications Activity is an event, it will take place at a mutually agreed date and location.

e) The requestor of the Joint Communications will provide an equal opportunity for the other Parties or the Ultimate Recipient to participate and choose their own designated representative (in the case of an event).

f) Saskatchewan or the Ultimate Recipient will be responsible for providing onsite communications and logistics support. Any related costs are eligible for cost-sharing in accordance with the formula outlined in the funding Agreement.

g) Joint Communications products must be bilingual and include the Government of Saskatchewan logo and Canada or word mark. Canada has an obligation to communicate in English and French. Canada will provide the translation services and final approval on products.

h) The conduct of all Joint Communications will follow the *Table of Precedence for Canada*.

C.5 INDIVIDUAL COMMUNICATIONS

a) Notwithstanding Section C.4 of this Communications Protocol (Joint Communications), Canada and Saskatchewan retain the right to meet their obligations to communicate information to Canadians about the IBA and the use of funds through their own Communications Activities.

b) Canada, Saskatchewan and the Ultimate Recipient may each include general Program messaging and examples of Projects funded though the Agreement in their own Communications Activities. The authoring Party will not unreasonably restrict the use of such products or messaging by the other Parties; and if web or social-media based, from linking to it.

c) Where a website or web page is created to promote or communicate progress on a funded Project or Projects, it must recognize provincial and federal funding through the use of a digital sign or through the use of Government of Saskatchewan logo and the Canada wordmark and the following wording, "This project is funded in part by the Government of Canada." and "This project is funded in part by the Government of Saskatchewan." The Canada wordmark or digital sign must link to Infrastructure Canada's website, at www.infrastructure.gc.ca. Canada will provide and publish guidelines for how this recognition is to appear and language requirements. The Saskatchewan logo or the text "Government of Saskatchewan" must link to the Government of Saskatchewan website at www.Saskatchewan.ca.

d) The Ultimate Recipient will be required to send a minimum of one photograph to each of the Parties of the construction in progress, or of the completed Project, for use in social media and other digital individual communications activities. Sending the photos will constitute permission to use and transfer of copyright. Photographs are to be sent to INFC.photos@canada.ca along with Project name and location.

C.6 OPERATIONAL COMMUNICATIONS

a) The Ultimate Recipient is solely responsible for operational communications with respect to Projects, including but not limited to: calls for tender, or construction and public safety notices. Operational communications as described above are not subject to the federal official language policy.

b) Saskatchewan does not need to be informed on operational communications. However, such products should include, where appropriate, the following statement, "This project is funded in part by the Government of Saskatchewan and the Government of Canada." As appropriate, operational communications will also recognize the funding of Saskatchewan in a similar manner.

C.7 MEDIA RELATIONS

a) Canada, Saskatchewan and the Ultimate Recipient will share information promptly with the other Parties should significant media inquiries be received or emerging media or stakeholder issues arise to a Project or the overall fund.

C.8 SIGNAGE

a) Canada, Saskatchewan or the Ultimate Recipient may request a Project sign recognizing their funding contribution to a Project.

b) Where a physical sign is to be installed, unless otherwise agreed upon by Canada, it will be the Ultimate Recipient who will produce and install a joint physical sign that recognizes funding of each Party at each Project site in accordance with current federal signage guidelines.

c) The joint sign design, content, and installation guidelines will be provided by Canada.

d) The recognition of funding contributions of each of the Parties will be of equal prominence and visibility.

e) Digital signage may also be used in addition or in place of a physical sign in cases where a physical sign would not be appropriate due to project type, scope, location or duration.

f) Where the Ultimate Recipient decides to install a permanent plaque or other suitable marker with respect to a Project, it must recognize the federal and provincial contribution and be approved by Saskatchewan and Canada.

g) Saskatchewan and the Ultimate Recipient agree to inform Canada of sign installations through the Project progress reports referenced in Section 14 (Reporting) of the IBA.

h) Where a physical sign is being installed, signage should be installed at each Project site one (1) month prior to the start of construction, be visible for the duration of that Project, and remain in place until one (1) month after construction is completed and the infrastructure is fully operational or opened for public use.

i) Signage should be installed in a prominent and visible location that takes into consideration pedestrian and traffic safety and visibility.

C.9 COMMUNICATION BETWEEN CANADA AND ULTIMATE RECIPIENTS

a) Saskatchewan agrees to facilitate, as required, communications between Canada and the Ultimate Recipient for Communications Activities.

C.10 ADVERTISING CAMPAIGNS

Recognizing that advertising can be an effective means of communicating with the public, Canada and/or Saskatchewan and/or the Ultimate Recipient may, at their own cost, organize an advertising or public information campaign related to this Agreement or eligible Projects. However, such a campaign will respect the provisions of this Agreement. In the event of such a campaign, the sponsoring Party will inform the other Parties of its intention no less than twenty-one (21) business days prior to the campaign launch.

SCHEDULE D – DECLARATION OF COMPLETION

Applicant Name: Resort Village of Elk Ridge
Project Title: Elk Ridge - Water Treatment Plant Upgrades
Project Number: 20220101

In the matter of the Agreement concerning the Canada-Saskatchewan IBA ICIP, entered into between His Majesty the King in Right of Canada and Saskatchewan, as represented by the Minister of SaskBuilds ("Saskatchewan"), in the Province of Saskatchewan

I, ______________________(Name), of _____________________________________ (entity), in the Province of Saskatchewan, declare as follows:

1. I hold the position of ______________________ with ________________________(entity) and as such have knowledge of the matters set forth in this declaration and believe this declaration to be true.

2. a) I have received the following documents for the Elk Ridge - Water Treatment Plant Upgrades Project and have the following documents on file, if applicable:

   - ☐ Certificate of Substantial Performance of subcontract as per the Saskatchewan Builder's Lien Regulation B-7.1 REG 1.
   - ☐ Certificate of Substantial Performance of Contract as per the Saskatchewan Builder's Lien Regulation B-7.1 REG 1.
   - ☐ Construction Completion Certificate for each output signed by engineer (e.g. wells, reservoir, water treatment process upgrades, wet well/dry well) responsible for the project.
   - ☐ Letter of Good Standing and Clearances from Workers Compensation Board.
   - ☐ Other – Please specify: ____.

   b) Based on the above documents and the representations made to me by the professionals identified in Section 2(a) above, I declare to the best of my knowledge and belief that this Project has met Project Substantial Completion on the _______ day of ____________ 20___.

3. All terms and conditions of the Agreement that are required to be met as of the date of this declaration have been met.

Declared at ______________________ (Location), in __________________________ (Province)

this ________ day of _________________, 20_____.

____
(Signature)

____
(Title)

Contact Number: ______________________________

Email: ____

Water Security Agency

Approval to Operate Works

File: E3/4966

Issued Pursuant to *The Water Security Agency Act* for the Operation of Ground Water Works.

Approval No. 4966 issued on April 8, 2015

ELK RIDGE UTILITY LTD. of **WASKESIU, SASKATCHEWAN**

hereinafter called the proponent, is hereby granted Approval to Operate Works in accordance with this Approval subject to the conditions and restrictions contained in *The Water Security Agency Act* and the regulations under that *Act,* each as amended or replaced from time to time.

A. Description of Ground Water Works

Well: PW7-2014: Approximately 94.35 m of 203 mm diameter PVC casing, with 7.62 m of 203 mm diameter stainless steel screens completed to a depth of 101.50 m below ground surface, and equipped with a submersible pump.

Pipeline: Approximately 15 m of 51 mm diameter HDPE pipeline connecting PW7-2014 to the water treatment plant as shown on the submitted plans.

B. Project Information

Source of Supply:	Glacial Deposits
Point of Diversion:	LSD 05-05-57-27 W2M (Blk/Par BB Plan 01PA06245 Ext 1)
Point of Delivery:	LSD 05-05-57-27 W2M (Blk/Par BB Plan 01PA06245 Ext 1)
Purpose:	Municipal (Urban Distribution)
Maximum Rate of Diversion:	4.4 litres per second (58 igpm)

This Approval does not negate the proponent's responsibility to comply with the requirements of any other relevant municipal, provincial and/or federal legislation.

This Approval issued and recorded at Moose Jaw, Saskatchewan is subject to the conditions listed on the following page(s).

WATER SECURITY AGENCY

for Water Security Agency

RG-106

Revised 30/05/2013

6.0 Well and Aquifer Yield Analyses

From a hydrogeologic perspective, a developed aquifer system must be capable of supplying the average day raw water requirements of a user(s) on a sustained basis and the water supply well(s) should be capable of supplying the maximum day raw water requirements of a user(s) on an intermittent basis.

6.1 Estimated Average Day Aquifer Capacity

As noted in the 2012 BHL report prepared for Elk Ridge Utility, Catterall and Wright – Consulting Engineers had estimated that Elk Ridge has an average day water requirement of 125 cubic metres per day or 0.087 cubic metres per minute. Catterall and Wright also estimated that Elk Ridge has a maximum day (intermittent) raw water requirement of 200 cubic metres per day or 0.139 cubic metres per minute.

Since well PW7-2014 is a replacement/redundant well, the hydrogeologic scope of work approved for this project did not include a formal assessment of the average day (sustainable) capacity of the developed aquifer. However, based on the available hydrogeologic data, it appears that the static water level in the developed aquifer has remained relatively stable since at least 1997. A stable static water level over time indicates that an aquifer is being recharged at an average rate that equals or exceeds the total groundwater extraction volume(s) from the aquifer by all users and that the aquifer is being properly managed as a locally renewable resource.

It was previously concluded by BHL that the developed aquifer can supply Elk Ridge with their average day raw water requirement of 125 cubic metres per day on a sustainable basis. Continued collection and regular hydrogeologic analyses of water level and well(s) production data over time is required to confirm or revise this conclusion.

There are four (4) irrigation wells, two (2) of which were operational at the time of this project, installed around the pond and maintenance yard. These wells are operated by the Elk Ridge Golf Course and Conference Center and are developed in the same aquifer as the Elk Ridge Utility Wells. Historical production data from these wells was not available to BHL. Additional hydrogeologic testing and analyses is required to determine the combined effect of pumping the Elkridge utility and the Elkridge Golf water wells on the developed aquifer.

6.2 Estimated Maximum Day Well Capacity

The maximum day capacity of a water well is primarily dependant on the design characteristics of the intake screen and on the hydraulic properties of the aquifer into which the well is installed and does not necessarily represent the sustainable capacity of the developed aquifer.

PW7-2014 was designed, located and constructed to provide redundancy to existing well PW6-2011, but not to be operated simultaneously with well PW6-2011.

With well PW6-2011 shut off and assuming that the static water level in the developed aquifer remains stable and that the well efficiency is maintained through regular and effective rehabilitation work, it is estimated that well PW7-2014 is capable of a maximum day (intermittent) pumping rate 0.265 cubic metres per minute, which is the same rate as that previously recommended by BHL for well PW6-2011. The recommended individual maximum day well(s) capacities exceed the Elk Ridge Utility's estimated maximum day raw water requirement of 0.139 cubic metres per minute.

The service pump has been installed with the fluid intake at a depth of 77.87 metres below the top of the well casing (pitless adapter barrel). Assuming new well efficiency, this installation depth will accommodate the anticipated water level drawdown at a maximum day (intermittent) pumping rate of 0.265 cubic metres per minute.

It is normal for the efficiency and therefore the maximum day pumping capacity of a water well to decline with use over time as the openings in the well intake screen and/or the surrounding filter sand and aquifer sediments become partially plugged due to chemical, biological or mechanical processes. Therefore, BHL recommends that mechanical rehabilitation work be completed on municipal water wells every five (5) years, or more frequently if the specific capacity (pumping rate per unit of water level drawdown) declines by more than 25 percent of new condition. Timely and effective rehabilitation work will maintain the efficiency and maximum day pumping capacity of a water well and will also maximize the overall service life of the well.

7.0 RAW WATER QUALITY ANALYSES

Water samples were collected from production well PW7-2014 near the conclusion of the pumping test. These samples were then sent to the Saskatchewan Research Council (SRC) laboratory for general chemical and chemical health and toxicity analyses.

The results from the water sample taken from well PW7-2014 are included in Appendix C, along with the water quality results from PW6-2011 and Obs PW5-2000 for comparative purposes. All three wells have also been plotted on a Piper Trilinear Graph shown on the next page.

The suitability of the water quality for municipal purposes, any addition water sampling requirements and any additional water treatment requirements should be assessed by an engineer that is qualified to provide consulting services in water treatment.

The piper trilinear graph shown below, allows a visual comparison of the overall chemical characteristics of the individual water sources. Based on the similar plotting position of the samples within the central diamond shaped portion of the graph, it was concluded by BHL that the water from all three wells is chemically the same.

ALS Canada Ltd.

right solutions.
right partner.

CERTIFICATE OF ANALYSIS

Work Order	: **SK2300358**	Page	: 1 of 5
Client	: **Elk Ridge Utility Ltd.**	Laboratory	: Saskatoon - Environmental
Contact	: Russell Nelson	Account Manager	: Kimberley Head
Address	: Box 182 Waskesiu SK Canada S0J 2Y0	Address	: 819 58 Street East Saskatoon SK Canada S7K 6X5
Telephone	: 306 961 0637	Telephone	: +1 306 668 8370
Project	: ----	Date Samples Received	: 31-Jan-2023 09:35
PO	: ----	Date Analysis Commenced	: 31-Jan-2023
C-O-C number	: ----	Issue Date	: 06-Feb-2023 11:39
Sampler	: Terri		
Site	: ----		
Quote number	: ----		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Colby Bingham	Laboratory Supervisor	Inorganics, Saskatoon, Saskatchewan
Colby Bingham	Laboratory Supervisor	Metals, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Janiko Lindain	Laboratory Assistant	Metals, Saskatoon, Saskatchewan
Kimberly Hanson	Laboratory Analyst	Metals, Saskatoon, Saskatchewan
MaryJade Erederos	Laboratory Assistant	Administration, Saskatoon, Saskatchewan
Milad Khani	Laboratory Analyst	Inorganics, Saskatoon, Saskatchewan

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	Description
-	no units
%	percent
µS/cm	microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
SFP	*Sample was filtered and preserved at the laboratory.*

Analytical Results

Sub-Matrix: Water
(Matrix: Water)

Analyte	CAS Number	Method	LOR	Unit	Result	----	----	----	----
				Client sample ID	TREATED AT WATER PLANT	----	----	----	----
				Client sampling date / time	30-Jan-2023 13:30	----	----	----	----
					SK2300358-001	--------	--------	--------	--------
Field Tests									
Chlorine, free, field	7782-50-5	EF001	0.01	mg/L	0.13	----	----	----	----
Chlorine, total, field	7782-50-5	EF001	0.01	mg/L	1.17	----	----	----	----
Turbidity, field	----	EF001	0.01	NTU	0.14	----	----	----	----
Physical Tests									
Hardness (as CaCO3), dissolved	----	EC100	0.50	mg/L	433	----	----	----	----
Conductivity	----	E100	2.0	µS/cm	913	----	----	----	----
pH	----	E108	0.10	pH units	7.87	----	----	----	----
Alkalinity, bicarbonate (as HCO3)	71-52-3	E290	1.0	mg/L	592	----	----	----	----
Alkalinity, carbonate (as CO3)	3812-32-6	E290	1.0	mg/L	<1.0	----	----	----	----
Alkalinity, hydroxide (as OH)	14280-30-9	E290	1.0	mg/L	<1.0	----	----	----	----
Alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	485	----	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L	554	----	----	----	----
Anions and Nutrients									
Chloride	16887-00-6	E235.Cl	0.50	mg/L	17.4	----	----	----	----
Fluoride	16984-48-8	E235.F	0.020	mg/L	0.165	----	----	----	----
Nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L	0.056	----	----	----	----
Nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L	<0.020 DLDS	----	----	----	----
Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	17.8	----	----	----	----
Nitrate + Nitrite (as N)	----	EC235.N+N	0.0500	mg/L	0.0560	----	----	----	----
Ion Balance									
Anion sum	----	EC101	0.10	meq/L	10.6	----	----	----	----
Cation sum	----	EC101	0.10	meq/L	10.8	----	----	----	----
Ion balance (APHA)	----	EC101	0.01	%	0.93	----	----	----	----
Ion balance (cations/anions)	----	EC101	0.010	%	102	----	----	----	----
Total Metals									
Aluminum, total	7429-90-5	E420	0.0030	mg/L	<0.0030	----	----	----	----
Antimony, total	7440-36-0	E420	0.00010	mg/L	<0.00010	----	----	----	----
Arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00129	----	----	----	----
Barium, total	7440-39-3	E420	0.00010	mg/L	0.150	----	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

				Client sample ID	TREATED AT WATER PLANT	----	----	----	----
				Client sampling date / time	30-Jan-2023 13:30	----	----	----	----
Analyte	CAS Number	Method	LOR	Unit	SK2300358-001	--------	--------	--------	--------
					Result	----	----	----	----
Total Metals									
Beryllium, total	7440-41-7	E420	0.000020	mg/L	<0.000020	----	----	----	----
Bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	----	----	----	----
Boron, total	7440-42-8	E420	0.010	mg/L	0.140	----	----	----	----
Cadmium, total	7440-43-9	E420	0.0000050	mg/L	<0.0000050	----	----	----	----
Calcium, total	7440-70-2	E420	0.050	mg/L	105	----	----	----	----
Cesium, total	7440-46-2	E420	0.000010	mg/L	<0.000010	----	----	----	----
Chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	----	----	----	----
Cobalt, total	7440-48-4	E420	0.00010	mg/L	0.00018	----	----	----	----
Copper, total	7440-50-8	E420	0.00050	mg/L	0.0745	----	----	----	----
Iron, total	7439-89-6	E420	0.010	mg/L	<0.010	----	----	----	----
Lead, total	7439-92-1	E420	0.000050	mg/L	0.000275	----	----	----	----
Lithium, total	7439-93-2	E420	0.0010	mg/L	0.0319	----	----	----	----
Magnesium, total	7439-95-4	E420	0.0050	mg/L	42.5	----	----	----	----
Manganese, total	7439-96-5	E420	0.00010	mg/L	0.00038	----	----	----	----
Molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.00714	----	----	----	----
Nickel, total	7440-02-0	E420	0.00050	mg/L	0.00072	----	----	----	----
Phosphorus, total	7723-14-0	E420	0.050	mg/L	<0.050	----	----	----	----
Potassium, total	7440-09-7	E420	0.050	mg/L	4.28	----	----	----	----
Rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00055	----	----	----	----
Selenium, total	7782-49-2	E420	0.000050	mg/L	<0.000050	----	----	----	----
Silicon, total	7440-21-3	E420	0.10	mg/L	10.7	----	----	----	----
Silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	----	----	----	----
Sodium, total	7440-23-5	E420	0.050	mg/L	46.4	----	----	----	----
Strontium, total	7440-24-6	E420	0.00020	mg/L	0.521	----	----	----	----
Sulfur, total	7704-34-9	E420	0.50	mg/L	6.69	----	----	----	----
Tellurium, total	13494-80-9	E420	0.00020	mg/L	<0.00020	----	----	----	----
Thallium, total	7440-28-0	E420	0.000010	mg/L	<0.000010	----	----	----	----
Thorium, total	7440-29-1	E420	0.00010	mg/L	<0.00010	----	----	----	----
Tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	----	----	----	----
Titanium, total	7440-32-6	E420	0.00030	mg/L	<0.00030	----	----	----	----

Work Order : SK2300358
Client : Elk Ridge Utility Ltd.
Project : ----

Analytical Results

Sub-Matrix: **Water**

(Matrix: **Water**)

					Client sample ID	TREATED AT WATER PLANT	----	----	----	----
					Client sampling date / time	30-Jan-2023 13:30	----	----	----	----
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*		**SK2300358-001**	--------	--------	--------	--------
						Result	----	----	----	----
Total Metals										
Tungsten, total	7440-33-7	E420	0.00010	mg/L		<0.00010	----	----	----	----
Uranium, total	7440-61-1	E420	0.000010	mg/L		0.000515	----	----	----	----
Vanadium, total	7440-62-2	E420	0.00050	mg/L		<0.00050	----	----	----	----
Zinc, total	7440-66-6	E420	0.0030	mg/L		0.115	----	----	----	----
Zirconium, total	7440-67-7	E420	0.00020	mg/L		<0.00020	----	----	----	----
Dissolved Metals										
Calcium, dissolved	7440-70-2	E421	0.050	mg/L		103	----	----	----	----
Iron, dissolved	7439-89-6	E421	0.030	mg/L		<0.030	----	----	----	----
Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L		42.6	----	----	----	----
Manganese, dissolved	7439-96-5	E421	0.00500	mg/L		<0.00500	----	----	----	----
Potassium, dissolved	7440-09-7	E421	0.050	mg/L		4.16	----	----	----	----
Sodium, dissolved	7440-23-5	E421	0.050	mg/L		47.5	----	----	----	----
Dissolved metals filtration location	----	EP421	-	-		Laboratory [SFP]	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 914962

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Environmental Division
Saskatoon
Work Order Reference
SK2300358

Telephone : + 1 306 668 8370

Report To	Contact and company name below will appear on the final report
Company:	Elk Ridge Utility LTD
Contact:	Russell Nelson
Phone:	1306 961 0637
	Company address below will appear on the final report
Street:	Box 182
City/Province:	Waskesiu Lk, SK
Postal Code:	S0J 2Y0
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: Utility-manager@hotmail.com

Email 2

Email 3

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: utility_manager@hotmail.com

Email 2

Turnaround Time (T...

☑ Routine [R] if received by 3pm M-F - n...

☐ 4 day [P4] if received by 3pm M-F - 2...

☐ 3 day [P3] if received by 3pm M-F - 2...

☐ 2 day [P2] if received by 3pm M-F - ...

☐ 1 day [E] if received by 3pm M-F - 10...

☐ Same day [E2] if received by 10am M-S... may apply to rush requests on weekends,...

Date and Time Required for all E&...

For all tests with...

...DE LABEL HERE ...e only)

Project Information	
ALS Account # / Quote #:	25885
Job #:	
PO / AFE:	
LSD:	STN:# SK05GG0003
ALS Lab Work Order # (ALS use only):	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: Kim HEAD	Sampler: Terri

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	GENERAL Chemical Health	general toxicity	FREE	TOTAL	NTU	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	TREATED AT WATER PLANT	30-01-23	1:30 pm	treated water	2	1	1	.13	1.17	.14			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☑ YES ☐ NO

Are samples for human consumption/ use?
☑ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C: 5.8

FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)		
Released by: [signature]	Date: Jan 30/23	Time: 2:00 pm

INITIAL SHIPMENT RECEPTION (ALS use only)		
Received by: ME3	Date: 31/1/23	Time: 9:35

FINAL SHIPMENT RECEPTION (ALS use only)		
Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

ALS Canada Ltd.

right solutions.
right partner.

CERTIFICATE OF ANALYSIS

Work Order	: **SK2301322**	Page	: 1 of 4
Client	: **Elk Ridge Utility Ltd.**	Laboratory	: Saskatoon - Environmental
Contact	: Russell Nelson	Account Manager	: Kimberley Head
Address	: Box 182 Waskesiu SK Canada S0J 2Y0	Address	: 819 58 Street East Saskatoon SK Canada S7K 6X5
Telephone	: 306 961 0637	Telephone	: +1 306 668 8370
Project	: ----	Date Samples Received	: 04-Apr-2023 08:55
PO	: ----	Date Analysis Commenced	: 04-Apr-2023
C-O-C number	: ----	Issue Date	: 11-Apr-2023 09:12
Sampler	: Terri		
Site	: ----		
Quote number	: ----		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Colby Bingham	Laboratory Supervisor	Inorganics, Saskatoon, Saskatchewan
Colby Bingham	Laboratory Supervisor	Metals, Saskatoon, Saskatchewan
Hedy Lai	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Milad Khani	Laboratory Analyst	Inorganics, Saskatoon, Saskatchewan
Milad Khani	Laboratory Analyst	Metals, Saskatoon, Saskatchewan
Ruth Islas	Laboratory Assistant	Metals, Saskatoon, Saskatchewan

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
SFP	*Sample was filtered and preserved at the laboratory.*

Analytical Results

Sub-Matrix: Water
(Matrix: Water)

Analyte	CAS Number	Method	LOR	Unit	GENERAL CHEMISTRY 2011 Well	----	----	----	----
Client sampling date / time					03-Apr-2023 12:00	----	----	----	----
					SK2301322-001	--------	--------	--------	--------
					Result	----	----	----	----
Physical Tests									
Hardness (as CaCO3), dissolved	----	EC100	0.50	mg/L	440	----	----	----	----
Conductivity	----	E100	2.0	μS/cm	869	----	----	----	----
pH	----	E108	0.10	pH units	8.03	----	----	----	----
Alkalinity, bicarbonate (as HCO3)	71-52-3	E290	1.0	mg/L	608	----	----	----	----
Alkalinity, carbonate (as CO3)	3812-32-6	E290	1.0	mg/L	<1.0	----	----	----	----
Alkalinity, hydroxide (as OH)	14280-30-9	E290	1.0	mg/L	<1.0	----	----	----	----
Alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	498	----	----	----	----
Solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L	538	----	----	----	----
Anions and Nutrients									
Chloride	16887-00-6	E235.Cl	0.50	mg/L	2.65	----	----	----	----
Fluoride	16984-48-8	E235.F	0.020	mg/L	0.179	----	----	----	----
Nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L	<0.040 DLDS	----	----	----	----
Nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L	<0.020 DLDS	----	----	----	----
Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	17.4	----	----	----	----
Nitrate + Nitrite (as N)	----	EC235.N+N	0.0500	mg/L	<0.0500	----	----	----	----
Ion Balance									
Anion sum	----	EC101	0.10	meq/L	10.4	----	----	----	----
Cation sum	----	EC101	0.10	meq/L	10.5	----	----	----	----
Ion balance (APHA)	----	EC101	0.01	%	0.48	----	----	----	----
Ion balance (cations/anions)	----	EC101	0.010	%	101	----	----	----	----
Dissolved Metals									
Calcium, dissolved	7440-70-2	E421	0.050	mg/L	105	----	----	----	----
Iron, dissolved	7439-89-6	E421	0.030	mg/L	<0.030	----	----	----	----
Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	43.3	----	----	----	----
Manganese, dissolved	7439-96-5	E421	0.00500	mg/L	0.0782	----	----	----	----
Potassium, dissolved	7440-09-7	E421	0.050	mg/L	4.42	----	----	----	----
Sodium, dissolved	7440-23-5	E421	0.050	mg/L	36.5	----	----	----	----
Dissolved metals filtration location	----	EP421	-	-	Laboratory SFP	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

ALS www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

COC Number 21 -

Page of

Canada Toll Free: 1 800 668 9878

Report To	Contact and company name below will appear on the final report
Company:	Elk Ridge Utility Ltd
Contact:	Russell Nelson
Phone:	13069610637
	Company address below will appear on the final report
Street:	Box 182
City/Province:	Waskesiu Lake, SK.
Postal Code:	S0J2Y0
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax utility_manager@hotmail.com
Email 2
Email 3

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax utility_manager@hotmail.com
Email 2

Turnaround Time (TAT) Requested

☑ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm
☐ 2 day [P2] if received by 3pm
☐ 1 day [E] if received by 3pm
☐ Same day [E2] if received by
Additional fees
Date and Time Required
For
Indicate Fi

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Environmental Division
Saskatoon
Work Order Reference
SK2301322

Telephone : +1 306 668 8370

Project Information

Account 25885
Job #:
PO / AFE:
LSD: WSA STATION # SK: SK05GG0603 / WSA PERMIT #: 00002164-05-00

ALS Lab Work Order # (ALS use only):

Sample Notes (location, sample type, frequency, etc)

ALS Contact: Kim Head | Sampler: Terri

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Reason for Bacteriological Analysis (Bacti type)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)	Number of Containers
	GENERAL CHEMISTRY 2001 Well	~~Regular/Routine~~	3·04·23	12:00 NOON	RAW	1				1

Reason for Bacteriological Analysis	Bacti Type
Please choose the bacti type that best describes your bacteriological sample above	Regular/Routine Other Special Repeat

Drinking Water (DW) Samples¹ (client use)

Are samples taken from a Regulated DW System? ☑ YES ☐ NO

Are samples for human consumption/ use? ☑ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

Report any Positive Bacteria Results immediately to and WSA
Daily Bacti

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO
Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A
INITIAL COOLER TEMPERATURES °C: 4.9° | FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by: [signature]	Date: April 3/23	Time: 12:15 pm	Received by: JSL2	Date: 04/04/23	Time: 8:55	Received by: JSL2	Date:	Time: 8:55

Gaudet's Sci Tech Services

SITE VISIT / REPORT

OWNER:	Elk Ridge Utility			REPORT NO.:	01
PROJECT:	Bench testing Greensand			SHEET:	1 of 6
COMPONENT:	Site Visit	DATE:			
LOCATION:	Water Treatment Plant, Elk Ridge	PROJ. MGR.:	Bertrand (Bert) Gaudet, A.Sc.T.		

OTHERS PRESENT: Terri Kowbel-Nesbitt – Operator
Russell Nelson - Operator

PROJECT REPORT Greensand Bench Testing

Overview

Gaudet's Sci Tech Services (GSTS) was asked to see if water quality can be improved at the water treatment plant using greensand technology as a treatment of the raw water.

Currently the addition of sodium hypochlorite (Cl), which is the chlorine addition, is above the maximum usage limit (MUL) set by the Saskatchewan Water Security Agency (WSA). Also the volume of water treated is just meeting demand.

GSTS used a bench scale greensand column to determine the possibilities.

The current process uses pre-chlorination to breakpoint using a contact tank. This water then enters into 2 greensand filters. Post chlorination is used to adjust for primary disinfection.

Testing

Breakpoint Determination

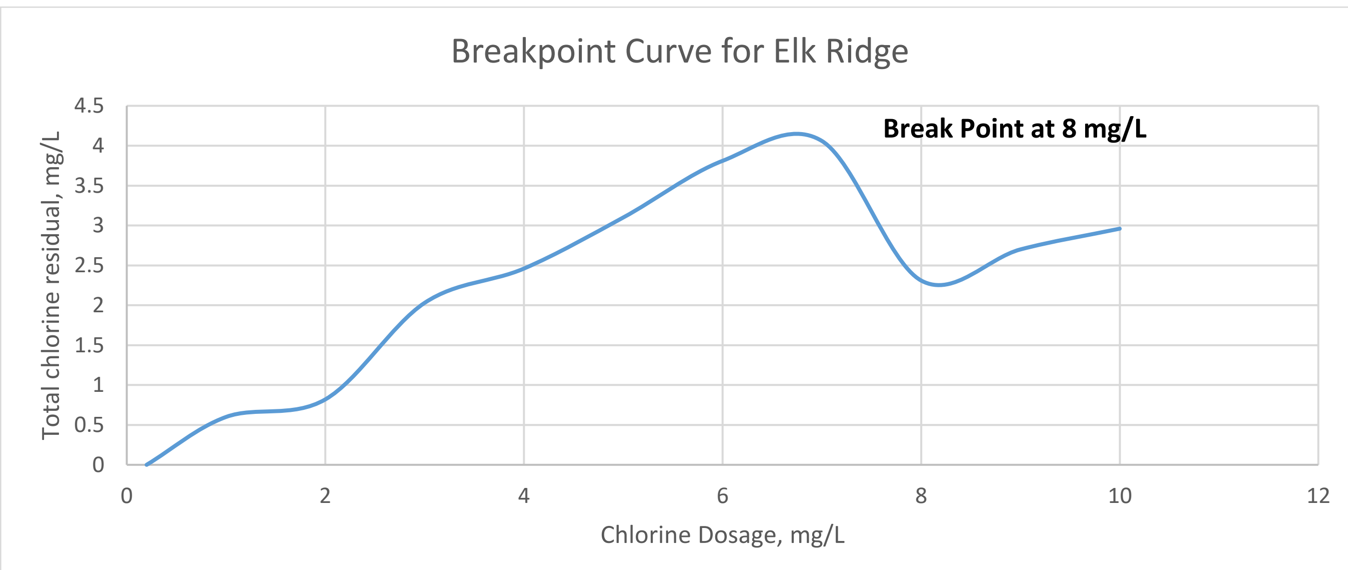
Chlorine, Oxidation									Chart one	
Dosage	T Cl	F Cl	Mono	F NH3	T NH3	T Fe	D Fe	T Mn	D Mn	
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
0.2	0	0	0	0.59	0.59	2.23	1.28	0.127	0.107	
1	0.6	0.04	0.55	0	0.71	2.1	2	0.09	0.068	
2	0.82	0	0.82	0.56	0.72	2.07	0.05	0.11	0.096	**Fe Oxidation**
3	2.03	0	1.93	0.32	0.7	2.14	0	0.069	0.056	
4	2.46	0	2.44	0.17	0.65	2.46	0	0.119	0.06	
5	3.1	0	2.59	0.12	0.63	2.35	0	0.095	0.057	
6	3.81	0	2.46	0	0.4	2.3	0	0.1	0.041	
7	4.06	0	2.42	0	0.38	2.18	0	0.087	0.046	
8	2.31	1.13	0.14	0	0	2.28	0	0.077	0.019	**Breakpoint, NH3 removal**
9	2.7	0.4	0.53	0	0.1	2.15	0	0.199	0.11	
10	2.96	2.25	0	0	0	2.24	0	0.049	0.043	**Mn Oxidation**

Where: T Cl = total chlorine, F Cl = free chlorine, Mono = Mono Chloramine, F NH3 = Free Ammonia, T Fe = total iron, D Fe = dissolved iron, T Mn = total manganese, D Mn = dissolved manganese

KMnO4 Oxidation									Chart two
Dosage	**A Colour**	**ORP**	**F Cl**	**T Fe**	**D Fe**	**T Mn**	**D Mn**	**UVT**	**DUVT**
mg/L	pt colour	mV	mg/L	mg/L	mg/L	mg/L	mg/L	%UVT	%UVT
0.5	130	314	0.75	2.11	0	>0.8	0.323	47.57	73.55
0.4	119	405	0.4	2.33	0	>0.8	0.224	48.08	75.51
0.3	244	361	0.35	2.3	0	0.752	0.241	39.48	72.28
0.2	398	312	0	2.17	0	0.758	0.169	49.68	73.79

Where: A Colour = apparent colour, ORP = oxidation reduction potential, UVT = ultraviolet transmission 254nm, DUVT = dissolved UVT.

Onsite Analysis



Bench test column, second pass from treated before post chlorination					Chart three
			Treated	Treated	
		Raw water	Before BW	After BW	2^{nd} Pass
Loading	gpm/ft2				2
T UVT	%UVT	72.34	76.71	76.96	76.84
D UVT	%UVT		76.73	76.89	76.73
T Cl	mg/L		1.48	1.41	0.42
F CL	mg/L		0.92	0.84	0.13
Mono	mg/L		0.09	0.09	0
F NH3	mg/L		0.04	0	0
T NH3	mg/L	0.67	0.06	0	0
Temp	°C	4.5	5.5	7.3	12.8
pH	units	7.21	7.43	7.69	7.65
TDS	mg/L	619.1	631.3	632.8	622.6
Cond	mS/cm	906.9	927.7	930.2	918.3
ORP	mV	-29	533	557	446
T Fe	mg/L	2.25	0	0.07	0
D Fe	mg/L	2.16	0	0	0
T Mn	mg/L	0.123	0.039	0.006	0.038
D Mn	mg/L	0.119	0.008	0	0.003
Hardness	mg/L	462			

Where: Temp = temperature, TDS = total dissolved solids, Cond = conductivity

Bench Test column					Chart four
		Before	Treated	After	Treated
		Contactor	Column	Contactor	Column
Loading	gpm/ft2		2		2
T UVT	%UVT	48.09	76.12	49.16	75.41
D UVT	%UVT	73.04	76.36	74.35	76.48
T Cl	mg/L	6.01	0.42	2.97	0.39
F CL	mg/L	2.72	0.19	0.97	0.14
Mono	mg/L	1.35	0	0.97	0
F NH3	mg/L	0	0	0.37	0
T NH3	mg/L	0.27	0	0.07	0
Temp	oC	5.5	15.5	5.5	5.6
pH	units	7.64	7.56	7.69	7.71
TDS	mg/L	631.5	636.2	629.5	630.6
Cond	mS/cm	925.2	938.5	923.2	930.4
ORP	mV	581	479	556	425
T Fe	mg/L	1.86	0	2.06	0
D Fe	mg/L	0	0	0	0
T Mn	mg/L	0.189	0.018	0.06	0.01
D Mn	mg/L	0.037	0.011	0.002	0.004
Hardness	mg/L				

Summary

The current process is operating at peak efficiency.

From chart three we see the reduction of iron (Fe) and manganese (Mn) through the process before and after the filter backwash. The frequency of the backwash on the existing filters is providing potable water in regards to Fe and Mn. The current process is designed to remove only Fe and Mn. Chart three also shows that a second pass through a greensand would not improve the removal of Fe and Mn. On Chart four the dissolved Mn went from 0.037 mg/L before the contactor to 0.002 mg/L after the contactor. This indicates that the contactor has enough contact time to oxidize both the Fe and Mn.

The issue becomes the amount of ammonia in the water and the amount of Cl needed to reach break point. Chart one indicates that the Fe is readily oxidized at 2 mg/L of Cl. Then the ammonia (NH3) requires another 6 mg/L to bring us to a breakpoint of 8 mg/L. But to achieve the oxidation of Mn an additional 2 mg/L of Cl is need which will bring us to 10 mg/L for breakpoint. An additional 1 to 2 mg/L is then needed to satisfy primary disinfection and regenerating the greensand. This brings the total Cl to 11 or 12 mg/L. This requires additional treatment for NH3 removal.

Chart two was a trial using potassium permanganate (KMnO4) as the primary oxidant. It indicates that it will oxidize the Fe and is inconclusive for Mn due to the test used for determination, the KMnO4 has Mn in it so there is an interference.

The KMnO4 is not as efficient as the Cl but could reduce the chlorine demand by reducing Fe and Mn before chlorine is added. Traditionally the greensand process utilized KMnO4 as the primary oxidant which did oxidize and remove both Fe and Mn. The hazard of using KMnO4 becomes an issue with most operators as it is messy to use.

Recommendations

The WTP has just recently had a bio-oxidation pilot done on the raw water by BrewNature, with the reduction of Fe only. Mn and ammonia were not reduced. This is unfortunate as this would have required no chemicals to achieve the end result needed, which is the removal of iron, manganese and ammonia.

The goal for this WTP would be to remove the Fe, Mn, NH3 and to increase treated water flow from current to approximately 5 L/s (80 usgpm).

Method one:

Converting existing 4' filters to birm media filters would increase the loading rate to approximately 2 gpm/ft2. The current process has a lower loading rate (1.0 gpm/ft2) as the anthracite/greensand mixed media has a short run time for the removal of Mn. An air venturi would provide the oxidation of iron and filter out any turbidity that might precipitate from the air oxidation. This would be pre-treatment for a membrane treatment unit (MTU). The MTU would remove the Mn and ammonia in the water. It would also remove the mineral salts and hardness from the water. A disadvantage of a MTU is the need for chemicals; an antiscalelant to keep the Mn in solution and sodium hydroxide for pH control. Another disadvantage is allowing the Mn to pass into the MTU. It is a possibility that the membranes require changing more often (perhaps every 3 years), as an added operational cost. The existing 4' diameter filters could be replaced with 5' filters with an added air scour to help with the backwash.

Method two:

Install a larger diameter bio filter to accommodate the amount of water needed for the community. This will remove the Fe with no chemicals added. This would be pre-treatment for a membrane treatment unit (MTU). The MTU would remove the Mn and ammonia in the water. It would also remove the mineral salts and hardness from the water, with the same disadvantages as method one.

Method three:

Remove the existing filters and install bigger vessels to accommodate the amount of water need for the community (approximate 7' to 8' diameter, for 80 usgpm). Media would be a mixed bed of greensand and anthracite. The process would use KMnO4 as the primary oxidant with a loading rate of 1 gpm/ft2. Install ultraviolet disinfection as the primary disinfection. The process would use the intrinsic NH3 with added chlorine (approximately 4:1 ratio, chlorine to NH3) for monochloramine as a secondary disinfection. Ultraviolet disinfection depends on the UVT and hardness of the water, which is borderline for this raw water.

Method four:

Remove the existing filters and install bigger vessels to accommodate the amount of water need for the community (approximate 7' to 8' diameter, for 80 usgpm with a loading rate of 1 gpm/ft2). Media would be a mixed bed of greensand and anthracite. The process would use chlorine as the primary oxidant to breakpoint as a pre-treatment to a MTU. There would have to be an added chemical to quench the excess chlorine before the MTU. This may increase the life of the membranes to 5 years.

All four methods have been tried at other water treatment plants with success. Using MTU may have some disadvantage but the advantages are great. The water will need less chlorine as a disinfectant, the removal of mineral salts (no more hardness) and no more residual left around the water fixtures are but a few. The technologies around the MTU has been improved over the years, but the membranes still need to be cleaned periodically probably every quarter to treat this raw water.

Any process change would have to be proven and reviewed by an engineering firm and meet approvals with the WSA.

Gaudet's Sci Tech Services thanks you for the opportunity to help your community and would like to offer further assistance to either bench scale or pilot any of the process that has been decided on for proof of concept.

Bert Gaudet, A.Sc.T.
Process Specialist, GSTS
306 961 4088

Biological Filtration Piloting Study at Village of Elk Ridge

Demonstration Project Summary

May 2024

Prepared By:

Babak Roshani, PhD, P. Eng.

Scott McKerracher, Engineer-in-Training

Reviewed By:

Dillon Petrucha, P. Eng.

Drop Solutions Inc.
(Drop Water Service)
306-344-1270
service@dropsolutions.ca

BrewNature Inc.
306-716-6551
info@brewnature.ca

Table of Contents

1. Problem Statement

Groundwater is a crucial water resource in the Canadian Prairies. Currently, Saskatchewan is a national leader in economic growth associated with natural resource development and industrial activities. There is a strong demand for securing clean water in a variety of public and industrial sectors. However, groundwater in the Canadian Prairies frequently contains unacceptably high levels of iron, manganese, ammonia, nitrate, arsenic and organic substances, and thus, does not meet drinking water quality standards. Considering future water consumption rates and water infrastructure costs, the development of cost-effective treatment technologies for the removal of contaminants from water has become increasingly urgent in the water treatment industry in the Canadian Prairies.

Various treatment technologies have been employed to enhance potable water quality by removing these inorganic contaminants. In the last two decades, research has focused on individual removal of ammonia, iron, and manganese by biological oxidation from polluted groundwater. However, the combined and simultaneous biological removal of the above contaminants is a difficult task since different conditions are necessary to activate the biological oxidation of each pollutant. Simultaneous biological removal of the above pollutants was studied using two or three treatment stages in order to achieve high removal rates and high-quality potable water that meets or surpasses Canadian Drinking Water standards.

The local groundwater (well water) source at the Village of Elk Ridge, Saskatchewan contains iron, ammonia, and manganese at concentrations higher than the drinking water standards (DWS). The groundwater source contains iron and manganese, at 1.84 and 0.13 mg/L, respectively. Therefore, a combination of a biological filtration process would be a potentially cost-effective option to treat this groundwater for domestic applications. The groundwater also contains a high level of ammonia (0.75 mg/L) which would require a high amount of chlorine to oxidize the ammonia to chloramines if it were not removed in the treatment process. The presence of 0.75 mg/L of ammonia nitrogen in the groundwater may require 6 to 8 mg/L of chlorine to achieve breakpoint chlorination. A high amount of chlorine may result in a high concentration of total chloramines that exceeds the MAC level of 3.0 mg/L set by Health Canada and interferes with the DPD (i.e. N, N-diethyl-p-phenylenediamine) test method for free chlorine. Trihalomethanes (THMs), halogenated acetic acids (HAAs), bromates, chlorates, and chlorides are other concerns associated with a high dosage of chlorine-based disinfectants. By applying biological filtration technology for biological iron, manganese, and ammonia removal from the groundwater, we can produce safe drinking water and considerably reduce the chlorine consumption for disinfection of treated water.

The biological filtration process, a fixed-film biological process, is a specific engineering design that supports the growth of microbial communities capable of metabolizing contaminants through mediating oxidation-reduction reactions. The oxidants (electron acceptors) are normally oxygen, nitrate, perchlorate, sulfate, and iron (III); the reductants (electron donors) include organic matter, trace organic compounds, ammonia, arsenic (III), iron (II), and manganese (II). In a fixed-film biological process, biofilms are developed on the filter media.

A biofilm process mainly consists of two simultaneous steps, substrate diffusion and biological reaction. Electron donors and acceptors diffuse from a bulk fluid into the biofilm and are metabolized by microbial cells. Diffusion profiles are caused to be parabolic by this process. Bio-filtration allows a combination of aerobic biodegradation and physical retention of suspended solids by filtration through the filter bed. The accumulation of a critical mass of micro-organisms, required to bring about the desired reactions, is key to any biological process.

2. Pilot Description

2.1. Pilot Setup

Figure 1: Pilot installation at Village of Elk Ridge.

Drop Water was requested to run a comprehensive pilot study at the Village of Elk Ridge to treat ground water. The 2-gpm pilot skid was provided, including biological filtration system equipment. The biological filtration system has a 2-stage filter vessel array to simulate the operation of the existing system with the required upgrades. This unit is designed to replicate a full-scale system and remove iron, manganese, and ammonia. The piloting study was started in November 2023 and continued until end-March 2024. Through this pilot study, we intended to test the validity of biological filtration as a cost-effective technology for removing iron, manganese, and ammonia at the Village of Elk Ridge. This pilot is specifically designed to perform pilot testing functions and serves as a base on which to further develop new technologies and optimize existing technologies for water treatment.

A pilot-scale biological filtration unit was installed at the Village of Elk Ridge in Saskatchewan. The pilot-scale biological filter consisted of a translucent PVC column, 150 cm high and 12 cm internal diameter. This pilot filter height is typical of a full-scale industrial filter. The height and diameter of the pilot were chosen to ensure enough of the filtrate is available for the bacteria to colonize. The pilot is a scaled-down version of a full biological filtration system, although offers the same filtration capacity for the 2.5 gpm/ft^2 capacity of water. The pilot skid also allows for pressurization of the vessel to closely emulate the conditions inside a full biological filtration system. Air injection is also necessary for the survival of the bacteria in the vessels. Air injection for the pilot skid is supplied by an air compressor that was installed with the pilot skid.

The pilot was running when the full-scale water treatment plant turned on to produce water. The groundwater was pumped directly through the biological filter columns. Ideally, the pilot was to operate 24 hours per day, although the configuration available at the Village of Elk Ridge only allowed for 4-6 hours of operation time, refer to Figure 2 for the graphic of Pilot operational hours. Due to the low run time, the pilot experienced warmer temperatures when not running. The impacts of low runtime and warmer static temperature will be discussed in pilot biofilter performance.

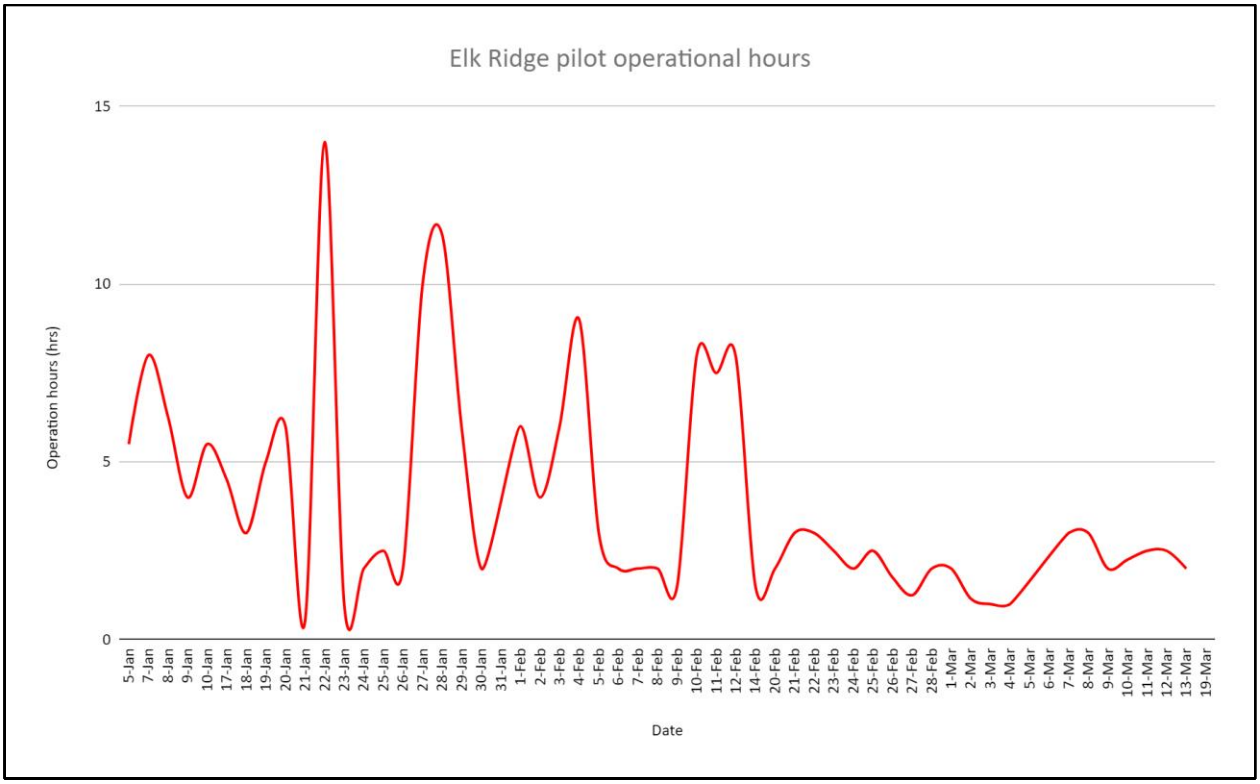


Figure 2: Elk Ridge pilot operational hours.

The groundwater quality parameters and characteristics of the groundwater treated by the biological filtration process are summarized in Table 1.

Table 1: Groundwater quality and treated water by biological filtration at the Village of Elk Ridge.

Parameter	Raw Water	SK Guideline
Ammonia-N (mg/L)	0.71	No guideline
Iron (mg/L)	1.84	<0.3
Manganese (mg/L)	0.13	<0.05
TDS (mg/L)	570	<1500
pH	7.96	7-10.5
Total Alkalinity (mg/L $CaCO_3$)	538	<500
Bicarbonate (mg/L)	656	No guideline
Carbonate (mg/L)	<1	No guideline
Hydroxide (mg/L)	<1	No guideline
Total Hardness (mg/L $CaCO_3$)	446	<800
Conductivity (uS/cm)	913	<2300
Calcium (mg/L)	108	No guideline
Magnesium (mg/L)	43	<200
Potassium (mg/L)	3.6	No guideline
Sodium (mg/L)	36	<300

For more information, please see the laboratory reports found in Appendix A

The key items to highlight in the groundwater samples are high levels of

- Iron
- Manganese
- Ammonia

It is expected that the first filter column will remove iron and part of the ammonia and the second filter column is primarily responsible for the removal of manganese, and remaining ammonia. In the first filter iron-oxidizing bacteria and nitrifying-bacteria (nitrification) are selectively enriched. Whereas, in the second filter a combination of nitrifying-bacteria (nitrification) and manganese-oxidizing bacteria are enriched. Depending on the bed height in the filter and the flux rate, there is a possibility there is a possibility to enrich these three groups of bacteria within a single column of a biofilter.

2.2. Design Criteria and Flux Rate

During the pilot operation at Village of Elk Ridge, following parameters in both filters were monitored on day-to-day basis:

- Iron
- Manganese
- Ammonia
- Flow rate
- Air Injection
- Operating Hours

In this pilot study, iron, manganese, and ammonia concentrations in groundwater and biofilter effluents were measured on a daily basis (The details of these results are explained in the below sections). The results of the previous pilot studies indicate that the filtration rate, or hydraulic loading, is the key design parameter for the filtration processes. The micro-organisms are normally present only in the upper layer of the bed, but as the filtration rate is increased the food supply to the bacteria is carried deeper into the medium. Under these conditions the bacteria adapt themselves to living at greater depths, but only to a limited extent. If the flow rate velocity becomes too high a break-through of ammonia, iron and manganese into the effluent may occur. A satisfactory way of assessing the filter depth and the proper filtration rate is to carry out experiments, either in the laboratory or a pilot-plant, filtering the actual groundwater to be treated through media of differing depth. During two months of piloting, the pilot biofilters were operating at a flux rate of 2.5 USgpm/ft^2 or (6 m^3/m^2/h).

2.3. Backwashing Information

The key to long-term operating success of biofilters is proper bed design and adequate bed cleaning during backwashing. Filters with inefficient backwashing tend to accumulate aggregates of sediments in the pores, increasing local velocities and having a potentially negative impact on filtrate efficiency and filter run time. During backwash, the filters are cleaned with water and gentle air scour in order to remove excess micro-organisms and built-up particulates or solids.

Generally, water used in backwashing must be unchlorinated and, in some cases, groundwater sources can be used. Biological filters often run for periods of one week to few months between backwashes, resulting in less wastewater than most other filtration technologies. The backwashing process essentially involves rinsing or flushing the biofilters. The low back wash rates, along with rapid filter ripening following backwash, increase the water production efficiency of the treatment plant. Micro-organisms remain attached to the filter media in the system even after backwashing, which allows the system to run continuously for an indefinite period of time, as long as backwashing is carried out on a regular basis and no biocides or harsh oxidants are introduced.

This pilot study at Elk Ridge resort, to remove iron, manganese, and ammonia from the local groundwater source, was conducted approximately for four months (15 Nov 2023 to 19 March 2024). During the piloting, approximately 28,800 gallons of groundwater was treated through the biofilter columns. And the biofilters were backwashed three times throughout the course of piloting, indicating a very low backwashing rate is required by using a biological filtration system. The biological filtration pilot was backwashed using the raw water. After backwashing, the system was ripened for 20 minutes at the lower flow rate till the turbidity became equal or below 0.1 NTU. Generally, the following parameters should be considered for backwash time and automation of the system:

- Backwash when the differential pressure reaches 5 PSI or accumulative water volume.
- Backwash when there are increasing Fe & Mn levels in the outlet of the filter; and
- Backwash when turbidity equal to or higher than 0.5 NTU.

The biofilter columns at the Elk Ridge were backwashed with a combination of air scour (rate = 0.5 scfm/ft^2) plus water (flow rate = 4-6 US gpm/ft^2). The media in the column experienced 25-30% bed expansion. Backwash water from the first filter which removes iron is orange in colour, whereas the water from the second filter which removes manganese is dark brown.

The Pilot underwent backwashing on three occasions:

- On January 19th, the first backwash of 2.5 gallons per minute (gpm) was conducted on filter one using raw water.
- On February 6th, both vessels underwent backwashing with air scour.
- The filters were reseeded with Leask Colony's backwashed water on February 14th.
- On February 23rd, filter 1 underwent air scour backwashing again.

For the duration of the pilot, the backwash water was captured and analyzed based on the colour from both vessels. Figures 3 and 4 are examples of the backwash water. Figure 3 shows the backwash from the first vessel after three months of operation. The distinct red-brown colour is expected from the first vessel because this colouring usually coincides with iron removal. The backwash water also was fairly opaque signifying lots of removal from the first filter. The red-brown colouring is created when the iron rusts due to the increases in oxygen present in the vessel, the iron then precipitates getting captured in the vessel's media.

Figure 3: Filter 1 backwashed water, February 6th.

The backwash from vessel 2 is consistent with the results found from testing. Figure 4 shows the backwash water from the second vessel after three months of operation. The backwash water was dark brown almost blue, this coloring is consistent with manganese removal. Although different from the backwash water from vessel 1, the vessel 2 backwash water was slightly transparent. Therefore vessel 2 does not have the same removal as vessel 1 was achieving.

Figure 4: Filter 2 backwash water, February 6th.

2.4. Dissolved Oxygen Consumption

Dissolved oxygen (DO) concentration strongly influences the performance of biological processes as it is necessary for micro-organism growth. The minimum dissolved oxygen content in the effluent of Filter 2 should not be allowed to fall below 5 mg/L. By controlling the DO level with sensors in the biological filter, we are able to provide a uniform and stable environment for the microorganisms, which reduces sludge production and energy costs. During biological filtration piloting at the Elk Ridge, the pilot was operating at a water flow rate of 0.3-0.5 USGPM, the air flow rate to the Filter-1 and Filter-2 was 0.035 SCFH and 0.07 SCFH, respectively. This is equal to the air flow of 2 SLPM for Filter-1 and 1 SLPM for Filter-2.

3. Pilot-scale Biofilter Performance

3.1. Iron Removal

Iron concentration in the local groundwater source at the Village of Elk Ridge ranged between 2.21 to 2.41 mg/L during the piloting period. Saskatchewan's guideline for iron in drinking water is ≤0.3 mg/L. The biological filtration pilot has shown conclusive evidence from this study that the iron concentrations in the groundwater can meet drinking water guidelines and can be consistent with biological removal. Time-dependent profiles of iron concentration and its removal efficiency over the two months of piloting are shown in Figures 5, and Figure 6, respectively. As shown in Figure 5 and 6, it is evident that the biological iron removal was rapid and was consistently below the standards over the course of operation, where iron removal efficiency was higher than 99%.

The sharp peak detailed in the figures around February 8th was due to a reconfiguration of the pilot's settings. On February 7th the inlet pressure was increased from 4 psi to 10 psi to test how the pilot operated at different pressures. The pilot was left at this increased pressure for the remainder of the piloting study. The pilot had also undergone an air scour and backwash on February 6th. The combination of the increased inlet pressure and a recent air scour and backwash would have caused the rapid decrease in performance in vessel 1, although vessel 1 responded quickly. The Iron removal in the effluent from vessel 1 returned to normal removal numbers after six days as the system naturally adapted. Throughout the spike, the effluent from vessel 2 maintained 99% iron removal.

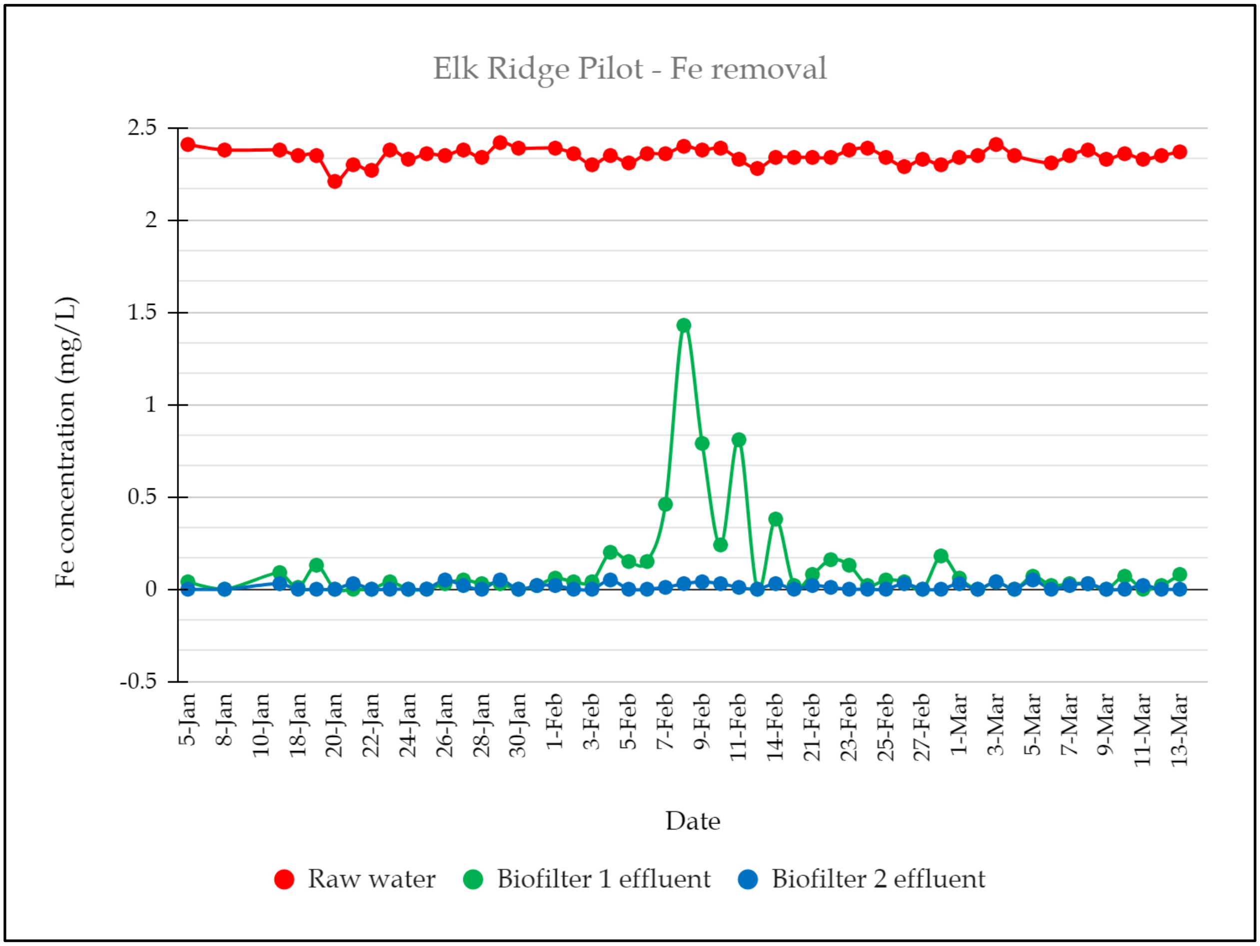


Figure 5: Profile of iron (Fe) concentration in the groundwater, Bio-1, and Bio-2 outlet for the Village of Elk Ridge.

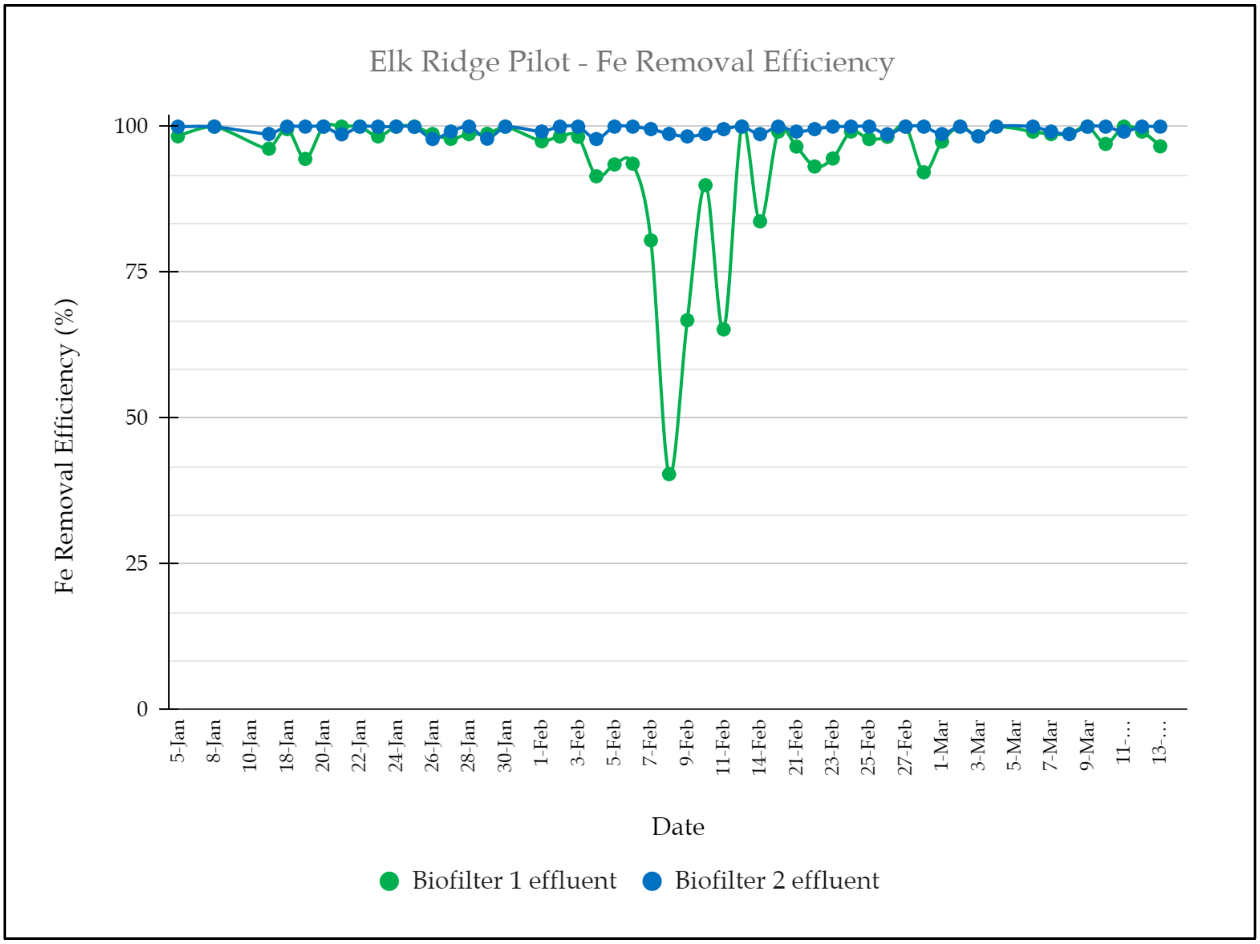


Figure 6: Profile of iron (Fe) removal efficiency in the Bio-1 outlet and Bio-2 outlet for the* Village of Elk Ridge*.

3.2. Manganese Removal

In this pilot study, along with iron, the potential of manganese removal by biological filtration was investigated. Manganese concentration in the local groundwater source at the Village of Elk Ridge varied between 0.029 to 0.123 mg/L during the duration of the pilot. Saskatchewan guideline for manganese in drinking water is ≤0.05 mg/L. For the given manganese concentration in local groundwater source, the biological filtration system had shown commendable performance in the biofilter effluent from the start of the pilot till around February 14th. After this date, we see a breakdown of the manganese removal shown in figure 7. In the early phases of biofilter operation, manganese removal was mainly promoted in the Filter-2 of the pilot.

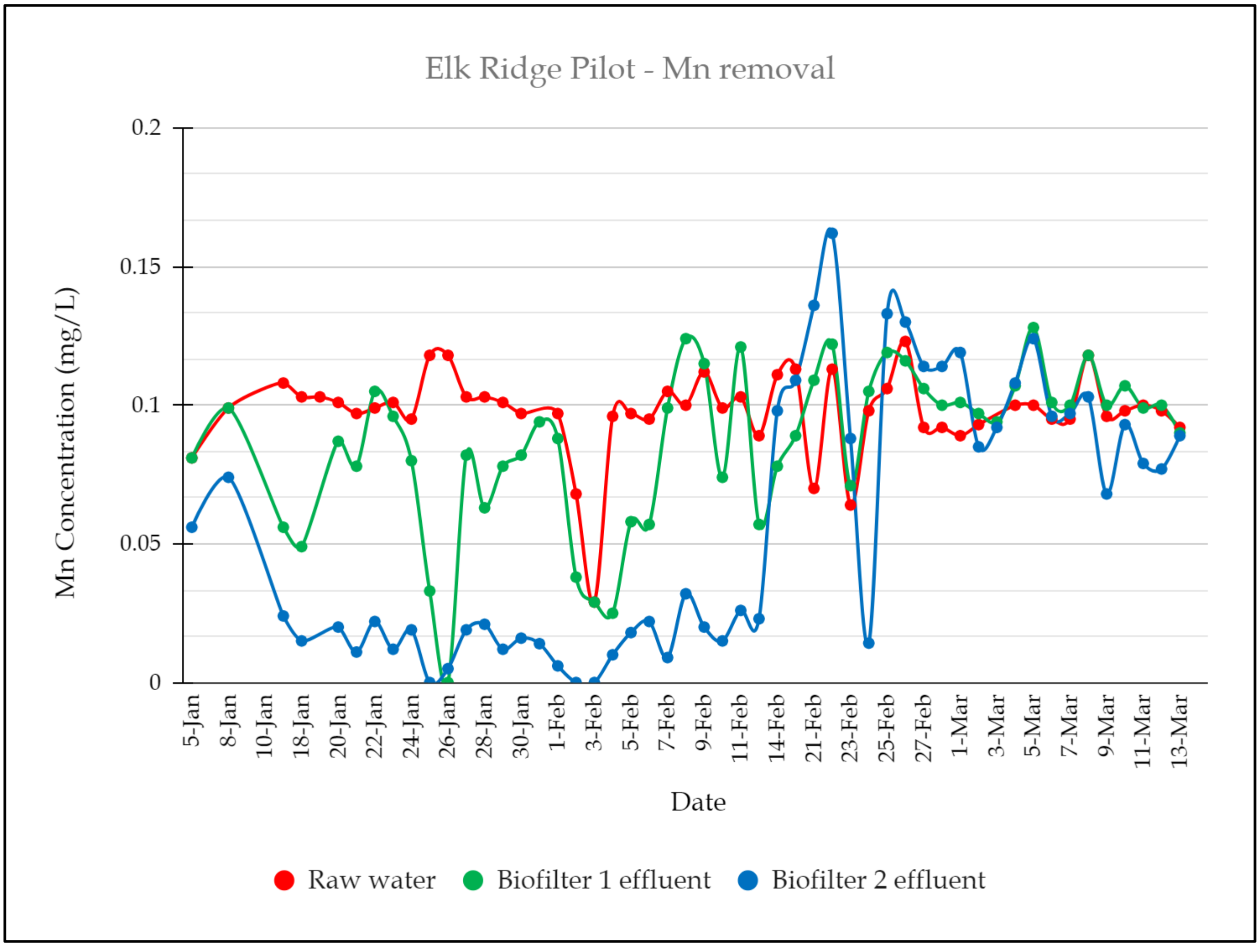


Figure 7: Profile of manganese (Mn) concentration in the groundwater, Bio-1, and Bio-2 outlet over the Pilot at the Village of Elk Ridge.

Time-dependent profiles of manganese concentration and its removal efficiency in the biofilter effluent over the two months of piloting were depicted in Figure 7, and Figure 8, respectively. Manganese concentration in the filter 2 outlet met SK standard after 15 days of operation and held under the 0.05 mg/L for 26 days.

The fluctuation in manganese concentration can be attributed in part to inconsistent operational hours. The variability in operation affects the bacterial population within the vessels, as warmer temperatures facilitate increased bacterial growth. This fluctuation in bacterial population may account for the inconsistencies observed from the beginning of the pilot study through mid-February. Subsequently, a significant reduction in pilot operation hours, as illustrated in Figure 2, resulted in inconsistent manganese removal.

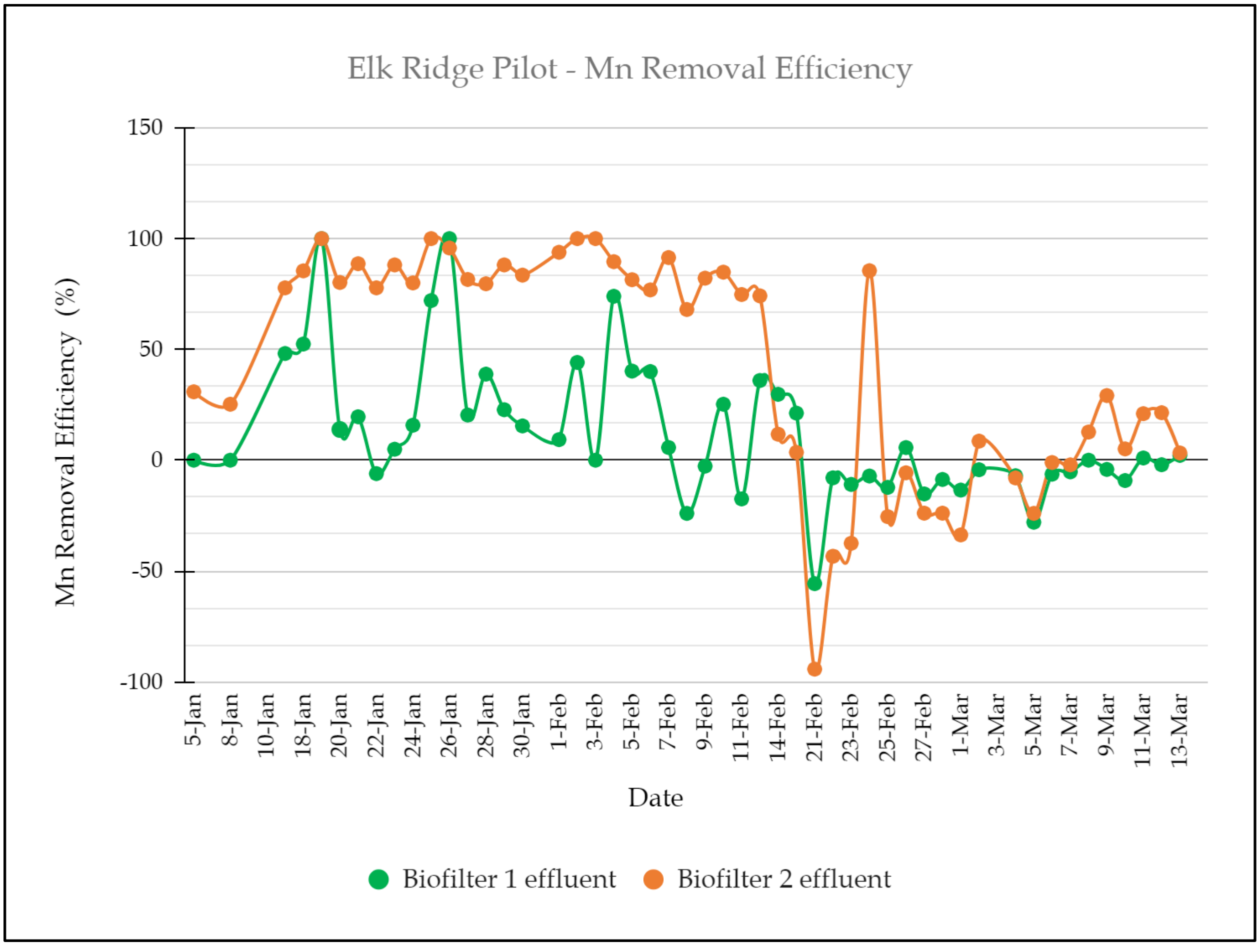


Figure 8: Profile of manganese (Mn) removal efficiency in the bio-1, and bio-2 outlet over the Pilot at the Village of Elk Ridge.

As depicted in Figure 8, during the initial stages of piloting, the manganese levels in the groundwater remained relatively constant. Throughout this phase, the Filter-2 effluent consistently exhibited an average removal rate of 81% for manganese. It is not believed that the operational times had a strong correlation with removal percentages, refer to section 3.4 for more analysis on operational times. After February 14, it is believed the void spaces in the filter media became filled with precipitated manganese. The precipitated manganese would then be added to the filtered water as it runs, leading to a negative removal efficiency of manganese leading to poor pilot performance from February 14th to the conclusion of the pilot. It is believed that this precipitation could be avoided in a full-scale biological filtration system. Typically, biological filtration is employed for manganese removal once ammonia has been removed prior. Based on the findings of this pilot project and previous pilots, the manganese would be able to be removed by a biological filtration system. The subsequent section on ammonia removal will elucidate why biological removal of ammonia was not achievable.

3.3. Ammonia Removal

3.3.1. Biological Ammonia Removal

Biological ammonia removal by bacteria needs very specific environmental conditions. To promote conditions for biological ammonia removal in a water/wastewater treatment process of a plant, an understanding of the processes and careful control of process conditions are required. Untreated groundwater can contain nitrogen in the form of organic nitrogen, ammonia (NH_3-N). Ammonia removal in biological filters involves oxidation of ammonia contained in the water to nitrate (NO_3-N) by nitrifying bacteria. This process is called nitrification. Nitrification is the two-step biological oxidation of ammonia (NH_3-N) to nitrate (NO_3-N). The oxidation is performed by aerobic autotrophic bacteria frequently called nitrifiers. The predominant species that are commonly encountered in water treatment plants for nitrification belong to genera *Nitrospira*, *Nitrobacters,* and *Nitrosomonas*. Equations describing the oxidation of NH_3-N to NO_2^--N and oxidation of NO_2^--N to NO_3^--N are presented as follows:

$$2NH_4^+ + 3O_2 \text{ -----> } 2NO_2^- + 2H_2O + 4H^+ + \text{New Cells}$$

$$2NO_2^- + O2 \quad \text{-----> } 2NO_3^- + \text{New Cells}$$

Nitrification occurs only under aerobic conditions, so dissolved oxygen must be available to the bacteria in the treatment process. It requires approximately 4.6 kg of oxygen for every kg of ammonia converted to nitrate by the bacteria. Temperature, pH, and alkalinity are other factors which impact biological nitrification. Alkalinity is consumed at a rate of approximately 7.14 kg per kg of ammonia nitrified. During nitrification, this alkalinity reduction causes the pH of the water to drop. The rate of nitrification is dependent on pH, temperature and the water components. The optimum pH for nitrification is approximately 8.4. The rate of nitrification drops off rapidly at pH levels of less than 7.0. There is also a significant drop in nitrification rates at temperatures less than 15°C.

3.3.2. Ammonia Removal at Village of Elk Ridge Pilot

In addition to iron and manganese, biological filtration pilots at the Village of Elk Ridge have also shown poor and sporadic removal of ammonia through biological processes. Ammonia concentration in the local groundwater source at the Village of Elk Ridge ranged mainly between 0.60 to 0.92 mg/L throughout the pilot. Although there is no guideline for ammonia in drinking water, Saskatchewan Water Security Agency developed an operational guideline of ≤0.1 mg/L to minimize chlorine consumption. Within a few days of operation, the biological filtration pilot has shown complete removal of ammonia from groundwater source by biological process and has met process guidelines. Although this removal was short-lived because a couple days later there was minimal removal. The inconsistencies continued throughout the pilot's duration.

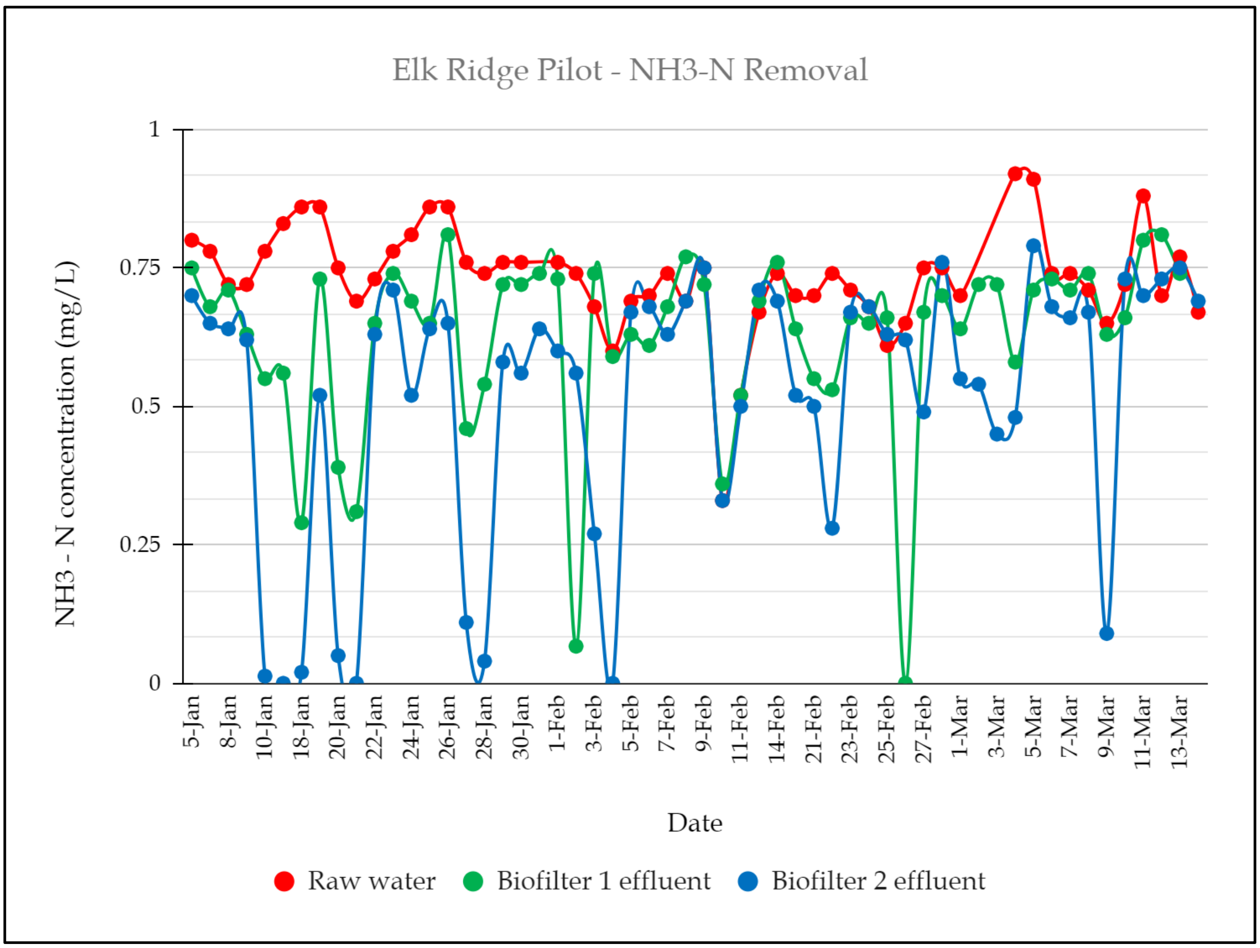


Figure 9: Profile of ammonia-N (NH_3-N) concentration in the groundwater, Filter-1 and Filter-2 outlet over the Pilot at the Village of Elk Ridge.

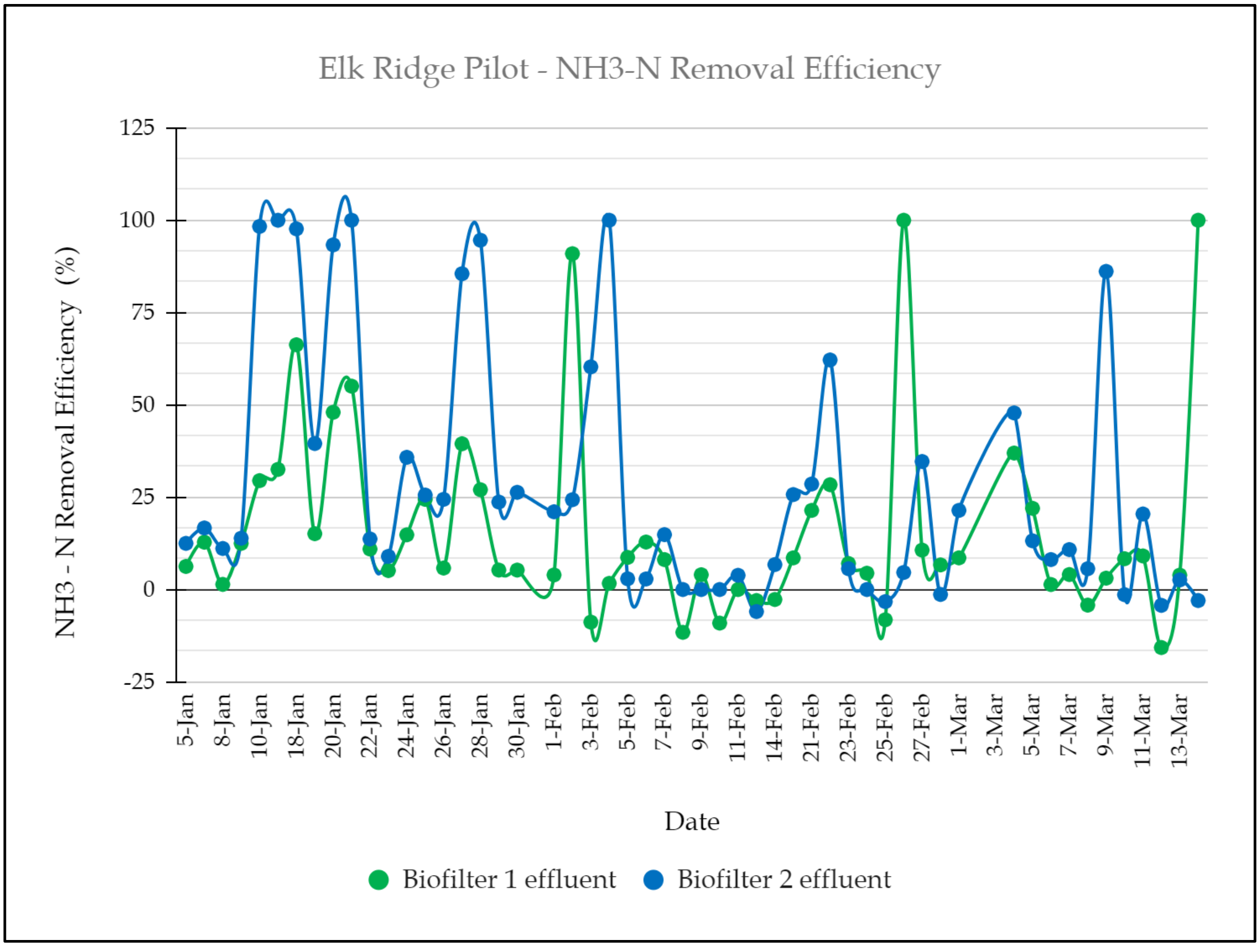


Figure 10: Profile of ammonia-N (NH_3-N) removal efficiency in the Filter-1, and Filter-2 outlet over the Pilot at the Village of Elk Ridge.

Figure 11 illustrates the operational hours of the pilot in red, measured on the left vertical axis, alongside the percentage of ammonia removal in orange, measured on the right vertical axis. This figure offers valuable insights into the relationship between operational time and ammonia removal. A noticeable trend from the graph suggests that extended operational periods, followed by shorter intervals of activity, result in higher percentages of ammonia removal due to increased bacteria count in the vessels. For instance, on January 22, the pilot was operational for 14 hours, followed by less than 3 hours of operation over the next four days. This pattern led to a substantial increase in ammonia removal on January 26th and 27th.

The trend continues from January 28th to February 3rd, where a large operation time followed by decreased activity sees a spike in ammonia removal. An explanation for this trend could be low nitrifying bacteria in the raw water. For example, when the pilot is run for long amounts of time, the vessels can build up nitrifying bacteria and their food source. Then, when the pilot is run for less time, the bacteria are given a chance to bolster populations in a warmer environment leading to more ammonia removal. For every 10°C the total micro-organism population doubles. The increased bacteria would lead to a small unsustainable peak of ammonia removal as seen in figure 10.

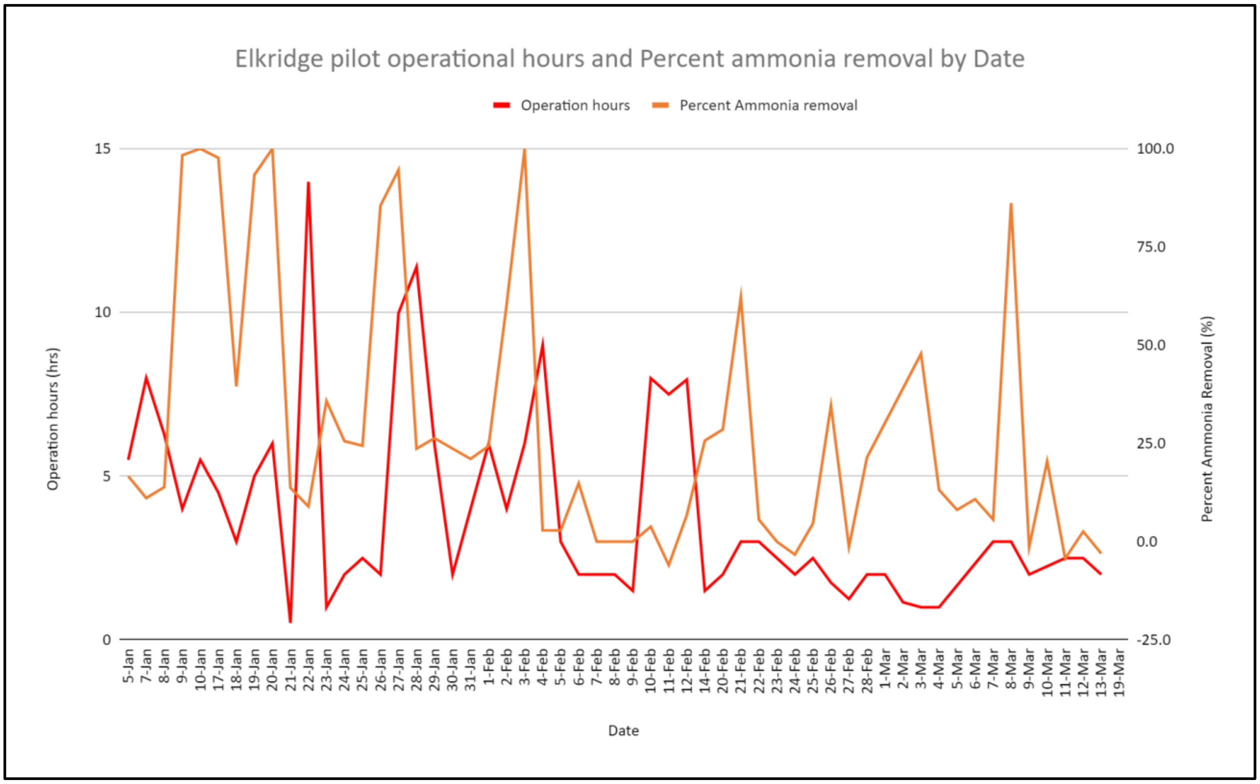


Figure 11: Elk Ridge pilot operation vs percent ammonia removal.

After conducting over three months of piloting at Elk Ridge and comparing it with previous piloting efforts in various locations, we made a significant observation regarding the depth of the well water. At Elk Ridge, the well water depth is exceptionally deep, averaging around 360 feet. This contrasts with our prior successful piloting experiences, where the well water depth typically did not exceed 200 feet. This variance in depth led us to speculate about the reason for the low indigenous nitrifying bacteria crucial for promoting ammonia removal.

Upon seeding the biofilter, we initially observed promising results in ammonia removal. However, this efficiency declined after a few days, which we attribute to an insufficient number of indigenous bacteria at such depths to maintain sufficient ammonia removal. Additionally, Elk Ridge's location within a federally protected area limits activities like farming and animal husbandry, which are typically sources of live organisms and bacteria in the soil. Which could also affect the amounts of nitrifying bacteria present in the well water. Consequently, the biological filtration system's efficacy is compromised due to the scarcity of these essential organisms.

We conclude that biological filtration systems are more feasible when fed from shallow wells rather than excessively deep ones like those found at Elk Ridge because of the higher likelihood of sufficient nitrifying bacteria. This insight underscores the importance of considering environmental factors, such as well depth and surrounding land use, when implementing such filtration systems for effective ammonia removal. It is possible to complete an HPCs test to validate low amounts of nitrifying bacteria. Heterotrophic plate counts (HPCs) are commonly used to assess the general microbiological quality of drinking water.

3.4. Correlation between Operational time and Percent removal

Due to the inconsistent run time of the pilot, it is necessary to analyse the correlation between pilot run time and the removal of manganese and ammonia from the water to ensure proper recommendations are made. Correlation is a statistical measurement of the relationship between two variables. The analysis will be done using a scatter plot graph with trend lines indicating possible correlations. The correlation coefficient value or r value will also be calculated throughout analysis. r value can range from 1 for a strong positive correlation meaning an increase of one variable leads to an increase of the other variable, to -1 a strong negative correlation where an increase of one variable leads to a decrease in the other. An r value of 0 indicates no correlation, meaning the variables do not have a relationship with each other. For this analysis the relationship between operational run time and percent removal will be calculated. A strong relationship, an r value close to 1, would mean the longer the pilot is run the better the removal percentage. No correlation or an r value close to 0 would mean that the operational time does not have a relationship with the removal percentage.

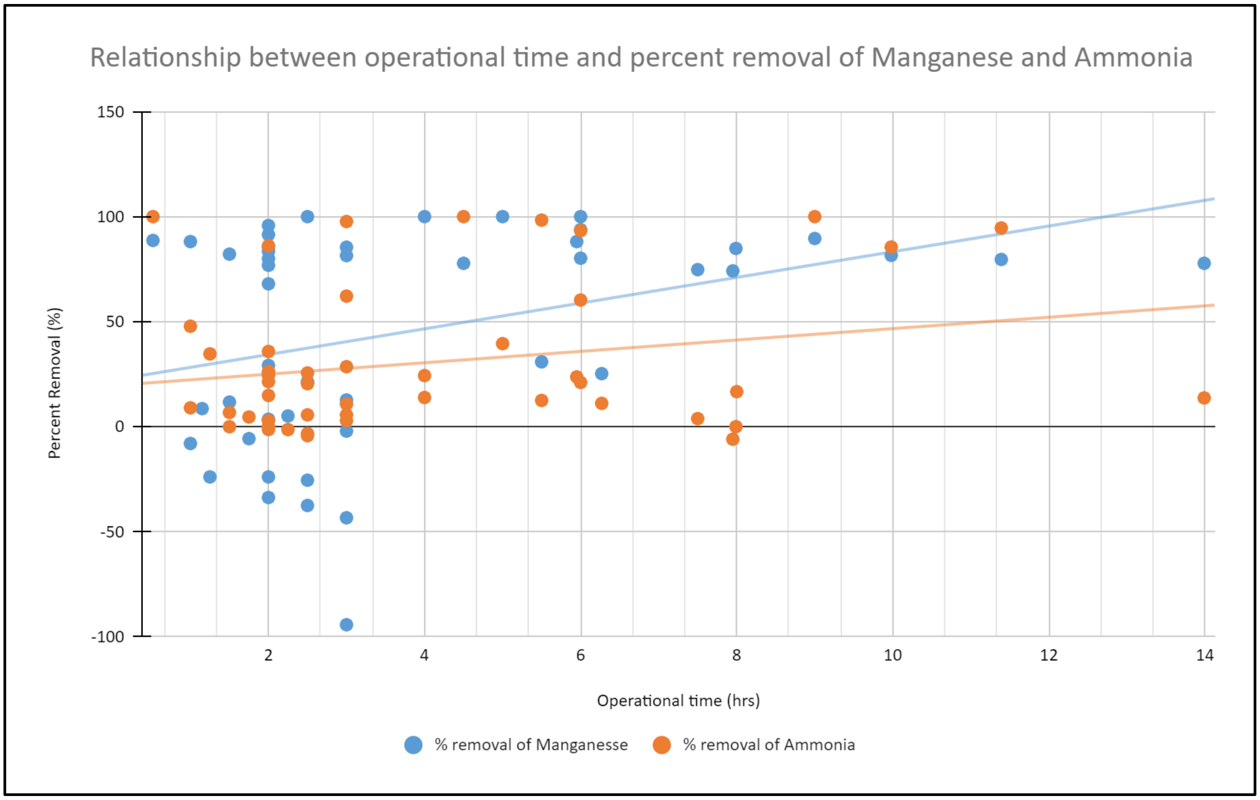


Figure 12: Relationship between operational time and percent removal of Manganese and Ammonia

The figure above displays the relationship between the Operational time of the pilot and the percent removal of manganese and ammonia. The left axis is for percent removal while the horizontal is for the operational hours of the pilot. The percent removal of manganese is displayed in blue, while ammonia is in orange. The linear slope is depicted for both relationships. Manganese removal has a higher slope than ammonia removal which indicates a stronger relationship between operational time and manganese removal than operational time and ammonia removal. Both slopes are positive, representing more operational time would lead to more percent removal. To determine the strength of the relationship the equation pictured below will be used where r_{xy} is the correlation coefficient, X_i is the x variable values, $\overline{X}$ is the mean value of the x variables, y_i is the y variable values, and

$\bar{y}$ is the mean of the y variables.

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Figure 13: Equation for calculating the correlation coefficient

The equation used over the data set correlation coefficient can be calculated for both relationships. The value for the relationship between the operational time and percent removal of manganese was calculated to be r = 0.36, therefore the relationship can be described as a weak relationship. The values of the relationship between operational time and the percent ammonia removal was calculated to be r = 0.24, therefore the relationship can be described as weak as well bordering on very weak/ no association. (These determinations were based on a table from Boston universities educational website, and the table will be included in the appendix) While both correlation coefficients are positive slopes, due to their low value operational time would not be the leading factor in affecting percent removal for both manganese and ammonia. Therefore, it is accurate to describe operational time as not having significant enough effect on percent removal of manganese and ammonia to invalidate our piloting project. It is still believed that low bacteria present in the raw water has the largest impact on the pilots poor inconsistent removal of Ammonia from the water.

4. Conclusions and Recommendations

The analysis reveals that Filter-1 effectively eliminates iron, while Filter-2 encountered challenges in removing both ammonia and manganese. Iron and manganese concentrations consistently adhered to drinking water and process standards. Conversely, the biofilter proved ineffective in removing ammonia due to the potentially low amounts of indigenous bacteria in the well water and the inconsistent operation of the pilot. In summary, the pilot study at the Elk Ridge WTP reveals conclusions in the following areas:

- Iron concentrations in the local groundwater source were effectively reduced by over 99% through biological filtration, all achieved without the need for chemical additives.
- Manganese concentrations in the groundwater underwent a reduction of over 80% via biological treatment, although the consistency of this reduction varied.
- Biological filtration resulted in an average 28% decrease in ammonia concentrations within the groundwater.
- Despite a prolonged acclimation period during the biological filtration pilot aimed at removing ammonia from the given groundwater source, the potential for a low number of indigenous bacteria and inconsistent operation hindered the ability to achieve full ammonia removal.
- A next step could be to ensure that the absence of nitrification bacteria is confirmed to eliminate it as a cause, then comp the pilot with more consistent run times and possibly add a third stage.
- The use biological filtration as primary treatment system to effectively eliminate iron and manganese, is possible and it is recommended that breakpoint chlorination for ammonia removal be employed at the outlet of the final biofilter to ensure targets are achieved. The main advantage of a biological filtration system will be less backwashing of the filters compared to greensand filters. Typical backwash requirements for the first biofilter is every two weeks and the second biofilter is every three months, comparing the greensand filters that must be backwashed every second day.

5. Acknowledgements

Drop Water would like to thank **Mr. Russel and Ms. Terri** for their assistance in measuring water parameters during the pilot study at the Elk Ridge WTP.

APPENDIX
Laboratory Results and Daily Log sheet and Correlation Coefficient table

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	FRIDAY	SAT	SUN	MON	Tuesday	Wed.
Date	Jan 5	Jan 6	Jan 7	Jan 8	Jan 9	Jan 10
Raw Water						
Operating (hr)	5.5		8 hrs	6.27	4.00	5.5
Iron (mg/L)	2.41			2.39		
Manganese (mg/L)	.081			.099		
NH3-N (mg/L)	.80		.78	.72	.72	.78
Outlet Filter 1						
Iron (mg/L)	.04			0.00		
Manganese (mg/L)	.081			.099 ~~.099~~		
NH3-N (mg/L)	.75		.68	.71 ~~.099~~	.63	1st .53 / 2nd .55
Inlet Press. (PSI)	.2		5	5	5	0
Outlet Press. (PSI)	3		5	5	5	0
Outlet Filter 2						
Iron (mg/L)	0.00			0.00		
Manganese (mg/L)	.056			.074		
NH3-N (mg/L)	.70		.65	.64	.62	0.00 / 2nd .015
Inlet Press. (PSI)	4		5	4	5	0
Outlet Press. (PSI)	4		5	4	4	0
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:

.34/m

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	Wed	Thur	Frid	Sat	Sun	Mon	Tues
Date	Jan 17	18	19	20	21	22	23 (Startup)
Raw Water							
Operating (hr)	4.5	3	5	6	.52	13.99	(5min) / 1hr
Iron (mg/L)	2.38	2.35	2.35	2.21	2.30	~~13.99~~ 2.27	2.38
Manganese (mg/L)	.108	.103	.103	.101	.097	.099	.101
NH3-N (mg/L)	.83	.86	.86	.75	.69	.73	(.78) / .78
Outlet Filter 1							
Iron (mg/L)	.09	.01	.13	.00	.00	.00	.04
Manganese (mg/L)	.056	.049		.087	.078	.105	.096
NH3-N (mg/L)	.56	.29	.73	.39	.31	.65	(.41) / .74
Inlet Press. (PSI)	2	2	8	2	2	5	5
Outlet Press. (PSI)	2	2	8	2	2	7	5
Outlet Filter 2							
Iron (mg/L)	.03	.00	.00	.00	.03	.00	.00
Manganese (mg/L)	.024	.015		.020	.011	.022	.012
NH3-N (mg/L)	.00	.02	.52	.05	.00	.63	(.01) / .71
Inlet Press. (PSI)	2	2	7	2	2	5	5
Outlet Press. (PSI)	2	2	6	2	2	5	5
Air Scour (Bio 1 or 2)							~~5~~
Backwashing (Bio 1 or 2)			#1 - 5 5gal				

Comments:

Taking 5 min well on warm

run from Colder water

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	Wed	Thur	Fri	SAT	SUN	Mon
Date	Jan 24	25	26	27	28	29
Raw Water						
Operating (hr)	2 hrs cold	2.5	2	9.98	11.39	5.95
Iron (mg/L)	2.33	2.36	2.35	2.38	2.34	2.42
Manganese (mg/L)	.095	.118	.118	.108	.103	.101
NH3-N (mg/L)	.81	.86	.86	.76	.74	.76
Outlet Filter 1	—	—	—	—	—	—
Iron (mg/L)	.00	.00	.03	.05	.03	.03
Manganese (mg/L)	.080	.033	.000	.082	.063	.078
NH3-N (mg/L)	.69	.65	.81	.46	.54	.72
Inlet Press. (PSI)	4	3	4	2	2	2
Outlet Press. (PSI)	4	3	4	2	2	4
Outlet Filter 2	—	—	—	—	—	—
Iron (mg/L)	.00	.001	.05	.02	.00	.05
Manganese (mg/L)	.019	.000	.005	.019	.021	.012
NH3-N (mg/L)	.52	.64	.65	.11	.04	.58
Inlet Press. (PSI)	4	3	5	2	2	2
Outlet Press. (PSI)	4	3	5	2	2	4
Air Scour (Bio 1 or 2)	—	—	—	—	—	—
Backwashing (Bio 1 or 2)	—	—	—	—	—	—

Comments: cold to test

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	Tue	Wed	Thurs	Fri	Sat	Sun
Date	Jan 30	31	Feb 1	Feb 2	Feb 3	Feb 4
Raw Water						
Operating (hr)	2 hrs		6	4	6	(… call 9) ran well 45 min - 1 hr
Iron (mg/L)	2.39		2.39	2.36	2.30	2.35
Manganese (mg/L)	.097		.097	.068	~~[illegible]~~ .028	.096
NH3-N (mg/L)	.76		.76	.74	.68	.60
Outlet Filter 1						
Iron (mg/L)	.00	.02	.06	.04	.04	.20
Manganese (mg/L)	.082	.094	.088	.038	.029	.025
NH3-N (mg/L)	.72	.74	.73	.67	.74	.59
Inlet Press. (PSI)	4	6	10	8	9	5
Outlet Press. (PSI)	5	6	10	10	9	6
Outlet Filter 2						
Iron (mg/L)	.00	.02	.02	.00	.00	.05
Manganese (mg/L)	.016	.014	.006	.000	---	.010
NH3-N (mg/L)	.56	.64	.60	.56	.27	.00
Inlet Press. (PSI)	5	5	10	7	9	5
Outlet Press. (PSI)	5	6	10	9	9	6
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:

Jan 31 - Increase output pressure to 10 lbs Increase Filter 2 Air to 2 after Bubbler

did mang 2X same results

Daily Monitoring of Biofilters @ Elk Ridge WTP

Elk Ridge Weekly Log	Feb						
Date	5	6	7	8	9	10	11
Raw Water		10 AM				Hr	Hr
Operating (hr)	3 act/run	2 hrs	2 hrs	2 hrs	1.5 hrs	7.99 (1.5)	7.5 (1
Iron (mg/L)	2.31	2.36	2.36	2.40	2.38	2.39	2.33
Manganese (mg/L)	.097	.095	.105	.100	.112	.099	.103
NH3-N (mg/L)	.69	.70	.74	.69	.75	.33	.52
Outlet Filter 1							
Iron (mg/L)	.15	15	.46	1.43	.79	.24	.01
Manganese (mg/L)	.058	.057	.099	~~.100~~ .124	.115	.074	.121
NH3-N (mg/L)	.63	.61	.68	.77	.72	.36	.52
Inlet Press. (PSI)	5	4	10	12	13	8	16
Outlet Press. (PSI)	7	5	10	11	12	8	16
Outlet Filter 2							
Iron (mg/L)	.00	.00	.01	.03	.04	.03	.01
Manganese (mg/L)	.018	.022	.009	.032	.020	.015	.026
NH3-N (mg/L)	.67	.68	.63	.69	.75	.33	.50
Inlet Press. (PSI)	5	4	10	10	10	7	13
Outlet Press. (PSI)	7	5	10	10	10	8	14
Air Scour (Bio 1 or 2)		yes @ 230 pm					
Backwashing (Bio 1 or 2)		yes					

Comments:

very cold
well ran long 3hr

Filter 1 has
air when
openning to
Sample
We did
Mang
raw .100
filter 1 .124

Elk Ridge WTP

Elk Ridge Weekly Log						
Date	Feb 12	13	14	20	21	22
Raw Water	3		1.5			
Operating (hr)	7.95			2	3	3
Iron (mg/L)	2.28		2.34	2.34	2.34	2.34
Manganese (mg/L)	.089		.111	.113	.070	.113
NH3-N (mg/L)	.67		.74	.70	.70	.74
Outlet Filter 1						
Iron (mg/L)	0.00		.38	.02	.08	.16
Manganese (mg/L)	.057		.078	.089	.109	.122
NH3-N (mg/L)	.69		.76	.64	.55	.53
Inlet Press. (PSI)	9	16	16	10	7	12
Outlet Press. (PSI)	9	15	15	12	10	13
Outlet Filter 2						
Iron (mg/L)	0.00		.03	.00	.02	.01
Manganese (mg/L)	.023		.098	.109	.136	.162
NH3-N (mg/L)	.71		.69	.52	.50	.28
Inlet Press. (PSI)	9	15	15	10	7	12
Outlet Press. (PSI)	8	15	15	11	8	12
Air Scour (Bio 1 or 2)						#1
Backwashing (Bio 1 or 2)						#1

Comments:

Feb 16
Scott added Bio
to filter 1+2
restart 20

BackWash #1 - 22nd

... @ Elk Ridge WTP

Elk Ridge Weekly Log						
Date Feb	23	24	25	26	27	28
Raw Water						
Operating (hr)	2½	2hrs	2.5hr	1.75	1.25	2.0
Iron (mg/L)	2.38	2.39	2.34	2.29	2.33	2.3
Manganese (mg/L)	.064	.098	.106	.123	.092	.092
NH_3-N (mg/L)	.71	.68	.61	.65	.75	.75
Outlet Filter 1						
Iron (mg/L)	.13	.02	.05	.04	.00	.18
Manganese (mg/L)	.071	.105	.119	.116	.106	.100
NH_3-N (mg/L)	.66	.65	.66	[illegible]	.67	.70
Inlet Press. (PSI)	14	12	9	9	4-5	5
Outlet Press. (PSI)	14	10	11	11	6	6
Outlet Filter 2						
Iron (mg/L)	.00	.00	.00	.03	.00	.00
Manganese (mg/L)	.088	.142	.133	.130	.114	.114
NH_3-N (mg/L)	.67	.68	.63	.62	.49	.76
Inlet Press. (PSI)	11	10	10	9	5	5
Outlet Press. (PSI)	11	10	10	10	6	6
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:
took 2 pails out of filter 1 as per Mr B.

ran bio ran 2hrs. evening 6:30-8:30

ran 30 min AM

… @ Elk Ridge WTP

Elk Ridge Weekly Log						
Date	Mar 1	Mar 2	Mar 3	4	5	6
Raw Water						
Operating (hr)	2	1.15	1	/		
Iron (mg/L)	2.34	2.35	2.41	2.35	—	~~.095~~ 2.31
Manganese (mg/L)	.089	.093	—	.100	.100	.095
NH3-N (mg/L)	.70	—	—	.92	.91	.74
Outlet Filter 1				—		
Iron (mg/L)	.06	.00	.04	.06	.07	.02
Manganese (mg/L)	.101	.097	.094	.107	.128	.101
NH3-N (mg/L)	.64	.72	.72	.58	.71	.73
Inlet Press. (PSI)	9	5	5	9	12	9
Outlet Press. (PSI)	10	5	6	11	15	10
Outlet Filter 2				—		
Iron (mg/L)	.03	.00	.04	.00	.05	.00
Manganese (mg/L)	.119	.085	.092	.108	.124	.096
NH3-N (mg/L)	.55	.54	.45	.48	.79	.68
Inlet Press. (PSI)	8	5	5	9	10	10
Outlet Press. (PSI)	9	5	5	10	12	10
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:

... @ Elk Ridge WTP

Elk Ridge Weekly Log						
Date	Mar 7/24	Mar 8	9	10	11	12
Raw Water						
Operating (hr)	3	3	2	2.25	2½	2.5
Iron (mg/L)	2.35	2.38	2.33	2.36	2.33	2.35
Manganese (mg/L)	.095	.118	.096	.098	.100	.98
NH3-N (mg/L)	.74	.71	.65	.72	.88	.70
Outlet Filter 1			—			
Iron (mg/L)	.03	.03	.00	.07	.00	.02
Manganese (mg/L)	.100	.118	.100	.107	.099	.100
NH3-N (mg/L)	.71	.74	.63	.66	.80	.81
Inlet Press. (PSI)	9	10	8	12	11	10
Outlet Press. (PSI)	10	11	10	14	12	10
Outlet Filter 2			—			
Iron (mg/L)	.02	.03	.00	.00	.02	.00
Manganese (mg/L)	.097	.103	.068	.93	.079	.077
NH3-N (mg/L)	.66	.67	.09	.73	.70	.73
Inlet Press. (PSI)	8	8	8	11	11	11
Outlet Press. (PSI)	10	10	10	14	14	10
Air Scour (Bio 1 or 2)			—			
Backwashing (Bio 1 or 2)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

Comments:

Date	Mar 13	Mar 19				
Raw Water						
Operating (hr)	2					
Iron (mg/L)	2.37					
Manganese (mg/L)	.092					
NH3-N (mg/L)	~~77~~	.67				
Outlet Filter 1						
Iron (mg/L)	.08					
Manganese (mg/L)	.090					
NH3-N (mg/L)	.74					
Inlet Press. (PSI)	15					
Outlet Press. (PSI)	15					
Outlet Filter 2						
Iron (mg/L)	.00					
Manganese (mg/L)	.089					
NH3-N (mg/L)	.75	.69				
Inlet Press. (PSI)	15					
Outlet Press. (PSI)	15					
Air Scour (Bio 1 or 2)						
Backwashing (Bio 1 or 2)						

Comments:

ELK RIDGE UTILITY LTD. - WATER QUALITY DATA

Source		PW7-2014	PW6-2011	PW6-2011	OBS PW5-2000	Sask / Canada Municipal Treated Water AO and MAC
Developed Aquifer		Un-named Aquifer	Un-named Aquifer	Un-named Aquifer	Un-named Aquifer	
Location		Elk Ridge Utility Ltd.	Elk Ridge Utility Ltd.	Elk Ridge Utility Ltd.	Elk Ridge Utility Ltd.	
Lab and Sample No.		SRC	SRC	Sask Disease Control	Sask Disease Control	
		29643	32460	1053954	1042983	
Date Sampled		Sep-17-14	22-Sep-11	22-May-14	Apr-2-13	
Well Completion Depth (metres)		101.50	100.81	100.81	N/A	
Major Constituents						
Bicarbonate, HCO_3	mg/L	656	619	608	608	no criteria
Calcium, *Ca*	mg/L	108	105	109	111	no criteria
Carbonate, CO_3	mg/L	<1	<1	0	0	no criteria
Chloride, *Cl*	mg/L	3	4	14.8	13.5	250
Hydroxide, *OH*	mg/L	<1	<1	0	0	no criteria
P. Alkalinity	mg/L	<1	<1	0	0	no criteria
Magnesium, *Mg*	mg/L	43	40	43	43	200
Potassium, *K*	mg/L	3.6	4.3	5	5	no criteria
Sodium, *Na*	mg/L	36	37	47	48	300 / 200
Sulphate, SO_4	mg/L	23	20	21	19	500
Sum of Ions (calc.)	mg/L	874	829			1500
Total Alkalinity	mg/L	538	507	498	498	500
Total Hardness	mg/L	446	426	449	454	800 / 200
Nutrients/Organics						
Ammonia, as N	mg/L	0.71	0.64			no criteria
Nitrate, NO_3	mg/L	<0.04	<0.04	<0.2	<0.2	45
Organic Carbon, *Total*	mg/L	7.2	8.5			no criteria
Organic Carbon, *Dissolved*	mg/L	7	8.5			no criteria
Trace Constituents						
Cyanide, total	ug/L					200
Fluoride, *F*	mg/L	0.21	0.22	0.21	0.4	1.5
Mercury, Hg	ug/L					1.0
Phosphorous, *P*	mg/L					no criteria
Selenium, *Se*	mg/L	<0.0001	<0.0001	<0.00096		0.01
Trace Metals						
Aluminum, *Al*	mg/L	0.16	<0.0005	<0.00214		no criteria
Arsenic, *As*	ug/L	27.0	23	1.4		25 / 10
Barium, *Ba*	mg/L	0.16	0.16	0.129		1.0
Boron, *Bo*	mg/L	0.13	0.12	0.1		
Cadmium, *Cd*	mg/L	<0.00002	<0.00001	<0.00056		0.005
Chromium, *Cr*	mg/L	<0.0005	<0.0005	0.0003		0.05
Copper, *Cu*	mg/L	0.0012	<0.0002	0.238		1
Iron, *Fe*	mg/L	1.84	1.88	<0.1	<0.1	0.3
Lead, *Pb*	mg/L	0.0004	<0.0001	0.9		0.01
Manganese, *Mn*	mg/L	0.13	0.084	<0.01	<0.01	0.05
Zinc, *Zn*	mg/L	0.0041	<0.0005	0.0851		5
Physical Properties						
Total Dissolved Solids, *TDS*	mg/L	570	546	848	848	1500 / 500
Total Suspended Solids, *TSS*	mg/L		<1			no criteria
Turbidity	NTU		0.1			no criteria
Sp. Conductivity	uS/cm	913	901	919	908	no criteria
pH of Water	pH units	7.96	7.7	7.6	7.6	6.5 - 9.0
Radiochemicals						
Uranium, *total*	ug/L	0.8	<0.0005	0.0006		20

Legend	
MAC - Maximum Acceptable Concentration	Exceeded Sask or Federal AO
AO - Aesthetic Objective	Exceeded Sask or Federal MAC
< Not detected at the concentration stated	

Correlation Coefficient (r)	Description (Rough Guideline)
+1.0	Perfect positive + association
+0.8 to 1.0	Very strong + association
+0.6 to 0.8	Strong + association
+0.4 to 0.6	Moderate + association
+0.2 to 0.4	Weak + association
0.0 to +0.2	Very weak + or no association
0.0 to -0.2	Very weak - or no association
-0.2 to – 0.4	Weak - association
-0.4 to -0.6	Moderate - association
-0.6 to -0.8	Strong - association
-0.8 to -1.0	Very strong - association
-1.0	Perfect negative association