System Assessment Report & Pre-Design Study:

Inverness Wastewater Treatment Facility and Conveyance System

Municipal Council Update:
January 21st, 2021

CANADA'S MUSICAL coast

Inverness County

Water & Wastewater Assessment

In 2019, Dillon Consulting completed an assessment of existing water and wastewater infrastructure within the Municipality.

Project goal:

- Overview of Water & Wastewater infrastructure
- Identify potential capital investments over the next 10 years

Project Focus:

- Linear Infrastructure - Piping
- Complex Infrastructure
  - Treatment plants
  - Water storage tanks
  - Lift stations

Water & Wastewater Assessment - Executive Summary

Executive Summary

- The Municipality currently owns an estimated **$186 Million** of Water and Wastewater Assets.
- Based on the condition, age and performance of water and wastewater assets the estimated 10-year investment cost to renew and repair the condition of the assets is **$103,100,000.00.**
- Of the $103,100,000.00 approximately 37% for linear infrastructure and 63% for complex.
- This is significantly higher than the national average.
- Failures could lead to potential risks to public health, environmental damages, inability to operate within compliance with regulatory approvals, fines and significant disruptions to the communities served.

Capital Investment by Community

Community	Estimated Asset Replacement Value	Estimated 10 year Investment Cost	% of Total 10 Year Estimated Investment
Cheticamp	$19.8 M	$16.0 M	15.5%
Inverness	$48.5 M	$42.6 M	41.3%
Judique	$12.0 M	$4.1 M	4.0%
Mabou	$28.0 M	$6.0 M	5.8%
Port Hood	$30.4 M	$16.4 M	15.9%
Whycocomagh	$28.0 M	$7.7 M	7.5%
Port Hastings	$19.2 M	$10.3 M	10.0%
Total	$185.9 M	$103.1 M	100%

Inverness Wastewater Treatment Plant

The Inverness Wastewater Treatment Plant (WWTP) provides treatment to wastewater to the community of Inverness. The WWTP is a lagoon based, extended aeration facility, located at 58 Lower Railway Street. The WWTP service area includes approximately 1500 connections in the community of Inverness including the hospital. It operates under an NSE Approval and has an average rated capacity of 946 m^3/d. The WWTP was originally constructed as a two-cell lagoon system in 1973. In 1996, the lagoon system was upgraded to an extended aeration system. The upgrade included the addition of aeration and secondary clarification, UV disinfection, and aerobic sludge digester/storage to the existing system. The upgrade used one of the two existing lagoon cells while the second one was decommissioned. The effluent flow is discharged through an outfall into the Northumberland Strait, offshore of Inverness beach. The outfall spans approximately 90m from the WWTP to the onshore manhole. The Average Daily Flow based on flow data is 880 m^3/d which is 93% of the rated capacity of 946 m^3/d.

Recently Completed WWTP Upgrades

- Aeration lines have been cleaned, repaired and weighted down.
- Two mechanical aerators have been added to the aeration pond.
- A flow totalizer has been installed.
- UV system (bulbs replaced, UVI transmitter replaced).
- Digester aeration lines have been repaired.
- Weirs at clarifier have been repaired.
- Waste pumps have been repaired and timers have been installed.
- Clarifier, digester and aeration basin: sludge has been cleaned out.
- Sewage Discharge By-Law was approved by Municipal Council for source control measures.

System Assessment Report

The Municipality through an open invitation process selected R.V. Anderson Associates Limited in association with Mitchelmore Engineering Company Limited (MECO) to conduct a System Assessment Report and Pre-Design Study of the WWTP and Conveyance System.

Purpose:

- To increase Municipal capacity to handle and treat current and projected future flows while addressing the lack of aeration, odour and noise control issues, and meeting current and projected future effluent criteria under the Nova Scotia Environment (NSE) Approval to Operate and the Federal Wastewater Systems Effluent Regulations (WSER).

System Assessment Report

Objectives

Objectives:

- Review development potential and determine long-term growth projections to the year 2045.
- Establish design flows, loadings and effluent parameters.
- Identify system deficiencies relative to regulatory guidelines and develop design solutions for the conveyance system and the wastewater treatment plant, to serve a growing population while meeting effluent discharge objectives.
- Determine upgrade/expansion criteria with respect to future flows, effluent criteria, and seasonal loading variations.
- Provide different conceptual design alternatives, including upgrading the existing plant and proposing a new wastewater treatment plant.
- Estimate the capital, O&M and life cycle costs for each of provided alternatives.
- Develop the re-use, decommissioning, and removals plan for each of the alternatives.
- Evaluate each alternative's benefits and drawbacks based on capital and operational cost, easiness of operation, meeting the effluent characteristic requirements, and flexibility for handling the influent loading fluctuations.
- Recommend the preferred alternative based on the evaluation comparison.

Evidence Based Decision Making: Community of Inverness

- Growth Management Strategy
- Flushing & CCTV Program
- Outfall Inspection
- Climate Risk Assessment
- Archaeological Assessment
- Environmental Assessment
- Geotechnical Investigation
- Flow Monitoring Program
- Biosolids Management Plan

Project Deliverables & Status

Status:

On-going

Project Administration & Management

- Project Management Plan, including a Risk Management Plan and Communications Plan.
- Bi-monthly project status updates regarding scope, scheduling, and budgetary review.
- Monitoring and updating risk register as required.
- Project documentation management.

Project Deliverables & Status

Status:

Completed

Assessments & Authorizations

- Background information review: identify system deficiencies and needs, and enhancement opportunities.
- Topographic survey review.
- Geotechnical and hydrogeological desktop investigation.
- Confirm locations of subsurface of utilities onsite through documentation review.
- Stage 1 Archaeological Impact and Cultural Heritage Assessment.
- Phase 1 Environmental Site Assessment (ESA).
- Active Transportation Review.
- Agency meetings to verify the permit and approvals requirements.
- Confirm regulatory approvals for replacement of WWTP including EQOs and EDOs and establish effluent sampling requirements.
- Environmental Risk Assessment (ERA).
- Climate Risk Analysis.
- Prepare summary of background studies and assessments.
- Technical Memorandum No.1: Compilation of background studies and assessments.

Project Deliverables & Status

Status:

Completed

Optimization

- Meet with County stakeholders to identify conveyance system deficiencies, bottlenecks, and operational constraints.
- Prepare plan for field investigation of lift station and selected manholes within conveyance system.
- Prepare plan for an in-field flow monitoring program within conveyance system. The priority will be to determine flows into the WWTP. Capacity assessment of conveyance system for current and future flows incorporating potable water metering records to estimate I&I.
- Identify areas for upgrades/replacements/further investigation requirements by CCTV.
- Prepare draft Asset Condition Assessment Report and summary of findings and recommendations.
- Technical Memorandum No.2: Asset Condition Assessment Report for the conveyance system infrastructure.

Project Deliverables & Status

Status:

Completed

Develop Design Parameters

- Determine long-term growth projections and catchment boundaries, and review development potential.
- Establish wastewater design flows, influent loading, and effluent discharge objectives.
- Evaluate the wastewater design flows and effluent parameters with and without onsite sludge management.
- Establish criteria for future expandability of WWTP considering seasonality of flows.
- Prepare draft Design Parameters and Scoping Report and summary of findings and recommendations.
- Technical Memorandum No.3: Design Parameters and Scoping Report.

Project Deliverables & Status

Status:

On-going

Option Evaluation, Conceptual Design

- Develop and evaluate conceptual alternatives for conveyance system configurations.
- Establish requirements for levels of treatment and compliance.
- Determine capacity of existing outfall.
- Develop WWTP re-use, decommissioning, and removals plan.
- Develop conceptual treatment options for various sludge management scenarios.
- Develop capital, O&M, lifecycle cost comparison of options.
- Determine technical, environmental, and socioeconomic benefits and/or drawbacks of each approach.
- Develop recommendations of preferred options and select systems.
- Technical Memorandum No.4: Conceptual Design Report

Project Deliverables & Status

Status:

Pending

Preliminary Design of a Preferred System

- Complete preliminary calculations including loading rates, sizing, and removal rates.
- Complete preliminary process design and drawings, with hydraulic grade line (HGL), profiles, process flow diagrams, and an equipment list.
- Preliminary Building Mechanical and Odour Control Design and Modelling.
- Complete preliminary site layout and stormwater management.
- Complete preliminary structural and architectural design and drawings.
- Complete preliminary electrical design and drawings, specifically single line diagrams and service connection review.
- Complete preliminary instrumentation and controls design and drawings.
- Draft Preliminary Design Report.
- Meet with Municipal staff and Council to present and review the Preliminary Design Report.
- Finalize the Preliminary Design Report.

Existing Conditions: Wastewater Conveyance System

The Community of Inverness is served by a conventional sanitary sewer piping system which drains by gravity, pump stations and force-mains, to a wastewater treatment plant.

Most of the system was constructed in the early 1970s, however some sections of pipe have remained in the ground since the 1940s, along sections of Central Avenue and James Street. Gravity sewer pipes range in size from 200mm diameter to 450mm diameter and consist of asbestos cement, concrete and PVC materials.

Pipes are situated within the street rights-of-way and connected via concrete and/or brick manhole structures.

Land use served by the sewers generally consist of residential dwellings with light commercial along Central Avenue. Since 2011, golf course development situated north of Central Avenue has seen construction of new condominiums and newer commercial buildings which are also served by the main gravity system. Two private lift stations exist at Cabot Cliffs and MacLeod's Beach Village that connect to the main sewers.

The majority of the collection system was installed in the early 1970s.

No activity on pipe installation occurred over the next 30 years, until 2003, when PVC pipe was installed near Old Deepdale Road.

The most recent work was the installation of an extension to the system which occurred in 2017 to service the Maple Street Extension residential area.


Legend
Facilities
WW Pumping Station
Water Treatment Plant
Sewer Install Year
1930
1974
2003
2010
2012
2017
0
250
500
750
1000 m
Highway 19

Current Wastewater Conveyance System Conditions

- The existing conveyance system is rated as fair to poor in accordance with Nova Scotia Department of Municipal Affairs guidelines and standards.
- The main trunk system along Central Avenue and Lower Railway street is approximately 47 years in age, consists of asbestos cement pipe, brick and concrete manholes and has abrupt hydraulic conditions in many manholes.
- Some piping sections exhibit longitudinal and circumferential cracking, lateral protrusions, pipe material transitions and inline obstructions due to significant debris build-up and deposition of material.
- The recent CCTV inspection identifies types and location of cracks, protrusions and other deficiencies at selected locations of the sanitary collection system.
- The preliminary hydraulic assessment model for the system indicates that a portion of the Central Avenue sewer is operating at near capacity under dry weather flow conditions, thus posing a risk to the municipality if not corrected, considering the community is in a rapid growth pattern.
- Inflow and Infiltration is known to occur in the system and can reach in excess of four times the average dry weather rate.

Existing Conditions - Manholes

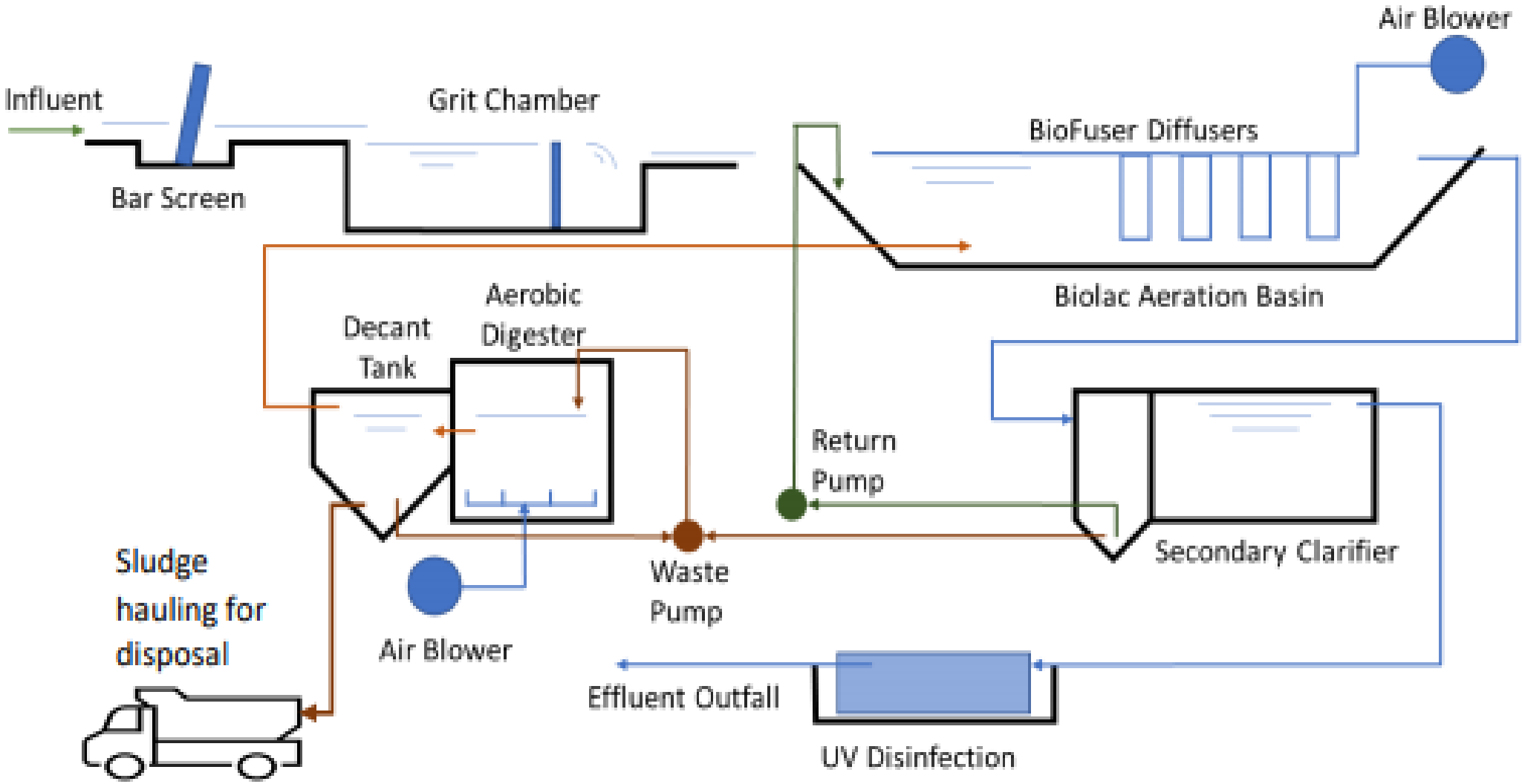
Manholes

Sanitary manholes are located within asphalt areas, gravel shoulders and grassed areas.

- Manhole covers and grade rings are situated within depressed asphalt areas that collect surface ponding resulting in unwanted inflow.
- Grade rings at some manholes are mis-aligned and exhibiting signs of inflow.
- Some manhole section joints exhibit signs of infiltration.
- Manhole benching is uneven and rough in some manholes.
- Pipe connections at some manholes protrude into manholes and cause poor hydraulic flow conditions.
- Some older manholes are of brick construction and exhibit poor structural condition and signs of infiltration.
- Roof drains and basement drains are connected to the sanitary sewer system and contribute inflow.

Wastewater Conveyance System - Upgrades

- Options are being identified to undertake necessary Conveyance System Upgrades. All options identified will aim to provide future development conveyance capacity, long term operations with minimal maintenance and a significant useful life beyond 2045.
- Sanitary force-main systems are identified as being under 25 years in age and do not require recapitalization at this time.
- It is necessary that pump station #1 be fitted with new guide bars, a new second pump, new floats/level sensors, safety grating, and new dual stainless lockable hatch and an electrical connection for portable backup power connection.
- Planned replacement of the conveyance system along Central Avenue will significantly, increase conveyance capacity, and reduce inflow and infiltration, thereby reducing WWTP flows and increasing system capacity in response to wet weather conditions.


Air Blower
Influent
Grit Chamber
BioFuser Diffusers
Bar Screen
Biolac Aeration Basin
Aerobic
Digester
Decant
Tank
Return
Pump
Secondary Clarifier
Sludge
hauling for
disposal
Waste
Pump
Air Blower
Effluent Outfall
UV Disinfection

Existing Conditions - WWTP

Site & General Conditions

Assessment Summary

- The current operation has noise and odour issues which are critical due to proximity of the golf course and beach.
- There is no automation, control, or SCADA at the WWTP with the entire operation run manually. Lack of automation and process contributes to the current poor treatment efficiency.
- The lack of automation and generally poor condition of the equipment and buildings make the current operation onerous and a H&S concern for the operating staff. The absence of washroom facilities for the operating staff further adds to this concern.
- The WWTP has approached its designed capacity, with most mechanical equipment having reached the end of their useful lives.
- In addition, high I&I in the conveyance system and loadings from the golf season stress the plant operation. These factors lead to recurring non-compliance with the current effluent criteria, which is an environmental, social, and regulatory concern.
- There is no back-up power available for power outages.
- The current outsourcing of sludge management is a costly practice, with a significant potential for cost reduction.
- Lack of strict enforcement of sewer use by-law subjects the plant to shock and inhibitory loads which can cause process upsets and non-compliance at the WWTP. These can be avoided by a strong and strictly enforced sewer-use by-law.

Existing Conditions - WWTP

Site & General Conditions

Opportunities

- The large site area provides an opportunity for expansion and upgrades of the WWTP.
- The current treatment capacity and efficiency of the plant can be significantly improved to meet the compliance standards via cost effective optimization measures like improved aeration and mixing in the lagoon, operation in sludge-recycling mode and technology retrofits.
- Improved aeration and mixing, and sludge recycling would also potentially mitigate the occasional odour issues currently experienced by the plant. In addition, the expected higher quality of secondary effluent with these measures would likely contribute to an improved UV disinfection efficiency.
- A gen-set for power back-up for the critical process components of a WWTP is a norm under the current best practices and guidelines and therefore should be considered for the Inverness WWTP in the imminent upgrades.
- There is a significant potential to reduce the current operational cost of the plant via optimization of liquid and sludge handling processes.

Existing Conditions - WWTP

Preliminary Treatment

Assessment Summary

The mechanical screen has poor operational efficiency and frequent mechanical failures due to age and poor design, which causes frequent overflows and by-passes of unscreened/poorly screened sewage through to the downstream processes. This is not only an operational nuisance and risk, but also adds avoidable maintenance requirements to the downstream processes and equipment. The small enclosure for the mechanical screen poses an operational and maintenance constraint contributing to the poor efficiency.

- The screens are potentially undersized for the current high wet weather flows.
- The manual cleaning and screening handling due to these reasons is a health risk for the operators.
- Grit facility has no moving equipment and is in reasonably good condition. However, lack of automated grit removal requires manual removal which is a H&S issue.

Opportunities

Grit facility with no moving equipment is in a reasonably good condition and can be retained for future operation.

Existing Conditions - WWTP

Secondary Treatment (Aerated Lagoon & Secondary Clarifier)

Assessment Summary

- The aerated lagoon and the secondary clarifier tankages are in a reasonably good condition and are potentially usable assets that can be retained for current and future treatment needs with some maintenance upgrades.
- The capacity and treatment efficiency of the secondary system is limited by the current mode of operation with no sludge recycling and the lack of aeration capacity. In addition, lack of automation and process contributes to the current poor treatment efficiency.
- The aeration piping and diffusers are old and potentially undersized for the current maximum month loads during summer. In addition, the return sludge pumps have reached the end of their useful life and need replacement along with the associated piping.

Opportunities

- The current treatment capacity and efficiency of the secondary system can be significantly improved to meet the compliance standards via cost-effective optimization measures like improved aeration and mixing in the lagoon, and operation in sludge-recycling mode.
- The recent addition of mechanical aerators in the lagoon to supplement aeration capacity has improved the treatment efficiency of the secondary system via improved mixing and air supply especially during high loads in summer.
- In addition, these measures would also potentially mitigate the occasional odour issues currently experienced at the plant.
- Blowers and blower panel were replaced in 2014 and therefore assets with up to 20 years of usable lifespan.

Existing Conditions - WWTP

UV Disinfection

Assessment Summary

- The system has a poor disinfection efficiency leading to recurring exceedances of the disinfection criterion over the last 2-3 years.
- The poor efficiency is due to the fact it is an outdoor facility. Absence of an enclosure/building for the UV system makes its maintenance very difficult in the winter due to freezing and windy conditions, leading to frequent exceedance of disinfection limits during these months.
- Secondary effluent scum and poor quality in general are also potential contributors to poor efficiency of the UV system.
- While the recent improvements in the secondary treatment operation and the resulting improved quality of the secondary effluent would potentially mitigate these issues to some degree, an enclosure to facilitate proper operation and maintenance in winter is required to fully address the issues.

Opportunities

- Provision of an enclosure for the UV system would allow its proper maintenance in winter. This would not only help maintain consistent compliance with the disinfection criteria but also add to the life of the UV system.

Existing Conditions - WWTP

Sludge Digestion & Storage

Assessment Summary

- The sludge digestion and storage system tankage are in a reasonably good condition and are potentially usable assets that can be retained for current and future treatment needs with some maintenance upgrades.
- The digester system equipment including blowers, aeration piping, and diffusers, are old and potentially undersized for the current maximum month loads during summer.
- The waste sludge pumps have potentially reached the end of their useful life and would need replacement in the near future.

Opportunities

- Improved aeration and mixing in the aerated lagoon and operation of the secondary system in recycling mode would allow it to be run at much higher SRT than currently achievable and thereby achieve partial digestion within the secondary system without over reliance on the digester system.
- This would not only improve the digested sludge quality (potential Class B) but also reduce the hauled sludge volume via improved volatile sludge destruction.

Next Steps

Municipal staff and engineering consultants will be meeting with Nova Scotia Environment to ensure design parameters are within regulatory compliance. This will enable and inform the evaluation of upgrade and replacement options for both the WWTP and conveyance system.

A preferred replacement or upgrade options will then be recommended and chosen based upon the following criteria:

- Capital Cost - overall project cost to implement the technology.
- Operational complexity - level of expertise required to operate the technology, including process knowledge, specialized skills, and training.
- Maintenance requirements -frequency, complexity, and level of effort required for maintenance.
- Technology risk - number of installations, track record and proprietary nature requiring specialized after sales services.
- Operational robustness - ability to handle hydraulic and organic loading fluctuations.
- Modularity of design - ability to add capacity in small increments.

Final presentation will be made to Council by Consultants and Staff.

Municipal Council and Staff will plan accordingly to advance the Detailed Design of the preferred options.

Municipal Council and staff will prioritize planned work and continue to find funding to offset the capital cost of the planned work.