**REGIONAL DISTRICT OF NORTH OKANAGAN**

# Greater Vernon Water
# 2017 Master Water Plan

Prepared by: Zee Marcolin, P.Eng. and
Stephen Banmen, MBA
Regional District of North Okanagan
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## EXECUTIVE SUMMARY

Greater Vernon Water (GVW) is a function of the Regional District of North Okanagan (RDNO) and is the public water utility that provides water services to the City of Vernon, District of Coldstream and areas of Electoral Areas "B", "C" and "D" and the Township of Spallumcheen. GVW updated their Master Water Plan in 2012 and a referendum was held in 2014 to borrow up to $70 million to complete six (6) priority projects identified in the 2012 Master Water Plan (2012 MWP). The referendum failed and the RDNO Board of Director's (BOD) created a Stakeholder Advisory Committee (SAC) to receive input from a stakeholder and community perspective as to the adequacy and completeness of the 2012 MWP.

From the fall of 2015 to spring of 2016, the SAC met monthly to complete an in-depth review of the 2012 MWP and provided a number of recommendations to the Greater Vernon Advisory Committee (GVAC) and the RDNO BOD. These recommendations were used to move forward with the master water planning process for GVW resulting in the 2017 MWP.

During the development of the 2017 MWP, a number of events occurred that also influenced the outcomes of the 2017 MWP as follows:

- GVW initiated a detailed sampling program at the Duteau Creek Water Treatment Plant (DCWTP) to support the installation of UV treatment to meet Provincial standards,
- GVW commissioned a number of studies and pilot tests,
- Progress was made with the GVW asset management and infrastructure renewal planning process which has been incorporated into the financial implementation strategy of the 2017 MWP,
- GVW received a grant from the Clean Water and Wastewater Fund in early 2017 to install UV treatment at the DCWTP and the design and construction began immediately to commission the UV treatment plant in 2018, and
- Provincial and Interior Health (IH) policies were incorporated into the 2017 MWP, which resulted in a formal letter of agreement under section 38 of the BC *Public Health Act* between IH and GVW to address the uncertainty of filtration at the DCWTP outside of the MWP,

The long term treatment and supply strategy for GVW developed for the 2017 MWP includes the following major infrastructure projects:

| Project Description | Cost (2017 $'s) | 2017 Master Water Plan Project Staging |
|---|---|---|
| Duteau Creek UV Treatment | $7.0 M | 2017 |
| Mission Hill Filtration | $33.1 M | 2023 |
| Aberdeen Dam | $7.0 M | 2026 |
| System Separation | $33.4 M | 2028, 2033, 2037 |
| Gold-Paradise Extension | $4.0 M | 2035 |
| Goose Lake Supply from Okanagan Lake | $3.3 M | 2041 |

The Financial Implementation Strategy (FIS) for the 2017 MWP incorporates the following:

- The use of reserves as a funding source for larger projects.
- The use of senior government infrastructure grants as a funding source for major projects.
- The use of Development Cost Charges (DCC) as a funding source for growth-related projects.
- Annual increases in the level of funding for asset renewal phased-in over the life for the plan, consistent with the asset management investment plan.
- The use of current revenue as a funding source, and balanced between new capital projects with renewal projects from year to year.

The time horizon of the 2017 MWP is 25 years, and the total investment in infrastructure projects is $311 million. Of that total, $186 million (or 60%) relates to asset renewal and replacement and 40% towards new capital projects identified in the preferred option.

The impact to water rates in the short term as recommended in the FIS includes a 5% rate increase phased-in over five (5) years (2018 to 2022) over and above the rate of inflation. The 5% increase can be fully attributed to the phase-in of the asset management investment plan. The necessity for even higher rate increases to fund the full phase-in of the asset management investment plan was offset by reduced debt servicing costs over the plan's time horizon and growth in the number of water users.

There is adequate financial flexibility within the financial implementation strategy to deal with and mitigate various challenges and issues that may arise in the future.

## Table of Contents

## ACRONYMS

| | |
|---|---|
| AALCI | Annual Average Life Cycle Investment |
| AAI | Average Annual Investment |
| BOD | RDNO Board of Directors |
| DAF | Dissolved air flotation |
| DBP | Disinfection by-products |
| DCC | Development Cost Charge |
| DCWTP | Duteau Creek Water Treatment Plant |
| GCDWQ | Guidelines for Canadian Drinking Water Quality |
| FIS | Financial Implementation Strategy |
| GVAC | Greater Vernon Advisory Committee |
| GVW | Greater Vernon Water |
| HAA | Haloacetic Acids |
| IH | Interior Health |
| M | Million |
| MHO | Medical Health Officer |
| MHWTP | Mission Hill Water Treatment Plant |
| MWP | Master Water Plan |
| RDNO | Regional District of North Okanagan |
| SAC | Stakeholder Advisory Committee |
| TAC | Technical Advisory Committee |
| THM | Trihalomethanes |
| TM | Technical Memorandum |
| TOC | Total Organic Carbon |
| UV | Ultraviolet irradiation |

# 1. INTRODUCTION

Greater Vernon Water (GVW) is a function of the Regional District of North Okanagan (RDNO) and is the public water utility that provides water services for the City of Vernon, District of Coldstream and areas of Electoral Areas "B", "C" and "D" and the Township of Spallumcheen. GVW was formed as a regional water system in 2003 as a result of a consolidation of three (3) large water utilities – the City of Vernon, District of Coldstream and North Okanagan Water Authority (previously operated as the Vernon Irrigation District) and a number of small private utilities.

To facilitate the formation of GVW and to guide infrastructure improvement required to meet legislative requirements for drinking water, the 2002 GVW Master Water Plan (MWP) was developed. This MWP was updated in 2004 to accommodate changes in the legislative environment and utility conditions. GVW continued to operate under the 2002/04 MWP until Interior Health (IH) issued an order for the RDNO to update the MWP on March 11, 2011.

# 2. BACKGROUND

## 2.1. Greater Vernon Water 2012 Master Water Plan

The development of the GVW 2012 MWP was initiated after the IH order and took approximately two (2) years to complete. GVW retained a team of three (3) consultants (AECOM, Associated Engineering and Kerr Wood Leidal) to guide and complete the document.

The project included:

- compiling a Technical Advisory Committee (TAC) made up of representatives of the consulting engineering firms and engineers, technologists, corporate administrative officers, finance and other representatives from the RDNO, City of Vernon, District of Coldstream and the agricultural community,
- monthly TAC meetings were scheduled from November 2011 to June 2013 that reviewed the work as it was completed and assisted in the MWP development.
- developing ten (10) Technical Memorandums (TMs) to address all the components within the work scope of the project,
- presenting the findings to the RDNO Board of Directors (BOD),
- submission to IH for acceptance, and
- final adoption of the GVW 2012 MWP by the BOD.

The 2012 MWP examined all aspects of the GVW utility and consisted of the following ten Technical Memorandums (TMs):

TM1 – Domestic and Agricultural Water Demand Forecast

TM2 – Evaluation of Water Supply Sources

TM3 – Source Storage and Supply

TM4 – Domestic Water System Analysis

TM5 – Independent Agricultural System

TM6 – Water Conservation Strategies

TM7 – Water Treatment

TM8 – Financial Issues and Principles to Support the MWP

TM9 – System Separation Option Analysis

TM10 – GVW Financial Plan

From the information provided in the first eight (8) TMs, TM9 compiled nine (9) long term supply and treatment options to guide GVW over the next 40 years. The nine (9) options examined included using each source available to GVW as a single source (Duteau Creek, Kalamalka Lake or Okanagan Lake), using a combination of two (2) sources (Duteau Creek and Kalamalka Lake) and included a variation of separation projects from no further separation, partial separation to full separation of agricultural water. A cost benefit analysis and a review of non-cost considerations was completed by the TAC members on all nine (9) options.

Option 2 was chosen as the preferred option that would bring GVW up to Provincial standards while also addressing other non-cost considerations in the most cost effective manner. Option 2 included using two (2) sources (Duteau Creek and Kalamalka Lake) to service GVW customers and completing partial separation in the Lavington area. After review by the RDNO Board of Directors (BOD), oversizing the transmission main for the agricultural water was added to the plan to allow future generations the option of completing full separation in the BX area.

### 2.2. Referendum to Finance the MWP

In 2014, the BOD endorsed a referendum process to ask the electorate to endorse borrowing $70 Million to finance the following six (6) priority projects identified within the 2012 MWP:

1. Filtration at Duteau Creek Water Treatment Plant (DCWTP) - $26.5 M
2. System Separation in Lavington Area - $19.5 M
3. Oversizing the Transmission Main for Future Separation - $3.5 M
4. Domestic Distribution Improvements - $9.8 M
5. Building a New Pump Station on Okanagan Lake for Agriculture - $2.6 M
6. Raising Aberdeen Dam - $6.4 M

On November 15, 2014, the borrowing referendum failed with 67% against and 33% in favour of borrowing for the system upgrades. As the referendum failed, the project staging and financial strategy of the 2012 MWP could not be achieved and the 2012 MWP was no longer in compliance with IH conditions on permit.

## 3. STAKEHOLDER ADVISORY COMMITTEE

During and after the referendum, there was substantial public discussion to change the direction of the preferred option from Option 2 to an option that used Okanagan Lake as the main water source and the Duteau Creek source as an agricultural source. A request was made to the BOD to complete a peer review of the MWP. After the failure of the referendum, the BOD decided at their July 22, 2015 meeting to establish a Stakeholder Advisory Committee (SAC) to complete a review of the MWP. The scope of

the SAC was to *"review the 2012 MWP and provide input from a stakeholder and community perspective which will be considered as part of the 2012 MWP review."* The SAC was made up of a variety of water users in different customer classes to ensure full representation of users (i.e. residential, industrial, commercial, institutional and agricultural). There was a total of eleven (11) SAC committee meetings held between October 1, 2015 and April 21, 2016 where each of the ten (10) Technical Memorandums (TMs) of the 2012 MWP were presented and discussed in detail. A detailed account of the SAC activities is outlined in the *2012 Master Water Plan Review Stakeholder Advisory Committee Report* (GVW, 2016).

### 3.1. SAC Recommendations

Through the review process, the SAC developed a number of recommendations to further guide the GVW MWP. All recommendations were presented to the Greater Vernon Advisory Committee (GVAC) for consideration and those recommendations requiring Board endorsement were forwarded to the BOD.

The following SAC recommendations were carried by GVAC at a Special Meeting held on June 29, 2016, that guided staff on the development of the 2017 MWP but were not forwarded to the BOD for endorsement as specific action items were not required:

I. That the SAC is satisfied that all Options contained in TM9 (subject to variations) have adequately considered all feasible options available to meet Ministry of Health standards.

II. That the following points presented by the General Manager, Finance be considered by the Greater Vernon Advisory Committee when finalizing the financial strategy of the Master Water Plan:

- Finalize the Option, then develop a financial strategy.
- Use existing reserves as a funding source in plan.
- Use grants as a funding source in plan.
- Use DCC as a funding source in plan.
- Use current revenue as a funding source – balance with renewal projects from year to year.
- Delay timing of major projects, where feasible.
- Increase annual contribution to reserves – balance with annual capital plan from year to year.

III. That the SAC is satisfied with the level of detail provided in TMs 1 through TM8 supplemented by the additional information provided to the Committee within the SAC Question Papers provided throughout the 2012 MWP SAC review.

IV. That the SAC is satisfied with the engineering analysis provided in TMs 1 through TM8 supplemented by the additional information provided to the Committee within the SAC Question Papers provided throughout the 2012 MWP SAC review.

V. That the SAC is satisfied with the cost estimates provided in TMs 1 through TM8 supplemented by the additional information provided to the Committee within the SAC Question Papers provided throughout the 2012 MWP SAC review.

VI. That the SAC put forth the following three (3) Options to the Greater Vernon Advisory Committee for consideration:

a. Option 1 - the option with the lowest financial impact to water users based on the

lowest Net Present Value (NPV) with no further separation;

b. Option 2 - the option with the highest benefit to cost ratio (NPV) with partial separation; and

c. Option 3 - the option with the highest benefit to cost ratio (NPV) that supports full separation.

VII. That the SAC select Option 2 being the option with the highest benefit to cost ratio (Net Present Value) with partial separation as their first choice moving forward with the 2012 Master Water Plan.

VIII. That the SAC select Option 1 being the option with the lowest financial impact to water users based on the lowest Net Present Value (NPV) with no further separation as their second choice moving forward with the 2012 Master Water Plan.

The following SAC recommendations were carried by GVAC at a Special Meeting held on June 29, 2016 and presented and endorsed by the BOD at their regular meeting of July 20, 2016:

IX. That the request from the Citizens for Changes to the Master Water Plan to hire an independent engineering consultant to undertake a peer review of the 2012 Master Water Plan not go forward.

X. That any option that includes the DCWTP as a potable water source will examine using UV and air scrubbing in the DCWTP Reservoir to support a Filtration Exclusion application.

XI. That the final Master Water Plan option provide for the use of two water sources and two water treatment plants.

XII. That Options 4, 6, 7, 8 and 9 be removed from the Options list based on the highest capital cost with lowest non-cost benefit ratio and not be considered in the Financial Planning Stage for the Stakeholder Advisory Committee review of the 2012 Greater Vernon Water Master Water Plan.

XIII. That the staging of the treatment plants be changed so that MHWTP filtration is constructed first, noting that a Filtration Exclusion at DCWTP may be successful.

XIV. That [regardless of the Option preferred, except Option 1] any separation should include sizing of the irrigation transmission main to allow for continued separation of domestic and irrigation water supplies and enable full separation in the future.

XV. That alternative sources for irrigation be explored fully with the objective of reducing capital and operation costs.

XVI. That a scheduled review of the MWP be completed every five to ten (5 – 10) years or prior to the construction of any significant capital project.

XVII. That the Stakeholder Advisory Committee be reassembled after the Board of Directors has adopted a revised Master Water Plan, including a revised financial plan, to work with RDNO staff in preparation of a Communications Plan and an education package for distribution to the public prior to proceeding with a referendum.

The endorsement of these recommendations provided staff guidance on moving forward with the planning process and where applicable, have been incorporated into the 2017 MWP.

It should be noted that the following SAC recommendation forwarded to the GVAC for consideration could not be endorsed as it would conflict with the GVAC's mandate and responsibility as the Committee appointed by the BOD to consider GVW issues:

XVIII. That a Stakeholder Advisory Working Group be formed to deal with Greater Vernon Water issues.

## 4. TECHNICAL BACKGROUND FOR THE GVW 2017 MWP

A Master Water Plan (MWP) is a planning tool that water utilities use to guide utility improvements and infrastructure renewal decisions to ensure investments are completed in an organized and cost effective manner. That being said, a MWP provides a snapshot in time as to the position of the utility, government legislation/policies and technologies available. It is always prudent for utilities to be flexible so that as new information about the utility, changes to government policy and/or as new technologies become available, these can be incorporate into utility planning. As such, a number of changes from the 2012 MWP to the 2017 MWP have occurred, which are outlined in this section.

### 4.1. Technical Overview

The 2012 MWP process completed an in-depth review and analysis of GVW's available water supplies, storage, distribution deficiencies and treatment options with the goals that GVW meet Provincial standards and to make improvements so that all customers receive the same level of service. Much of the compilation and analysis completed in the 2012 MWP is still relevant in 2017 and are included directly into the 2017 MWP (TM1 through 8 as per Section 4.2).

Most of the identification and analysis of options for long term compliance with Provincial standards completed in TM9 are also still relevant; however, there have been some significant changes with respect to meeting IH standards at the DCWTP and in projects staging (timing of the projects). Hence, TM9 is being carried into the 2017 MWP with modifications as outlined in Section 4.3.

The financial plan provided in TM10 is no longer valid. However, the additional financial analysis of the three (3) short-listed options is still relevant to the eventual determination of Option 2 being selected as the preferred option. As such, TM10 is being provided in the 2017 MWP for background information, but the new Financial Implementation Strategy (FIS) was created based on the updated option, project staging plan and new funding parameters. The FIS for the 2017 MWP is provided in Section 6.

Other changes since 2012 MWP include installation of UV treatment at the DCWTP, implementation of a Chlorine Management Program to reduce DBP in the distribution system and discussions with IH regarding the requirement of filtration at the DCWTP. The following sections provide more detail about the TMs or TM modifications and any other significant direction changes since the 2012 MWP was originally endorsed.

### 4.2. Technical Memorandums 1 through 8

The SAC completed a thorough review of the all of the Technical Memorandums within the 2012 MWP as part of their committee mandate and provided the following recommendations:

- That the SAC is satisfied with the level of detail provided in TMs 1 through 8 supplemented by

- the additional information provided to the Committee within the SAC Question Papers provided throughout the 2012 MWP SAC review.
- That the SAC is satisfied with the engineering analysis provided in TMs 1 through TM8 supplemented by the additional information provided to the Committee within the SAC Question Papers provided throughout the 2012 MWP SAC review.
- That the SAC is satisfied with the cost estimates provided in TMs 1 through 8 supplemented by the additional information provided to the Committee within the SAC Question Papers provided throughout the 2012 MWP SAC review.

As such, TMs 1 through 8 are being included directly as is into the 2017 MWP and are provided as Appendix A through to Appendix H.

The following provides a brief summary of the content of each TM:

*TM1 – Domestic and Agricultural Water Demand Forecast* – reviews the current water use ("demand") for GVW and provides a prediction of how much water will be required in the future for domestic and agricultural customers. These demands are then used as a basis for the rest of the MWP.

*TM2 – Evaluation of Water Supply Sources* – reviews all the water licenses that GVW holds, adds up how much water this totals and looks at where and how the water available can be used. TM2 also assesses how vulnerable GVW's water sources are to drought and climate change and looks at other water sources that could be available to GVW.

*TM3 – Source Storage and Supply* - builds upon the work completed in TM1 and TM2 and looks at the total storage licenses that GVW holds, how much water GVW can currently store and examines opportunities to increase storage to support growth within the GVW service area.

*TM4 – Domestic Water System Analysis* – reviews the current state of the domestic (potable) distribution system and identifies capital improvements required to address deficiencies in the system to ensure an adequate level of service for all customers and for the long-term sustainability of the utility.

*TM5 – Independent Agricultural System* – with the goal of reducing capacity stress on the domestic system and lowering the cost of providing agricultural water, this TM examines the capital costs to separate the domestic system from the agricultural system to provide non-potable water for irrigation and treated water for domestic use.

*TM6 – Water Conservation Strategies* - provides a Water Conservation Strategy to guide GVW in achieving water conservation targets.

*TM7 – Water Treatment* - benchmarks the current treatment technologies used to treat GVW's two (2) main potable water sources, analyzes the raw water of each source to identify long term treatment goals and examines the treatment options available to GVW in order to meet Provincial legislation.

*TM8 – Financial Issues and Principles to Support the MWP* - reviews progress made on key management and financial strategies recommended in the 2002 MWP and outlines water utility Best Management Practices for financial planning and administration to incorporate into GVW policies and financial strategies.

### 4.3. Technical Memorandum 9

The main purpose for a water utility to complete a MWP is to develop a long term plan to meet Provincial Standards and ensure a sufficient supply of water to its customers into the future. In GVW's case, the long term plan must ensure that a sufficient supply of water is available to sustain agriculture in addition to providing potable water in sufficient quantities for domestic use.

TM9 of the 2012 MWP used all the information assembled in TMs 1 through 8 to develop nine (9) long term conceptual water supply and treatment options. This analysis included calculating the lifecycle cost for each option using consistent unit estimates in order to complete a commensurate cost comparison between the options. The options were then rated based on non-cost considerations important to operating a sustainable water utility. This rating process was completed by both the TAC (in 2013) and the SAC (in 2016).

Option 2 was the recommended/preferred option for both the TAC and the SAC based on a weighted Benefit-to-Cost Ratio of both that included the lifecycle cost and non-cost considerations. Option 2 included:

- Using two (2) sources for supply (Kalamalka Lake and Duteau Creek),
- Installing filtration on both sources to bring the sources in compliance with Provincial water quality requirements,
- Increasing storage on Aberdeen Dam,
- Using Okanagan Lake to supply non potable water for agricultural use,
- Extending the Gold-Paradise diversion to increase supply in the Duteau watershed,
- Completing system upgrades to address deficiencies in the domestic system,
- Completing partial separation of the potable and non-potable supplies in the Lavington area to reduce treatment costs, and
- Oversizing the transmission main for the agricultural water to allow future generations the option of completing full separation in the BX area (was added to the plan by the RDNO Board).

Based on Provincial and IH policy changes (outlined in Section 4.9) and SAC recommendations, a modified version of Option 2 is the basis for the 2017 MWP, which is outlined in Section 5 below. As the calculations and analysis for the nine (9) options contained within TM9 are considered valid for inclusion in the 2017 MWP, TM9 is provided in Appendix I.

The following sections within TM9 are no longer valid for inclusion in the 2017 MWP:

- The timeframe to provide domestic water that meets Provincial standards has been extended to 2025 (assuming filtration at DCWTP is not required and the filtration at MHWTP is operational by 2025).
- The project staging and timing provided for the preferred option (and for all options) is no longer valid (see Section 5 for the project staging of the preferred option within the 2017 MWP).
- The costs in TM9 were reported in 2012 dollars. These costs have been updated for the 2017 MWP to reflect 2017 dollars based on published inflation rates.

- UV Treatment has been added as a disinfection method at the DCWTP with the goal of supporting a Filtration Exclusion for the DCWTP (or other form of approval that will exclude installing filtration at the DCWTP) (Outlined in Sections 4.9).
- Filtration at the DCWTP has been addressed in the agreement with IH (Outlined in Section 4.5)
- The calculations for Net Present Value Analysis presented in Section 5 of TM9 are no longer valid as they are dependent on a strategy that relied solely on borrowing to finance major projects; and due to the result of the referendum the project staging is no longer valid.

### 4.4. Technical Memorandum 10

The objective of TM10 of the 2012 MWP was to complete a more detailed financial analysis and financial plan of the three (3) shortlisted options (Options 1, 2 and 3) based on the recommended project staging of the main capital projects within TM9. TM10 provided further financial comparisons of the shortlisted options that included total life cycle costs over a 50 year time horizon, net present values, annual revenue requirement forecasts and an index on the impact to water rates. The main financing strategy of the preferred option was to borrow $70 million to complete six (6) priority projects by 2022. Because the referendum failed, the financial plan and financing strategy provided within TM10 is no longer valid and is not included in the 2017 MWP.

Section 5 and Section 6 below provide the new project staging and financial implementation strategy for the 2017 MWP.

### 4.5. Treatment Requirements at the Duteau Creek Water Treatment Plant

The GCDWQ provides recommended limits of substances and outlines conditions that affect the quality of drinking water and includes limits for microbiological characteristics, chemical and physical parameters, radiological characteristics and lists a number of parameters under review. The Province of BC, through the Ministry of Health (with enforcement designated to Interior Health in the Okanagan Region) have established drinking water treatment objectives. The objectives follow a multi-barrier approach which has been established in North America as an effective method to provide potable water. The objectives include using the GCDWQ for water quality parameters, watershed protection, appropriate planning/financing, monitoring, emergency response and treatment to achieve the 4-3-2-1-0 Rule, which refers to:

- 4 log (99.99%) removal or inactivation of viruses,
- 3 log (99.9%) removal or inactivation of protozoa (*Giardia and Cryptosporidium*),
- 2 barriers, minimum, for pathogens,
- 1 NTU turbidity – must be less than 1 NTU, and
- 0 Total Coliforms and E. coli in the treated water.

TM7 of the 2012 MWP (Appendix G) reviewed the raw water quality of the GVW water sources (Kalamalka Lake and Duteau Creek) in comparison to the Provincial objectives to identify treatment requirements. The Duteau Creek source was identified as having highly variable water quality which can change with weather events with no warning, particularly impacting turbidity with frequent exceedances. In addition to turbidity, other parameters that exceeded the GCDWQ included Total Organic Carbon (TOC), colour, and the presence of protozoa.

The addition of Dissolved Air Flotation (DAF) at the DCWTP in 2010 has stabilized the turbidity of the drinking water produced to < 0.5 NTU (with a typical turbidity reading of around 0.3 NTU) and reduced the colour and TOC significantly. Nonetheless, the Provincial drinking water objective for 3 log removal or inactivation of protozoa is not being achieved and hence filtration was recommended in the 2012 MWP.

Additional treatment was also recommended to further reduce the TOC concentrations. TOC's are undesirable as they produce Disinfection By-products (DBP) when chlorinated. The GCDWQ has limits for Trihalomethanes (THM) and Haloacetic Acids (HAA), two main DBP formed when TOC is chlorinated. DBP concentration increases with water age and hence, higher concentrations of DBP are observed at the ends of the distribution system where the water age is greater.

With the failure of the 2014 referendum to borrow funds to install filtration at the DCWTP, other possibilities of meeting the GCDWQ for 3 log removal of protozoa and THM reduction were examined. It was noted that the 2004 GVW MWP amendment recommended the installation of UV treatment at the DCWTP as a second barrier of protection until filtration was installed at the site. With the stabilization of turbidity at the DCWTP by DAF, staff started to explore the possibility of applying for a Filtration Deferral (current requirements are "Filtration Exclusion" criteria) for water post DAF treatment and installing UV treatment post-DAF as a means of meeting standards and increasing public safety.

In addition, there was a recommendation to review air scrubbing in the DCWTP reservoir as a possible means to reduce the DBP/THM. The theory being that chloroform as the main component of the THM group of chemicals is volatile and therefore aerating the reservoir would volatilize the chloroforms out of the water at the DCWTP thereby reducing DBP production in the distribution system.

The following SAC recommendation endorsed by the BOD further encouraged staff to further examine the direction outlined above:

> *That any option that includes the DCWTP as a potable water source will examine using UV and air scrubbing in the DCWTP Reservoir to support a filtration exclusion application.*

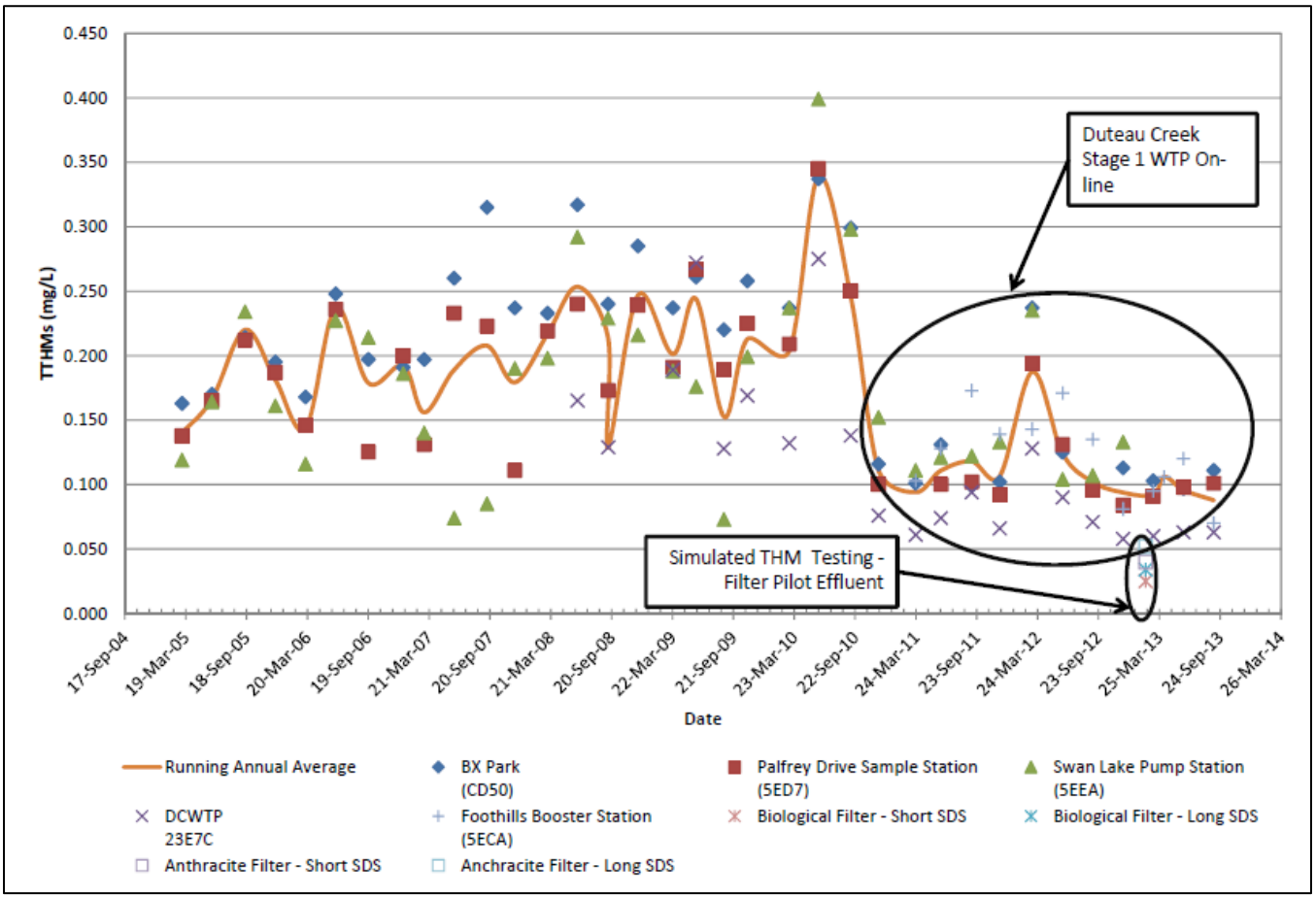
### 4.6. Protozoa Monitoring

In order to gather supporting documentation for a Filtration Exclusion application and to install UV treatment at the DCWTP, GVW initiated a two (2) year monthly sampling program for *Giardia* and *Cryptosporidium* on the raw water from Duteau Creek and after DAF treatment. After a year of sampling, GVW retained Stantec to review the sampling results to support a grant application to the Clean Water and Wastewater Fund for the installation of UV treatment (Stantec, 2016a). The results indicted a 2.2 log or greater removal for *Giardia cysts*. *Cryptosporidium oocysts* removal was more difficult to evaluate due to the low presence in the raw water; however, there was no detectable oocysts in the treated effluent. These results were used to support the application for the successful grant application to fund UV treatment at the DCWTP as outlined in Section 4.8.

### 4.7. Disinfection By-product Reduction

The installation and commissioning of DAF at the DCWTP has reduced DBP production significantly as demonstrated in Figure 1 below.

Figure 1: THM removal before and after commissioning of the DCWTP




Reference: Figure 4-8 from *Duteau Creek WTP – Filtration Pilot Testing Report,* (AECOM, 2014).

Nonetheless, quarterly distribution sampling completed by GVW continues to show exceedances of THM and HAA at the ends of the distribution system at certain times of the year.

AECOM was retained to complete a pilot test of filtration methods in 2013 and as part of this study, a pilot of aerating the filtration water was included to assess if this would result in DBP reduction,. This pilot test was completed when filtration at the DCWTP was still in the MWP. The pilot test concluded that filtration alone would not provide a significant reduction in THM removal, however a reduction of 35% THM within the reservoir and 20% drop within the distribution system could be potentially be realized with aeration in the reservoir (AECOM, 2013). This could potentially provide a sufficient reduction in THM to meet Provincial standards.

The defeat of the referendum in 2014 created an uncertainty of when filtration would be installed at the DCWTP. As the pilot test to aerate the reservoir was completed with filtered water, Stantec was retained to review if aerating water in the reservoir when the water was unfiltered would still assist in DBP reduction (Stantec, 2016b). The review indicated that another pilot test should be completed on the unfiltered water that should also test for Haloacetic Acids (HAA), which has been included in the GVW work plan for 2018.

However, the recommendations caution that aerating the reservoir is predicted to only lower the THM production and may not be effective at reducing HAA. Stantec also recommended that GVW continue to review other options to examine lowering DBP production such as lowering the chlorine input into the system and/or improving operational procedures.

This recommendation initiated the GVW "Chlorine Management Program" in early 2017. This program is predicted to be a multi-year program that brings together the GVW engineering and operations groups to review monitoring data, system configuration, water movement, water age and operational procedures with the goal of implementing strategies to reduce chlorine input into the system and/or reduce water age. Strategies developed for 2017 implementation have included improved monitoring, equipment purchase to improve operations, (i.e. reservoir mixers, chlorine boosting, additional flushing in low water use areas, exercising reservoirs and capital work projects (i.e. installing water loops in problem areas).

As part of the Chlorine Management Program, it was recognized at the initial meeting that the chlorine dose at the DCWTP is currently relatively high to obtain sufficient contact time for *Giardia* deactivation, which is a risk from on the Duteau source. After the UV treatment plant is commissioned, it is expected that the dose can be dropped significantly at the DCWTP as only virus reduction will be required, assisting DBP reduction.

### 4.8. UV Treatment at the DCWTP

In the spring of 2016, the Clean Water and Wastewater Fund grant program was announced. GVW had initiated monitoring and sampling programs in previous years (UV Transmittance, continuous turbidity, Total coliform and E.coli, protozoa sampling) to support an application to install UV treatment at the DCWTP as a method of meeting Provincial standards or to support a Filtration Exclusion. At the time of the grant program announcement, the preliminary results of the protozoa sampling program demonstrated that UV treatment after the DAF would allow GVW to meet the 3 log removal requirements for protozoa disinfection. Thus, the Regional District submitted a $7 million grant application for 83% funding from the federal and provincial governments in November of 2016. In March 2017 the announcement was made that GVW was successful in its application for a $5.81 million grant towards the installation of UV Treatment, which is currently under construction and scheduled to be completed in the spring of 2018.

### 4.9. Interior Health Agreement

There have been a number of Provincial and IH policy changes in the last few years that have impacted the direction of the 2017 MWP, with the two most significant as follows:

- The Province released the *Drinking Water Treatment Objectives (Microbiological) For Surface Water Supplies In British Columbia, November 2012.* The main impact of this document was the direction for all regions within BC to use the Filtration Exclusion as provided in the Guidelines for Canadian Drinking Water Quality (GCDWQ). This was a change from the IH Filtration Deferral policy that implemented the criteria of the Filtration Exclusion with additional requirements of planning for filtration that included siting of a filtration location, and including filtration in the utility financial strategy in the event that filtration is required in the future.
- The Office of the Medical Health Officer (MHO) released the report *Drinking Water in Interior Health, An assessment of Drinking Water Systems, Risks to Public Health, and Recommendations for Improvement* in January 2017. This report reviewed the progress of water purveyors in meeting Provincial drinking water standards within the Interior Health region. It also

examined health impacts from waterborne diseases and assessed the number of public notifications in relation to improvements to water systems and the implementation of the multiple barrier approach (MBA) to protect public health. The report concluded with six (6) recommendations with the following recommendation impacting project staging for the 2017 MWP: *Drinking Water Officers (DWO) should work with large water systems using a surface source to achieve provincial treatment objectives by 2025 and implement improvement plans that consider community, engineering and construction needs with grant opportunities and cost.*

In the initial draft version of the project staging and financial strategy for the 2017 MWP, GVW added filtration at DCWTP in the distant future (i.e. 2042) for planning purposes using the Filtration Deferral criteria and assuming that DAF, UV treatment and chlorination would meet Provincial standards; however, under the new policies outlined above, the direction from IH was that:

(a) either filtration is required and improvements need to be in-place to meet the 2025 deadline or

(b) filtration is not is required and it should not be in the financial strategy (as per Filtration Exclusion criteria).

At the time of the grant application for UV treatment, IH supported the application as it was seen as an improvement for public health, but did not commit to approving this treatment train as it was unique to GVW and one other water supplier in BC. IH indicated DAF, UV treatment and chlorine was not an established treatment method and opted to retain a consultant to complete a third party review of the process before they would approve it as meeting Provincial standards (or provide a Filtration Exclusion).

This created an uncertainty of whether filtration at the DCWTP was required or not that could not be addressed in the 2017 MWP. After discussions with IH, it was agreed that the uncertainty of filtration at the DCWTP would be addressed in a separate agreement as per Section 38 of the *Public Health Act* as provided in Appendix K. As a result of the agreement, filtration at DCWTP has been removed from the 2017 MWP project staging and financial strategy and will evaluate filtration with IH in 2018. This allows GVW to complete the 2017 MWP in order to move forward with projects and other policy/bylaw reviews that require an endorsed MWP (i.e. updating the Development Cost Charge (DCC) bylaw).

## 5. LONG TERM TREATMENT AND SUPPLY STRATEGY FOR GVW

The following table lists the major projects, their staging and estimated costs in 2017 dollars that form the direction of the GVW 2017 MWP.

| Project Description | Cost (2017 $'s) | 2017 Master Water Plan Project Staging |
|---|---|---|
| Duteau Creek UV Treatment | $7.0 M | 2017 |
| Mission Hill Filtration | $33.1 M | 2023 |
| Aberdeen Dam | $7.0 M | 2026 |
| System Separation | $33.4 M | 2028, 2033, 2037 |
| Gold-Paradise Extension | $4.0 M | 2035 |
| Goose Lake Supply from Okanagan Lake | $3.3 M | 2041 |

The direction of the 2017 MWP is consistent with the direction of the preferred option of the 2012 MWP, as amended following recommendations of the SAC and replacing filtration with UV treatment at DCWTP. It provides for two (2) water sources (Duteau Creek and Kalamalka Lake), partial separation in the Lavington area and oversizing the transmission main to allow for separation in the BX area if deemed a benefit to future generations.

It should be noted that the preferred option of the 2012 MWP included $10 million in *Improving the Domestic Distribution System*, which entailed a number of smaller projects required to fix deficiencies of the water system as identified in TM4. These projects are included in the 2017 MWP however are listed separately within the 25-year long term capital plan as outlined in Section 6.0.

## 6. 2017 MWP FINANCIAL IMPLEMENTATION STRATEGY

The following financial implementation strategy (FIS) for the 2017 MWP was approved by the BOD on October 18, 2017. The FIS incorporates 'Recommendation II' from the SAC as follows:

- Finalize the Option, then develop a financial strategy.
- Use existing reserves as a funding source.
- Use grants as a funding source.
- Use DCC as a funding source.
- Use current revenue as a funding source – balance with renewal projects from year to year.
- Delay timing of major projects, where feasible.
- Increase annual contribution to reserves – balance with annual capital plan from year to year.

### 6.1. Master Water Plan Capital Plan and Time Horizon

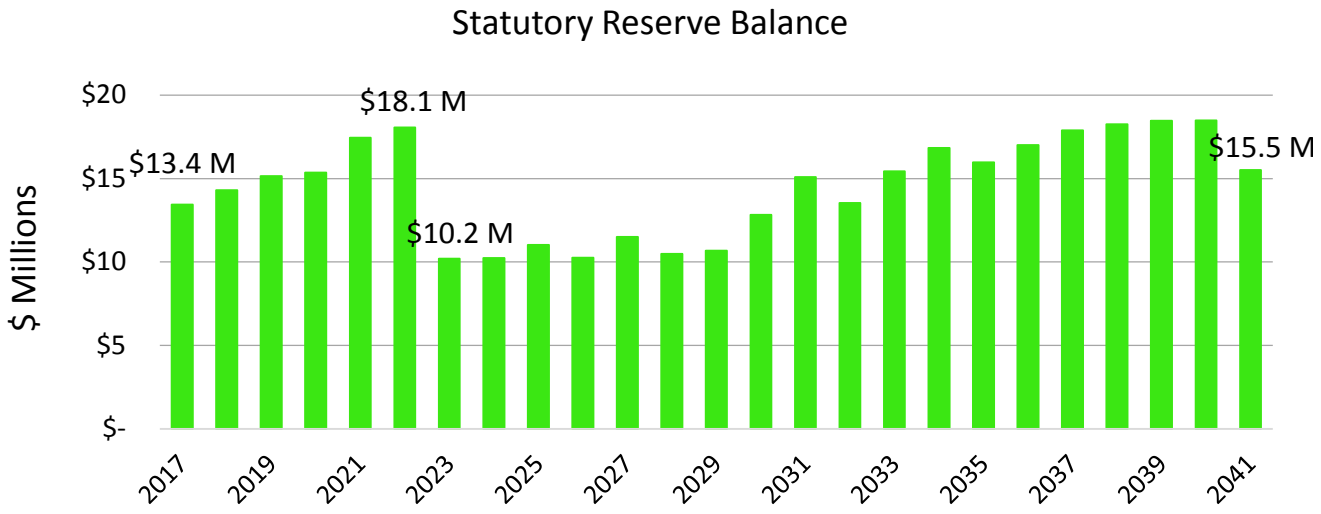
GVW has developed a 25-year long term capital plan (2017 to 2041) that includes the major projects of the 2017 MWP (see Section 5.0 above), improvement projects to address existing system deficiencies and infrastructure renewal projects (Appendix L). The total investment in infrastructure projects is $311 million. Of that total, $186 million (or 60%) relates to asset renewal and replacement and 40% towards new capital projects.

The FIS also uses a 25-year time horizon to match the long term capital plan and incorporates grants, DCC, current revenue, borrowing and reserves as funding sources.

Urban Systems was retained in 2016 to assist GVW in developing financial strategies for infrastructure renewal including an Asset Management Investment Plan. The 2017 MWP incorporates increased investment levels for asset renewal phased-in over the 25-year time horizon as outlined in the Section 6.5 below.

### 6.2. Statutory Capital Reserve Funding

In the 2017 MWP FIS, a statutory reserve is used to assist in funding larger capital projects that could not otherwise be fully funded by current revenues or other funding sources. During years where current revenue is higher than required for the capital budget, the additional revenue is transferred to the statutory reserve for future capital expenditures. The following graph presents the balance of the reserve over the 25-year time horizon. The balance peaks in 2022 at $18.1 million and hits a low at $10.2 million in 2023 with the construction of the Mission Hill Filtration project.




### 6.3. Infrastructure Grant Funding

An assumption of grant funding is used to finance the following major projects in the 2017 MWP. The following table presents the assumptions regarding senior government infrastructure grants.

| Project Description | Grant % | Grant Amount |
|---|---|---|
| Mission Hill Filtration | 67% | $ 22.2 million |
| Aberdeen Dam | 50% | $ 3.5 million |
| System Separation | 50% | $ 16.7 million |
| **Total** | | **$ 42.4 million** |

Including the approved $5.8 million DCWTP UV Treatment project grant, a total of $48.2 million in infrastructure grants is built into the FIS as a funding source for the 2017 MWP.

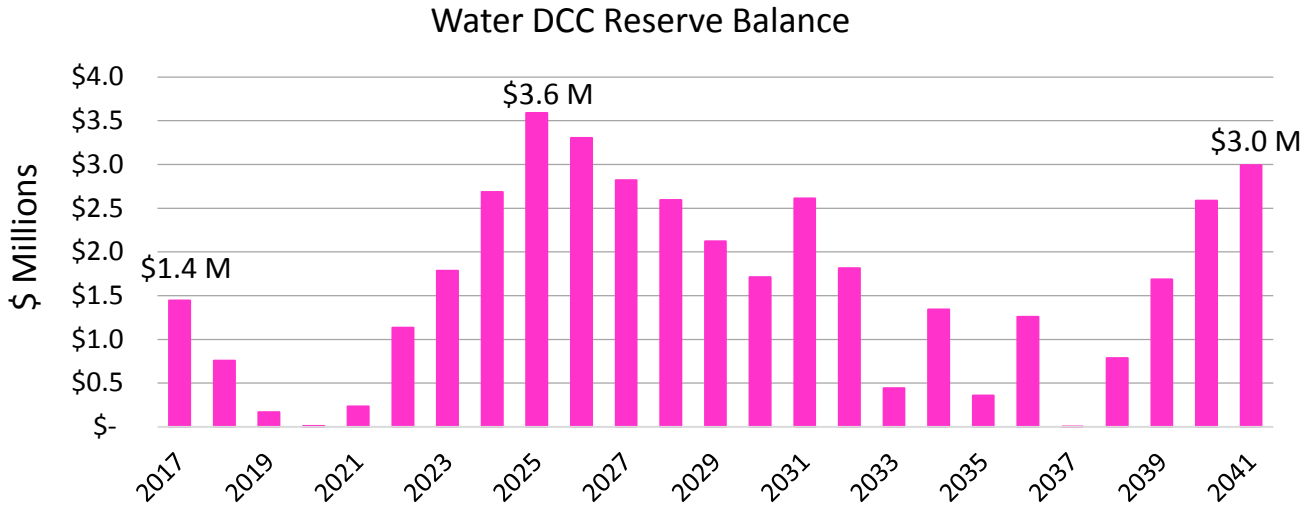
Although a small level of risk is introduced to the MWP's financial implementation strategy, it is prudent to assume the Regional District will be successful in some grant applications in future years. Furthermore, at 15% of the overall capital plan, the total amount of grants being projected is relatively conservative.

The BOD has reiterated that the above projects will only proceed with grant funding provided from senior levels of government with a requirement of at least 2/3 funding for water treatment projects.

### 6.4. Water Development Cost Charge Reserve Funding

Development Cost Charges (DCC) are levied on new development to help pay for some of the capital cost burden created by new development. When collected, DCC are placed in a DCC reserve. The FIS assumes that a new GVW DCC bylaw will be adopted and become effective by 2019. Further detailed analysis will be done as part of the DCC bylaw and program update.

Within the FIS, it has been assumed that the new DCC bylaw will generate an average of $1 million per year once adopted. DCC were not utilized as a funding source for the 2012 MWP and reflect an additional source of revenue in the 2017 MWP.




### 6.5. Infrastructure Asset Renewal

Urban Systems was retained in 2016 to develop an Asset Management Investment Plan for renewal planning for GVW assets. The following table summarizes three (3) different scenarios for the required investment in GVW's existing assets based on an Annual Average Life Cycle Investment (AALCI) approach and a 20 Year Average Annual Investment (20 Year AAI) approach.

| Asset Category | Scenario 1: Standard Service Life | Scenario 2: Service Life Increased by 25% | Scenario 3: Service Life Increased by 50% |
|---|---|---|---|
| AALCI | $13,500,000 | $10,800,000 | $9,000,000 |
| 20 Year AAI | $17,200,000 | $3,500,000 | $2,500,000 |

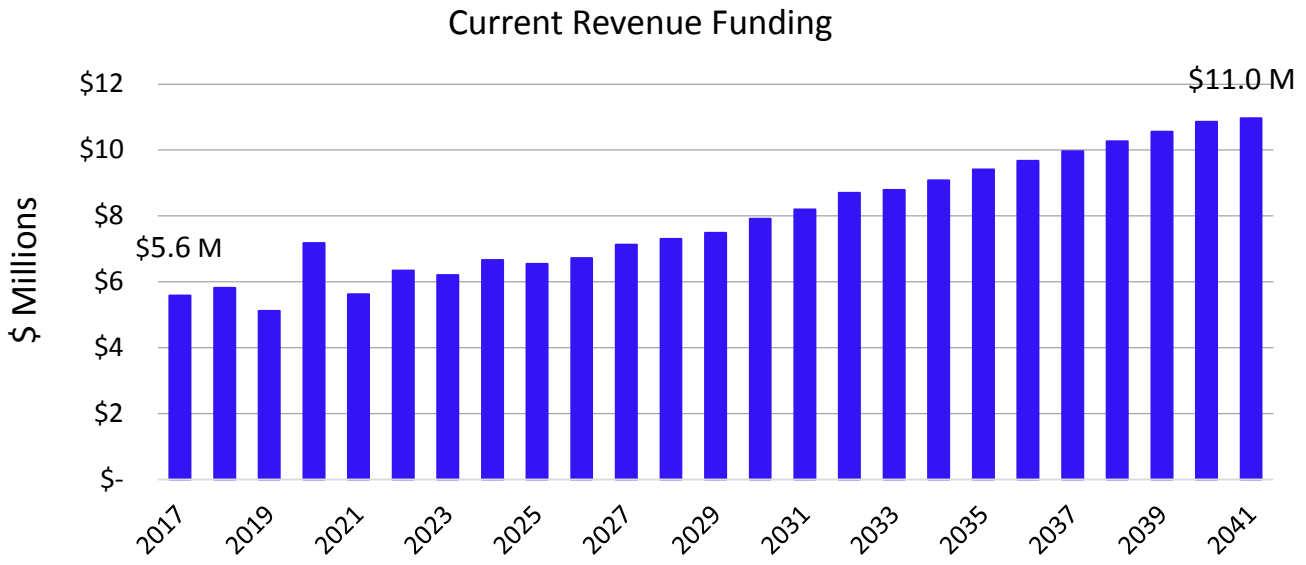
The GVW annual budget already invests in the renewal of its existing assets at a level consistent with Scenario 2 of the 20 Year AAI. Assuming GVW achieves an increase of 25% in the service life of its GVW assets, the current investment level is sufficient in the short term because GVW's assets are

considered to be 'mid-life'. However, as the assets depreciate over time and as time passes, it will be important to meet the higher AALCI of $9 to $13.5 million per year.

The 2017 MWP includes a significant asset renewal component. Asset renewal represents 60% of the capital plan. The FIS includes a phase-in of increased investment in asset renewal to reach the $9 million 'Scenario 3 AALCI' by year 19 (2035) and the $10.8 million 'Scenario 2 AALCI' by year 25 (2041).

### 6.6. Current Revenue Funding of Capital

The annual level of current revenue allocated to financing the long term capital plan increases over the 25-year plan from $5.6 million to $11.0 million. As a percentage of total annual revenue, the percentage of current revenue allocated towards the capital plan increases from 27% to 44% by 2041.

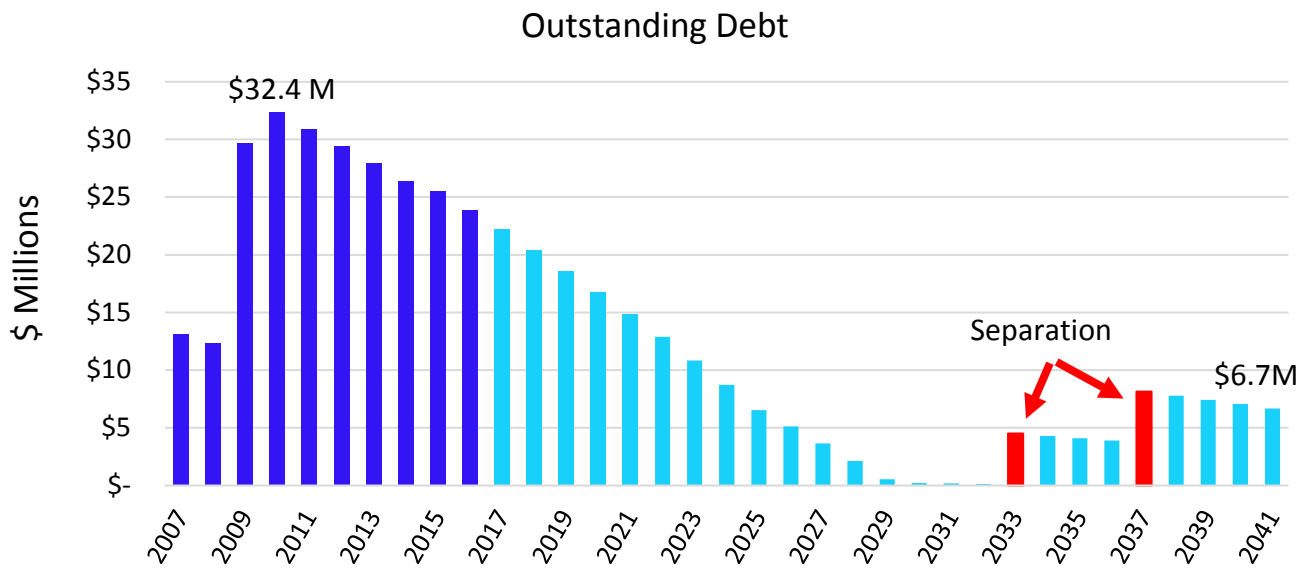



### 6.7. Borrowing and Debt

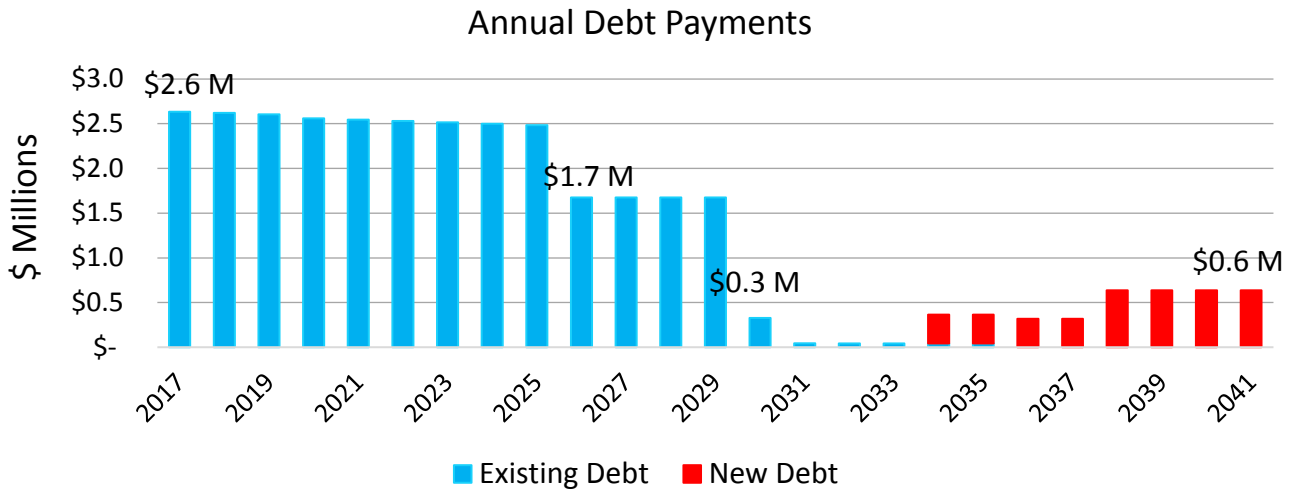
The level of GVW debt will have dropped from a peak of $32.4 million in 2010 to $22.2 million by the end of 2017. Over the next few years, outstanding debt will decline by approximately $1.8 million per year.

Over the next 25 years, two (2) debt issues of approximately $4.4 million each will be required to help fund the Lavington Separation Program projects in 2033 and 2037. By 2041, the projected debt level will be $6.7 million.

The graph below presents the outstanding debt over the past 10 years and the next 25 years.

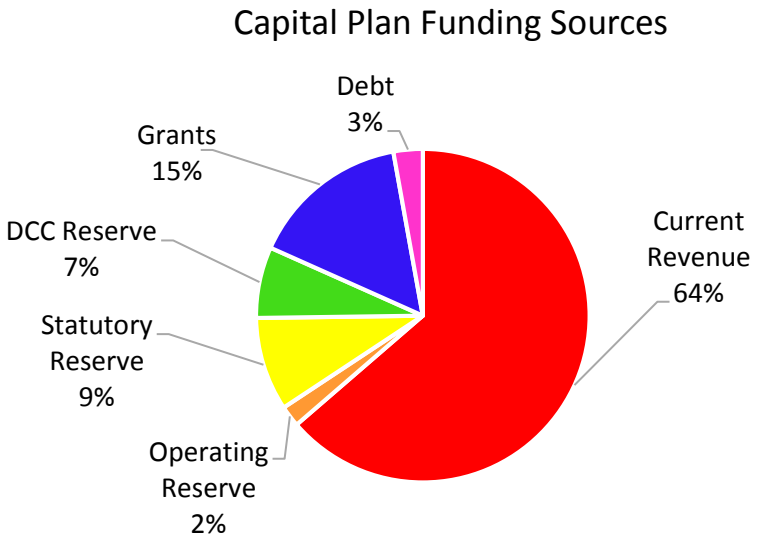



The graph below presents the annual principal and interest payments related to existing and new debt. Significant annual savings are realized in 2026 and 2030 as various debt issues fully mature.




## 6.8. Overview of Capital Funding Sources for the 2017 MWP

The 25-year capital plan totals $311 million. Of that total, $186 million (or 60%) relates to asset renewal and replacement. The following graph summarizes the funding sources of the plan.




### 6.9. Water Rate Impacts

The recommended financial implementation strategy includes a 5% rate increase phased-in over five (5) years (2018 to 2022) over and above the rate of inflation. The 5% increase can be fully attributed to the phase-in of the asset management investment plan. The necessity for even higher rate increases to fund the full phase-in of the asset management investment plan was offset by reduced debt servicing costs over the plan's time horizon and growth in the number of water users.

## 7. DIFFERENCES BETWEEN 2012 AND 2017 MWPS

A significant change has been the removal of the DCWTP filtration project from the MWP. In the 2012 Master Water Plan, the DCWTP filtration project was scheduled for 2017 and in a draft financial strategy of the 2017 MWP presented to the Board in June 2017, the $29.3 million project was delayed until 2042. Following discussions with IH, the DCWTP filtration project is no longer included within the 2017 MWP and will be reviewed in the future according to the agreement with IH (Section 4.9).

### 7.1. Timing and Magnitude of Capital Projects

The timing and updated cost figures of the major projects included in the 2012 MWP are highlighted in the table below and provides a comparison to the staging of the 2017 MWP:

| Project Description | Cost (2017 $'s) | 2012 Master Plan | 2017 Master Plan |
|---|---|---|---|
| Duteau Creek Filtration | $29.3 M | 2017 | eliminated |
| Mission Hill Filtration | $33.1 M | 2022 | 2023 |
| System Separation | $33.4 M | 2013 to 2017 | 2028, 2033, 2037 |
| Aberdeen Dam | $7.0 M | 2022 | 2026 |
| Goose Lake Supply from Okanagan Lake | $3.3 M | 2014 | 2041 |
| Gold-Paradise Extension | $4.0 M | 2037 | 2035 |

The Goose Lake Supply from Okanagan Lake has been delayed as a preliminary study indicated that it would cost more than originally estimated and was delayed into the future when it will likely be required to assist in growth in the domestic supply.

### 7.2. Infrastructure Grant Funding

The 2017 MWP includes grants assumptions to finance completing three (3) major projects. A total of $48.2 million in grants is built into the funding model, including the approved grant of $5.8 million in 2017 for UV treatment at the DCWTP. The 2012 MWP did not include senior government grants as a funding source.

### 7.3. Debt Funding

A significant difference in the 2017 MWP relative to the 2012 MWP is the amount of new debt to be issued to implement the plan. The 2012 MWP relied heavily on borrowing to complete the major projects identified with $100 million in new debt (the $70 million referendum, plus an additional $30 million later in the plan). The 2017 MWP includes $8.8 million in new debt, representing only 3% of the 25-year capital plan.

### 7.4. Asset Renewal

The 2017 MWP includes a significant asset renewal component. Asset renewal represents 60% of the long term capital plan, and the annual funding towards asset renewal is projected to increase from $4.0 million in 2018 to $10.8 million in 2041. This increase will match the AALCI figure of $10.8 million that was identified in the asset management investment plan, assuming a 25% increase in the service life of the assets.

While the 2012 MWP only included an annual allocation of $2 million for asset renewal, each annual budget process since the plan was adopted has incrementally increased the asset renewal budget beyond $2 million.

With the additional work that has been completed on asset management within the GVW system over the past few years, the revised 2017 MWP includes a more complete and sustainable capital plan.

## 8. REFERENCES

AECOM, October 8, 2014, Duteau Creek WTP - Filtration Pilot Testing Report. Prepared for RDNO.

Greater Vernon Water, May 2016, (GVW, 2016), 2012 Master Water Plan Review Stakeholder Advisory Committee Report.

Greater Vernon Water, October 24, 2017 (GVW, 2017), Chlorine Management Program Progress Report.

Stantec Consulting Ltd., Dec. 22, 2016 (Stantec, 2016a), Duteau Creek WTP Protozoa Monitoring and Dissolved Air Floating Removal Review. Prepared for Greater Vernon Water.

Stantec Consulting Ltd., December 22, 2016 (Stantec, 2016b), Duteau Creek WTP DBP Aeration and Chlorination Testing Plan. Prepared for Greater Vernon Water.

Urban Systems, March 2017, Asset Management Investment Plan, Greater Vernon Water, Parks and Culture. Prepared for RDNO.

# APPENDIX A

## TECHNICAL MEMORANDUM NO. 1
## DOMESTIC & AGRICULTURAL WATER DEMAND FORECAST

Link to TM on the RDNO website:
http://www.rdno.ca/docs/TM1_Domestic_Ag_Water_Demand_Forecast.pdf

# APPENDIX B

## TECHNICAL MEMORANDUM NO. 2
## EVALUATION OF WATER SUPPLY SOURCES

Link to TM on the RDNO website: http://www.rdno.ca/docs/TM2_Eval_Water_Source_130226.pdf

# APPENDIX C

## TECHNICAL MEMORANDUM NO. 3
## SOURCE STORAGE AND SUPPLY

Link to TM on the RDNO website:
http://www.rdno.ca/docs/TM3_GVW_Source_Storage_and_Supply.pdf

# APPENDIX D

## TECHNICAL MEMORANDUM NO. 4
## DOMESTIC WATER SYSTEM ANALYSIS

Link to TM on the RDNO website:
http://www.rdno.ca/docs/TM4_2013_02_26_KWL_DomesticWaterSystemAnalysis_v2.pdf

# APPENDIX E

## TECHNICAL MEMORANDUM NO. 5
## INDEPENDENT AGRICULTURAL SYSTEM

Link to TM on the RDNO website: http://www.rdno.ca/docs/TM5_IndependentAgrSystem.pdf

# APPENDIX F

## TECHNICAL MEMORANDUM NO. 6
## WATER CONSERVATION STRATEGIES

Link to TM on the RDNO website: http://www.rdno.ca/docs/TM6_Water_Conservation.pdf

# APPENDIX G

## TECHNICAL MEMORANDUM NO. 7
## WATER TREATMENT

Link to TM on the RDNO website: http://www.rdno.ca/docs/130610_TM7_Water_Treatment.pdf

# APPENDIX H

## TECHNICAL MEMORANDUM NO. 8

## GVW FINANCIAL ISSUES AND PRINCIPLES TO SUPPORT THE MASTER WATER PLAN

Link to TM on the RDNO website: http://www.rdno.ca/docs/TM8_Financial_Strategy_130308.pdf

# APPENDIX I

## TECHNICAL MEMORANDUM NO. 9
## SYSTEM SEPARATION OPTION ANALYSIS

Link to TM on the RDNO website:
http://www.rdno.ca/docs/130711_TM9_System_Separation_Option_Analysis.pdf

# APPENDIX J

## TECHNICAL MEMORANDUM NO. 10
## GVW FINANCIAL PLAN

Link to TM on the RDNO website: http://www.rdno.ca/docs/TM10_Financial_Plan_FINAL.pdf

# APPENDIX K

## FORMAL AGREEMENT WITH INTERIOR HEALTH UNDER SECTION 38 OF THE BC PUBLIC HEALTH ACT

Link to the Agreement on the RDNO website:
http://www.rdno.ca/docs/171020_AGR_IH_Public_Health_Act_DCWTP_filtration.pdf

# APPENDIX L

## 2017 MASTER WATER PLAN 25-YEAR CAPITAL PLAN

Link to the 25-Year Capital Plan on the RDNO website:
http://www.rdno.ca/docs/2017_MWP_25_Yr_Capital_Plan.pdf