ABBOTSFORD-MISSION **JOINT WASTEWATER**

Master Plan Summary | May 2018

DISTRICT OF Mission ON THE FRASER

ABBOTSFORD

Abbotsford Mission Water & Sewer Services

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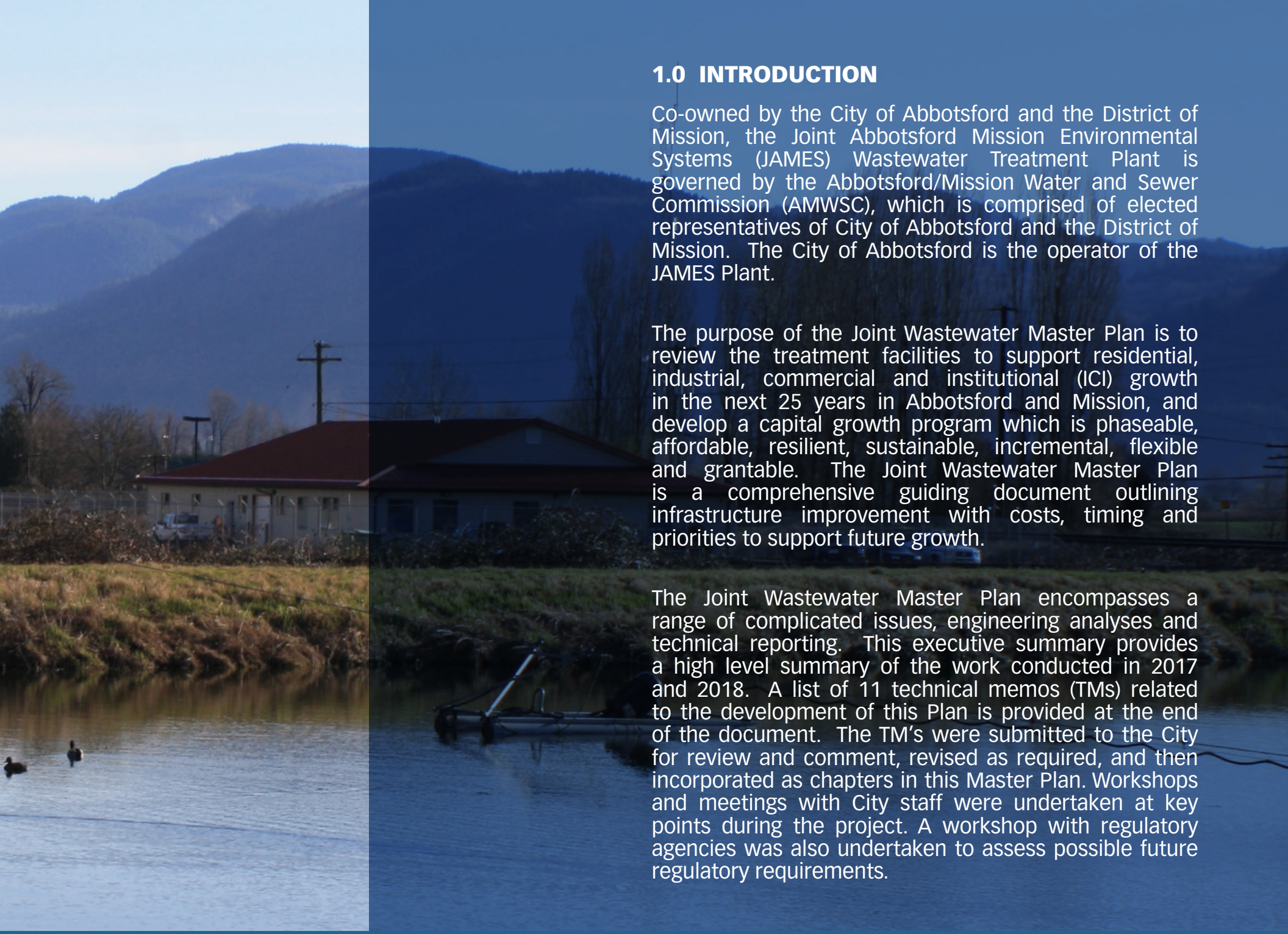


1.0 INTRODUCTION

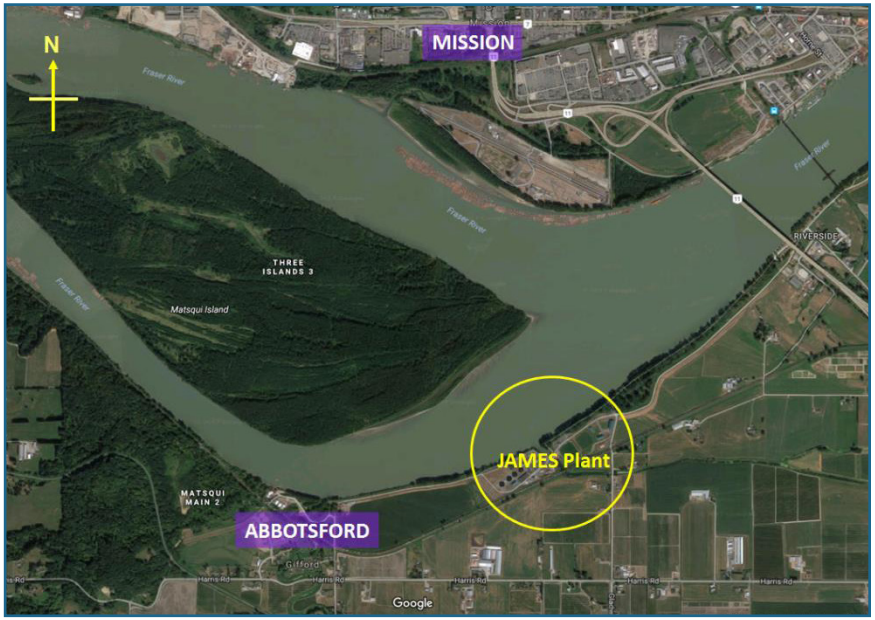
Co-owned by the City of Abbotsford and the District of Mission, the Joint Abbotsford Mission Environmental Systems (JAMES) Wastewater Treatment Plant is governed by the Abbotsford/Mission Water and Sewer Commission (AMWSC), which is comprised of elected representatives of City of Abbotsford and the District of Mission. The City of Abbotsford is the operator of the JAMES Plant.

The purpose of the Joint Wastewater Master Plan is to review the treatment facilities to support residential, industrial, commercial and institutional (ICI) growth in the next 25 years in Abbotsford and Mission, and develop a capital growth program which is phaseable, affordable, resilient, sustainable, incremental, flexible and grantable. The Joint Wastewater Master Plan is a comprehensive guiding document outlining infrastructure improvement with costs, timing and priorities to support future growth.

The Joint Wastewater Master Plan encompasses a range of complicated issues, engineering analyses and technical reporting. This executive summary provides a high level summary of the work conducted in 2017 and 2018. A list of 11 technical memos (TMs) related to the development of this Plan is provided at the end of the document. The TM's were submitted to the City for review and comment, revised as required, and then incorporated as chapters in this Master Plan. Workshops and meetings with City staff were undertaken at key points during the project. A workshop with regulatory agencies was also undertaken to assess possible future regulatory requirements.

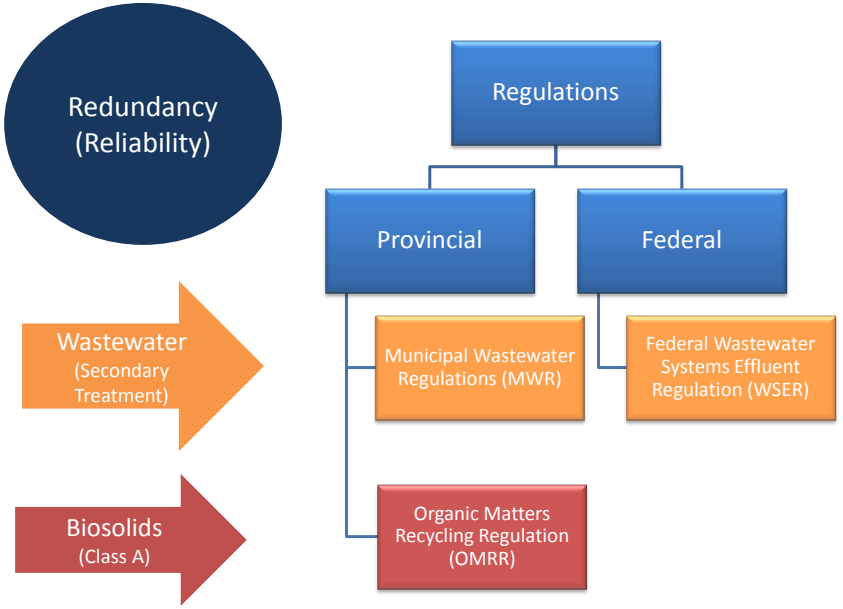
1.1 OVERVIEW

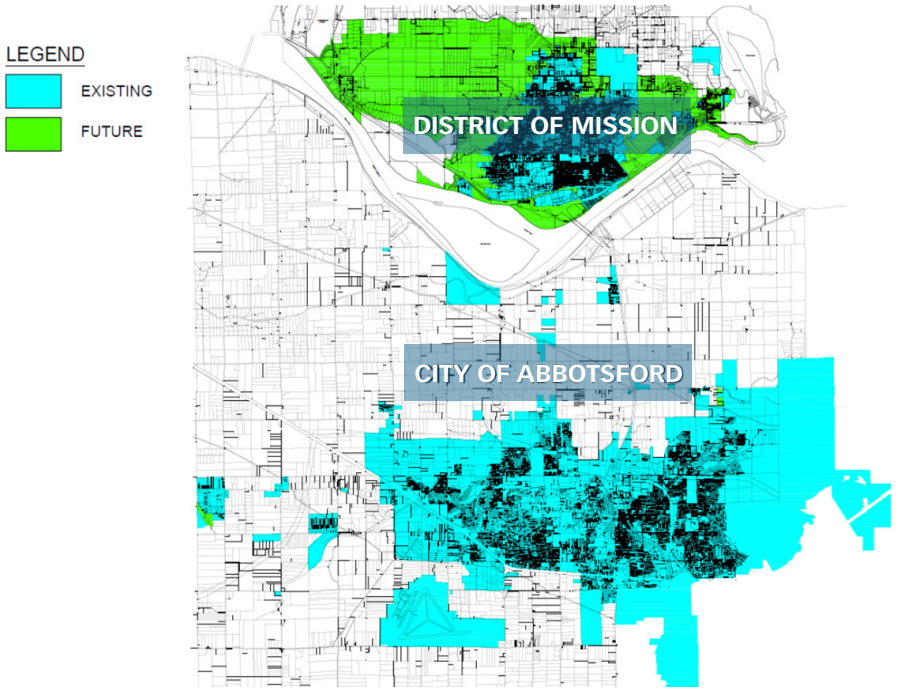
Located south of the Fraser River, the original Joint Abbotsford Mission Environmental System Wastewater Treatment Plant (JAMES Plant) was constructed in between 1980 and 1981, and commissioned in November 1981. The plant has undergone several expansions since commissioning, with Stage VII completed in 2014 being the most recent major expansion



The liquid treatment processes include screening, aerated grit removal, primary sedimentation, trickling filter/solids contact (TF/SC) process, secondary clarification, chlorination/dechlorination. The solids treatment consists of pre-pasteurization, anaerobic mesophilic digestion, centrifuge dewatering. The treated effluent is discharged into a high current area of the Fraser River. Class A biosolids are produced as a result of the pre-pasteurization and digestion process.

The JAMES Plant provides secondary treatment services to its contributory area including Abbotsford, Mission, and Sumas, Washington (USA). The effluent and biosolids meet and exceed both the Provincial and Federal Regulations.





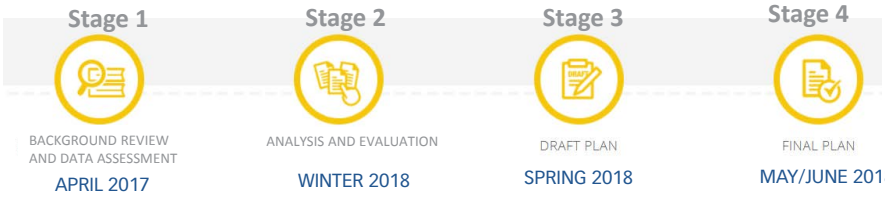

Regional Sewer
Regional infrastructure by the numbers
53,400m³/d average annual flow
7mg/L Effluent BOD
8mg/L Effluent TSS
5,400 wet tonnes of biosolids

1.2 PROCESS

A comprehensive Wastewater Master Plan was completed in 1977 to provide a planning tool for the upgrades and has gone through several updates due to projected population growth and land use criteria changes within the JAMES service area. The last update of the Wastewater Master Plan was completed in 2010. The current update to the Wastewater Master Plan outlines capital improvements to 2041.

Over the project period of the 2017 Joint Wastewater Master Plan, work was represented in four stages as follows:

- Stage 1 - Background Review and Data Assessment
- Stage 2 - Analysis and Evaluation
- Stage 3 - Draft Plan
- Stage 4 - Final Plan



Stage 1 included a review of the system and its current state, summarized the guiding principles and assumptions, and provided a highlight of six key issues and opportunities for further review in later stages (Refer to Section 2.0 for details).

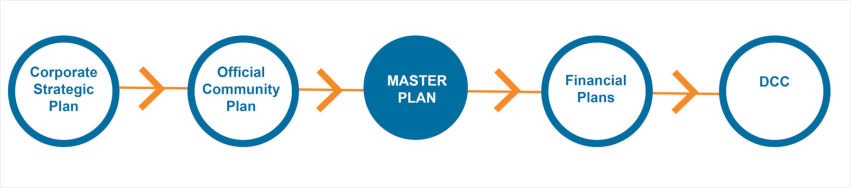
Stage 2 focused on exploring and analyzing options for how our utilities services and infrastructure will grow to meet the needs of a growing population.

Stage 3 focused on preparing a draft of the Master Plan with findings from the previous stages and feedback received.

Stage 4 focused on refining the Master Plan for AMWSC's consideration and adoption.

LOOKING AHEAD

The Council Strategic Plan of each community informed the development of its Official Community Plan (OCP), which provided a vision and framework for growth. This update of the Joint Wastewater Master Plan will ensure our future operations, development, infrastructure, services, amenities and programs align with the vision set out in the OCPs. The Plan will support the needs of preparing future financial plans and updating of the Development Cost Charge (DCC) programs, and will provide adoptable management policies and criteria to assist in management of future development and enhance our environment.



2.0 PROJECTED POPULATION, FLOW & LOAD

The JAMES Plant currently services the City of Abbotsford, District of Mission, and the City of Sumas, Washington (USA). The communities of Aldergrove and Gloucester previously discharged to the JAMES Plant but were disconnected in 2011. The current service equivalent population in the master plan was 254,000.

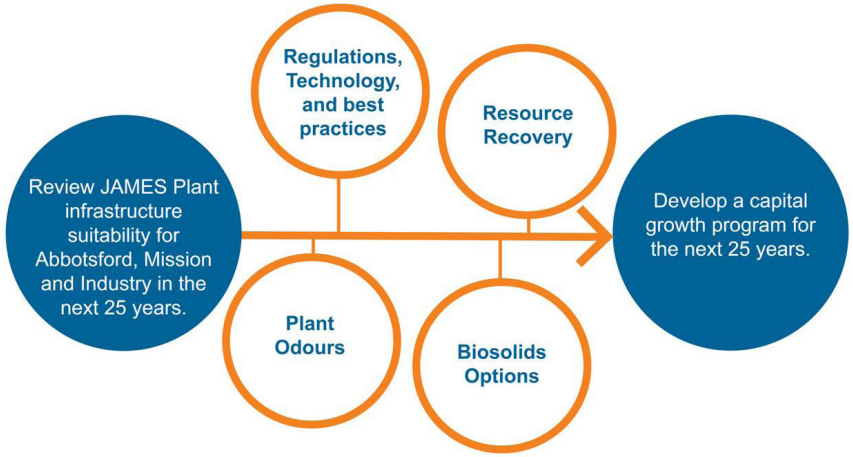
Projected residential service populations and corresponding equivalent populations for industries-monitored (IM) and industrial, commercial, institutional (ICI) non-monitored customers are summarized in Table E-1, below for the JAMES Plant 25-year horizon from 2016 to 2041. Projected equivalent populations are based on an annual growth rate of 1.7%.

	Projection
	2041
Abbotsford (including Sumas)	
Residential Population	199,700
ICI Population (Flow based)	82,300
SUBTOTAL	282,000
Mission	
Residential Population	35,800
ICI Population (Flow based)	7,300
SUBTOTAL	43,100
Total	
Residential Population	235,500
ICI Population (Flow based)	89,600
Industries-Monitored Population Equivalent (Flow based)	60, 600
TOTAL	**385,600**

Table E-1: JAMES Plant Projected Service Populations

Total influent flow to the plant has been relatively consistent based on data from 2009 to 2016, with an average annual flow of approximately 55,100 m3/d. On average, the City of Abbotsford contributes approximately 77% of the total plant flow, the District of Mission contributes approximately 22%, and the City of Sumas contributes approximately 1%.

Of the customer classes discharging to the JAMES Plant, residential and ICI customers contribute approximately 89% of total plant flow and IM customers contribute approximately 11%.



Developing a phaseable, affordable, resilient, sustainable, incremental, flexible and grantable capital program.

In 2015, the City requested a revision to its Municipal Wastewater Regulation (MWR) registration to allow a step-wise annual increase to the current permitted maximum day discharge of 122,500 m3/d. The City is awaiting confirmation on this request. Projected average annual flows for the 25-year horizon are provided in Table E-2 below:

Year	Average Annual Flow (m^3/d)		
	Total Plant Flow	Residential &ICI	Extra Strength (or Industry Monitored, IM)
2021	57,800	51,700	6,100
2026	63,500	56,900	6,600
2031	69,100	62,000	7,100
2036	74,600	67,000	7,600
2041	80,200	72,100	8,100

Table E-2: Average Annual Flow Projections by Section (25-year Horizon)

Analysis of historic Plant organic (represented as 5-day Biochemical Oxygen Demand, or BOD5) loading data found that per capita loads range from 30 to 50 g-BOD5/capita/day, which is very low relative to typical domestic sewage. After consultations with the City, it was agreed that for the purposes of projecting future BOD5 loads, a per capita load of 40 g-BOD5/capita/day would be used. Based on this, the BOD5 load to the plant is projected to increase by approximately 50% from 2016 to 2041.

Based on BOD5 load data, IM customers contribute approximately 51% to the total plant BOD5 load. Under the assumption that all customer classes will continue to grow at the same annual rate of 1.7%, this represents a significant increase to plant loading over the next 25 years. Projected BOD5 loads to the plant are provided in Table E-3 below.

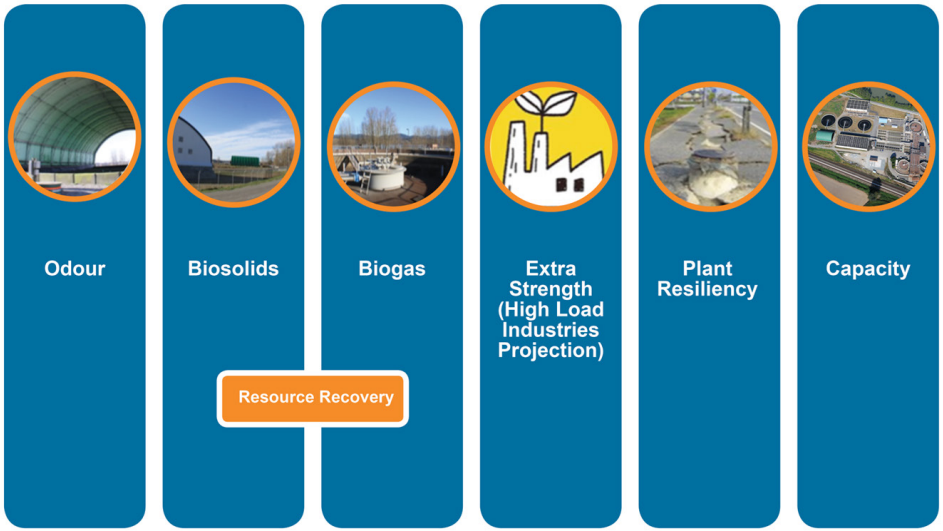
Year	Equivalent Service Population (BOD_5)	Avg. Day Plant Load (kg/d)
2021	433,000	17,300
2026	473,000	18,900
2031	514,000	20,600
2036	558,000	22,300
2041	602,000	24,100

Table E-3: Average Daily BOD_5 Load Projections to 2041

Total Suspended Solids (TSS) loading to the plant were also analysed but not found to have as significant an impact as BOD5 in terms of plant capacity in meeting regulatory discharge requirements.

3.0 ISSUES & OPPORTUNITIES

Six issues and opportunities were discussed and consulted with the AMWSC and the public throughout the development of the Master Plan.



3.1 ODOUR

The JAMES Plant is located in a primarily agricultural region. Currently, there are no regulated odour targets, however, with the goal of being unobtrusive, and acting as a good neighbor, the intent is that odours are not detectable off of Plant property. There have been minimal odour complaints in recent years, but previously odour concerns have been raised. Ongoing monitoring is recommended, and new odour control units will be constructed as the Plant expands.

3.2 BIOSOLIDS

The Plant is currently dependent on pasteurization in order to produce Class A biosolids under Provincial Organic Matters Recycling Regulation (OMRR), which are then applied to land. There is currently no redundancy in the pasteurization system; if biosolids are not pasteurized, Class B biosolids are produced.

The City is currently meeting the regulations; however, shear experienced in the centrifuge dewatering process encourages regrowth of fecal coliform. The City is doing its due diligence to mitigate this by on-site curing. The City is looking at other options for achieving Class A biosolids without dependence on the pasteurization system and requirement for additional curing time, as well as other mutually beneficial uses for biosolids.

Some options provided in this Master Plan include microwave enhanced oxidation process, thermophilic anaerobic digestion and drying of dewatered biosolids. There is currently work investigating both thermophilic digestion and a pilot project for microwave enhanced oxidation process. However, it is recommended to continue the current pasteurization and on-site curing system followed by land application.

3.3 BIOGAS

An analysis of the JAMES plant's past six years' biogas production, use, and wastage yielded averages of 6,700 m3/d (biogas generated), 3,900 m3/d (biogas used), and 3,000 m3/d (biogas unused). The approximate heating value of the biogas is 22,400 kJ/m3, which yields an average energy value for total daily produced biogas of approximately 150 GJ/d (1,700 kW). The primary heating load at the plant is for sludge heating in the pasteurization process. At an estimated annual growth rate of 1.7% over the next 25 years, the estimated sludge heating requirements in 2041 is ~610 kW in summertime, and ~750 kW in wintertime.

Of the options explored, it is recommended that the City continue with the status quo, but to seek request for interest in the sale of excess biogas or to provide district heating to nearby industrial or agricultural buildings. Grant opportunities may be available for cogeneration, which would make this option financially feasible. However, any option pursued to utilize this resource must be weighed between the plant heating needs, financial benefit and overall sustainability.

3.4 EXTRA STRENGTH HIGH LOAD PROTECTION

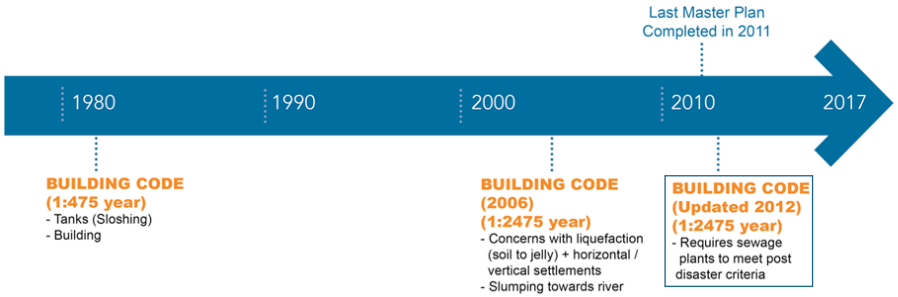
A review of current extra strength rates for BOD and TSS suggests a need to adjust the rates, which were in place since 2011. In addition, the impact of increasing extra strength industries (or industries-monitored, IM) discharge to the Plant is anticipated to accelerate the need for capital expansion of certain load-based process units. As a result, the City will be seeking consultation with IM customers to discuss options.

3.5 PLANT RESILIENCY

3.5.1 SEISMIC

The BC Building Code has been updated a few times over the last 30 years. The latest update was in 2012, which now requires treatment plants to meet post disaster criteria. As the last master plan was completed in 2011, this issue is new to this Master Plan.

In planning for future expansion, the previous Master Plan studies have adopted the approach of adding process units to the existing plant site as loading increases.



In consultation with AMWSC, a decision was made to plan for future upgrades that meet current Building Code and seismic code requirements. This necessitates a new direction from the previous Master Plan, for two reasons:

- It is not feasible to improve the existing plant infrastructure to meet current seismic and BC Building Code requirements
- Building new process units tied in to existing plant infrastructure does not satisfy the City's objective to eventually create a facility that is compliant with current seismic codes. Stage 2 - Analysis and Evaluation

In order to satisfy Building Code and seismic code requirements, ground improvements are required prior to construction of new process units. A geotechnical report provided by WSP recommended that ground improvements include a seismic dyke along the river side of the site that is approximately 30 m wide and 20 m deep, and ground densification via stone columns (plant foundation) below proposed structures to a depth of approximately 27 m and extend approximately 10 m beyond the structure footprint. Future expansion process units are proposed to be constructed on expansion lands to the west and east of the existing plant site. The west expansion area was previously farmland that was acquired by the City for the purposes of future expansion. The east expansion area is currently occupied by the equalization and storage lagoons. Cost estimates of ground improvements are included in Table K-4.

Ground Improvements		
	West site	**East site**
Seismic Dyke	$7M	$9M
Plant foundation	$58M	$50M
Subtotal	**$65M**	**$59M**

Table E-4: Cost estimates for Ground Improvements

3.5.2 FLOODPROOFING

To address climate change and sea level rise, options have been reviewed to floodproof the JAMES Plant. The existing dyke elevation is 9.4m. Options reviewed include raising the future expansion sites (west and east) to:

- Option 1: 1:500 year event (10.4m)
- Option 2: 1:1000 year event (11.2m)
- Option 3: 1:5000 year event (12.2m)

Between the three options, an additional $7M for Option 3 for each site provides the Plant added protection from the uncertainty of climate change, and benefits from a hydraulic perspective to ensure gravity discharge to the river. With these benefits, Option 3 is recommended to provide the greatest protection to an approximately $300M investment. Cost estimates are included in Table E-5.

Floodproofing		
	West site	**East site**
Raising to 12.2m	$23M	$24M

Table E-5: Cost estimates for floodproofing

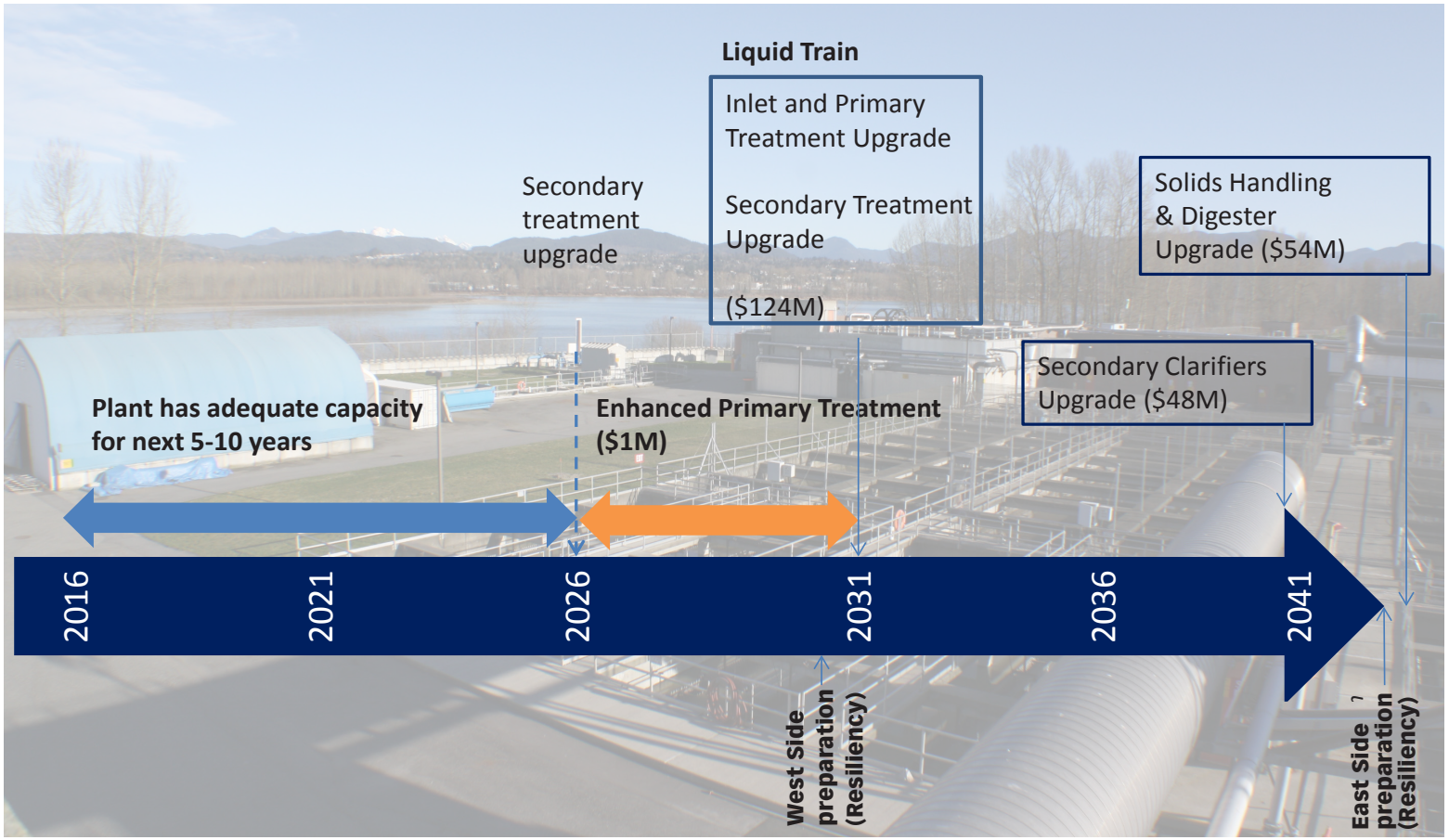
3.6 PLANT CAPACITY

The Plant is projected to have adequate capacity over the next 5-10 years. The existing trickling filters (secondary treatment) are the first process units that require capacity expansion as sewage loads increase.

As it is impractical to construct only addition secondary treatment tanks on the new site and tie-in to the existing facility, an entire new liquid train is proposed for the west expansion area and will include a new influent pump station, headworks, primary sedimentation tanks, bioreactors (secondary treatment), and a new service building.

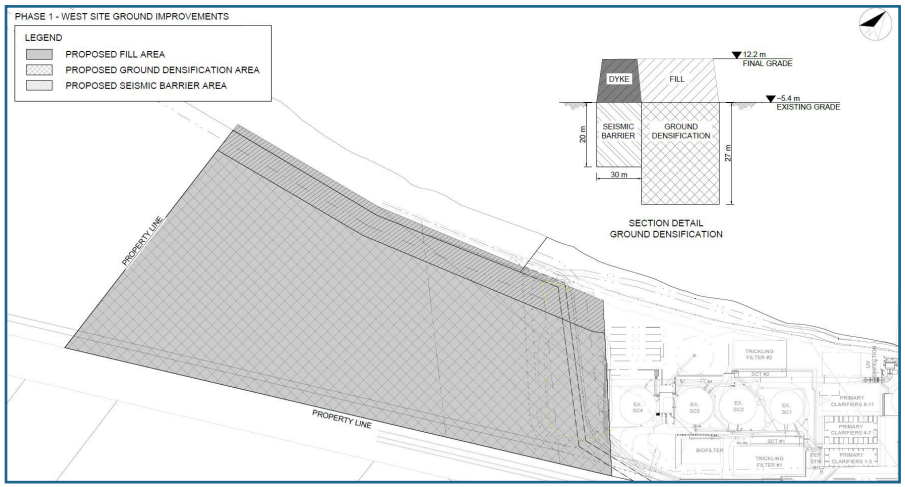
The Master Plan envisions the addition of enhanced primary treatment starting in approximately 2026 to reduce loading on the secondary treatment process, and thus delay the need to construct the new liquid treatment works until around 2031.

Expansion of the solids handling facilities are to follow, after ground improvements have been completed on the east expansion

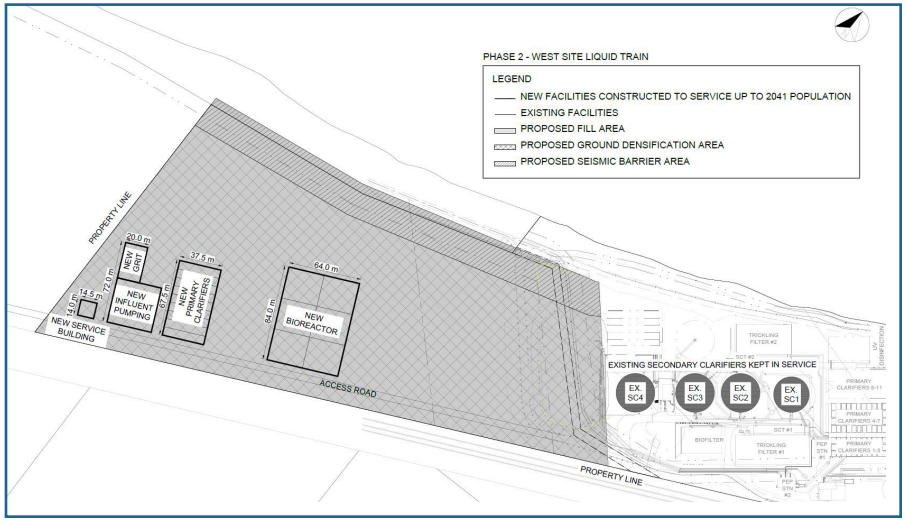


A high-level 6-phase future upgrade plan is proposed as follows. Phases 1, 2 and 3 are within the 25 year horizon, and Phases 4, 5 and 6 are post 2041.

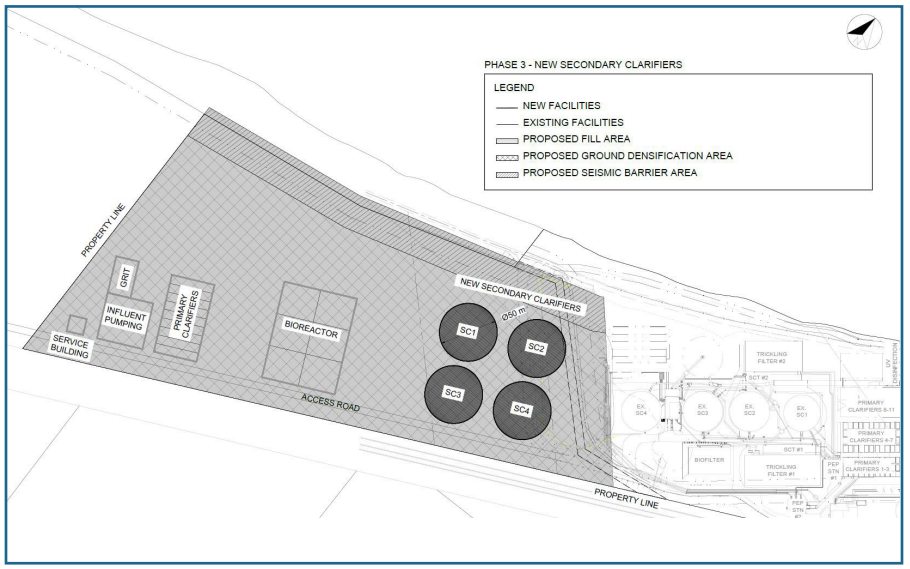
Phase 1: West Site – Ground Improvements (2030)



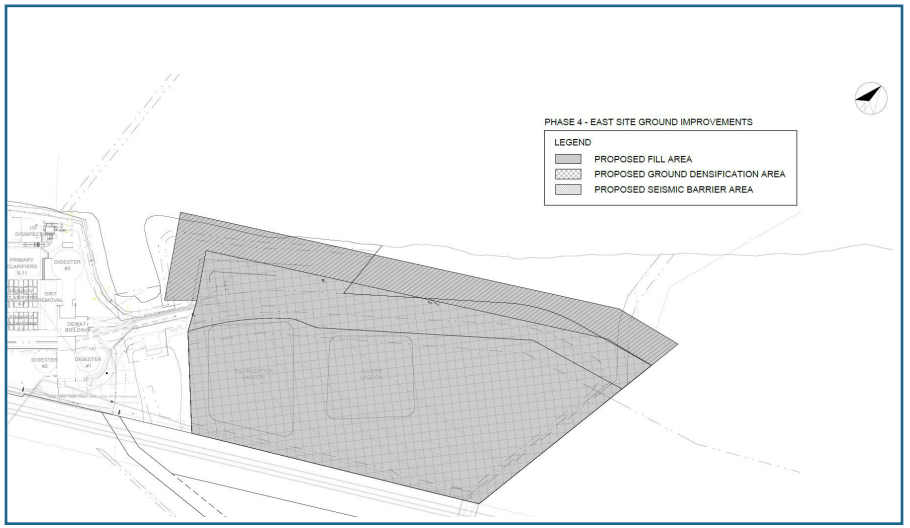
Phase 2: West Site – Liquid Train (2031)



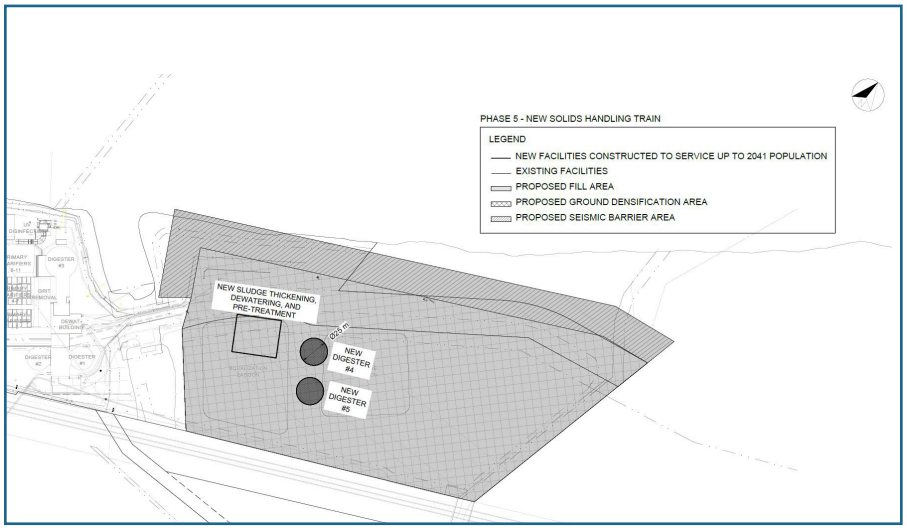
Phase 3: West Site – Secondary Clarifiers (2041)



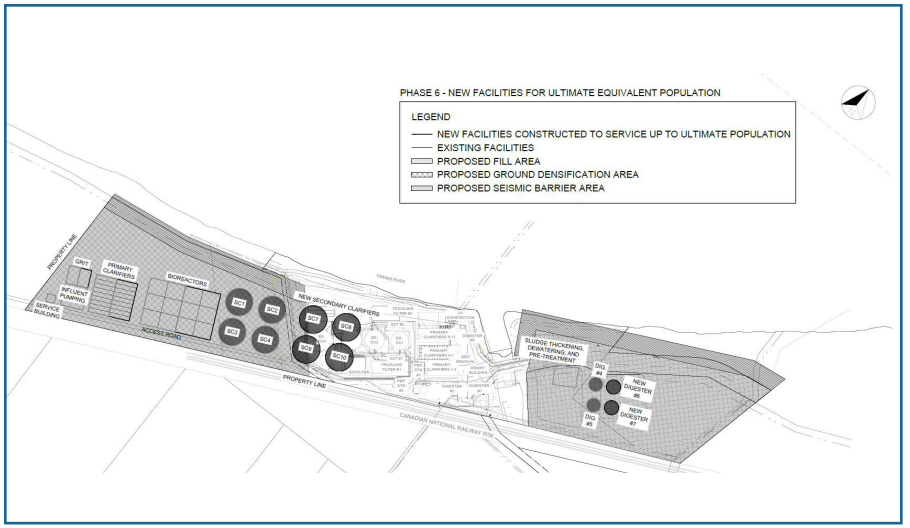
Phase 4: East Site – Ground Improvements (Post-2041)



Phase 5: East Site – Solids Train (Post 2041)



Phase 6: Ultimate Build-out (Post 2041)



4.0 PROPOSED CAPITAL EXPENDITURES

A summary of the preliminary capital upgrade cost estimates is provided in Table E-6 in 2018 dollars.

TO 2041		
2026	Enhanced Primary Treatment	$1M
Phase 1 (2030)	West Ground Improvement	$88 M
Phase 2 (2031)	New Liquid Train	$124 M
Phase 3 (2041)	New Secondary Clarifiers	$48 M

POST 2041		
Phase 4	East Ground Improvement	$83 M
Phase 5	Solids Handling Upgrades	$54 M

Table E-6: Preliminary Capital upgrade costs to 2041 and post 2041.

The proposed capital expenditure up to 2041 is estimated at approximately $260M.

Figure E-1 illustrates a projected timeline of cash flow for the future plant upgrades as described in the above sections, for high-level planning purposes. More detailed cash flow estimates should be evaluated prior to start of future expansion projects.

The current budget of capital projects up to 2041 is approximately $390M. With the new direction of the Master Plan, capital projects could be reduced to a total of $155 million, which comprises of primarily asset replacement/renewal type projects. Together with the proposed capital expenditure of $260M, this new Plan would envision a capital expenditure of approximately $415M over the next 25 years.

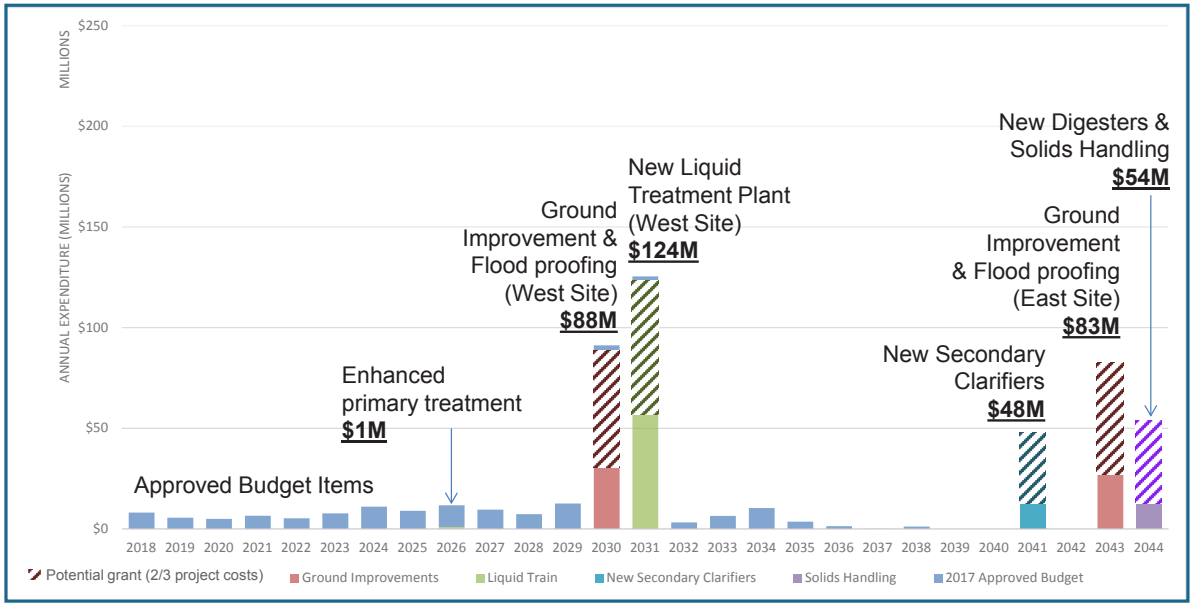


Figure E-1: Projected Capital Expenditure Timeline

5.0 MASTER PLAN HIGHLIGHTS

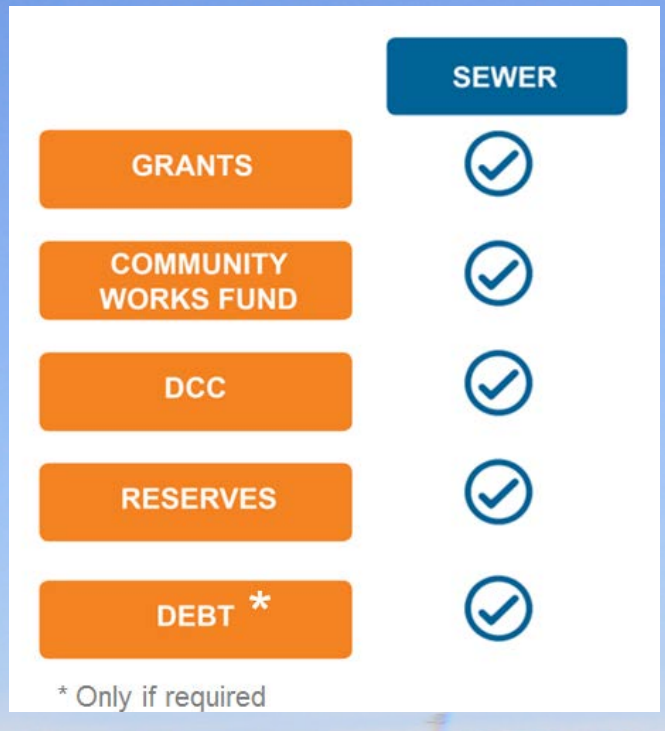
1. **Long term financial plan:**
   - New plant on stable ground towards the end of 15 years
   - Maximize usage on existing assets towards end of life

2. **Substantial cost increase due to Seismic and Flood proofing which are new to this Master Plan: $141 M.**

3. **Proposed capital plan (to 2041):**
   - Proposed new plant $260 M
   - Current capital plan Renewal and replacements $155 M

4. **Grants will be sought after for major projects within the Capital Program.**

5. **Future master plans (every 5 years) to review innovative technologies.**



6.0 ENGAGEMENT

The development of the Joint Wastewater Master Plan was presented in four stages. Table E-7 summarizes the meetings and public engagement at each stage, leading up to the proposed final plan in Stage 4.

In addition to the information in the table, a council workshop was undertaken for Abbotsford Council on May 25, 2017, and Mission Council in July 10, 2017.

The City of Abbotsford has initiated the Plan 200K website for all of the City's projects that they are undertaking, including the Joint Wastewater Master Plan discussed in this report. The information has been provided to Mission for updates on their website.

STAGES	UMC	JSSC/JOINT COUNCIL	PUBLIC ENGAGMENT
Introduction	April 26, 2017	May 18, 2017	
1 – Background and Data Assessment	August 30, 2017	September 14, 2017	• Farmers Market • Canada Day
2 – Analysis and Evaluation	October 26, 2017	November 9, 2017	• Abbotsford Seven Oaks Mall • Mission Leisure Centre
3 – Draft Plan	February 21, 2018	March 22, 2018	• Abbotsford Clearbrook Library • Mission Leisure Centre

Tabke E-7: Engagement for various stages of the Joint Wastewater Master Plan.

TECHNICAL MEMORANDA

The 2017 Master Plan Update was undertaken through the preparation of 11 Technical Memoranda (TM) as follows

- TM 1 – Gather Background Information
- TM 2 – Review of Historical Flow and Load Data
- TM 3 – Mass Loadings Balancing Review
- TM 4 – Prepare Flow and Load Projections for 25 Years
- TM 5 – Review Existing Plant Performance and Determine System Unit Capacity
- TM 6 – Odour Control System for Existing Facilities
- TM 7 and 7A– Evaluate Environmental Conditions and Industry Extra Strength Rate Review for Capital Component
- TM 8 – Review Solids Treatment, Handling, and Management Issues
- TM9 – Review of Cogen System and Excess Digester Gas
- TM 10 – Assess Geotechnical and Seismic Issues
- TM 11 – Assess Future Expansion of Facilities to 2041

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