Village of Harrison Hot Springs

WATER MASTER PLAN

CTQ

ENGINEERING PLANNING URBAN DESIGN

JUNE 2015

HARRISON HOT SPRINGS

Naturally Refreshed

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STATEMENT OF QUALIFICATIONS & LIMITATIONS

The Water Master Plan Report (the "Report") contained herein has been prepared by CTQ Consultants Ltd. ("CTQ") for the benefit of The Village of Harrison Hot Springs ("VHS") in accordance with the agreement between CTQ and VHS, including the scope of work detailed therein (the "Agreement").

The information used to prepare the water model and this Report was obtained from record information provided by VHS, site reconnaissance by CTQ and hydrant flow tests to calibrate the model.

The Report has been prepared to assist the VHS to understand the existing condition of the overall water system and to plan for future growth within the community. Possible growth patterns were provided to CTQ by VHS to enable future population scenarios to be included in the water model.

The information contained herein is to be read as a whole and such sections should not be extracted and read out of context.

As the Report is based on possible future population and development growth patterns, trigger points for capital and operational improvements have been identified and should be updated periodically to reflect actual conditions.

Unless expressly stated to the contrary in the Report or the Agreement, CTQ:

- shall not be responsible for any events or circumstances that may have occurred since the date on which the Report was prepared;
- shall not be responsible for any inaccuracies contained in information that was provided to CTQ by other firms or agencies;
- agrees that the Report represents professional judgment for the specific purpose described in the Report and the Agreement, but CTQ makes no other representations with respect to the Report or any part thereof.

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- as agreed, in writing, by CTQ and VHS;
- as required by law;
- for use by governmental reviewing agencies.

Any use of this Report is subject to this Statement of Qualifications and Limitations. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report.

LETTER OF SUBMISSION

Project No.: 12004-13

COST

25 June 2015

TIME

Village of Harrison Hot Springs
495 Hot Springs Road
Harrison Hot Springs, BC V0M 1K0

QUALITY

Attention: Mr. Ian Gardner, Operations Manager

Dear Ian:

Re: Village of Harrison Hot Springs Water Utility Master Plan

Please find attached the Water Utility master Plan. Do not hesitate to contact either myself or Matt Cameron at any time regarding this report.

Yours truly,

CTQ CONSULTANTS LTD.

Per:

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ACKNOWLEDGEMENTS

As a Resort Municipality, VHS faces the difficulty of constructing and maintaining infrastructure sufficient to serve a large number of day trip and short term visitors sustained by a relatively small tax base. Funding provided through UBCM for the completion of the Water Utility Master Plan is gratefully acknowledged.

The VHS operations personnel were invaluable in finding archived data, responding to inquiries, and providing context. Thanks to:

Ian Gardner, Manager of Operations
Tyler Simmonds, Utilities Technician
Bruce Malfait, Utilities Chief Operator
Mark Yasinski, Utilities Labourer
Todd Kafi, Public Works Foreman

EXECUTIVE SUMMARY

The Harrison Hot Springs water utility supplies treated water for the Village of Harrison Hot Springs (VHS). Over the past decade, upgrades have been undertaken to ensure clean drinking water continues to be available for a growing population of residents and visitors. The system currently includes a main water intake structure in Harrison Lake with two pumping stations, a state-of-the-art membrane treatment facility and a water storage reservoir. The distribution piping infrastructure is approximately 15 km total in length; however it is not fully looped and has several dead ends. VHS recognizes the infrastructure is not complete, and commissioned CTQ Consultants Ltd. (CTQ) to generate a comprehensive Water Utility Master Plan to address current issues and to provide a roadmap for the utility over the coming years.

The purpose of any utility master plan is to establish a strategy for providing the required levels of service to the tax payers of the community both now and into the future. It is very difficult to forecast future needs in a resort-based community like VHS. As such CTQ reviewed several options for projections and based the report on demand flows triggering improvement events rather than timelines based on traditional population growth models.

Existing system infrastructure and demands were reviewed, modeled using WaterGEMS ™ software, and calibrated using historical data and field tests. Scenarios were created to determine necessary improvements as the population increases. It is estimated that 55% of demand within VHS is currently met by private water supplies. The impact of adding all the existing lots and then combining the various growth scenarios was investigated.

The model was used to quantify upgrades to the pipe network, treatment plant, storage reservoir and pump stations based on existing and future demands. Operational issues such as residual chlorine levels during both the summer peaks and winter lows were quantified. This enabled a review of and recommended modifications to the current flushing program.

As the Harrison Hot Springs Resort and Spa is the largest single user of water in VHS and is currently not serviced by the VHS water utility, potential impact to the system of this large customer was reviewed.

The projects identified by the Water Master Plan were itemized as Capital Projects rather than development driven projects. These projects were reviewed based on a “Triple Bottom Line” (Social, Environmental and Economic) assessment.

This Water Master Plan is to be read in conjunction with the Figures and Tables found in the appendices includes recommendations based on CTQ’s knowledge and expertise in water systems. It is very much a living document and needs to be revisited from to time to confirm the outcomes based on the increased future demands.

ABBREVIATIONS

ADD	Average Day Demand. Water consumption in liters per day averaged over a specific time period (usually 12 months). For VHS, ADD was determined for peak (summer) and off-peak (winter) periods.
AWWA	American Water Works Association. The largest non-profit, scientific and educational association dedicated to managing and treating water.
BCWWA	BC Water & Waste Association. A non-profit organization with a mandate to safeguard public health and the environment on matters related to water and wastewater.
FUS	Fire Underwriters Survey. An organization which provides data on public fire protection for fire insurance statistical work and underwriting purposes of subscribing insurance companies.
FVRD	Fraser Valley Regional District.
GCDWQ	Guidelines for Canadian Drinking Water Quality, 2012. Provides guidelines and limits for contaminant concentrations based on current, published scientific research related to health effects, aesthetic effects, and operational considerations.
HP	Horsepower.
HRS	Harrison Hot Springs Resort & Spa.
MAC	Maximum Acceptable Concentration for drinking water parameters according to the GCDWQ.
MMCD	Master Municipal Construction Documents. Documents created by MMCD Association - a non-profit society supported by BC municipalities to create improved construction documents for roads, sidewalks, sewers, water, traffic signals and street lighting.
MDD	Maximum Daily Demand. Maximum volume of water in liters per day consumed during a 24 hour period in a given year. For this report, it is calculated as 2xADD.
OCP	Village of Harrison Hot Springs Official Community Plan. Bylaw 864 March, 2007.
PHD	Peak Hour Demand. Maximum volume in liters of water consumed in a one hour period in a given year. For this report, it is calculated based on 1.5xMDD.
UF	Ultrafiltration. A type of membrane filtration (for water treatment in VHS) in which forces such as pressure or concentration gradients lead to a separation through a semipermeable membrane.
VFD	Variable Frequency Drive. A type of adjustable-speed drive used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage. The VHS beach pumps have VFDs.
VHS	Village of Harrison Hot Springs.
WTP	Village of Harrison Hot Springs Water Treatment facility, as constructed 2014.

1. Introduction

1.1 Water System Background

A reliable supply of clean water is necessary for the environmental, economic and social wellbeing of any community. The function of a safe and dependable water system extends beyond the significant social requirements of basic health and sanitation. A public water system also protects property through adequate fire supply, contributes to the local economy by providing capacity for commercial enterprises, and, through irrigation, enhances the environment surrounding businesses, homes and public spaces. In doing all of this, the system must also be financially sustainable while meeting stringent government standards.

The Harrison Hot Springs water utility supplies treated water for the Village of Harrison Hot Springs (VHS). Over the past decade, upgrades have been undertaken to ensure clean drinking water continues to be available for a growing population of residents and visitors. The system now includes an intake structure, two pumping stations, a state-of-the-art membrane treatment facility, a water storage reservoir, and 15 km of pipeline.

VHS is a destination community with a small full time population. During the summer months, demands on infrastructure increase significantly with seasonal residents and tourist visits. This fluctuation puts immense pressure on the water system. A single large development, or sharp increase or decrease in the number of overnight tourist visits, could greatly impact the system requirements.

VHS recognizes the challenges ahead, and commissioned CTQ Consultants to generate a comprehensive Water Utility Master Plan to review the system in its entirety and provide a roadmap for the utility over the coming years.

1.2 Purpose of this Master Plan

The purpose of any utility master plan is to establish a comprehensive strategy for the utility. In the absence of a crystal ball, certain assumptions must be made to predict the future so that the utility is able to respond to the actual needs of the community. This includes long term planning required levels of service and identifying the most cost effective means of delivering the current and future service.

The creation of this Water Utility Master Plan is the first step towards cohesive, long term planning for VHS utilities. It is important that the water utility not be looked at in isolation, that master planning documents for sanitary sewer, drainage and roads be incorporated as they become available. It is recommended that an overall Asset Management Program be developed for VHS.

The objectives of this Plan are to:

- review existing and forecast future water demands
- identify threats to water supply
- review existing infrastructure and identify current deficiencies
- recommend infrastructure improvements to meet future demand

- make recommendations regarding demand management
- estimate costs of future works.

2. Existing System (2014)

2.1 Process Overview

The Existing Water Supply and Distribution System are illustrated on **FIGURE 1**.

1. Water enters the VHS system through a 350 mm intake line which extends just over one kilometer north into Harrison Lake.
2. Three 40 HP, VFD-controlled pumps located at the Harrison Lake shoreline transport water from the intake to the Water Treatment Plant located on the west side of Hot Springs Road at Balsam Avenue.
3. After membrane ultrafiltration and chlorination, two 40-HP pumps lift the water 60 vertical meters across the Miami Slough and through a section of above-ground piping bolted to Agassiz Mountain to the 2,745 m^3 reservoir.
4. Treated water is delivered to the consumer via gravity flow through a 15 km of distribution pipes ranging in size from 50 mm to 350 mm. Due to the relatively flat topography and lack of hillside development, the entire Village lies within a single pressure zone.

2.2 Water Metering

Only 25 of the properties serviced by the VHS water utility are currently metered. Residential customers pay a flat rate of $311.00 per year. Condominium developments and a handful of commercial customers have meters and are billed according to consumption. These metered properties are also illustrated on **FIGURE 1**. Any new residential water installation includes a meter but VHS policy is to continue to bill a flat rate until such time as all residences are metered.

2.3 Water Utility Customers

There are 754 properties in VHS, 443 properties are serviced by the VHS water utility. Although specific flow rates from the private sources are not available, CTQ estimates that nearly 55% of demand within VHS boundaries is currently met by privately owned and maintained groundwater wells and lake intakes. **FIGURE 1** illustrates the source of water for all VHS properties.

A Note Regarding the Harrison Hot Springs Resort & Spa

The Harrison Hot Springs Resort & Spa (HRS) is not currently supplied by the VHS water utility, operating an intake, reservoir and treatment facility separate from the VHS system. HRS's water license indicates a withdrawal limit of 500 m^3/day. Actual usage is estimated between 350-400 m^3/day at full occupancy, making HRS the largest single consumer of water within VHS. Resort management has indicated the intent to continue to operate the private system for the foreseeable future.

The VHS system currently has the capacity to supply treated water to HRS. However, without capital upgrades to the system this capacity will diminish over time, based on the actual rate of development and population growth the Village experiences combined with Resort expansion. Because of the significant impact the HRS connection would have on the VHS water utility, accounting for an increase in total system demand over 2014 levels in the order of 20%, implications of connection have not been investigated in detail within this report. Should both VHS and HRS management wish to pursue HRS connection in the future, a separate technical memorandum should be issued to address issues such as:

- Detailed HRS demand projections
- Continued use of HRS system components such as intake and reservoir
- VHS reservoir and pumping capacity upgrade requirements
- VHS water license amendment
- Rate structure
- Timing of connection and tie-ins
- Operations and maintenance

3. Water Supply, Quality and Treatment

3.1 Water Sources and Supply

In the Village of Harrison Hot Springs, water is supplied to properties one of three ways:

1. Harrison Lake surface water - VHS water utility
2. Harrison Lake surface water - privately owned and operated intake
3. Groundwater - privately owned and operated wells

In British Columbia, water licenses fall under the jurisdiction of the Ministry of Forests, Lands, and Natural Resource Operations. VHS holds a Conditional Water License (#114223) authorizing diversion of up to 100,000,000 gallons per year (454,609 cubic meters) from Harrison Lake. In addition, Permit #23174 allows for the occupation of Crown land for the lake intake pipeline and beach pump station.

3.2 Source Water Quality - Harrison Lake

Raw water quality from the Harrison Lake source is considered excellent. An examination of analytical data between 2012 and 2014 found that without exception all tests for metals, anions and nutrients were well within the Guidelines for Canadian Drinking Water Quality (2009). Turbidity is consistently higher than the Maximum Acceptable Concentration (MAC) of 0.1 NTU limit, and tests regularly indicate some presence of E. Coli and other Coliform bacteria. Raw water quality data can be found in **Appendix A**.

3.3 Source Water Treatment - Harrison Lake

The current membrane microfiltration treatment facility (commissioned in 2014) achieves the 4-3-2-1-0 microbiological treatment objectives outlined by the British Columbia Ministry of Health's Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia (2012):

- 4-log reduction or inactivation of viruses
- 3-log reduction or inactivation of *Giardia* and *Cryptosporidium*
- Two treatment processes for surface water
- Less than or equal to one nephelometric turbidity unit (NTU) of turbidity
- No detectable *E. Coli*, fecal coliform and total coliform

3.4 Threats to Water Quality, Water Supply, and Watershed Health

The Harrison/Lillooet watershed is part of the Fraser River Basin, originating with meltwater from the Lillooet Glacier high in the Coast Mountains north of Vancouver. The Lillooet River flows south and east past the towns of Pemberton and Mount Currie to the north end of Harrison Lake - the largest lake in the Fraser Valley - that drains by way of the Harrison River 18 km to the Fraser River (Fraser Basin Council, 2014). South of the Village of Harrison Hot Springs, the Miami River flows through a more developed area of the District of Kent and VHS into Harrison Lake. Although the watershed is largely comprised of remote and mountainous areas, several threats to watershed health and potentially to VHS drinking water quality do exist. Water quality is regularly monitored by VHS to provincial standards, but there is at this time no "early warning" instrumentation that would provide an indication of changing water quality prior to water entering the system.

3.4.1 Natural Disasters

Natural disasters such as earthquakes and landslides have the potential to adversely affect the Harrison Lake source water supply and quality. On August 6, 2010 a landslide in the magnitude of 45,000,000 cubic meters blocked both the Meager and Lillooet Rivers. This was the second largest landslide ever recorded in Canada. For two years the Meager Creek slide resulted in a significant increase in Harrison Lake turbidity levels at the intake of the VHS water utility system.

Meager Creek Slide looking into the Lillooet River Sunday 8 August 2010

Source: landslideblog.org

Earthquakes also pose a risk to water utility infrastructure. The importance of water supply in emergency response resulted in changes to the BC Building Code in 2012 requiring water infrastructure to be built to "post-disaster" standards and increasing the requirements for seismic design. Although the new WTP has been designed to this standard, the vulnerability of other components of the system to seismic events - specifically the reservoir, above ground piping and beach pump station - should be considered during emergency response planning and upgrades undertaken as practical.

Recommendations

- Consider the seismic vulnerability of the water utility during emergency response planning.
- Identify seismic upgrades required for the reservoir and beach pump station and undertake improvements as practical.
- Prioritize the upgrade of the critical above-ground piping.

3.4.2 Microbial Contamination

Sources of fecal contamination include wastes from humans, pets, farm animals and wildlife. Septic systems on the recreational properties within the Harrison Lake watershed, as well as contamination from agricultural operations upstream (either in the Lillooet Valley or within the District of Kent) could result in bacterial contamination of surface water supply. VHS currently monitors microbial levels of raw water according to Ministry of Health guidelines in order to detect the presence of these harmful organisms.

3.4.3 Land Use

Industrial

Historically, industrial land uses within the watershed have included forestry, mining and agriculture. Each industry can have a variety of impacts on the watershed. For example, habitat altered by forestry activities can result in increased runoff and sediment loading of rivers and lakes, contaminants such as fecal matter or chemicals used in agricultural operations can migrate into surface water, and mining operations may contribute to slope destabilization. Log booms transported near the VHS water intake line (which extends nearly a kilometer underwater) increase raw water turbidity and have the potential to damage the intake. It is important for VHS to be identified as a stakeholder on land use issues relating to watershed health, and to have a voice on committees where decisions potentially affecting water quality are made.

Recommendation

- Ensure VHS is identified as a stakeholder for projects and activities within the Harrison/Lillooet watersheds

Recreational

Water quality may be impacted by waste generated from recreational property users and campers in the watershed. Septic systems that are not properly maintained may result in bacterial and nutrient contamination of nearby waters. Nutrient enrichment in the lake could lead to algae blooms or eutrophication and decrease water quality.

Urbanization

Urban development in the watershed is minimal and is concentrated in just a handful of centers (Pemberton, Agassiz, and Harrison Hot Springs). With the growing Lower Mainland population in close vicinity to the watershed, the area is expected to see an increase in both development and recreational users. Urban runoff carries contaminants such as sediments, metals and hydrocarbons into local waterways increasing the concentration of these contaminants in the source water. Increased runoff due to urbanization can also impact stream channels because of increased total flow and velocities.

Recommendation

- Investigate upgrades to the VHS drainage system such as filtration and oil separators to minimize contaminants entering the Miami River and Harrison Lake that may affect water quality
- Create a Drainage Master Plan

3.4.4 Climate Change

In 2011, Engineers Canada issued the following statement on the subject of climate change:

"Regardless of causes, our climate is changing and it will increasingly affect infrastructure over time, exposing Canada's infrastructure to conditions it was not originally designed to withstand. This can reduce its useable lifespan and may result in economic loss, disruptions to the lives and daily routines of Canadians, and increased risks to public health and safety."

BCWWA expands on this in the 2013 Position Statement on Climate Change:

"Climate change is altering the context in which infrastructure needs to be designed, maintained and renewed to continue to provide water services at desired levels. Older infrastructure was simply not designed or built with such extreme climate variability in mind."

According to the BCWWA Position Statement, climate change impacts that directly affect water infrastructure include:

- rising temperatures and sea level
- reduced snowpack
- more frequent and severe storm events
- more frequent floods and droughts

BCWWA, and parent organization AWWA, encourages water utilities to:

- support regional climate change modeling
- respond proactively to anticipate climate changes
- develop adaptation and mitigation responses for a range of predicted climate change impacts
- reduce energy consumption and greenhouse gas emissions as reasonably feasible

AWWA also reminds us that:

"Water utilities are especially vulnerable to climate induced changes to water quality and quantity. They face risks to their water supplies and critical infrastructure... In spite of these new challenges and limited climate change data and decision support tools available at the local level, water utilities must ensure that an adequate supply of uninterrupted, high-quality and affordable drinking water is available for their customers"

Recommendations

- Ensure climate change is emphasized in the decision-making process for water utility infrastructure repair, upgrade, and expansion.
- Reduce energy consumption and greenhouse gas emissions created by the water utility wherever possible.

3.4.5 Vandalism

It is important to note the vulnerability of key system components to tampering. Although located 1 km into Harrison Lake, the intake for the VHS system is located in shallow water and unsecured. In addition, the drinking water supply reservoir and above-ground treated water supply lines is accessible to the public from the Campbell Lake trailhead.

3.5 Source Water Quality - Groundwater

Generally, there are two types of groundwater supply:

1. **GUDI**, or **G**roundwater **U**nder **D**irect **I**nfluence of surface water refers to groundwater sources (wells, springs, infiltration galleries, etc.) where microbial pathogens and other contaminants are able to travel from nearby surface water to the groundwater source.
2. **Non-GUDI** water is independent of surface water influence.

A shallow well in close proximity to a surface water source will generally be a GUDI supply.

The provincial register indicates well depths within VHS ranging from 8m to over 19m with water found between 1m and 3m below the ground surface. A series of studies completed in the 1990's by Urban Systems concluded that shallow wells could be affected by activities related to land use south of VHS. In addition, a preliminary water quality sampling program was undertaken in May 2014 by Western Water Associates (WWA) as part of an environmental impact assessment for a landfill site which operated east of McCombs Drive from the 1950's through 1983. The non-intrusive study focused on assessing water quality at selected existing domestic wells and at near-surface groundwater seepage zones into the Miami River, the closest surface water receptor. Water quality sample locations are provided in **Appendix B**. Of note were ambient conditions exceeding the Guidelines for Canadian Drinking Water Quality Guidelines (GCDWQ) for iron, manganese, pH, and temperature. At one location, coliforms were also detected. Nitrate did exceed GCDWQ for the near-surface groundwater at locations presumed to be down-gradient from the landfill site. For this reason, there is concern that nitrate potentially derived from the landfill site has contaminated the groundwater in this area.

The WWA report recommends that, at a minimum, all domestic wells located within the vicinity of "Site 12" be tested for landfill-associated leachate anions and pH. Because of the large number of properties served by shallow groundwater wells throughout the Village, and the potential liability of any contaminants to VHS, it is further recommended that a one-time sampling of all 218 properties listed in the VHS database as supplied by private groundwater wells be completed as soon as possible. Analysis of the samples will provide further guidance for additional groundwater monitoring, alternative water supply, and/or supplementary investigation.

A deep, non-GUDI test well completed to 31 m depth in March 2010 by VHS showed elevated hardness, manganese and sulfides at this location within the Agassiz aquifer. The aquifer is classified by the Province of British Columbia as "highly vulnerable", and there are a considerable number of wells within the aquifer that can serve as a conduit for contamination. A number of similar deep wells are known to exist within the Village, and as with the shallower GUDI wells, the VHS currently has little or no water quality and depth data for these privately owned and operated water supplies. Recognizing that VHS has no jurisdiction over wells on private property, property owners should be advised of the proximity to the VHS water utility. It is recommended that options for those interested in decommissioning groundwater wells in favor of utility connection be investigated.

VHS civic addresses supplied by wells (2014), in addition to a list of provincially registered wells is provided in **APPENDIX B.**

Recommendations

- Test all domestic wells within the vicinity of "Site 12" for landfill-associated anions and pH
- Sample all 218 properties within VHS which use groundwater
- Establish a policy for connecting properties previously served by groundwater to the VHS water utility

4. Water Model

Using AutoCAD's WATERGEMS^{TM} software, average daily demand (ADD) was modeled utilizing a combination of meter data and demand estimates based on land usage for each property within the Village.

Because of the seasonal variability experienced by VHS, "winter" (low flow) and "summer" (high flow) values were determined for ADD. The winter values were utilized in analysis of chlorine decay (**FIGURE 5**) and development of a flushing program. Summer demands, as most conservative, were used to identify current system deficiencies as well as to estimate future system requirements.

The model was calibrated to flow data recorded by VHS operations personnel between 2008 and 2014, and field calibrated in 2014 via hydrant flow tests. Maximum Daily Demand (MDD) and Peak Hourly Demand (PHD) were calculated based on ADD.

It should be noted that during the calibration process the water model flow results differed from the field in one area located in the vicinity of Hot Springs Road and Lillooet Avenue. After discussions with VHS operations staff a suspected restriction at the location of this intersection tee fitting was identified. When this is accounted for in the model the flows and pressures match the field data. All model runs have been completed assuming this fitting has been replaced, making this a top priority project.

VHS bylaws and MMCD Municipal Infrastructure Design Guideline Manual criteria were utilized for the model. Water model parameters are summarized in **APPENDIX C.**

2014 Water demand calculations are presented in **FIGURE 7**. Future demands are presented in **FIGURE 8** (reflecting the scenario where all properties within are serviced by the water utility) and **FIGURE 9** (full development to current zoning with all properties serviced by the water utility)

Additional criteria are discussed within the relevant sections herein.

5. 2014 System Deficiencies

5.1 Linear Assets

According to the VHS listing of Tangible Capital Assets, the first piping and valves were installed in 1984 and therefore all distribution infrastructure within VHS has been in service for 30 years or less. Supply and distribution lines are either plastic (PVC and HDPE) or ductile iron (DI), all of which have a theoretical design life span of 80 years.

One of the weaknesses of the VHS distribution system is the lack of readily available information with respect to as-built drawing and construction conditions. Because VHS has not yet adopted development guidelines which include design and installation policies, there has been some inconsistency in the requirements for the design and construction of municipal infrastructure. In 2014, VHS experienced a sanitary line rupture which appeared to be due to inconsistent backfill - a rock in direct contact with the line created a point load, weakening the line at that location. Other underground work within the Village has also revealed installation practices which could adversely impact the service life of underground assets. To address these concerns in the future, it is strongly recommended that MMCD standards be adopted for municipal infrastructure design and construction.

Recommendations

- Locate as-built drawings and construction inspection reports in archives, digitize and add to a Water Asset Management database.
- Adopt MMCD Design guidelines, with modifications as necessary, for all construction of Municipal Works within VHS

5.2 Fire Flows and Hydrant Coverage

Fire flows were modeled, and the results analyzed for conformance to FUS (Fire Underwriters Survey) and MMCD requirements as outlined in **TABLE 5.1**. Several issues were noted within the existing system when looked at as a whole, which is typical for systems constructed in pieces over several decades. It is recommended that all new development undergo an engineering review which includes a water model analysis to determine the impact of fire flow and demand to the VHS system prior to approval being issued.

TABLE 5.1 Fire Hydrant and Flow Criteria

Criteria	Units	MMCD	FUS
Flow			
Single Family (R-1, R-2, R-3)	L/s	60	
Apartments, Townhouses (R-4, R-5)	L/s	90	
Commercial (C)	L/s	150	
Institutional (P-1)	L/s	150	
Minimum System Pressure	psi	22	
Maximum Pipe Velocity	m/s	3.5	
Hydrant Spacing			
Single Family (R-1, R-2, R-3)	m		180
All Others	m		90
Hydrant Coverage Radius			
Single Family (R-1, R-2, R-3)	m		69
Apartments, Townhouses (R-4, R-5)	m		67
Commercial (C)	m		66
Institutional (P-1)	m		66

5.2.1 Fire Flow and Residual Pressure

Three existing hydrants were unable to provide adequate fire flows and/or maintain the minimum 22psi residual pressure under fire flow conditions. All these hydrants serviced commercially zoned properties at the south end of Hot Springs Road.

TABLE 5.2 Residual Pressure and Available Fire Flow

Hydrant	Zoning	Required Fire Flow (L/s)	Residual Pressure at Required Fire Flow (psi)	Available Fire Flow at 22psi Residual Pressure (L/s)
H-59	C-4	150	**18**	**144**
H-60	C-4, C-7	150	**13**	**139**
H-65	C-7	150	**7**	**132**

It is recommended that a section of water main on Hot Springs Road be upgraded from 250mm to 350mm in order to address this issue, with a plan in place to provide adequate firefighting supply through alternate means until such time.

5.2.2 Pipe Velocity

The velocity of water within the system under fire flow conditions is limited to 3.5 m/s under MMCD guidelines. Several locations were noted as exceeding this limit. **TABLE 5.3** lists those exceedances, as well as piping upgrades that would address the issue.

Maximum velocity limits in distribution piping are in place to address potential scour (due to the presence of granular material), cavitation, stress fractures (usually due to cycling) and transient forces created when flow conditions change suddenly (valves opening, pumps shutting off, etc). Fire flow conditions represent a deviation from the regular operation of the distribution system. Because pipe velocity under non-fire flow conditions is well under the MMCD limit, it is therefore recommended that piping upgrades to address velocity should be undertaken as opportunity arises (for example, when a section of line is replaced, or a service added in close proximity) rather than undertaken as a stand-alone project.

TABLE 5.3 Pipe Velocity (Fire Flow Conditions)

#	Hydrant	Zoning	Pipe Velocity at Fire Flow (m/s)	Location of highest recorded velocity	Upgrade required for pipe velocity under 3.5m/s	Upgrade Pipe Details
1	H-1	C-1	**4.87**			
2	H-2	C-1	**4.87**	J-240 to J45 (200mm)	J-240 to J45	11 m of 250 mm
3	H-3	C-1	**4.87**			
4	H-6	C-2	**4.77**	J-50 to J-202 (200mm)	J-50 to J-202	62 m of 250 mm
5	H-12	R-4	**5.24**	J-53 to J-204 (150mm)	J-53 to J-204	17 m of 200 mm
6	H-13	R-4	**5.24**			
7	H-26	C-5	**5.54**	J-212 to J-38 (150mm)	J-210 to J-40	20 m of 250 mm
8	H-27	P-1	**5.54**	J-210 to J-40 (150mm)	J-37 to J-40	51 m of 200 mm
9	H-32	P-1	**5.54**	J-212 to J-38 (150mm)	J-37 to J-36 J-39 to J-38	50 m of 250 mm 61 m of 200 mm
10	H-34	P-1	**3.77**	J-37 to J-40 (150mm)	J-38 to J-212	68 m of 250 mm
11	H-49	C-5	**5.93**	J-21 to J-217 (150mm)	J-21 to J-217	12 m of 250 mm

5.2.3 Hydrant Spacing

The maximum FUS spacing of hydrants in commercial, industrial, institutional and multi-family residential areas is 90 meters; in single family residential areas 180 meters is recommended. Several hydrants were found to have spacing exceeding FUS guidelines, and listed in **TABLE 5.4.** It is recommended that VHS review the value to property owners of adding hydrants to the existing system to meet FUS guidelines.

TABLE 5.4 Hydrant Spacing

#	Hydrant	Zoning	Hydrant Spacing* Yes/No	Distribution Main Section Affected
1	H-1	C-1	No	Between H-1 and H-2
2	H-2	C-1	No	Between H-2 and H-1
3	H-4	P-1, C-1, C-2, C-3	No	Between H-4 and H-5
4	H-5	C-2, C-3	No	Between H-5 and H-4, H-6, H-7
5	H-6	C-2	No	Between H-6 and H-5, H-7
6	H-7	R-2	No	Between H-7 and H-9
7	H-7	C-2	No	Between H-7 and H-6
8	H-9	R-2, R-3	No	Between H-9 and H-7
9	H-12	R-4	No	Between H-12 and H-13
10	H-13	R-4	No	Between H-13 and H-12
11	H-24	C-1	No	Between H-24 and H-25
12	H-25	C-1	No	Between H-25 and H-24
13	H-32	P-1	No	Between H-32 and H-31, H-33
14	H-33	P-1	No	Between H-33 and H-32
15	H-34	P-1	No	Between H-34 and H-33
16	H-44	C-5	No	Between H-44 and H-43, H-45
17	H-45	C-5	No	Between H-45 and H-44, H-46
18	H-46	C-5	No	Between H-46 and H-45, H-49
19	H-49	C-5	No	Between H-49 and H-46, H-54
20	H-53	R-4	No	Between H-53 and H-64
21	H-54	R-4	No	Between H-54 and H-55, H-49
22	H-54	C-5	No	Between H-54 and H-55, H-49
23	H-55	C-5	No	Between H-55 and H-54, H-56
24	H-56	C-4, C-5	No	Between H-56 and H-55, H-57
25	H-63	R-1	No	Between H-63 and H-64
26	H-64	R-1	No	Between H-64 and H-63

* Max space R-1, R-2, R-3 = 180m, all other zones = 90m

5.2.4 Hydrant Coverage Radius

FIGURE 2 depicts the properties which do not currently meet the FUS criteria for Hydrant Coverage Radius. Many of these "non-conforming" properties are not fronted by the VHS water utility, but several gaps were also noted for properties serviced by the existing system. Recommended "future" hydrant installations to partially mitigate this concern utilizing the existing distribution system can also be found on Figure 2. Figure 3 identifies the hydrant coverage upgrades required into the future on a Village-wide scale. A complete list of non-conforming civic addresses can be found in **APPENDIX C**

In order to bring all properties to FUS standards, new hydrants and associated distribution lines are recommended for the following streets:

- Ramona/Angus/Hadway/Myng/Nyms/Hope (875 m)
- Lillooet/Cedar (250 m)
- Lillooet/Bear (705 m)
- Naismith/Mount (595 m)
- Emerald/Diamond (350 m)
- Rockwell (610 m)
- Pine/Lakberg (400 m)

Based on current zoning, an upgrade to the existing system is also recommended for a 125 m section of Hot Springs Road between Ramona and the Holiday Park entrance. Construction of the distribution lines will also provide access to the VHS water utility for properties not currently served. Construction cost estimates for each of these locations are provided in **APPENDIX D.**

Recommendations

- Upgrade the 250 mm line on Hot Springs Road between Hydrants 59 and 65 to 350 mm line to address inadequate fire flows (125m).
- Add hydrants to the existing system to meet FUS linear spacing guidelines.
- Add hydrants to the existing distribution lines to meet FUS coverage guidelines.
- As opportunity arises, upgrade piping to address velocity concerns.
- Construct new frontage lines and upgrade existing distribution lines as funding is available to meet FUS coverage guidelines and provide water utility service to properties currently on private well systems. Until that time, ensure that residents have information regarding insurance, and that a fire fighting plan is in place to address the issue.
- Require that all new development undergo an engineering review which includes a water model analysis to determine the impact of fire flow and demand to the VHS system prior to issuing approval.

5.3 Flow Restrictions

As noted in Section 4, during the model calibration and field testing an undocumented flow restriction was noted at the corner of Cedar Avenue and Hot Springs Road. Further investigation indicates the probability of a damaged tee at this location. Replacement of this section of pipe is recommended as soon as possible in order to provide adequate fire protection to properties within the Village center. A cost estimate for this work is presented in **Appendix D**.

Anecdotal evidence from operations personnel also indicates the presence of significant amounts debris and granular material within the system. Depending on the severity of this problem, this debris could affect system efficiency and flow capabilities. System-wide flushing is recommended. Costs are provided in **TABLE 9.1**.

Note: The model was run assuming this restriction has been rectified.

Recommendations

- Replace tee at Cedar Avenue/Hot Springs Road as soon as possible.
- Allocate Funds to flush and clean both the supply and distribution lines.

5.4 Water Use Data

Although the amount of water entering the VHS system is measured, and some flow meters are installed on commercial properties, no means currently exists to universally monitor distribution flows. This limits the ability of the VHS water utility to analyze water usage to determine water rates, system losses, and conservation strategies. VHS has recognized the importance of metering as a demand management tool, as evidenced in the Water Conservation Plan, and the benefits of universal metering are discussed in detail in Section 8.

Recommendation

- Implement a strategy and a timeline to implement Universal Metering of all properties.

5.5 System Redundancy and Resiliency

Components of the system, specifically the above-ground piping, storage reservoir, beach pump station and below-to-above ground transitions are particularly vulnerable to seismic events. Resiliency of the distribution system to withstand a major disaster is also an issue. Without a fully looped system, should a break occur on one of the dead end legs, service to those properties will be disrupted until a repair can occur. Lack of electronic flow monitoring means that leaks and breaks can go undetected until visible above ground or property owners notice a reduction in flow or pressure.

There is no redundancy in the single intake, supply line and reservoir and if any one of these assets was compromised it would adversely affect the entire system.

Recommendation

- When planning expansions to the system and other capital works projects, system resiliency and redundancy should be a priority.

5.6 Emergency Power Supply

According to the MMCD design guidelines, standby power should be provided to allow the greater of MDD plus fire or PHD during a power outage. A generator was installed at the WTP in 2014 which will come on line automatically in the event of a power interruption. Emergency power for the beach pumps is provided by a generator on a trailer, shared by the VHS wastewater treatment facility, limiting water supply and treatment until manually brought online.

Recommendation

- Allocate funds for emergency power generation to be permanently located at the beach pump station, with a contingency plan in place until such time as installation occurs.

5.7 Electrical, Communication, and Instrumentation

VHS currently has water utility instrumentation at the beach pump station, the WTP site, and the reservoir. Efforts are currently underway to establish a Village-wide SCADA system to establish communicate between these sites. As opportunity and funding becomes available, the following improvements should be considered:

1. SCADA to oversee raw water pump station, WTP, reservoir with a focus on automated reporting and remote monitoring and control.
2. Remote access to SCADA.
3. Upgraded instrumentation, including analytics (turbidity specifically) and flow measurement at the beach pump station, allowing for improved detection of raw water quality and more accurate flow measurement.
4. Improve control panel at both the beach pump station and old chlorination facility.
5. Improve control and power wiring between the reservoir kiosk and the radio enclosure.
6. Update and collate all water utility electrical drawings.
7. Formalize an asset management plan for the electrical/instrumentation and communications systems.
8. The beach pumps currently operate outside of their design parameters (low lift to the WTP instead of high lift to the reservoir under same flow rates). Account for pump/motor replacement and VFD maintenance and repair in the next ten years.
9. VFDs at the WTP for power and wear reduction on the 40 HP motors and valve being used for flow restriction on the pump intake.

Recommendations

- Implement SCADA, electrical, and instrumentation items 1-5 (Section 5.7) as funding and opportunity allow
- Locate and digitize electrical drawings
- Formalize an Asset Management Plan for all water utility Assets
- Allocate funds for VFDs at the WTP, and maintenance costs at the beach pump station

5.8 Chlorine Concentration and Seasonal Flows

Until recently, VHS used chlorine alone for primary disinfection. With the commissioning of the ultrafiltration (UF) water treatment facility in 2014, chlorine is now utilized only as a secondary disinfectant. The purpose of a chlorine residual within the system is twofold:

1. To minimize bacterial regrowth in the distribution system with its associated taste, odour and health problems.
2. To provide an immediate indication of treatment process malfunction or a break in the integrity of the distribution system (evidenced by a rapid drop in disinfectant residual). (Health Canada, 2009).

Chlorine is injected downstream of the UF membranes at a concentration of 0.9 - 1.1 mg/L. Specific requirements for chlorine residual concentrations are set by regulatory authorities and vary among jurisdictions. A suggested operational range for free chlorine residual is between a detectable level and 5 mg/L, with most Canadian municipalities in the range of 0.04 to 2.0 mg/L (Health Canada, 2009).

All field measurements of chlorine in the distribution system should be carried out at a free-flowing or flushed sampling location according to appropriate sampling procedures, in order to achieve a fresh sample that is reflective of the system water quality (Health Canada, 2009).

VHS currently samples the distribution system from a number of locations around the Village. Although these sites have been chosen well to provide chlorine residual data, they do not meet Health Canada guidelines for sampling. It is therefore recommended that new free-flowing chlorine sample points be established as per operations requirements.

Recommendation

- Establish new Chlorine sampling pedestals as per Health Canada Guidelines.

All communities experience variation in flow between summer and winter. VHS, however, as a resort municipality, has extreme variations due to the influx of seasonal residents and tourists in the summer months. Historic water system flow data recorded by VHS personnel can be found in **APPENDIX A**. **FIGURE 10** illustrates these extremes graphically.

In the upper chart, variation between maximum daily flow rates as high as 2,576 m^3 and minimum daily flow rates as low as 0 m^3 can be seen. Flow is measured on the supply side, and a "zero" flow rate reflects a situation where no raw water was drawn from Harrison Lake, with all demand met by water already in the reservoir that day. The lower chart reflects monthly demands in the summer months (July/Aug) three to four times the winter monthly demand (Nov/Dec/Jan/Feb).

VHS residual chlorine levels were examined under both summer and winter flows, and the chlorine decay results are illustrated in **FIGURES 4** and **5**. In **FIGURE 4**, the red lines represent the very lowest levels of residual chlorine present in the system during summer flow conditions. Chlorine is added at the water treatment plant, so low levels are expected in the supply line between Harrison Lake and the WTP. Levels in this line are of no concern, as the water undergoes treatment prior to entering the distribution system. Low chlorine levels are also evident on the "dead end" legs of the system which service hydrants only along McCombs Drive, McPherson Road, Mount Street and Chehalis Drive. Although dead ends are not ideal, until development necessitates looping the system, chlorine levels in these pipes can be maintained by a regular flushing program. Of greater concern are the orange lines along McPherson Road and a small section at the east end of Driftwood Avenue. At these locations, chlorine levels are low due to long residence time resulting from low residential demand. A regular flushing program that takes into account moving water through at these locations is an absolute necessity to ensure adequate chlorine residuals.

FIGURE 5 illustrates the chlorine levels under winter flow conditions. In addition to the areas of concern found during the summer, sections of Hot Springs Road, Miami River Drive, Eagle Street, Naismith Avenue and the small development adjacent to Alder Avenue experience low levels. The red line along the beach is also of concern and must either be isolated from rest of the distribution system over the winter months and flushed prior to reconnection, or flushed regularly during the winter.

The manner in which chlorine levels decay over time on the McPherson Road dead leg is illustrated in **FIGURE 11** (Refer to **FIGURES 4** and **5** for junction locations). Junction J-95, at the corner of McPherson Road and Hot Springs Roads is represented by the blue line in all 4 graphs. There is enough demand at this junction (ie - enough water usage by the surrounding properties) to maintain a chlorine concentration around 0.250 mg/L in the summer (top left graph). A little further east along McPherson Road, however, at J-226 (red line in all four graphs), lower demand results in chlorine levels of 0.100 mg/L. The east end of McPherson Road is a "dead leg". There is no demand at J-96, and the associated green line in top left graph shows how chlorine levels decrease over time as a result.

The effect of flushing on chlorine levels along McPherson Road are presented in the bottom graphs of **FIGURE 11**. The bottom left had graph illustrates the summer flushing program (every 5 days for 20 minutes). The winter flushing program increases to 30 minutes every 3 days due to low demand.

To mitigate the risk to public health associated with low chlorine residuals, a flushing program has been established for both summer and winter months for the entire distribution system and is presented in **FIGURE 12**.

Recommendations

- Implement winter and summer flushing program as outlined in **FIGURE 12.**
- Eliminate dead legs at Mount Street, Lillooet Avenue, Cedar Avenue, McCombs Drive and McPherson Road as funding allows and/or development occurs.

5.9 Above ground piping

To the west of the Miami Slough, the 200 mm reservoir supply and 300 mm distribution lines are located above ground, following the shortest path between the slough bank and reservoir directly up the Agassiz Mountain rock face. The two lines, constructed separately between 20 and 30 years ago, are supported by structural steel bolted to the bedrock.

A 2014 study conducted by Elbury Consulting Ltd. (Structural Engineers) of this above-ground section yielded the following observations:

- Significant surficial corrosion of the support structures.
- Base plates completely buried in organic matter.
- Structural support members deformed due to rock fall impact.
- Significant vegetation surrounding the structures.

Photos of these concerns can be seen in **FIGURE 15**.

The 2012 British Columbia Building Code requires water systems to be designed as "Post-Disaster". It is expected that these systems remain functional with little or no damage after a seismic event in order to provide adequate supply for both safe drinking water and emergency fire response. Although no seismic analyses of the structures was undertaken by Elbury, it is their opinion that these support structures "would not meet current day seismic standards and it is more probable than not that the system would receive some sort of damage even after a moderate seismic event." The critical nature of these two lines necessitates prioritizing an upgrade to post disaster. Further study will need to be undertaken to determine the best option for VHS: retrofit the existing supports or relocate the existing lines to the access roadway.

The Elbury report is included as **APPENDIX E**

Recommendations

- Allocate funds for an engineering study and cost estimate to determine how to upgrade or replace the above-ground piping section to meet post-disaster requirements.
- Until upgrade/replacement occurs:
  - Scrub all loose rock, debris, and vegetation from the cliff face.
  - Remove all debris and loose soil from the support bases and anchor bolts.
  - Paint the structures to protect from further corrosion.

6. Future Development & Demand

6.1 Population Projection

Population growth is challenging to predict for a community such as Harrison Hot Springs. VHS is heavily tourism-dependent, with a high percentage of seasonal residents. The lack of industry, combined with the single sector job opportunities, aging demographic, and relatively small population within the community mean that typical population growth models cannot be applied.

TABLE 6.1 compares Statistics Canada population and age data for VHS and the much larger Fraser Valley Regional District.

TABLE 6.1 Census data

	1986	1991	1996	2001	2006	2011	Average Annual Growth Rate
Village of Harrison Hot Springs (VHS)	569	655	898	1,343	1,573	1,468	6.3% (1986-2011) 4.2% (1996-2011)
Median Age (VHS)				43.7	49.8	54.0	
Fraser Valley Regional District (FVRD)			222,397	237,550	257,031	277,593	1.7% (1996-2011)
Median Age (FVRD)				36.6	38.2	39.6	

Between 1986 and 2011, the population of VHS increased an average of 6.3% per year. During the five year interval between 2006 and 2011, the population **decreased** by 6.5%. In contrast, the population of the FVRD has steadily increased since 1996, at an average of 1.7% per year, with no period of decline. The growth rate for VHS over the same time interval was 4.2% per year.

It is also worth noting that although the median age of residents in both VHS and FVRD increased in the decade between 2001 and 2011, the median age of VHS residents increased by over 10 years, whereas in the FVRD as a whole the difference was a more modest 3 years.

Because the profile of the VHS population is so distinct from FVRD, and indeed from the province of BC, projecting that population 25, 50 or even 10 years into the future is challenging. **FIGURE 13** illustrates several different population projections for VHS. The 1986-2011 census data can be seen as a heavy, bright green line, with the most recent census population (1,468) noted at year 2011. Statistical analysis of the census data results in a linear regression illustrated by the black dotted line, with a population forecast in the year 2036 of 2,733.

The 1.7% FVRD growth rate is represented by the red dashed line. For VHS, this growth rate underestimates the current population, and does not fit the population profile. Likewise, the blue dashed line, which is based on 3.87% cumulative annual growth (based on the VHS census data between 1986 and 2011), results in a population in the year 2036 which is also out of line with the current declining population.

For resort focused communities, disposable income of people both within and outside the province has a large impact on population growth, and is strongly connected to the economy.

The average annual rate of growth between 1986 and 2011 is 6.3%, and is illustrated by the purple dashed line resulting in an estimated year 2036 population of 2367 people. Similarly, when only the data between 1996 and 2011 is examined, the 2036 population is estimated at 2,417 (orange dashed line).

So where does that leave the VHS population projection over the next two decades? In the absence of a crystal ball, and with the development community subject to highs and lows similar to those experienced over the past 25 years, it is estimated that the 2036 population will be in the range of 2,367-2,733 people. It will be important to re-evaluate this projection when the next census becomes available in 2016. A single large development, or sharp increase or decrease in the number of overnight tourist visits, could greatly impact the projected numbers.

Recommendation

- Re-evaluate population projections when then the next census data becomes available in 2016.

6.2 Development Projections:

In 2014, a detailed study was conducted by the VHS Department of Development and Community Services which projects ultimate buildout densities for all land within the Village. A copy of this report is included as **APPENDIX F**.

Based on OCP land use designations, except where zoning has been amended to a Comprehensive Development Zone, maximum future development is predicted to be comprised of 15,976 m^2 commercial area, 1,240 potential new redevelopment units, and 45 units of residential infill (construction on vacant lots).

FIGURE 6 shows the Development Projection areas, as well as a breakdown of the type of development anticipated in each area.

6.3 Demand Projections

As outlined in Section 4, average daily demand (ADD) for summer and winter was modeled in WATERGEMS™ utilizing a combination of meter data and demand estimates based on OCP land usage for each property within the Village. Maximum Daily Demand (MDD) and Peak Hourly Demand (PHD) were calculated based on ADD. Water demand calculations for current and future scenarios are presented in detail in **FIGURES 7, 8 and 9** and summarized in **TABLE 6.2**.

TABLE 6.2 System Demands

		ADD L/sec	MDD L/sec	PHD L/sec	System Capacity* L/sec
2014	**Existing System**	13.4	26.7	40.1	176.7
FUTURE	**2014 PLUS Unserviced Properties**	25	50	75	200
	Full Development	46	92	138	288
	Full Development PLUS Resort	50.4	100.8	151.2	250.8

*System Capacity is the greater of MDD + Fire Flow (max 150L/sec for VHS) or PHD

Calculating the 2014 existing system demand is relatively straightforward, and is validated by measurable historical data. Three future scenarios were also investigated:

1. **2014 Demand Plus Unserviced Properties**
   Servicing all properties within VHS boundaries. Approximately 54% of the population is currently served by the VHS water utility, with the other 46% served by private systems.
2. **Full Development:**
   Servicing all properties within VHS boundaries developed to their full potential as per OCP zoning.
3. **Full Development plus Resort:**
   All demand required for Scenario #2, with the very significant addition of the Harrison Hot Springs Resort & Spa (HRS). Please refer to Section 2 for a detailed discussion regarding the impact of HRS connection.

The most challenging aspect of predicting demand is estimating population and development growth rates. For this analysis, we have assumed that:

- VHS will have a goal of servicing all properties within a finite time frame - either 10 years or 25 years - (Scenario #1 above).
- development will take place in pace with a linear population growth rate between 6.3% and 7.3%, measured from 1986 levels (that translates into the addition of 36-43 people per year or a 2.45%-2.9% linear annual increase over 2011 levels). These ranges were discussed in greater detail in Section 6.1. It is imperative that growth rates be re-evaluated when the 2016 census becomes available, especially in light of the decline in population experienced between 2006 and 2011.

Recommendations

- Re-evaluate population growth rate assumptions when the 2016 census data becomes available
- Establish a plan to provide service to all properties within VHS within 10 or 25 years
- Allocate funds for a minor Water Master Plan update in 2017 to incorporate 2016 census data

6.4 Impact of Incremental Development:

TABLE 6.3 has been developed to "put numbers" to the impact that specific future development projects could have on the water system. The concept of Single Family Equivalent (SFE) has been used, allowing for a direct comparison of residential and commercial units for demand and storage requirements. It can be seen from the table that a 40-unit condo development has less of an impact on the system than 40 detached housing lots (single family subdivision).

Table 6.3 illustrates that commercial development of the size likely to occur in VHS will have minimal impact on the system. Residential development in the form of single or multi-family developments will have significantly more impact.

TABLE 6.3 SFE Demands - Future Development

	Number Units	SFE	ADD L/sec	MDD L/sec	PHD L/sec	Storage m^3
Single Family Subdivision	40	40	0.80	1.60	2.40	78.40
Multi Family	40	26.7	0.53	1.07	1.60	52.27
Campground Site	40	26.7	0.53	1.07	1.60	52.27
Commercial (C-4) 300 m^2	N/A	0.9	0.02	0.04	0.05	1.76
Commercial (C-5) 300 m^2	N/A	1	0.02	0.04	0.06	1.96
Commercial (Other) 300 m^2	N/A	2	0.04	0.08	0.12	3.92

7. Future System Analysis

7.1 Water Supply

VHS licensing allows for a withdrawal of 454,609 m^3 of water per year from Harrison Lake. The maximum annual withdrawal between 2007 and 2013 was 270,861 m^3 - nearly 60% of the maximum allowable limit. **TABLE 6.2** gives an indication of how demand is predicted to increase over time. When all VHS properties are serviced, 2014 demands are predicted to nearly double, which will necessitate either an amendment to the existing license, or development of an additional water source.

Recommendation
• Timely application for water license amendment as demand increases

7.2 Linear Assets

The National Water and Wastewater Benchmarking Initiative has developed excel-based templates for the assessment of water utility assets available on their website free of charge. The templates were used for a high-level evaluation of the VHS linear assets. Based on service life of 80 years, it is estimated that annual replacement costs for the VHS distribution pipelines will average approximately $3,000/year for the next 25 years, and $53,000/year over the next 100. These numbers reflect only the design life span of the pipes based on pipe material. The numbers do not take into account unknown or unforeseen circumstances such as installation conditions, accidental impact or manufacturing defects, but do give an idea of the health and relatively young age of the system. Results of this analysis are presented graphically in **FIGURE 14**. Unlike municipalities with lines that have been in service 50 or even 100 years, VHS has no "backlog" of lines operating beyond the designed service life, and in fact should not require major expenditure in this area due to "normal wear and tear" for decades.

Recommendation
• Contribute funds annually to a reserve for both the eventual and unexpected replacement of underground water utility assets.

7.3 Distribution and Fire Flow Capacity

There are three scenarios requiring upgrades to the VHS distribution system:

1. Analysis of the existing system indicates deficiencies in fire flow capability due to pipe size and hydrant location.
2. Additional piping is also necessary to service and provide fire flow and hydrant coverage to properties currently on private well systems.
3. Full development, as outlined in the development projections presented in **Appendix F** necessitates additional upgrades.

Future piping and hydrant requirements for #1 and #2 above are illustrated in **FIGURE 3**. **FIGURE 6** depicts the future system at full development (#3 above). **TABLE 7.1** summarizes the projects to be completed to achieve full service and fire flow capacity to all VHS properties. Detailed cost estimates and location plans are presented in **APPENDIX D**.

TABLE 7.1 Distribution Improvements for Full Service (Including Fire Flow)

Project	Description	Purpose	Scenario	Cost	DCC Eligible?
Hot Springs Road 'A'	Upgrade 375 m of watermain to meet commercial fire flow requirements	Provide fire flow for existing development	1	**$377,825**	PARTIAL
Hot Springs Road 'B'	Upgrade 125 m of watermain to meet commercial fire flow requirements	Provide fire flow for future development	2 and 3	**$225,450**	PARTIAL
Village Center Loop	Add 250 mm of watermain to Lillooet/Cedar	Provide service and hydrant protection to properties on wells	1 and 2	**$173,600**	PARTIAL
Lakeshore Residential	Add 605 m of watermain to Lillooet (east) and Bear	Provide service and hydrant protection to properties on wells	1 and 2	**$426,640**	PARTIAL
Naismith and Mount	Add 595 m of watermain to Naismith and Mount	Provide service and hydrant protection to properties on wells	1 and 2	**$341,640**	NO
Emerald and Diamond	Add 350 m of watermain to Emerald and Diamond	Provide service and hydrant protection to properties on wells	1 and 2	**$206,880**	NO
Angus Estates	Add 875 m of watermain to Angus Estates subdivision	Provide service and hydrant protection to properties on wells	1 and 2	**$555,600**	NO
Pine and Lakberg	Add 490 m of watermain to Pine and Lakberg	Provide service and hydrant protection to properties on wells	1 and 2	**$230,160**	NO
Marine Tourism 'A"*	Add 610 m of watermain to Rockwell	Provide service and hydrant protection to properties on wells	1 and 2	**$512,985**	YES
Marine Tourism 'B'*		Provide fire flow for future development	3		
Water Services**	Add 57 service connections	Connect all existing fronted properties	1 and 2	**$299,250**	NO
Water Hydrants**	Add 5 hydrants	Add hydrants to existing fronted properties	1	**$63,000**	NO
System Flushing	Improve system performance by flushing and/or pigging 15 km of pipe	Clean debris from system	1	**$75,000+**	NO
Sampling Pedestals	Install 6-10 Heath Canada compliant sampling locations	Construct compliant sampling locations	1	**$60,000**	NO

Total: 3,548,030

* Marine Tourism A and B projects have been combined ** Water Services and Water Hydrants have been combined into one project for cost estimating, and separated here for illustrative purposes

Analysis of the future scenarios under fire flow conditions yield residual pressures within acceptable range (with all lines constructed) but the full buildout scenario (#3) results in high velocities throughout the system. These future scenarios will necessitate many changes to the system, including storage, treatment and pumping capacity which will alter these model results. Detailed data is available in **APPENDIX C**.

Recommendations

- Determine the feasibility of constructing new watermains to service existing properties.
- Ensure that new developments and OCP amendments are analyzed using the VHS water model prior to final approval.

7.4 Pumping Capacity

VHS has two pumping stations, with pumps of similar capacity operating at each. There are three 40 HP pumps at the beach pump station, and two 40 HP pumps at the WTP with room for a third to be installed as flow rates increase. Both pumping stations are designed for one or two pumps to run, depending on demand, with a third as a "backup".

FIGURE 17 shows the pumping capacity of the 40 HP pumps at both the beach (top) and WTP (bottom) graphically.

A cautionary note is in order when considering the beach pumps **FIGURE 17**. From data collected during a 2013 field flow test (prior to the commissioning of the new WTP), the VFD-controlled beach pumps were individually capable of approximately 25 L/sec. Two pumps resulted in a flow of 38L/sec, and three pumps 44L/sec. Looking at the system pump curve in **FIGURE 17**, the theoretical capacity of any one of the beach pumps is approximately 39.5 L/sec, and two pumps should be able to produce flows of 67.5 L/sec. In other words, two pumps operating in parallel should be capable of producing flows 50% greater than what the field test indicates. It is unclear whether the lower-than-expected flows have to do with pump condition, control logic, or some sort of flow restriction downstream of the pump station. Adding to this uncertainty, the addition of the WTP necessitated a change in control logic to operate the beach pumps at a much lower pressure. This means that the beach pumps are no longer operating under the conditions for which they were originally selected, and could translate into increased wear and maintenance issues over time. Further investigation is necessary to determine the "true" capacity of these pumps and allocate funds for any necessary improvements to the beach pump station.

A Hazen-Williams analysis of the WTP system curve indicates that a single WTP pump is capable of 34 L/sec, and two pumps operating will result in a flow of 66 L/sec. Provision has been made for a third, redundant pump to be added as flow rates increase. In general, pumping capacity should meet maximum day demand (MDD) with largest pump out of service and balancing storage online. MDD for the various flow scenarios are presented in **TABLE 6.2**. As MDD reaches the 34 L/sec level, the third pump at the WTP should be budgeted for. Once MDD demand exceeds 66 L/sec, additional pumping and treatment capacity will be required.

Recommendations

- Allocate funds for the addition of the third pump at the WTP as demand increases.
- Commission an engineering study to investigate the flow capabilities of the two pump stations with the following focus:
  - investigate the impact of the current operating conditions of the beach pumps (low pressure, high flow vs. high pressure, high flow as originally designed).
  - determine the pumping capacity of both the beach pump station and the system as a whole, including redundancy.
  - perform a cost vs. benefit analysis for the addition of VFD control on the pumps at the WTP.
  - make recommendations for changes to the system if required.

7.5 Treatment Capacity

The VHS Ultrafiltration (UF) Membrane System is set for a nominal flow rate of approximately 31.5 L/sec with the expansion capability to bring the total flow up to 63 L/sec. Expansion of the system over time will be accomplished by the addition of membrane pairs and one 40-HP pump as demand increases with connection and/or development. Pumping capacity was discussed in Section 7.4.

Membranes can be added in pairs as needed as MDD exceeds 31.5L/sec, with each pair designed to provide just under 3 L/sec of additional treatment capacity.

A cost estimate for the completion of this work has been provided in **APPENDIX D**.

Recommendations

- Allocate funds for the addition of membranes to existing system as demand increases beyond 31.5 L/sec.
- Allocate funds for the design and construction of a second treatment facility as demand increases beyond 63 L/sec.

7.6 Storage Capacity

TABLE 7.2 provides a snapshot of the ability of the existing 2,745 m^3 reservoir to meet storage needs as demand increases over time. The impact of adding the HRS on to the system is also illustrated. The far right column indicates the amount of excess (in black) or deficit (in red) storage under the various development scenarios. VHS will have to add storage as development occurs. When ADD reaches 25 L/sec, less than 2% excess storage capacity will remain, and additional storage will be required. Options to meet future requirements may include recommissioning the existing concrete reservoirs (currently out of service), adding the HRS reservoir to the system, or construction of a new storage facility.

TABLE 7.2 Storage Requirements - Existing and Future (M^3)

		ADD L/sec	Fire Storage	Equalization Storage	Emergency Storage	Total Storage	Existing Storage	EXCESS DEFICIT
2014	Existing System	13.4	1,080	577	414	2,071	2,745	**674**
FUTURE	2014 PLUS Unserviced Properties	25	1,080	1,080	540	2,700	2,745	**45**
	Full Development	46	1,080	1,987	767	3,834	2,745	**-1,089**
	Full Development PLUS Resort	50.4	1,080	2,177	814	4,072	2,745	**-1,327**

all storage values in m^3

FIGURE 16 attempts to quantify demand growth over time, with several very significant assumptions:

- Population increases in a linear fashion over time as outlined in Section 6.1.
- connection of unserviced properties to the utility occurs linearly and completely over 10 or 25 years, and
- Development and tourism are linearly correlated with population growth, allowing for a "per capita" estimate of total VHS water usage.

The purpose of **FIGURE 16** is to illustrate visually the limited capacity of the existing reservoir to meet increasing demand, and the numbers presented should not be utilized as the basis for future design without further analysis.

In **FIGURE 16**, the solid black line shows the estimated current population serviced by the water utility. The red line shows the "maximum" population that can be served by the reservoir. The blue lines, referred to as "Scenario #1" represent connection of properties currently unserviced (meaning domestic water is supplied by private wells) at a constant rate over the next 10 years (dashed) or 25 years (solid). The green lines add the most modest population growth figures from Section 6.1 to the Scenario #1 blue lines. The green diamond shaped markers correspond to the years (2021 and 2026) that the population is predicted to first exceed the storage capacity for the green line scenarios if the assumptions are accurate. This is only 6 -11 years from the time of writing.

It is important to note here that ADD has been determined for both "summer" and "winter" flows due to the extreme seasonal variation in the Village. Because a 12-month ADD is generally used as the basis for reservoir sizing, there is a degree of conservatism in the winter months but summer conditions are better reflected.

The 2016 census will allow for fine-tuning of the population projections, and as demand-reduction strategies are put in place, a timeline can be established for the design and construction of additional storage.

Recommendations

- Undertake preliminary engineering study be to investigate options for increased storage.
- Monitor population and water usage to establish a timeline to add reservoir capacity.
- Implement demand reduction strategies in order to delay the necessity of adding storage capacity and addition of the third pump at the WTP as demand increases.

8. Demand Management

Within this report, most of the discussion regarding the limitations of the VHS water utility is presented in terms of "demand" rather than "timing". Statements such as "when ADD reaches 63 L/sec..." have been utilized as opposed to "in the year 2025...." The reason for this is twofold. First, the difficulty of predicting demand over time for a municipality such as VHS was discussed in Section 6.1. Small size, high seasonal variation due to tourism, census data indicating a declining population (and lack of correlation between VHS and larger-scale FVRD or BC statistical trends), and limited geographical area available for development all make forecasting growth over time challenging. Second, VHS must balance the need for infrastructure investment with a very limited annual budget. The Village often has to strategically pursue alternate funding sources such as grant programs and development fees in order to expand infrastructure - because the money is simply not available in general revenue.

Demand should be monitored over time, using flow data which is already collected by operations personnel. At the end of the year, if demand has increased from the year before, a simple analysis can be performed (Was it an exceptionally "dry" year? Was the environment for development better than in years past? Were new conservation measures put in place?) and demand forecasts adjusted accordingly.

The main reason that demand has been utilized rather than timing is because VHS has opportunities to limit (and even reduce) demand through policy changes which can decrease per capita water consumption. **Demand management**, incorporating water efficient applications, is a comparatively low cost, effective way to get more service out of existing systems, thus delaying or deferring the need to construct new works.

The wide range of water efficiency initiatives currently being undertaken by Canadian municipalities can be grouped under four principal categories (Environment Canada, 2013):

TABLE 8.1 Efficiency Initiatives

Structural	Operational	Economic	Socio-political
metering water recycling systems wastewater re-use flow control devices distribution system pressure reduction water saving devices (efficient fixtures, appliances and retrofits) drought resistant landscaping (xeriscaping) efficient sprinkling/irrigation technology new process technologies plant improvements	leak detection and repair water use restrictions elimination of combined sanitary/storm sewers to reduce loadings on sewage treatment plants plant improvements	rate structures pricing policies incentives through rebates and tax credits other sanctions (fines)	public education information transfer and training regulatory (legislation, codes, standards, by-laws)

With the dual priorities of fiscal responsibility and sustainability in mind, there are many ways VHS can decrease demand and potentially delay the need for major improvements to the system, in spite of increasing development and population.

8.1 Quantify Water Usage

In 2012, the BC Water & Waste Association released a comprehensive position paper on metering, advocating that every water utility should actively work towards accurately metering all water taken into its system and all water distributed from its system at its customers' point of service. A cost estimate has been prepared and is included in **APPENDIX D**.

Excerpt from BCWWA position paper on metering:

Why should a water utility implement a metering program? If metering is tied to an ongoing outreach program, data analysis and conservation-oriented water pricing, then it can provide substantial benefits to a water utility. The benefits of metering fall into three broad categories: operational or system management benefits, water conservation benefits, and benefits to water consumers. Combined, these benefits support triple-bottom line decision-making (balancing social, economic and environmental considerations), long-term system planning and the building of more sustainable and resilient communities.

1. **Metering programs can improve operational efficiencies, facility planning and evaluation of conservation measures**

Metering provides critical data on how much water is flowing at different locations, allowing water managers to more accurately monitor water within their systems. A well-managed metering program that includes comprehensive data analysis can significantly contribute to infrastructure deferral, and the management and mitigation of rising costs of service provision. With metering, data water managers can: identify opportunities to improve efficiency; plan facilities to meet actual water consumption needs, thereby reducing the costs associated with over-sized infrastructure; and assess conservation measures to improve them over time.

2. **Assists utilities to find and fix leaks, thereby reducing costs for water treatment and distribution of lost water**

AWWA cautions that water utilities that do not provide meters to their customers run the risk of losing track of large volumes of water (2012). Since water losses are estimated on unmetered systems and real water losses may be considerably higher, it is important to recognize that high "water loss may have significant short-term operating costs and long-term sustainability issues that may affect the ability of the water utility to meet the long-term water requirements of the community"(FCM & NRC 2003b). A water loss control program that integrates metering at the treatment plant, zone or district metering (of neighborhoods, building complexes, etc.) and end-use metering can substantially reduce leakage (ibid; Brandes, Maas, Reynolds 2006); saving a utility money through reduced operational costs and potential infrastructure deferral.

3. **Meters with backflow detection can help to protect public health**

Meters are available with backflow detection and alarming capabilities, making it possible to integrate meters into a more comprehensive backflow prevention program.

4. Allows for volume-based pricing of water services, which can support water conservation programs

The implementation of water metering programs coupled with volume-based pricing typically results in reduction of consumption by 15-30% (FCM & NRC 2003).The scale of savings varies across user types and is determined in part by the pricing structures put into effect and the commitment of a utility to reduced consumption. While residential users may save water through installation of low flow fixtures and reduced outdoor watering, agricultural water savings depend on irrigation system efficiency and the minimum water requirements of crops.

Water conservation benefits associated with successful metering programs:

1. Lower water usage results in lower energy consumption, reducing a utility's costs and energy footprint.
2. Lower water usage results in less wastewater to be collected and treated, creating cost savings and environmental benefits.
3. Can be used as a tool for drought management.
4. Reclaims water for future growth.

Consumer benefits:

1. Can help to ensure fair and equitable pricing within categories of water users.
2. Charging for metered volumes of water gives some consumers the ability to change their water costs through water conservation.
3. Meters create feedback loops to consumers, raising public awareness about water usage.

Recommendation

- Develop and implement a Universal Metering Program by 2020.

8.2 Conserve and Reduce

Once demand is quantified through metering, an accurate picture of how water is used and lost can be determined, along with how best to conserve and reduce water usage. **TABLE 8.2** looks at a community water balance in terms of Revenue vs. Non-Revenue consumption and losses.

TABLE 8.2 Revenue vs. Non-revenue Water (International Water Association)

<table>
<tr><td rowspan="9">System Input Volume</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="7">Non-Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="5">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Meter Inaccuracies</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission & Distribution Mains</td></tr>
<tr><td>Leakage & Overflows at Reservoirs</td></tr>
<tr><td>Leakage on Service Connections up to Metering Point</td></tr>
</table>

Only the blue boxes in **TABLE 8.2** are quantified in VHS. The volume of water in green, otherwise known as the "non-revenue water", is currently not measured. According to Environment Canada's 2011 Municipal Water Use Report, across Canada an average of 13.3% of water is lost from distribution systems before reaching consumers. Between provinces, the percent of water lost through leaks and system maintenance varies from a low of 7.5% in Newfoundland and Labrador to a high of 22.1% in Quebec. Water losses are related to a number of issues, including the condition of distribution infrastructure and level of pressure maintained in the distribution system. Mitigating these losses where possible, as well as analyzing the unbilled authorized consumption, is an important part of reducing overall water demand.

The benefits of water conservation were discussed in the context of metering were discussed in Section 8.1. In 2011, VHS adopted a Water Conservation Plan which includes many of the initiatives outlined in **TABLE 8.1**. It is recommended that this plan be reviewed and updated to determine which of the initiatives have been adopted over the past three years, determine the success of those programs in meeting the stated goals of the plan, update the time horizons, and prioritize implementation of some of the more costly items such as a metering and a leak detection program. The VHS Water Conservation Plan has been included as **APPENDIX G.**

Beyond the scope of this document, it is also recommended that water conservation measures be quantified by undertaking a Water Conservation Study (utilizing readily available and cost-effective tools such as the web-based Water Conservation Calculator, available as part of the BC Climate Action Toolkit) in order to focus conservation efforts and get the biggest conservation "bang" for any funds allocated.

Recommendations

- Review and update VHS Water Conservation Plan in 2015.
- Quantify water conservation measures by commissioning a water conservation study in accordance with AWWA Manual M36 - Water Audits and Loss Control Programs as funds are available.
- Implement demand reduction strategies in order to delay the necessity of adding storage capacity and addition of the third pump at the WTP as demand increases.

9. Capital Works Plan and Cost Estimates

9.1 Improvements

TABLE 9.1 identifies and quantifies the capital improvements identified as part of this Water Master Plan. Upgrades to storage, pumping, and treatment will be required as demand increases. Pricing and timing will depend on demand management strategies, preliminary design, and the ability to secure funding. Refer to the relevant sections for discussion and recommendations.

TABLE 9.1 Capital Improvements

Project	Purpose	Cost	DCC Eligible?	Priority
Above-Ground Supply/Distribution	Repair/replace above ground piping section	**TBD (Jun 2015)**		
Hot Springs Road 'A'	Provide fire flow for existing development	**$377,825**	PARTIAL	
Hot Springs Road 'B'	Provide fire flow for future development	**$225,450**	PARTIAL	
Village Center Loop	Provide service and hydrant protection to properties on wells	**$173,600**	PARTIAL	
Lakeshore Residential	Provide service and hydrant protection to properties on wells	**$426,640**	PARTIAL	
Naismith and Mount	Provide service and hydrant protection to properties on wells	**$341,640**	NO	
Emerald and Diamond	Provide service and hydrant protection to properties on wells	**$206,880**	NO	
Angus Estates	Provide service and hydrant protection to properties on wells	**$555,600**	NO	
Pine and Lakberg	Provide service and hydrant protection to properties on wells	**$230,160**	NO	
Marine Tourism 'A"*	Provide service and hydrant protection to properties on wells	**$512,985**	YES	
Marine Tourism 'B'*	Provide fire flow for future development			
Water Services	Connect all existing fronted properties	**$299,250**	NO	
Water Hydrants	Add hydrants to existing fronted properties	**$63,000**	NO	
Tee Replacement	Replace damaged tee at Cedar & Hot Springs	**$26,250**	NO	
Water Treatment Capacity Increase	Add Capacity to WTP as demand increases	**$224,000**	PARTIAL	
Universal Metering	Meter all existing (2014) serviced properties	**$695,723**	NO	
System Flushing	Clean debris from system	**$75,000+**	NO	
Sampling Pedestals	Construct compliant sampling locations	**$60,000**	NO	

Utility revenue sources available to VHS include:

- Water Utility Rates
- Development Cost Charges (DCC)
- Developer Funding
- Grants
- Taxes
- Public Private Partnerships (P3)

It is important to examine each capital project in terms of the applicable revenue source(s). For a municipality such as VHS, where there is no industrial base and costs are shouldered by a relatively small commercial and residential population, identifying and pursuing grant funding from higher levels of government is a necessity.

The VHS water utility has undergone numerous improvements over the past 5 years, including a new treatment plant and reservoir; upgrades to the beach pump station and communications system. In addition, underground assets are less than 30 years old. Funds should be placed in reserves annually for eventual replacement of these newer components, but over the next 25 years capital asset renewal will not be the main focus.

9.2 Cost Estimates

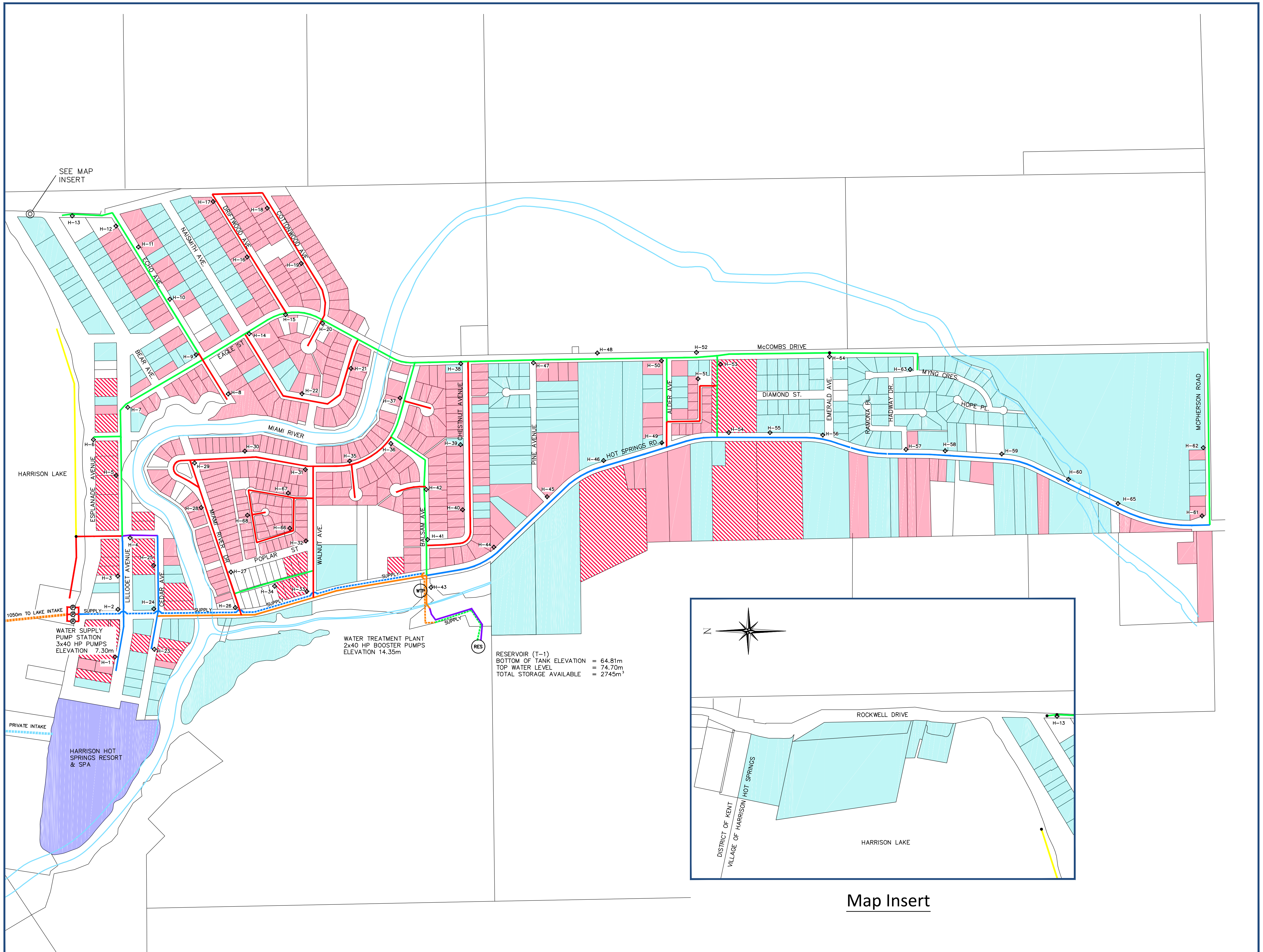
Detailed project cost estimates are presented in **APPENDIX D**.

10. Recommendations

Recommendations are summarized in Figure 18.

11. Figures

Figures 1 through 18 are included on the following pages.



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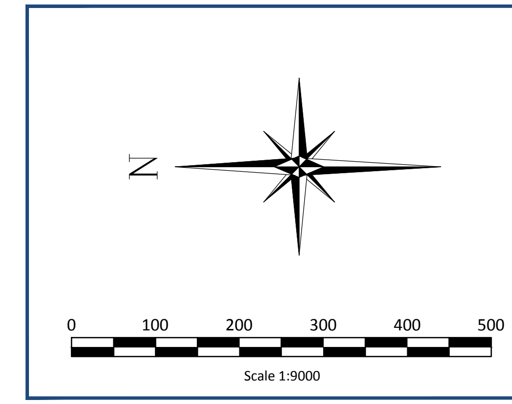

Legend

- 50mm Watermain
- 150mm Watermain
- 200mm Watermain
- 250mm Watermain
- 300mm Watermain
- 350mm Watermain
- SUPPLY Supply Line (see pipe size above)
- Hydrant
- Serviced by VHS Water Utility
- Serviced by VHS Water Utility and Metered
- Serviced by Private Wells
- Serviced by Private Surface Water
- Unserviced
- RES Reservoir
- WTP Water Treatment Plant
- Ⓟ Ⓟ Ⓟ Beach Pump Station

Village of Harrison Hot Springs

2014 Existing Water Supply & Distribution System
Figure 1

Project No. 12004 -13
Date: November 2014
Revision No. 0

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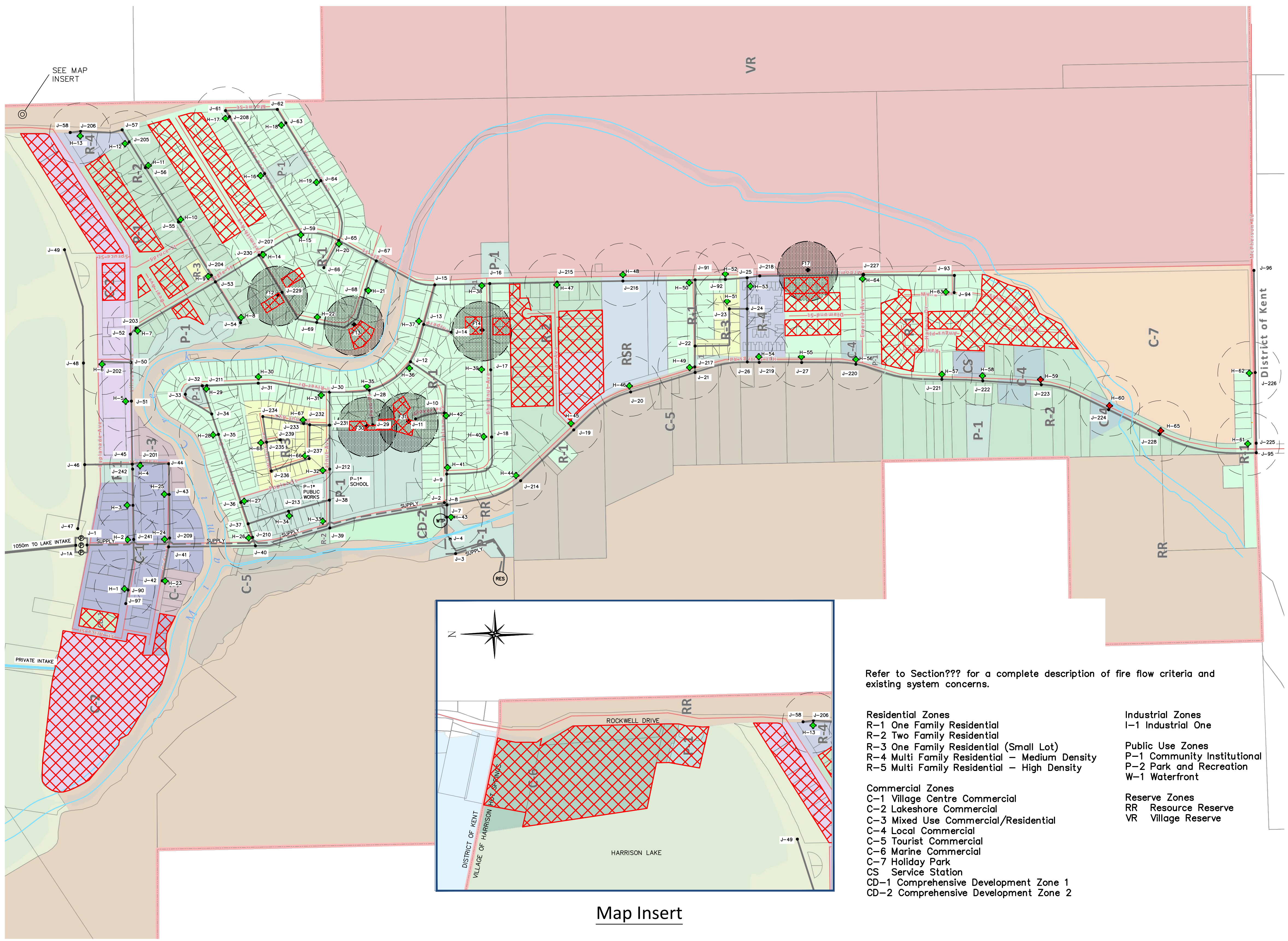


Map Insert

Refer to Section??? for a complete description of fire flow criteria and existing system concerns.

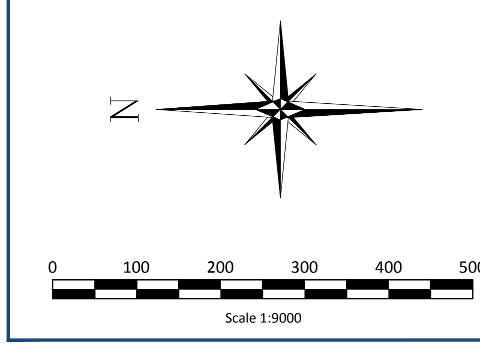
Residential Zones
R–1 One Family Residential
R–2 Two Family Residential
R–3 One Family Residential (Small Lot)
R–4 Multi Family Residential – Medium Density
R–5 Multi Family Residential – High Density

Commercial Zones
C–1 Village Centre Commercial
C–2 Lakeshore Commercial
C–3 Mixed Use Commercial/Residential
C–4 Local Commercial
C–5 Tourist Commercial
C–6 Marine Commercial
C–7 Holiday Park
CS Service Station
CD–1 Comprehensive Development Zone 1
CD–2 Comprehensive Development Zone 2

Industrial Zones
I–1 Industrial One

Public Use Zones
P–1 Community Institutional
P–2 Park and Recreation
W–1 Waterfront

Reserve Zones
RR Resource Reserve
VR Village Reserve



Legend

- Existing Watermain
- SUPPLY Supply Line
- H–1 Hydrant - Satisfied
- H–65 Hydrant - Failed
- J–1 Junction
- RES Reservoir
- WTP Water Treatment Plant
- Beach Pump Station
- Existing Hydrant Coverage
- Future Hydrant Coverage - Existing System
- Non Conforming Properties

Village of Harrison Hot Springs

2014 Existing System Hydrant Coverage Figure 2

Project No. 12004 -13
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Map Insert

N

0 100 200 300 400 500

Scale 1:9000

Legend

- Existing Watermain
- Future 100mm Watermain
- Future 150mm Watermain
- Future 200mm Watermain
- Future 250mm Watermain
- Future 350mm Watermain
- Future Hydrant and Coverage
- Existing Hydrant and Coverage
- Serviced by VHS Water Utility
- Metered
- Future Serviced Lots
- Serviced by Private Surface Water
- Reservoir
- Water Treatment Plant
- Beach Pump Station

Village of Harrison Hot Springs

Future Piping and Hydrant Requirements Figure 3

Project No. 12004 -13
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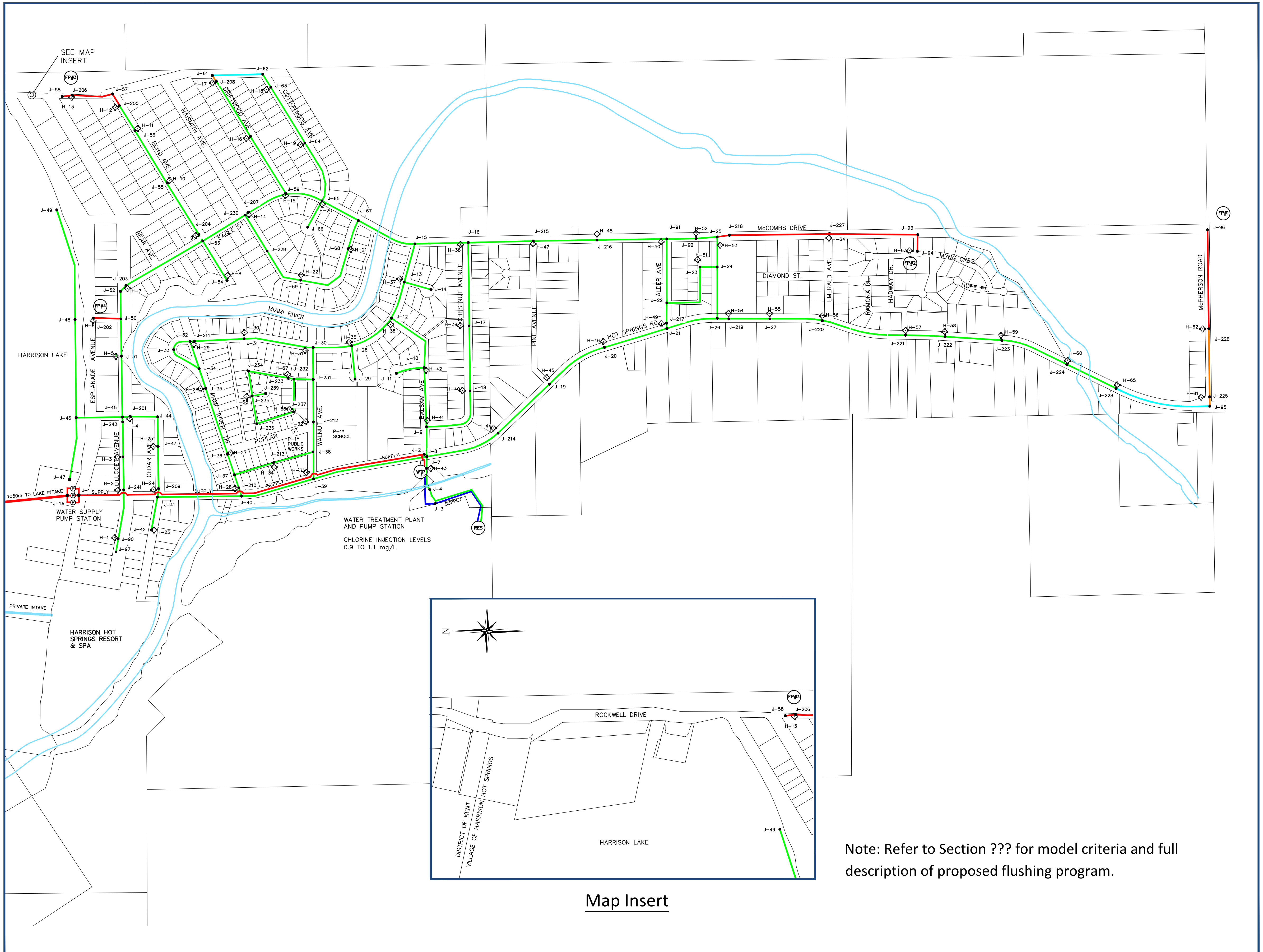

Note: Refer to Section ??? for model criteria and full description of proposed flushing program.

0 100 200 300 400 500
Scale 1:9000

Legend

Minimum Chlorine Concentration (mg/L)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- > 0.50
- H-65 Hydrant
- J-22 Junction
- Reservoir
- Water Treatment Plant
- Beach Pump Station
- Proposed Flushing Program

Village of Harrison Hot Springs

2014 Existing System Chlorine Decay Figure 4

Project No. 12004 -13
Date: Novmeber 2014
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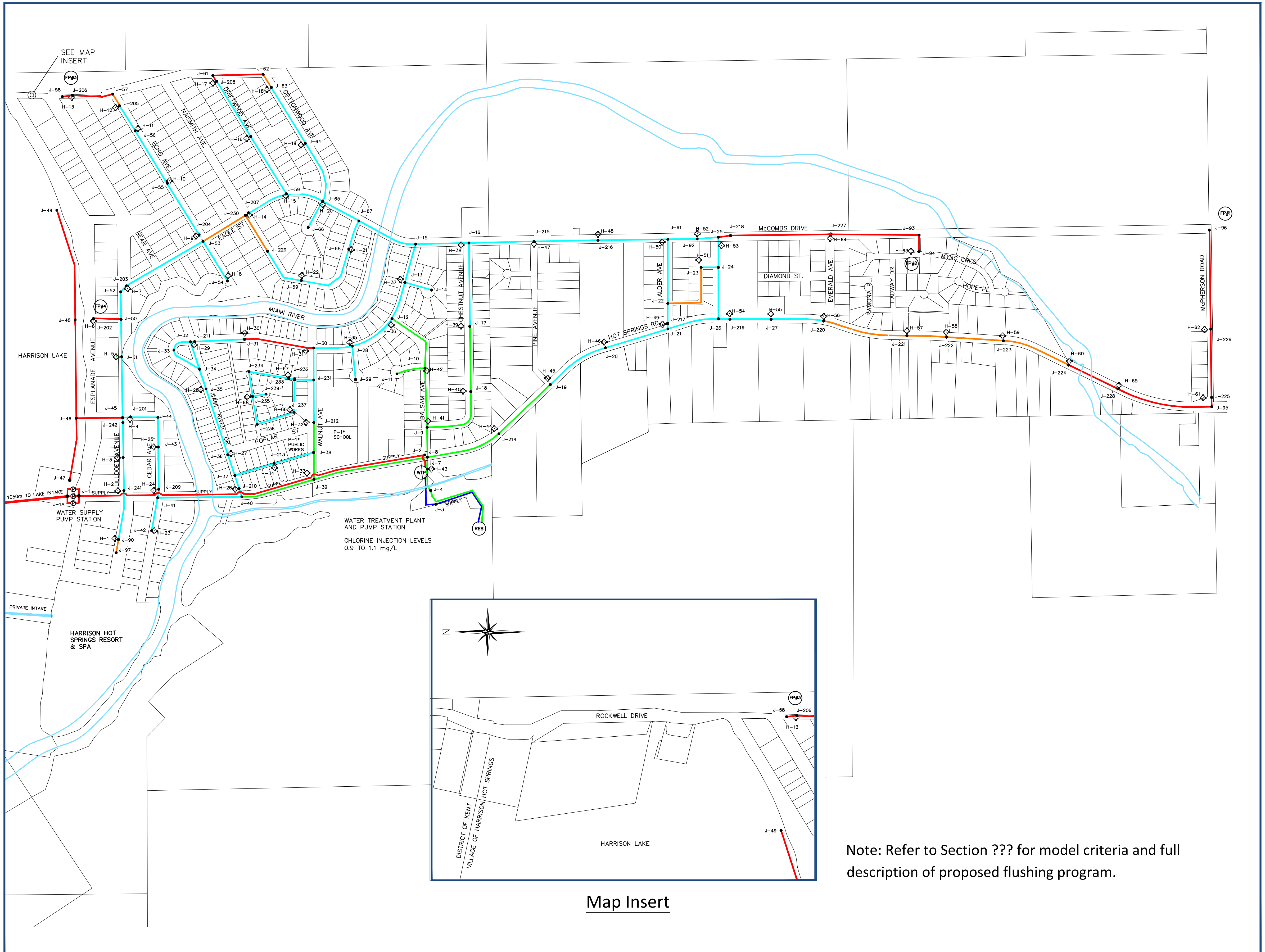
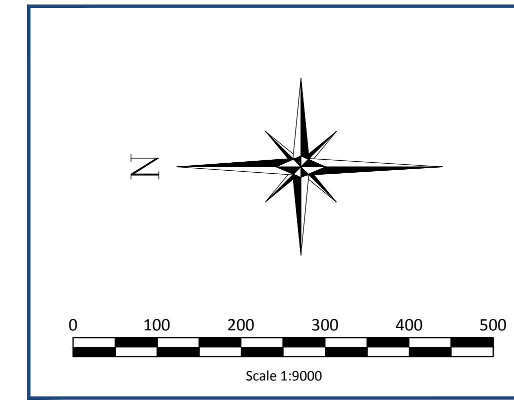


Note: Refer to Section ??? for model criteria and full description of proposed flushing program.

Map Insert



Legend

Minimum Chlorine Concentration (mg/L)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- > 0.50
- H–65 Hydrant
- J–22 Junction
- RES Reservoir
- WTP Water Treatment Plant
- Beach Pump Station
- FP#1 Proposed Flushing Program

Village of Harrison Hot Springs

2014 Existing System

Chlorine Decay - Winter Demands

Figure 5

Project No. 12004 -13
Date: November 2014
Revision No. 0

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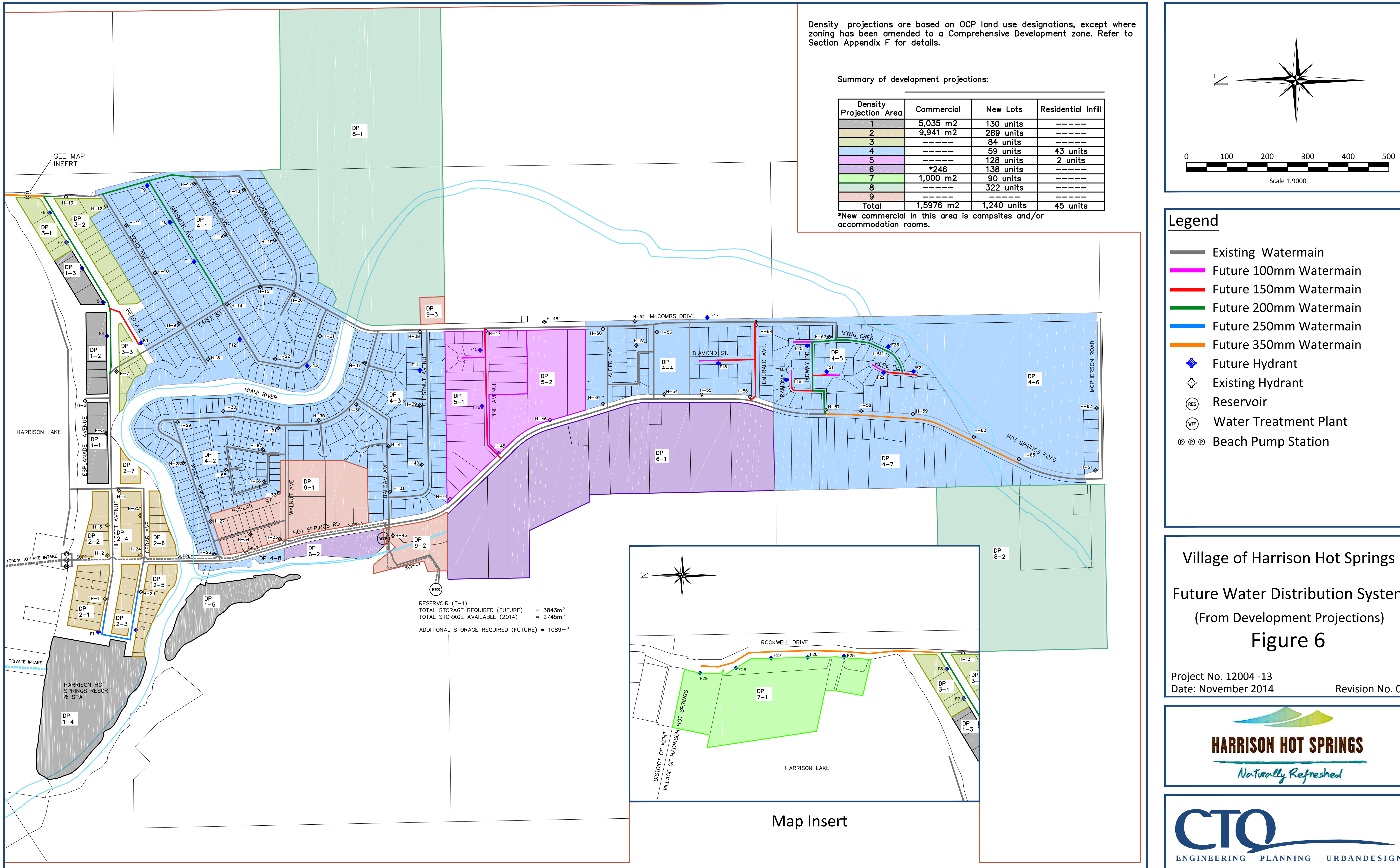

Density projections are based on OCP land use designations, except where zoning has been amended to a Comprehensive Development zone. Refer to Section Appendix F for details.

Summary of development projections:

Density Projection Area	Commercial	New Lots	Residential Infill
1	5,035 m2	130 units	------
2	9,941 m2	289 units	------
3	------	84 units	------
4	------	59 units	43 units
5	------	128 units	2 units
6	*246	138 units	------
7	1,000 m2	90 units	------
8	------	322 units	------
9	------	------	------
Total	1,5976 m2	1,240 units	45 units

*New commercial in this area is campsites and/or accommodation rooms.

Village of Harrison Hot Springs

Future Water Distribution System

(From Development Projections)

Figure 6

Project No. 12004 -13
Date: November 2014
Revision No. 0

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1 Average Daily Demand (Model)		
Average Daily Demand, ADD =	**13.4**	LPS
	1153786	L/day
2 Maximum Daily Demand = 2.0 X ADD		
Maximum Daily Demand, MDD =	**26.7**	LPS
	2307571	L/day
3 Peak Hourly Demand = 1.5 X MDD		
Peak Hourly Demand, PHD =	**40.1**	LPS
	3461357	L/day
4 Fire Storage, A = (Fireflow) * (Duration of fireflow)		
Fireflow, FF =	**150**	LPS
Fireflow Duration =	**2.0**	hrs
Fireflow Storage, A =	**1080000**	L
Fireflow Storage, A =	**1080**	m^3
5 Equalization Storage, B = (25% of Maximum Daily Demand)		
25% of MDD =	**576893**	L
Equalization Storage, B =	**577**	m^3
6 Emergency Storage, C = (25% of A + B)		
25% of A + B	**414223**	L
Emergency Storage, C =	**414**	m^3
7 Total Reservoir Storage Requirement = A + B + C		
Reservoir Storage =	**2071116**	L
Reservoir Storage =	**2071**	m^3
8 System Capacity = The greater of PHD or MDD + FF		
Peak Hourly Demand, PHD =	**40**	LPS
Maximum Daily Demand + Fireflow, MDD + FF =	**177**	LPS
9 Total Storage Available in Existing Reservoir		
Existing Total Storage =	**2745**	m^3
Volume Required =	**2071**	m^3
Additonal Storage Available =	**674**	m^3
% percentage	**25%**	

HARRISON HOT SPRINGS
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FIGURE 7: 2014 Existing System Water Demand and Storage Requirements

1 **Average Daily Demand (Model)**

Average Daily Demand, ADD =	**25.0**	LPS
	2160000	L/day

2 **Maximum Daily Demand =** 2.0 X ADD

Maximum Daily Demand, MDD =	**50.0**	LPS
	4320000	L/day

3 **Peak Hourly Demand =** 1.5 X MDD

Peak Hourly Demand, PHD =	**75.0**	LPS
	6480000	L/day

4 **Fire Storage, A =** (Fireflow) * (Duration of fireflow)

Fireflow, FF =	**150**	LPS
Fireflow Duration =	**2.0**	hrs
Fireflow Storage, A =	**1080000**	L
Fireflow Storage, A =	**1080**	m^3

5 **Equalization Storage, B =** (25% of Maximum Daily Demand)

25% of MDD =	**1080000**	L
Equalization Storage, B =	**1080**	m^3

6 **Emergency Storage, C =** (25% of A + B)

25% of A + B	**540000**	L
Emergency Storage, C =	**540**	m^3

7 **Total Reservoir Storage Requirement =** A + B + C

Reservoir Storage =	**2700000**	L
Reservoir Storage =	**2700**	m^3

8 **System Capacity = The greater of PHD or MDD + FF**

Peak Hourly Demand, PHD =	**75**	LPS
Maximum Daily Demand + Fireflow, MDD + FF =	**200**	LPS

9 **Total Storage Available in Existing Reservoir**

Existing Total Storage =	**2745**	m^3
Volume Required =	**2700**	m^3
Additonal Storage Available =	**45**	m^3
% percentage	**2%**	

HARRISON HOT SPRINGS
Naturally Refreshed

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FIGURE 8: Future (All Lots Serviced) System Water Demand and Storage Requirements

1	**Average Daily Demand (Model)**		
	Average Daily Demand, ADD =	**46.0**	LPS
		3974400	L/day
2	**Maximum Daily Demand =** 2.0 X ADD		
	Maximum Daily Demand, MDD =	**92.0**	LPS
		7948800	L/day
3	**Peak Hourly Demand =** 1.5 X MDD		
	Peak Hourly Demand, PHD =	**138.0**	LPS
		11923200	L/day
4	**Fire Storage, A =** (Fireflow) * (Duration of fireflow)		
	Fireflow, FF =	**150**	LPS
	Fireflow Duration =	**2.0**	hrs
	Fireflow Storage, A =	**1080000**	L
	Fireflow Storage, A =	**1080**	m^3
5	**Equalization Storage, B =** (25% of Maximum Daily Demand)		
	25% of MDD =	**1987200**	L
	Equalization Storage, B =	**1987**	m^3
6	**Emergency Storage, C =** (25% of A + B)		
	25% of A + B	**766800**	L
	Emergency Storage, C =	**767**	m^3
7	**Total Reservoir Storage Requirement =** A + B + C		
	Reservoir Storage =	**3834000**	L
	Reservoir Storage =	**3834**	m^3
8	**System Capacity = The greater of PHD or MDD + FF**		
	Peak Hourly Demand, PHD =	**138**	LPS
	Maximum Daily Demand + Fireflow, MDD + FF =	**242**	LPS
9	**Total Storage Available in Existing Reservoir**		
	Existing Total Storage =	**2745**	m^3
	Volume Required =	**3834**	m^3
	Additonal Storage Available =	**-1089**	m^3
	% percentage	**-40%**	

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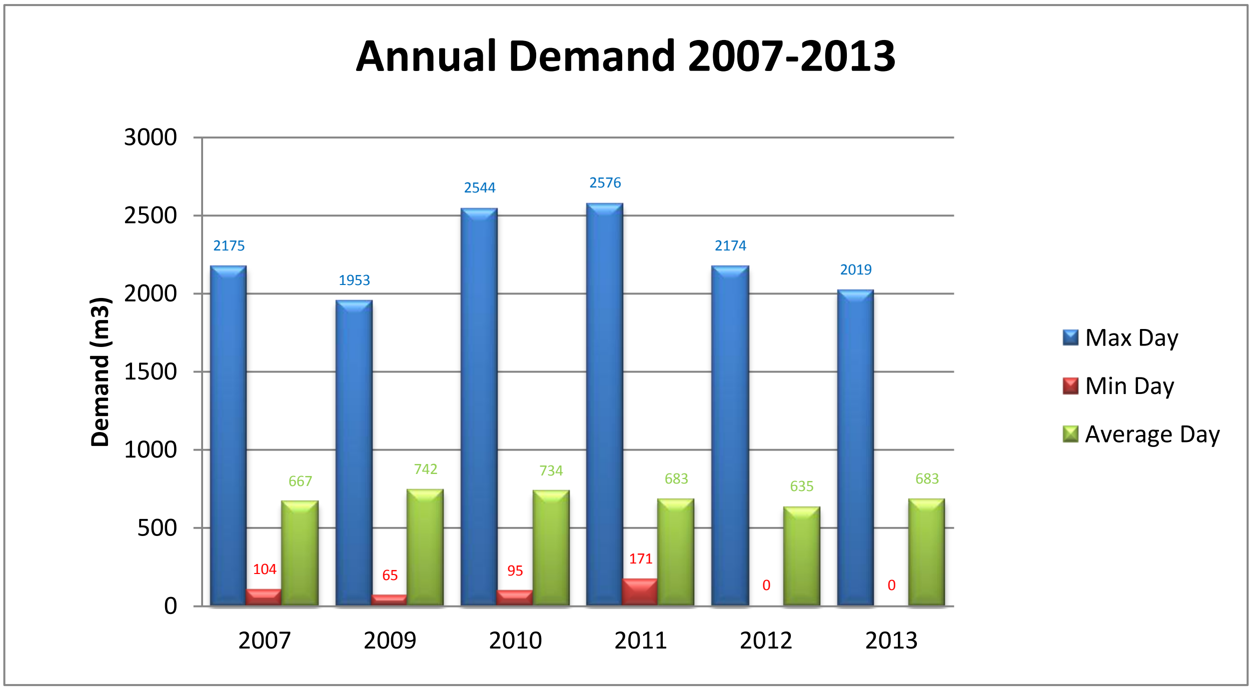
FIGURE 9: Future (Full Buildout) System Water Demand and Storage Requirements



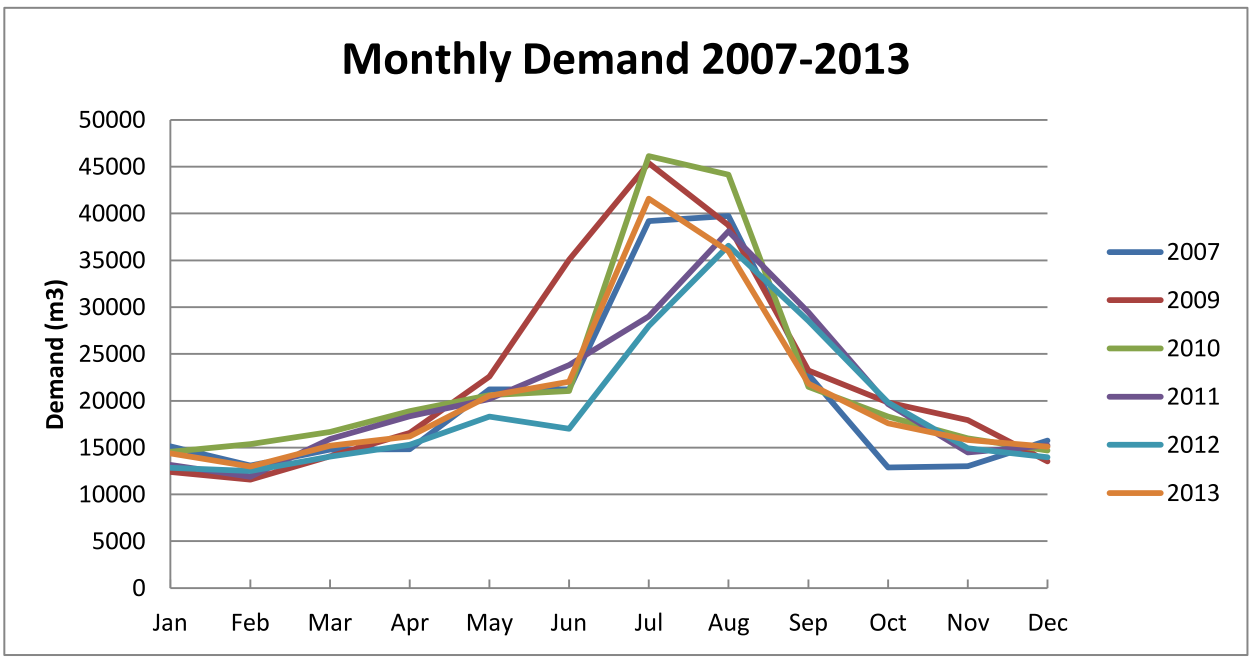


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FIGURE 10: Water System Flows 2007-2013

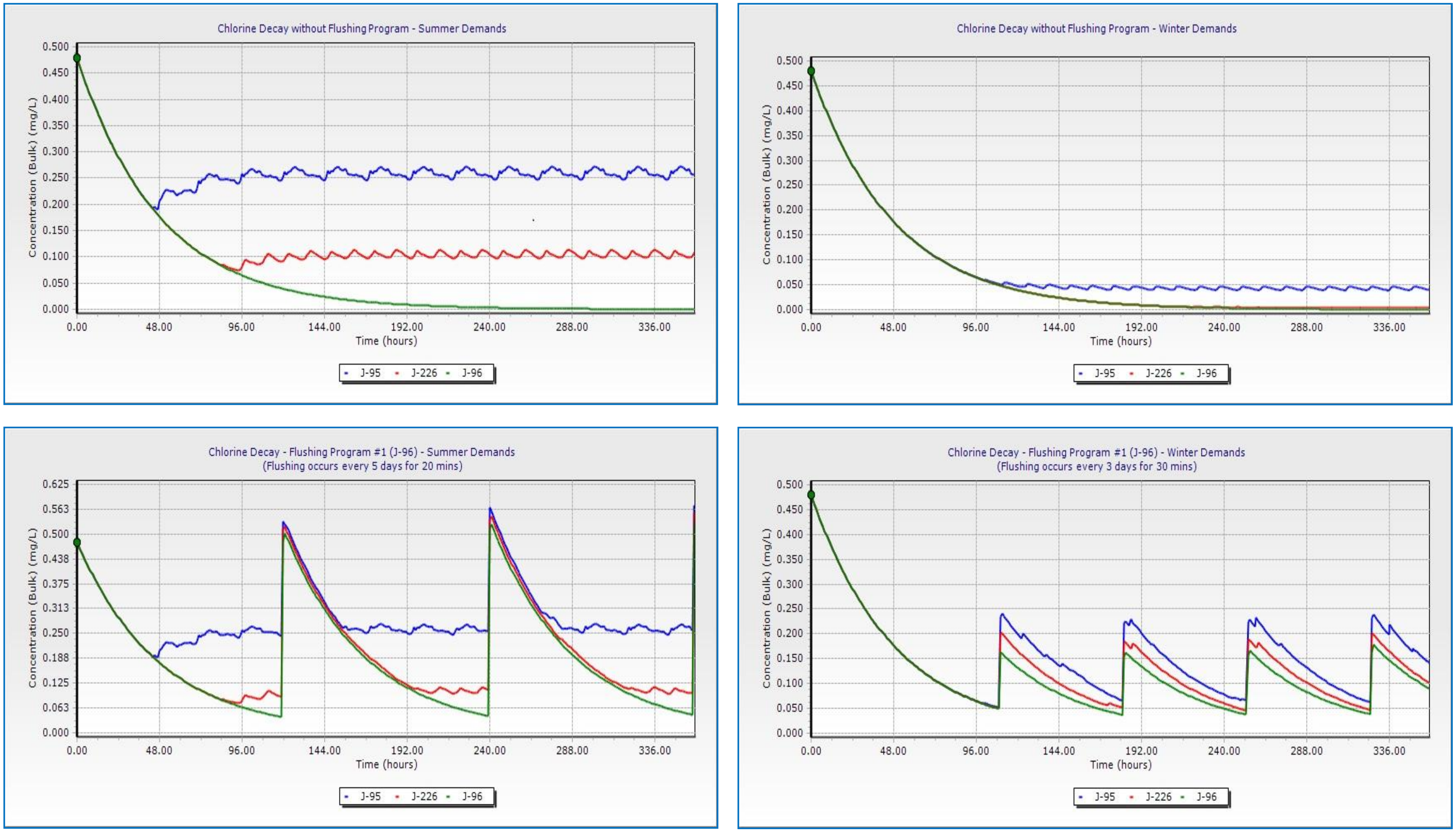

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FIGURE 11: Chlorine Decay - McPherson Road

	Pipe Dia. (mm)	Length (m)	Volume (L)	Flow L/s	Minimum Flushing Time (3 X Turnover) (mins)	Recommended Flushing Time (mins)	Total Flushing Vol. (L)	Min. Flushing Velocity (m/s)	Start Junction	End Junction/ Hydrant	Frequency - Summer	Frequency - Winter
Flushing Plan #1	200	400	12560	63	10	20	75600	2.01	J-95	J-96	5 Days	3 Days
Flushing Plan #2	200	490	15386	63	13	20	75600	2.01	J-25	H-63	5 Days	4 Days
Flushing Plan #3	200	122	3831	63	4	20	75600	2.01	J-205	H-13	5 Days	3 Days
Flushing Plan #4	200	70	2198	63	2	5	18900	2.01	J-50	H-6	5 Days	4 Days

Notes:

1. Operator must monitored the area to ensure that flooding does not occur during flushing.
2. Notification should be provided to all residents in the area that the water may be cloudy during flushing operations. It may be necessary to implement temporary boil water measures during flushing.
3. Minimum flushing time of 5 minutes used.
4. Flush each hydrant using 2 - 2 1/2" ports unless noted otherwise.

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FIGURE 12: VHS Watermain Flushing Plan

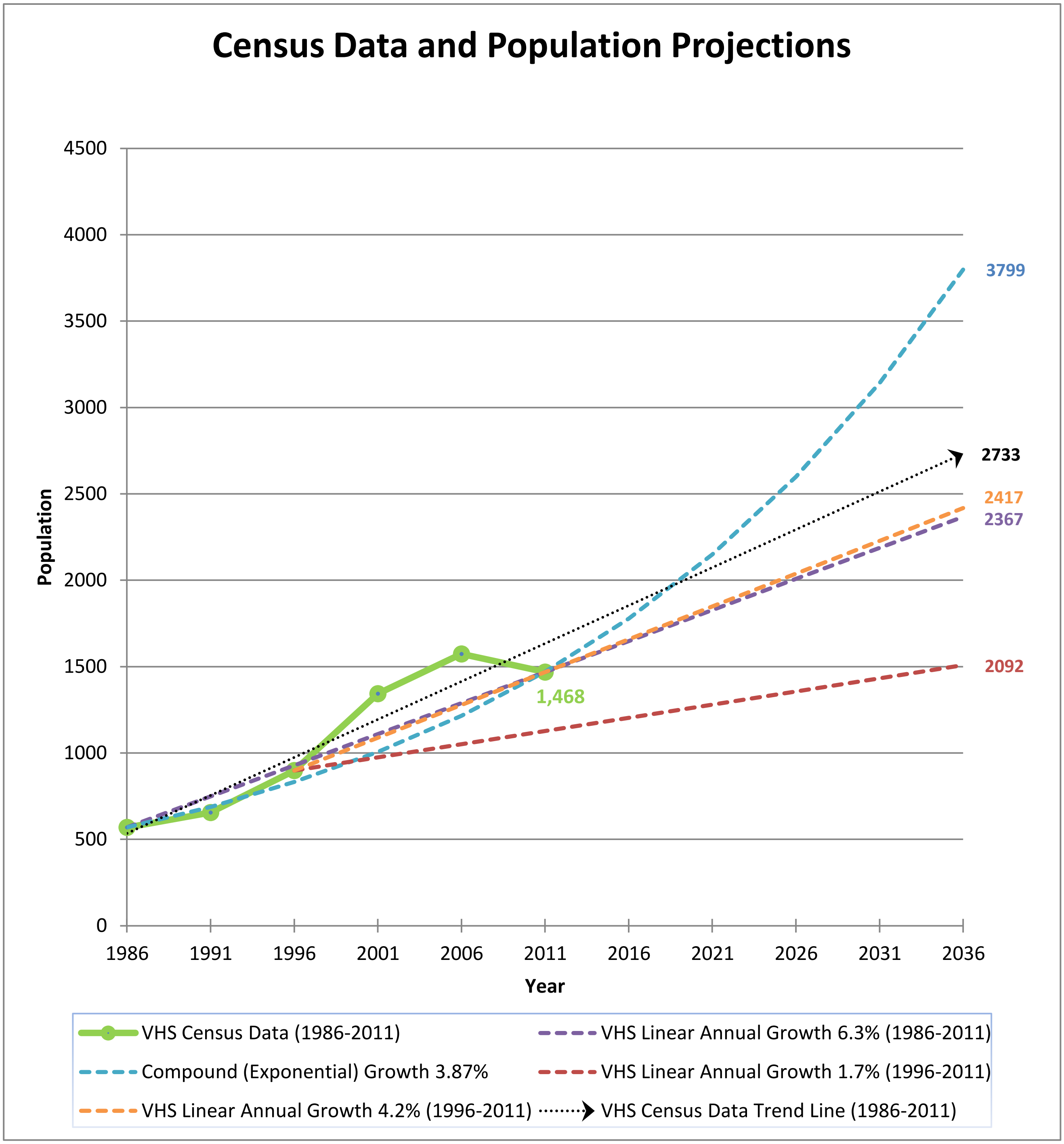

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FIGURE 13:
Census Data and Population Projections

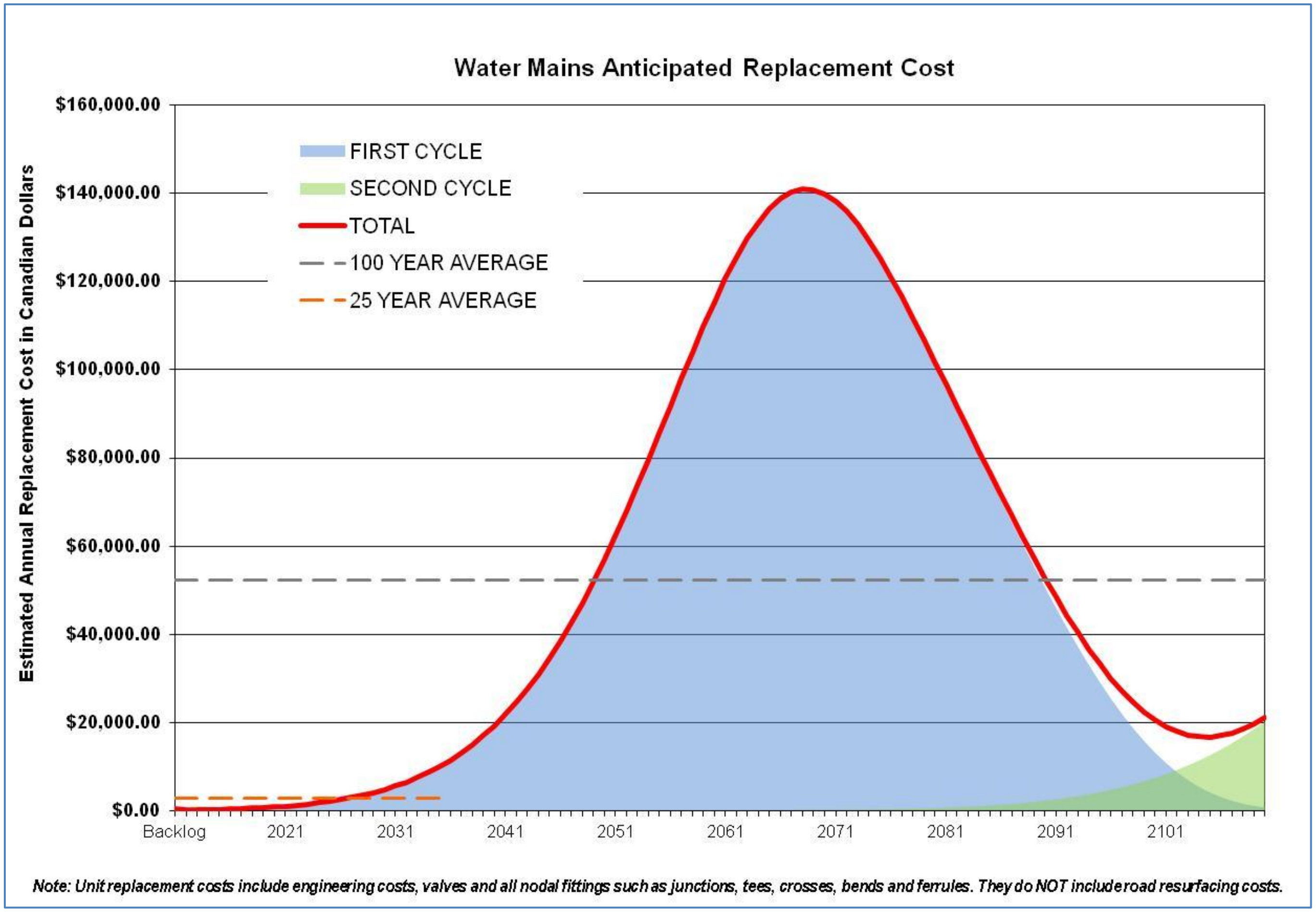

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FIGURE 14:
Water Mains Anticipated Replacement Costs - 100 Year

PHOTO 1: Diagonal members damaged

PHOTO 2: Looking up, north pipe is on the right

PHOTO 3: Vegetation growing in and around supports

PHOTO 4: Looking down, north pipe is on the left

PHOTO 5: Typical supports, north pipe is on the right

PHOTO 6: Bent support leg, likely from falling rocks

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FIGURE 15:
Above-Ground Piping Photos

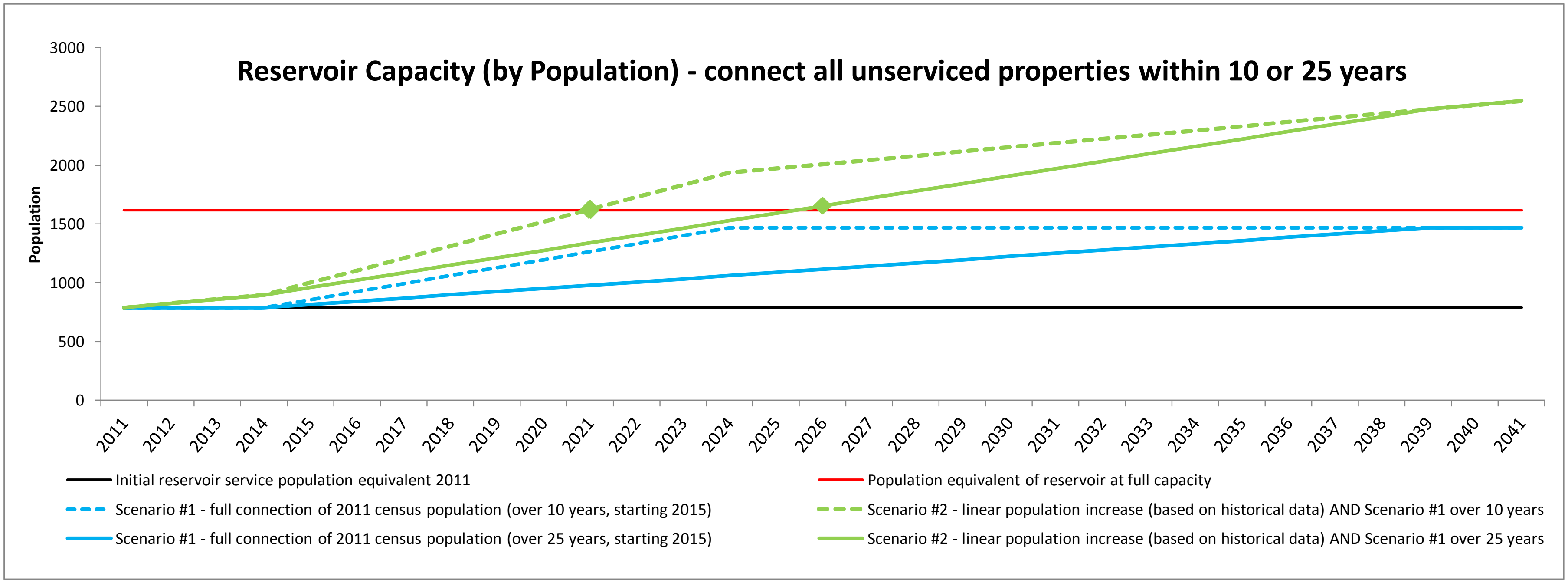

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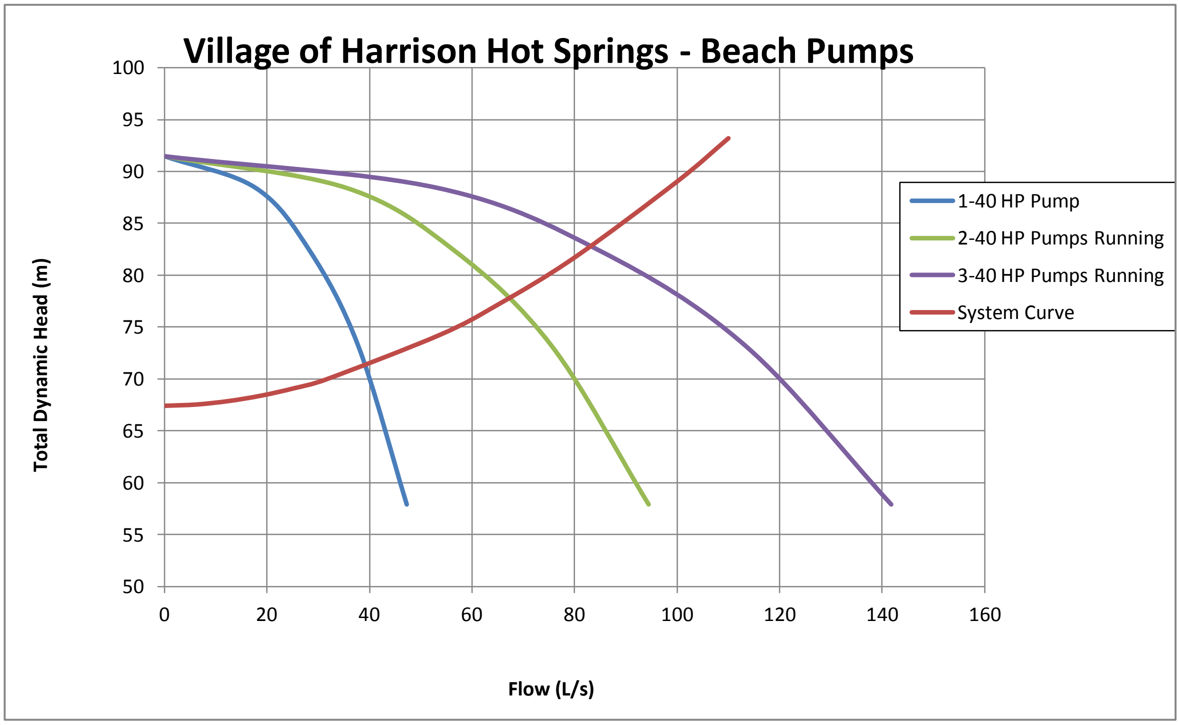
FIGURE 16:
Storage Capacity, Development and Population Growth



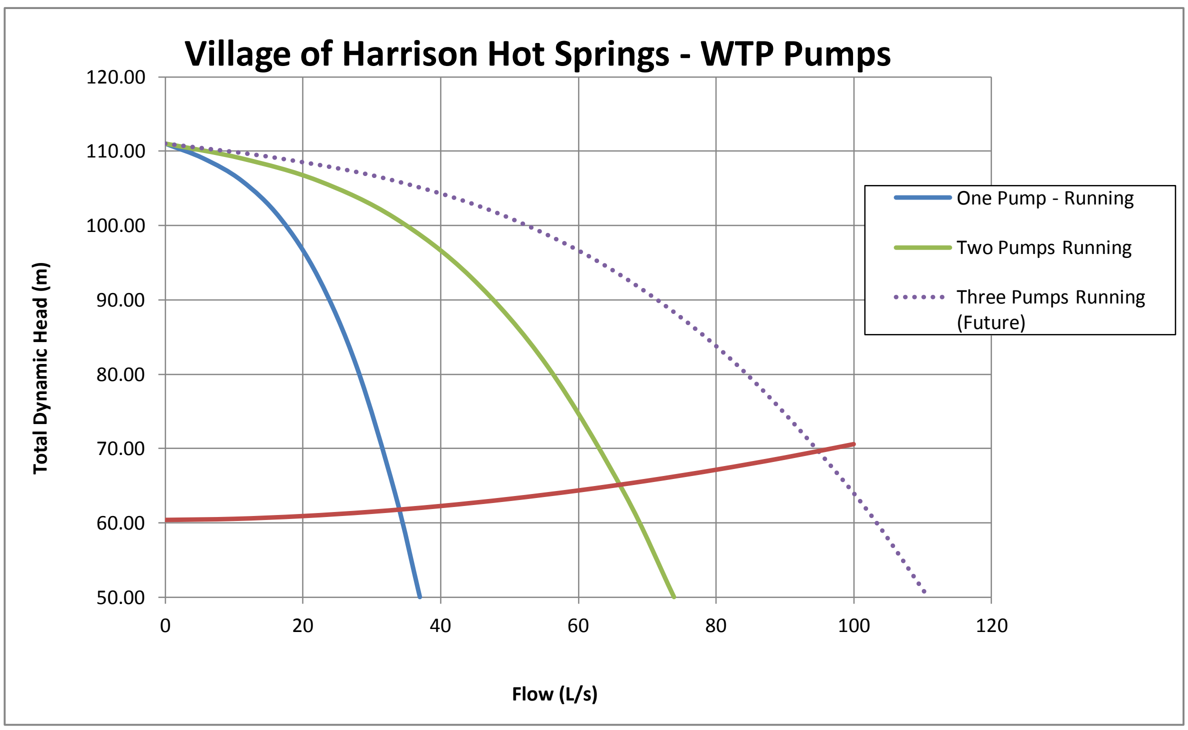


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FIGURE 17: System Pumping Capacity

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FIGURE 18 - RECOMMENDATIONS SUMMARY TABLE

Description			Recommendations	Reference
ISSUE #1: GROUNDWATER				
Groundwater Quality	A water quality sampling program undertaken in 2014 indicates the potential presence of contaminants	1.1	All domestic wells located within the vicinity of "Site 12" (Refer to Appendix B) be tested for landfill-associated leachate anions and pH	3.5
	There are a large number of properties served by shallow groundwater wells throughout the Village, and a potential liability to VHS relating to water quality	1.2	A one-time sampling of all 218 properties listed in the VHS database be completed in 2015	3.5
		1.3	Analysis of the samples will result in further recommendations which may include additional groundwater monitoring, alternative water supply, and/or further investigation	3.5
Connection to VHS water utility		1.4	Property owners currently serviced by private groundwater wells should be advised of the proximity to the VHS water utility	3.5
		1.5	Options for those property owners interested in decommissioning groundwater wells in favour of utility connection be investigated (strategy, timeline, funding)	3.5
ISSUE #2: 2014 SYSTEM DEFICIENCIES				
2014 System Deficiencies - Fire Flows	Inadequate fire flows for current zoning	2.1	Upgrade Hot Springs Road watermain from 250 mm to 350 mm between H-59 and H-65, with a plan in place to provide 150L/sec fire flow to commercial properties until such time	5.2.1
	Pipe velocities exceed MMCD guidelines under fire flow conditions	2.2	Upgrade piping to reduce velocities as budget and opportunity becomes available, rather than as stand-alone projects	5.2.2
	Hydrant spacing exceeds FUS guidelines	2.3	Review the value to property owners of adding hydrants to the system to meet FUS linear spacing guidelines	5.2.3
		2.4	Add hydrants to the existing distribution lines to meet FUS hydrant radius guidelines for non-conforming properties	5.2.4
	Properties not fronted by the VHS utility exceed FUS guidelines, affecting insurance rates and fire fighting capability for those properties	2.5	Construct new frontage lines and upgrade existing distribution lines as budget allows to meet FUS guidelines and provide water utility service to properties currently on private well systems. Until that time, ensure that residents have information regarding insurance, and that a fire fighting plan is in place to address the issue.	5.2.4
2014 System Deficiencies - Flow Restriction	During the model calibration and field testing, an undocumented flow restriction was noted at the corner of Cedar and Hot Springs. Further investigation indicates a damaged tee	2.6	Replacement of this section of pipe is recommended as soon as possible in order to provide adequate fire protection to properties within the Village center.	5.3
	Anecdotal evidence indicates significant debris within the pipelines	2.7	Budget to flush and clean both supply and distribution lines	5.3
2014 System Deficiencies - Emergency Power	VHS emergency standby power is limited to a single trailer-mounted generator	2.8	Budget for emergency power generation at the beach pump station, with a contingency plan in place until such time	5.6
2014 System Deficiencies - Electrical/Communication/Instrumentation	Motors experience multiple stop/starts daily and flow control is achieved by a manually set valve	2.9	Budget for VFDs at the WTP	5.7
	Motors are currently being operated outside of design	2.10	Budget for VFD and motor maintenance at the beach pump station	5.7
	Electrical components are aging and upgrading communications will increase operational efficiency	2.1	Implement SCADA, electrical, and instrumentation items 1-5 as budget and opportunity allow	5.7
2014 System Deficiencies - Chlorine	Sample locations are not sufficient to meet Health Canada guidelines	2.1	Establish new Chlorine sampling pedestals as per Operations requirements throughout the Village	5.8
	There is not enough demand in the "dead legs" to maintain minimum chlorine residuals without a flushing program	2.1	Eliminate dead legs at Mount, Lillooet, Cedar, McCombs and McPherson as budget allows and/or development occurs	5.8
		2.1	Implement winter and summer flushing program as outlined in FIGURE 12	5.8
2014 System Deficiencies - Above-ground piping	Limited maintenance over the past 30 years has resulted in corrosion and other damage to the structural supports of the reservoir supply and distribution lines	2.2	Scrub all loose rock, debris, and vegetation from the cliff face	5.9
		2.2	Remove all debris and loose soil from the support bases and anchor bolts	5.9
		2.2	Paint the structures to protect from further corrosion	5.9
		2.2	Perform a visual inspection of all supports yearly (minimum)	5.9
	The age and condition of the pipe supports makes it vulnerable to damage during a moderate seismic event. Damage to either of these lines would result in a shortage of drinking water and/or fire flow capability	2.2	Commission an engineering firm to study the problem, and identify option(s) for piping upgrade	5.9
ISSUE #3: FUTURE SYSTEM CONSIDERATIONS				
Future System Considerations - General	Unlooped distribution lines and critical components do not provide redundancy in the event of failure	3.1	Consider system resiliency and redundancy when planning capital projects	5.5
	Predicting population and development growth in VHS is challenging	3.2	Re-evaluate population projections when the 2016 census data becomes available	6.1
		3.3	Budget for a Water Utility Master Plan update in 2017 to incorporate 2016 census data	6.3
	Demand will eventually exceed water license withdrawal amounts	3.4	Timely application for water license amendment as demand increases	7.1
	46% of the population of VHS is not served by the water utility	3.5	Determine the feasibility of constructing new watermains to service existing properties	7.3
	As development occurs, the ability of the water utility to provide service will decease without upgrades	3.6	Ensure that new developments, and OCP amendments are analyzed using the VHS water model prior to final approval	7.3
	VHS has limited funds to deal with both expected and unexpected repairs/replacements to system assets	3.7	Contribute funds annually to a reserve for both the eventual and unexpected replacement of underground water utility assets	7.2
Future System Considerations - Pumping	Additional pumping capacity has been pre-piped to address demand increase	3.8	Budget for the addition of the third pump at the WTP as demand increases	7.4
	Because the water utility assets have been constructed in isolation, components are operating outside of original design parameters	3.9	Commission an engineering study to investigate system pumping capacity and limitations	7.4
Future System Considerations - Treatment	Additional treatment capacity has been pre-piped to address demand increase to 31.5 L/sec	3.10	Budget for the addition of membranes to existing system as demand increases beyond 31.5 L/sec	7.5
		3.1	Budget for the design and construction of a second treatment facility as demand increases beyond 6	7.5
Future System Considerations - Storage	As demand increases, storage will have to be added to the VHS system	3.12	As demand increases, commission a preliminary engineering study be undertaken for to investigate options for increased storage	7.6
		3.1	Monitor population and water usage closely to establish a timeline to add reservoir capacity	7.6
		3.1	Implement demand reduction strategies to delay the necessity of adding storage capacity	7.6
ISSUE #4: SYSTEM VULNERABILITY				
Surface Water Quality	Urban runoff within VHS currently does not undergo treatment prior to discharge to surface water, potentially carrying contaminants	4.1	Investigate upgrades to the VHS drainage system to minimize contaminants entering the Miami River and Harrison Lake	3.4.3
	Land use upstream of Harrison Lake can impact water quality	4.2	Ensure VHS is identified as a stakeholder on land use issues relating to watershed health, and is represented where decisions potentially affecting water quality are made.	3.4.3
Vulnerability to Seismic Events	Other than the WTP, water utility components are not designed to meet 2014 "post-disaster" standards	4.3	System vulnerability to seismic events - specifically the reservoir, above ground piping and beach pump station - should be identified.	3.4.1
		4.4	Implement upgrades as funding becomes available	3.4.1
		4.5	Until upgrades can be implemented, address system vulnerability in emergency response plans	3.4.1
Climate Change	Climate change will impact the water utility by increasing the severity and unpredictability of weather events	4.6	Ensure climate change is emphasized in the decision-making process for water utility infrastructure repair, upgrade, and expansion.	3.4.5
	VHS has a policy to reduce the impact of operations on the environment	4.7	Reduce energy consumption and greenhouse gas emissions created by the water utility wherever possible	3.4.5
ISSUE #5: DATA MANAGEMENT				
Data and Asset Management	Limited and/or inaccessible information regarding water utility assets results in additional expenditures to locate information on an "as-needed" basis, or to redo work previously completed	5.1	Create a Water Asset Management database to house all data (reports, photos, drawings, incidents) relating to the water utility	5.1. 5.7, 5.9
		5.2	Locate as-built drawings and construction inspection reports in archives, digitize and add to a Water Asset Management database.	5.1, 5.7, 5.9
		5.3	Implement and reference a basic GIS system	
		5.4	Create spreadsheet to track all water-related breaks and leaks. Info regarding location, probable cause, date, pipe size, and conditions noted when repairing (ie - installation/bedding conditions) are all important to track as the system ages.	
ISSUE #6: DEMAND MANAGEMENT				
Demand Management	Lack of water use data limits determination of effective demand management strategies to decrease water use and	6.1	It is recommended that a program to implement Universal Metering be developed and implemented within the next five years	5.4, 8.1
	A reduction in demand through conservation measures could delay infrastructure upgrades in the face of increasing population, tourism and development	6.2	Review and update VHS Water Conservation Plan	8.2
		6.3	Quantify water conservation measures by commissioning a water conservation study in accordance with AWWA Manual M36 - Water Audits and Loss Control Programs	
ISSUE #7: POLICY AND REGULATION				
Development Design, Approval and Construction	Historically, there is inconsistency in the design and construction, and integration of water utility infrastructure	7.1	Require all new development to connect to VHS water utility	5.2
		7.2	Adopt MMCD Design guidelines, with modifications as necessary, for all construction of Municipal Works	
		7.3	It is recommended that all new development undergo an engineering review which includes a water model analysis to determine the impact of fire flow and demand to the VHS system prior to approval being issued.	5.1

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Appendix A – Surface Water Data

1. SOURCE WATER QUALITY DATA
2. HISTORIC FLOW

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APPENDIX A-1.. Source Water Quality Data (2014)

			2012 CDWQG MAC	30-Oct-14	22-Sep-14	25-Aug-14	17-Jul-14	18-Jun-14	23-May-14	24-Apr-14	27-Mar-14
Physical Tests:	Colour, True	CU		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Conductivity	uS/cm		43.0	45.0	45.0	47.0	47.0	45.0	46.0	49.0
	Hardness (as CaCO3)	mg/L	none required	17.6	19.3		20.8	19.3	18.9	19.0	21.8
	pH	pH	6.5-8.5		7.12	7.12	7.19	6.78	7.49	7.30	7.53
	Total Suspended Solids	mg/L									
	Total Dissolved Solids	mg/L	AO<500	51	51	31	33	45	25	47	31
	Transmittance, UV (254 nm)	%T									
	Tubidity	NTU	<0.1	1.40	<0.1	1.40	0.80	0.80	0.30	0.40	1.10
Anions and Nutrients:	Alkalinity, Total (as CaCO3)	mg/L		19	12	13	15	16	14	15	16
	Chloride (Cl)	mg/L		0.46	0.50	0.48	0.55	0.59	0.50	0.53	0.92
	Fluoride (F)	mg/L		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Nitrate (as N)	mg/L	45	0.0200	0.0290	0.0240	0.0450	0.0650	0.0610	0.0680	0.0700
	Nitrite (as N)	mg/L	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Sulfate (SO4)	mg/L	AO<500	4.60	4.60	4.80	4.50	4.80	4.50	4.60	5.40
Bacteriological Tests:	E. coli	MPN/100mL		<1	<1	5	2	1	<1	<1	<1
	Background Colonies	CFU/100mL						>200	>200		
	Coliform Bacteria - Total	MPN/100mL		1	<1	3	6	1	<1	1	2
Total Metals:	Aluminum (Al)-Total	mg/L	OG <0.1	0.061	0.015		0.053	0.043	0.033	0.029	0.039
	Antimony (Sb)-Total	mg/L	0.006	0.0001	0.0003	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001
	Arsenic (As)-Total	mg/L	0.01	0.0009	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Barium (Ba)-Total	mg/L	1	0.12	0.01		0.013	0.011	0.011	0.011	0.011
	Beryllium - Total	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Bismuth - Total	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Boron (B)-Total	mg/L	5	0.009	0.006		0.007	0.009	0.007	0.011	0.014
	Cadmium (Cd)-Total	mg/L	0.005	0.00001	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
	Calcium (Ca)-Total	mg/L	none required	6.10	6.60		7.10	6.50	6.40	6.50	7.30
	Chromium (Cr)-Total	mg/L	0.05	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt-Total	mg/L		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Copper (Cu)-Total	mg/L	AO <1.0	0.0005	0.0005		0.0007	0.0005	0.0009	0.0010	0.0017
	Iron (Fe)-Total	mg/L	AO<0.3	0.310	<0.01		0.030	0.020	0.020	0.010	0.050
	Lead (Pb)-Total	mg/L	0.01	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
	Lithium - Total	mg/L		0.0007	0.0007		0.0008	0.0008	0.0006	0.0007	0.0007
	Magnesium (Mg)-Total	mg/L	none requried	0.59	0.68		0.75	0.73	0.69	0.69	0.87
	Manganese (Mn)-Total	mg/L	AO < 0.05	0.0013	0.0002		0.0010	0.0005	0.0005	0.0006	0.0044
	Mercury (Hg)-Total	mg/L	0.001		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
	Molybdenum- Total	mg/L		0.0008	0.0009		0.0009	0.0007	0.0008	0.0008	0.0008
	Nickel-Total	mg/L		<0.0002	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	0.0003	<0.0002
	Phosphorous-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Potassium (K)-Total	mg/L		0.57	0.59		0.77	0.53	0.62	0.58	0.56
	Selenium (Se)-Total	mg/L	0.01	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Silicon-Total	mg/L		2	2		2.7	1.7	2.4	2.4	2.5
	Silver-Total	mg/L		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Sodium (Na)-Total	mg/L	AO<200	1.1	1.21		1.48	1.33	1.19	1.22	1.59
	Strontium-Total	mg/L		0.029	0.03		0.037	0.029	0.03	0.028	0.031
	Sulfer-Total	mg/L		<1	<1	<1	4	<1	<1	<1	<1
	Tellurium-Total	mg/L		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
	Thalium-Total	mg/L		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
	Thorium-Total	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Tin-Total	mg/L		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
	Titanium-Total	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Uranium (U)-Total	mg/L	0.02	0.00003	0.00003		0.00004	0.00003	0.00003	0.00003	0.00004
	Vanadium	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Zinc (Zn)-Total	mg/L	AO<5.0	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Zirconuim-Total	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

APPENDIX A-1. Source Water Quality Data (2012-2013)

			2012 CDWQG MAC	7-Feb-13	16-Jan-13	27-Dec-12	22-Nov-12	23-Oct-12	19-Sep-12	2-Aug-12	28-Jun-12	1-Mar-12
Physical Tests:	Colour, True	CU		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Conductivity	uS/cm		42.2	42.2	42.7	41.2	41.8	44.4	43.4	45.9	46.2
	Hardness (as CaCO3)	mg/L	none required	18.2	19.0	17.9	18.5	18.5	18.5	18.5	19.9	18.9
	pH	pH	6.5-8.5	7.24	7.46	7.49	7.40	6.72	7.29	7.58	7.39	7.46
	Total Suspended Solids	mg/L				-	-	-	-	<3.0	<3.0	
	Total Dissolved Solids	mg/L	AO<500	19	31	28	22	31	29	34	33	28
	Transmittance, UV (254 nm)	%T						95				
	Tubidity	NTU	<0.1	1.28	1.67	1.46	2.16	2.49	3.27	4.27	2.16	3.88
Anions and Nutrients:	Alkalinity, Total (as CaCO3)	mg/L		15.3	15.2	15.9	14.8	15.3	14.5	15.4	17.1	15.7
	Chloride (Cl)	mg/L		0.59	0.58	0.62	0.58	0.56	0.52	0.61	0.68	0.62
	Fluoride (F)	mg/L		< 0.020	< 0.020	<0.020	<0.020	<0.020	<0.020	0.020	<0.020	<0.020
	Nitrate (as N)	mg/L	45	0.0614	0.0653	0.0758	0.0611	0.0509	0.0150	0.0614	0.0741	0.0732
	Nitrite (as N)	mg/L	10	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Sulfate (SO4)	mg/L	AO<500	4.80	4.73	4.83	4.72	4.73	4.46	4.87	5.16	5.13
Bacteriological Tests:	E. coli	MPN/100mL				<2	<2	-	-	<1	<1	
	Background Colonies	CFU/100mL										
	Coliform Bacteria - Total	MPN/100mL				4	2	-	-	5	<1	
Total Metals:	Aluminum (Al)-Total	mg/L	OG <0.1	0.055	0.073	0.059	0.102	0.135	0.173	0.186	0.146	0.201
	Antimony (Sb)-Total	mg/L	0.006	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total	mg/L	0.01	0.0002	0.00019	0.00019	0.00018	0.00024	0.0002	<0.00030	0.00018	0.00026
	Barium (Ba)-Total	mg/L	1	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Beryllium - Total	mg/L										
	Bismuth - Total	mg/L										
	Boron (B)-Total	mg/L	5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total	mg/L	0.005	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Calcium (Ca)-Total	mg/L	none required	6.19	6.46	6.09	6.28	6.26	6.21	6.25	6.72	6.41
	Chromium (Cr)-Total	mg/L	0.05	<0.0034	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Cobalt-Total	mg/L										
	Copper (Cu)-Total	mg/L	AO <1.0	0.0011	<0.0010	0.0011	0.0014	0.0012	0.0012	0.0011	<0.0010	<0.0014
	Iron (Fe)-Total	mg/L	AO<0.3	0.035	0.030	0.035	0.060	0.072	0.090	0.109	0.075	0.107
	Lead (Pb)-Total	mg/L	0.01	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium - Total	mg/L										
	Magnesium (Mg)-Total	mg/L	none requried	0.66	0.69	0.65	0.68	0.70	0.72	0.70	0.76	0.71
	Manganese (Mn)-Total	mg/L	AO < 0.05	<0.0020	<0.0020	<0.0020	0.0022	<0.0020	0.0023	0.0024	<0.0020	<0.0024
	Mercury (Hg)-Total	mg/L	0.001	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum- Total	mg/L										
	Nickel-Total	mg/L										
	Phosphorous-Total	mg/L	<0.020									
	Potassium (K)-Total	mg/L		0.65	0.60	0.60	0.63	0.61	0.67	0.62	0.64	0.63
	Selenium (Se)-Total	mg/L	0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon-Total	mg/L										
	Silver-Total	mg/L										
	Sodium (Na)-Total	mg/L	AO<200	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Strontium-Total	mg/L										
	Sulfer-Total	mg/L										
	Tellurium-Total	mg/L										
	Thalium-Total	mg/L										
	Thorium-Total	mg/L										
	Tin-Total	mg/L										
	Titanium-Total	mg/L										
	Uranium (U)-Total	mg/L	0.02	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Vanadium	mg/L										
	Zinc (Zn)-Total	mg/L	AO<5.0	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Zirconuim-Total	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

APPENDIX A-2 . Historic Average Flow

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007	Month total	15144	13065	14795	14816	21200	21208	39184	39724	22797	12883	13025	15738
	Daily Avg	488	466	477	493	684	707	1264	1223	760	416	434	508
	Daily Max	753	673	688	681	746	1577	2175	1908	1803	644	629	699
	Daily Min	250	323	303	208	340	334	698	730	344	110	104	310
2009	Month total	12411	11589	14076	16559	22594	35051	45359	38740	23231	19801	17916	13534
	Daily Avg	400	414	454	552	729	1168	1463	1250	774	639	597	437
	Daily Max	691	704	653	682	1337	1675	1953	1540	1101	778	1278	817
	Daily Min	141	224	302	316	476	720	750	644	501	332	173	65
2010	Month total	14564	15363	16652	18892	20583	21028	46141	44141	21477	18297	16001	14682
	Daily Avg	470	549	537	630	664	701	1488	1424	716	590	533	474
	Daily Max	745	972	950	1357	1364	1254	2262	2544	1084	716	863	879
	Daily Min	154	107	337	147	301	356	833	729	492	330	297	95
2011	Month total	13154	11880	15920	18356	20199	23826	28994	38093	29458	19637	14496	15246
	Daily Avg	424	424	514	612	652	794	935	1229	982	633	483	492
	Daily Max	737	784	1138	1198	1154	2576	1672	1905	2260	2367	815	722
	Daily Min	171	258	209	211	393	212	350	446	401	300	249	268
2012	Month total	12829	12492	14043	15313	18294	17015	27963	36571	28531	19815	14926	13972
	Daily Avg	414	446	453	510	590	567	902	1180	951	639	498	451
	Daily Max	832	560	575	792	866	805	1316	1706	2174	1199	685	739
	Daily Min	325	280	339	272	232	293	638	605	595	25	0	0
2013	Month total	14366	12989	15183	16180	20517	22045	41583	35965	21824	17607	15802	15092
	Daily Avg	463	464	490	539	662	735	1341	1160	727	568	527	487
	Daily Max	619	769	1065	746	1115	1137	1804	1613	2019	1157	781	814
	Daily Min	19	0	72	348	406	483	884	632	330	115	399	257

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AVG Month total (2007-2013)	13745	12896	15112	16686	20565	23362	38204	38872	24553	18007	15361	14711
AVG Daily Avg (2007-2013)	443	460	487	556	663	779	1232	1244	818	581	512	475
AVG Daily Max (2007-2013)	730	744	845	909	1097	1504	1864	1869	1740	1144	842	778
AVG Daily Min (2007-2013)	177	199	260	250	358	400	692	631	444	202	204	166

Source: Handwritten Village of Harrison Hot Springs Annual Reports 2007-2013 (2008 missing)

* note that errors have been found in the raw data *

Appendix B – Groundwater Data

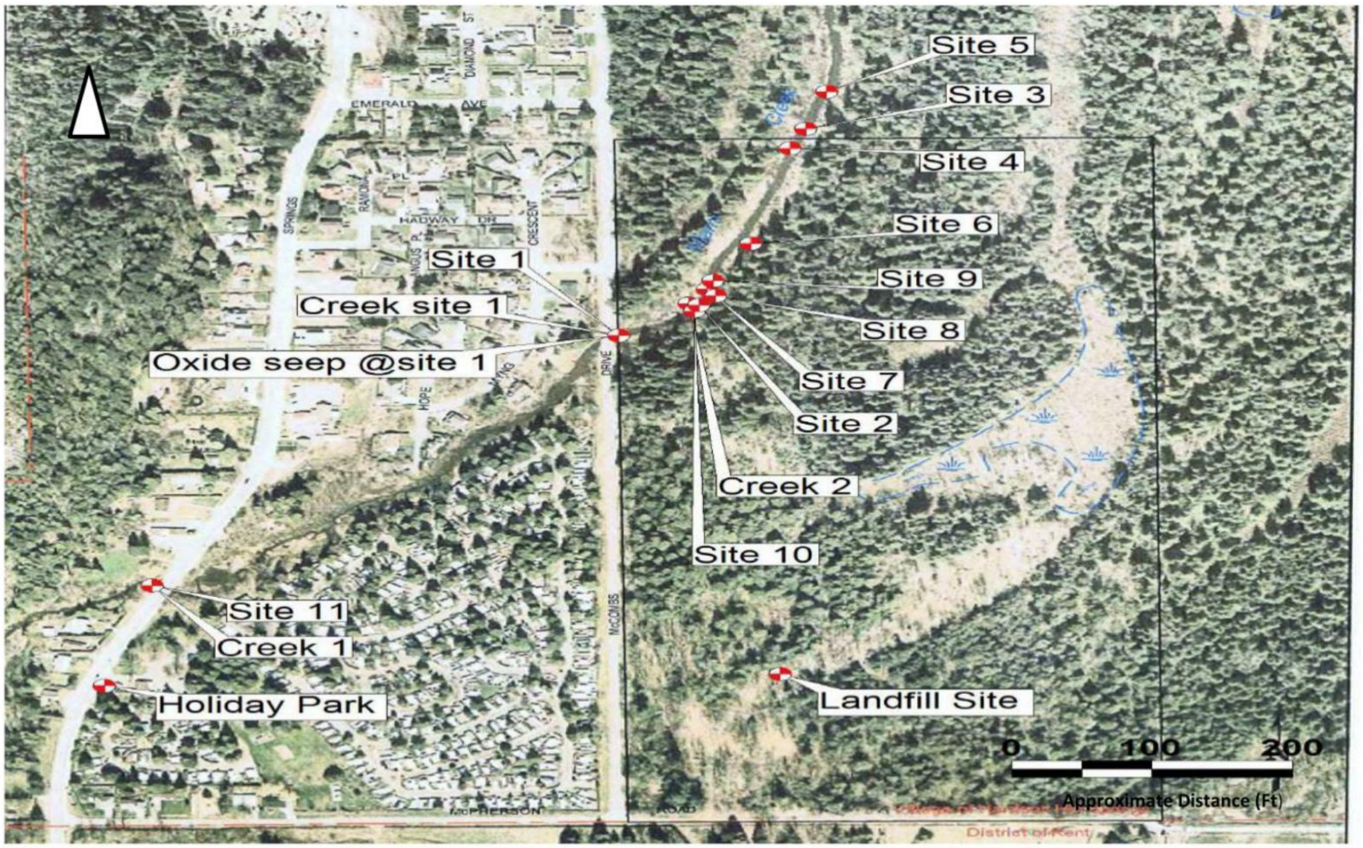
1. GROUND WATER QUALITY SAMPLE LOCATIONS
2. 2014 CIVIC ADDRESSES SUPPLIED BY PRIVATE WELLS
3. PROVINCIALLY REGISTERED WELLS WITHIN VHS

APPENDIX B-1 - Water Quality Sample Locations

CTQ - Village of Harrison Hot Springs	TITLE **Figure 2:** Water Quality Sample Locations					
western water ASSOCIATES LTD	DRAWN BRM		DATE July 2014		PROJECT NO. 14-007-01	
	CHECKED		SCALE See figure		DWG. NO. na	
	REVIEWED		FILE NO.		FIGURE VERSION NO. 1	

Reprinted from WWAL (2014)

APPENDIX B-1 - Water Quality Sample Locations



CTQ - Village of Harrison Hot Springs	TITLE **Figure 3:** Hyporheic Zone and Surface Water Quality Sample Locations		
western water ASSOCIATES LTD	DRAWN BRM	DATE July 2014	PROJECT NO. 14-007-01
	CHECKED	SCALE See figure	DWG. NO. na
	REVIEWED	FILE NO.	FIGURE VERSION NO. 1

Reprinted from WWAL (2014)

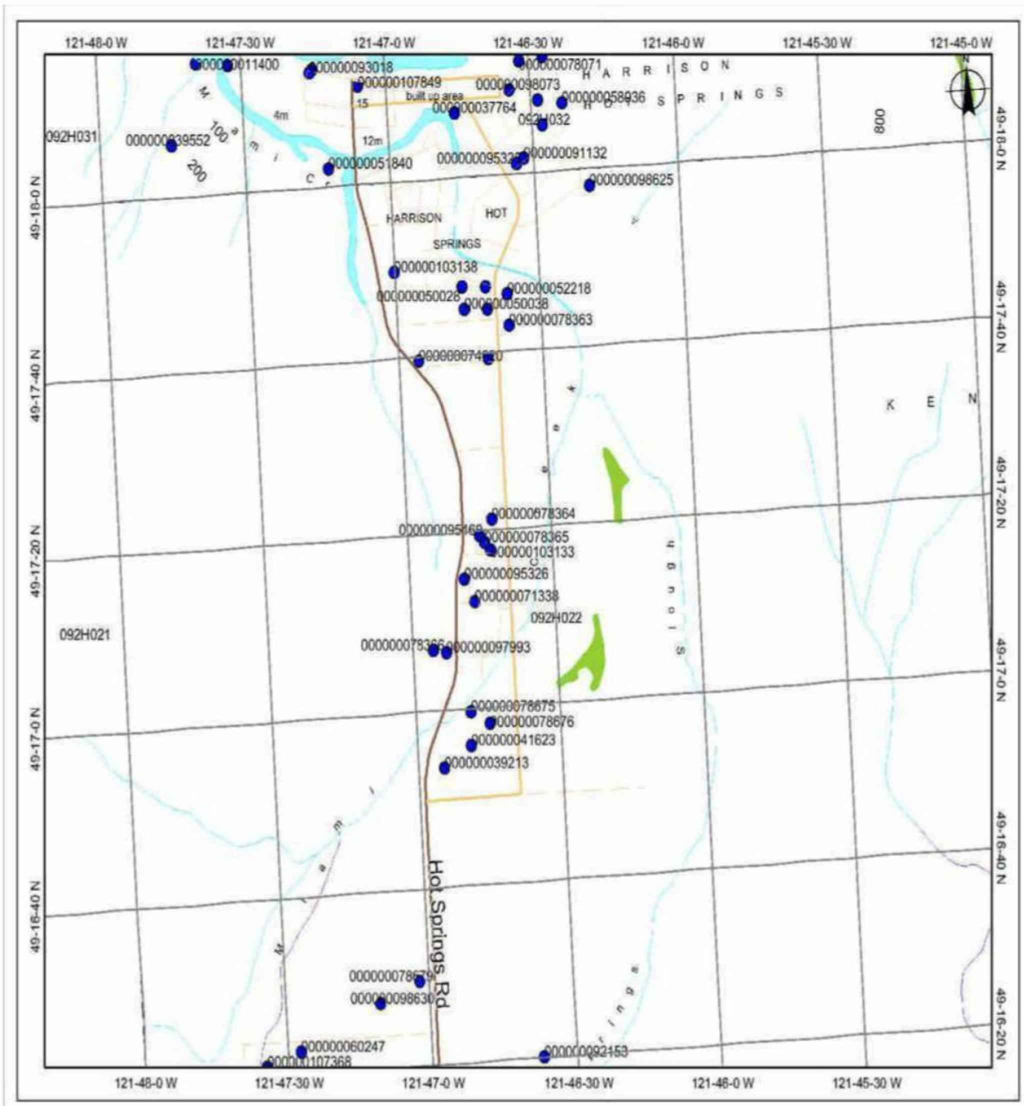
APPENDIX B-2 - 2014 Civic Addresses Supplied by Private Wells

Village of Harrison Hot Springs
Civic Addresses on Water supply Wells

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
303 McPherson Road	861 Myng Crescent	822 Ramona Place	780 McCombs Drive	607 Lakberg Crescent	560 Naismith Avenue	520 Lillooet Avenue
305 McPherson Road	865 Myng Crescent	826 Ramona Place	770 McCombs Drive	608 Lakberg Crescent	565 Naismith Avenue	526 Lillooet Avenue
307 McPherson Road	866 Myng Crescent	830 Ramona Place	760 McCombs Drive	608 McCombs Drive	566 Naismith Avenue	527 Lillooet Avenue
973 Hot Springs Road	870 Myng Crescent	836 Ramona Place	750 McCombs Drive	606 McCombs Drive	522 Echo Avenue	531 Lillooet Avenue
960 Hot Springs Road	871 Myng Crescent	836 Hot Springs Road	728 Hot Springs Road	604 McCombs Drive	531 Echo Avenue	533 Lillooet Avenue
950 Hot Springs Road	875 Myng Crescent	822 Hot Springs Road	720 Hot Springs Road	602 McCombs Drive	562 Echo Avenue	538 Lillooet Avenue
914 Hot Springs Road	856 Hope Place	791 Hot Springs Road	708 McCombs Drive	618 Hot Springs Drive	415 Eagle Street	544 Lillooet Avenue
912 Hot Springs Road	858 Hope Place	796 Hot Springs Road	704 McCombs Drive	613 Hot Springs Drive	501 Hot Springs Road	549 Lillooet Avenue
978 Hot Springs Road	862 Hope Place	400 Emerald Drive	454 Alder Avenue	464 Naismith Avenue	398 Hot Springs Road	550 Lillooet Avenue
905 Hot Springs Road	866 Hope Place	410 Emerald Drive	464 Alder Avenue	470 Naismith Avenue	410 Bear Avenue	553 Lillooet Avenue
904 Hot Springs Road	868 Hope Place	411 Emerald Drive	474 Alder Avenue	476 Naismith Avenue	420 Bear Avenue	556 Lillooet Avenue
879 Hot Springs Road	870 Hope Place	420 Emerald Drive	479 Alder Avenue	485 Naismith Avenue	430 Bear Avenue	562 Lillooet Avenue
876 Hot Springs Road	872 Hope Place	421 Emerald Drive	489 Alder Avenue	505 Naismith Avenue	114 Cedar Avenue	565 Lillooet Avenue
875 Hot Springs Road	878 Hope Place	430 Emerald Drive	685 Hot Springs Road	510 Naismith Avenue	140 Cedar Avenue	568 Lillooet Avenue
870 Hot Springs Road	881 Hope Place	431 Emerald Drive	673 Hot Springs Road	513 Naismith Avenue	150 Cedar Avenue	574 Lillooet Avenue
853 Hot Springs Road	884 Hope Place	440 Emerald Drive	657 Hot Springs Road	515 Naismith Avenue	160 Cedar Avenue	595 Lillooet Avenue
815 Myng Crescent	885 Hope Place	441 Emerald Drive	389 Pine Avenue	516 Naismith Avenue	318 Hot Springs Road	100 Esplanade Avenue
820 Myng Crescent	892 Hope Place	450 Emerald Drive	395 Pine Avenue	519 Naismith Avenue	316 Hot Springs Road	140 Esplanade Avenue
822 Myng Crescent	401 Hadway Drive	451 Emerald Drive	415 Pine Avenue	520 Naismith Avenue	310 Hot Springs Road	150 Esplanade Avenue
825 Myng Crescent	425 Hadway Drive	460 Emerald Drive	435 Pine Avenue	525 Naismith Avenue	248 Cedar Avenue	101 Hot Springs Road
826 Myng Crescent	835 Angus Place	470 Emerald Drive	442 Pine Avenue	526 Naismith Avenue	260 Cedar Avenue	234 Esplanade Avenue
830 Myng Crescent	836 Angus Place	795 Diamond Street	455 Pine Avenue	529 Naismith Avenue	259 Hot Springs Road	
831 Myng Crescent	841 Angus Place	790 Diamond Street	464 Pine Avenue	530 Naismith Avenue	200 Hot Springs Road	
835 Myng Crescent	844 Angus Place	785 Diamond Street	470 Pine Avenue	535 Naismith Avenue	124 Lillooet Avenue	
836 Myng Crescent	847 Angus Place	780 Diamond Street	473 Pine Avenue	536 Naismith Avenue	134 Lillooet Avenue	
839 Myng Crescent	848 Angus Place	775 Diamond Street	478 Pine Avenue	539 Naismith Avenue	146 Lillooet Avenue	
840 Myng Crescent	849 Angus Place	770 Diamond Street	480 Pine Avenue	540 Naismith Avenue	440 Lillooet Avenue	
846 Myng Crescent	850 Angus Place	765 Diamond Street	601 Lakberg Crescent	545 Naismith Avenue	490 Lillooet Avenue	
847 Myng Crescent	808 Ramona Place	760 Diamond Street	602 Lakberg Crescent	546 Naismith Avenue	498 Lillooet Avenue	
850 Myng Crescent	811 Ramona Place	755 Diamond Street	603 Lakberg Crescent	549 Naismith Avenue	231 Spruce Street	
851 Myng Crescent	812 Ramona Place	750 Diamond Street	604 Lakberg Crescent	550 Naismith Avenue	500 Lillooet Avenue	
856 Myng Crescent	816 Ramona Place	775 Hot Springs Road	605 Lakberg Crescent	555 Naismith Avenue	511 Lillooet Avenue	
857 Myng Crescent	820 Ramona Place	790 McCombs Drive	606 Lakberg Crescent	556 Naismith Avenue	519 Lillooet Avenue	

Page 1
As of January 2014

APPENDIX B-3 - Provincially Registered Wells within VHS



Source: Water Resources Atlas, 2014

CTQ – Village of Harrison Hot Springs	TITLE: Figure B1: Registered Wells in the Area		
western water ASSOCIATES LTD	DRAWN MJ	DATE July 2014	PROJECT NO. 14-007-01
	CHECKED BRM	SCALE 1:20,457	DWG. NO. na
	REVIEWED DG	FILE NO.	FIGURE NO. 1

Reprinted from WWAL (2014)

Appendix C – Water Model Criteria and Results

1. WATER MODEL CRITERIA
2. PIPE TABLES AND JUNCTION TABLES (EXISTING AND FUTURE SCENARIOS)
3. DEMAND PATTERNS
4. METER READING DATA
5. JUNCTION DEMANDS (EXISTING AND FUTURE SCENARIOS)
6. CIVIC ADDRESSES FOR NON-CONFORMING HYDRANT COVERAGE
7. HYDRANT REQUIREMENTS TABLES (EXISTING AND FUTURE SCENARIOS)

Appendix C - Water Model Criteria

Demand Criteria

Demand	Units	MMCD Design Guide/ VHHS Zoning Bylaw	People/unit	Average Daily Demand L/day (ADD)	Average Daily Demand L/sec (ADD)
Average Daily Demand (ADD)	L/capita/day	600			
Maximum Day Demand (MDD)	L/capita/day	1200			
Peak Hour Demand (PHD)	L/capita/day	1800			
R-1 - Conventional Lot (ADD)	people/unit	N/A	3	1800	0.021
R-2 - Duplex	people/unit	N/A	6	3600	0.042
R-3 - One Family Residental (small lot)	people/unit	n/a	2	1200	0.014
R-4 - Multi-Family - Meduim Density	people/ha	35		21000	0.243
R-5 - Multi-Family - HighDensity	people/ha	100		60000	0.694
CS - Service Station	people		28	16800	0.194
Hotel	people/unit	n/a	2	1200	0.014
Hall per Seat	seat/unit		1	8	0.000093
(All other C Zones) - Commercial	people/ha	200		120000	1.389
C-4	people/ha	90		54000	0.625
C-5	people/ha	100		60000	0.694
Institutional P-1	people/ha	50		30000	0.347
Harrison Holiday Park - C7	people/unit		2	600	0.007

*Used water meter data for all buildings that are metered by VHHS

*Summer Domestic Pattern was apply to all average demands

Peaking Factors		MMCD Design Guide
MDD = PF_1 X ADD	/	2.00 X ADD
PHD = PF_1 X ADD	/	1.50 X MDD

Roughness Criteria

Pipe	Size	MMCD Design Guide
Roughness (Hazen-Williams)		
PVC		125
DI, Conc., St.		125
Diameter	≥ 250mm	125
Diameter	≥ 200mm	125
Diameter	≤ 200mm	125
Diameter	≤ 150mm	125

Pipe Criteria

Pipe	Size	MMCD Design Guide
Minimum Diameter		
Distribution Mains	mm	*200
Fire Hydrant Connections	mm	150
Service Connections	mm	20
With Fire Sprinklers	mm	50

* For Looped Distribution mains with lengths less than 500m in residential subdivisions, the diameter can be reduced to 150mm, providing that fire flow requirments can be meet

Criteria	Units	MMCD Design Guide
PHD	m/s	3.5
FF	m/s	3.5

Fire Flow Criteria

Criteria	Units	MMCD Design Guide
Fire Flow		
Single Family (R-1, R-2, & R-3)	L/s	60
Apartments, Townhouses (R-4 & R-5)	L/s	90
Commercial (All C Zones)	L/s	150
Institutional (P-1)	L/s	150
Industrial (I-1)	L/s	225

Pressure Criteria

Criteria	Units	MMCD Design Guide
Pressure		
Max. Static	psi	123 (850 Kpa)
Min. Static	psi	N/A
Min. System at PHD	psi	44 (300 Kpa)
Min. System at FF	psi	22 (150 Kpa)

Appendix C - Pipe Table
(2014 Existing Water Supply Distribution System)

Label	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Length (m)	Installation Year
E-1	J-97	J-90	250	PVC	130	30	2011
E-2	J-90	J-241	250	PVC	130	111	2003
E-3	J-242	J-241	250	PVC	130	74	1992
E-4	J-240	J-242	250	PVC	130	79	1992
E-5	J-240	J-45	200	PVC	130	11	1992
E-6	J-46	J-47	150	PVC	130	141	
E-7	J-46	J-48	50	PVC	130	221	
E-8	J-48	J-49	50	PVC	130	253	
E-9	J-69	J-229	150	PVC	130	109	2009
E-10	J-229	J-230	150	PVC	130	95	2009
E-11	J-231	J-232	150	PVC	130	43	
E-12	J-232	J-233	150	PVC	130	14	
E-13	J-233	J-234	150	PVC	130	90	
E-14	J-234	J-235	150	PVC	130	57	
E-15	J-235	J-236	150	PVC	130	63	
E-15	J-238	J-235	150	PVC	130	31	
E-16	J-236	J-237	150	PVC	130	87	
E-17	J-237	J-232	150	PVC	130	74	
E-18	J-16	J-215	200	PVC	130	147	2005
E-19	J-215	J-216	200	PVC	130	143	2005
E-20	J-216	J-91	200	PVC	130	157	2005
E-21	J-27	J-220	250	PVC	130	119	2010
E-22	J-220	J-221	250	PVC	130	192	2010
E-23	J-221	J-222	250	PVC	130	89	2010
E-24	J-222	J-223	250	PVC	130	128	2010
E-25	J-223	J-224	250	PVC	130	158	2010
E-26	J-95	J-225	200	PVC	130	21	2010
E-27	J-225	J-226	200	PVC	130	154	2010
E-28	J-226	J-96	200	PVC	130	223	2010
E-30	J-227	J-93	200	PVC	130	198	2006
E-31	J-224	J-228	250	PVC	130	123	2010
E-32	J-228	J-95	250	PVC	130	218	2010
E-33	J-92	J-25	200	PVC	130	48	2006
L-1	H-1	J-90	150	PVC	130	7	
L-2	J-241	H-2	150	PVC	130	13	
L-3	J-242	H-3	150	PVC	130	11	
L-4	H-4	J-201	150	PVC	130	6	
L-5	H-5	J-51	150	PVC	130	12	
L-6	H-6	J-202	150	PVC	130	6	
L-7	H-7	J-203	150	PVC	130	8	
L-8	H-8	J-54	150	PVC	130	12	
L-9	H-9	J-204	150	PVC	130	7	
L-10	H-10	J-55	150	PVC	130	9	
L-11	H-11	J-56	150	PVC	130	10	
L-12	H-12	J-205	150	PVC	130	8	
L-13	H-13	J-206	150	PVC	130	4	
L-14	H-14	J-207	150	PVC	130	6	
L-15	H-15	J-59	150	PVC	130	5	
L-16	H-16	J-60	150	PVC	130	8	
L-17	H-17	J-208	150	PVC	130	8	
L-18	H-18	J-63	150	PVC	130	9	
L-19	H-19	J-64	150	PVC	130	8	
L-20	H-20	J-65	150	PVC	130	8	
L-21	H-21	J-68	150	PVC	130	7	
L-22	H-22	J-69	150	PVC	130	12	
L-23	H-23	J-42	150	PVC	130	7	
L-24	H-24	J-209	150	PVC	130	11	
L-25	H-25	J-43	150	PVC	130	10	
L-26	H-26	J-210	150	PVC	130	8	
L-27	H-27	J-36	150	PVC	130	9	
L-28	H-28	J-35	150	PVC	130	10	
L-29	H-29	J-211	150	PVC	130	7	
L-30	H-30	J-31	150	PVC	130	15	
L-31	H-31	J-30	150	PVC	130	19	
L-32	H-32	J-212	150	PVC	130	16	
L-33	H-33	J-39	150	PVC	130	20	
L-34	H-34	J-213	150	PVC	130	11	
L-35	H-35	J-28	150	PVC	130	9	
L-36	H-36	J-12	150	PVC	130	15	
L-37	J-13	H-37	150	PVC	130	11	
L-38	H-38	J-16	150	PVC	130	17	
L-39	J-17	H-39	150	PVC	130	19	
L-40	H-40	J-18	150	PVC	130	16	

L-41	J-9	H-41	150	PVC	130	14	
L-42	H-42	J-10	150	PVC	130	8	
L-43	H-43	J-7	150	PVC	130	10	
L-44	H-44	J-214	150	PVC	130	14	
L-45	H-45	J-19	150	PVC	130	15	
L-46	J-20	H-46	150	PVC	130	12	
L-47	H-47	J-215	150	PVC	130	7	
L-48	H-48	J-216	150	PVC	130	13	
L-49	H-49	J-217	150	PVC	130	11	
L-50	H-50	J-91	150	PVC	130	14	
L-51	H-51	J-23	150	PVC	130	16	
L-52	J-92	H-52	150	PVC	130	11	
L-54	H-54	J-219	150	PVC	130	12	
L-55	J-27	H-55	150	PVC	130	12	
L-56	J-220	H-56	150	PVC	130	10	
L-57	J-221	H-57	150	PVC	130	10	
L-58	J-222	H-58	150	PVC	130	10	
L-59	J-223	H-59	150	PVC	130	12	
L-60	J-224	H-60	150	PVC	130	10	
L-61	J-225	H-61	150	PVC	130	17	
L-62	J-226	H-62	150	PVC	130	12	
L-63	H-63	J-94	150	PVC	130	16	
L-64	J-227	H-64	150	PVC	130	9	
L-65	H-65	J-228	150	PVC	130	9	
L-66	H-66	J-237	150	PVC	130	10	
L-67	J-233	H-67	150	PVC	130	8	
L-68	H-68	J-235	150	PVC	130	10	
P-1	R-1	J-1A	350	PVC	130	1,050	2000
P-2	J-1A	PMP-1	150	PVC	130	5	2000
P-3	J-1A	PMP-2	150	PVC	130	5	2000
P-4	PMP-2	J-1	150	PVC	130	5	2000
P-5	PMP-1	J-1	150	PVC	130	5	2000
P-6	J-1	J-2	250	PVC	130	789	2000
P-7	J-2	J-3	250	PVC	130	134	1984
P-8	T-1	J-3	200	Ductile Iron	130	165	1984
P-9	T-1	J-4	300	Ductile Iron	130	199	1984
P-17	J-7	J-4	350	PVC	130	50	1984
P-18	J-8	J-7	350	PVC	130	27	1984
P-19	J-8	J-9	200	PVC	130	67	1984
P-20	J-9	J-10	200	PVC	130	133	1984
P-21	J-10	J-11	150	PVC	130	71	1984
P-22	J-10	J-12	200	PVC	130	152	1984
P-23	J-12	J-13	200	PVC	130	87	1984
P-24	J-13	J-14	150	PVC	130	62	1984
P-25	J-13	J-15	200	PVC	130	89	1984
P-26	J-15	J-16	150	PVC	130	120	1985
P-28	J-17	J-18	150	PVC	130	146	1984
P-29	J-18	J-9	150	PVC	130	164	1984
P-30A	J-8	J-214	250	PVC	130	172	1995
P-30B	J-214	J-19	250	PVC	130	160	1995
P-31	J-19	J-20	250	PVC	130	151	1995
P-32	J-20	J-21	250	PVC	130	147	1995
P-33A	J-21	J-217	150	PVC	130	12	1995
P-33B	J-217	J-22	150	PVC	130	45	1995
P-34	J-22	J-23	150	PVC	130	154	1995
P-35	J-23	J-24	150	PVC	130	39	1995
P-36	J-24	J-25	200	PVC	130	68	1995
P-37	J-24	J-26	200	PVC	130	116	1995
P-38	J-21	J-26	250	PVC	130	117	1995
P-39A	J-26	J-219	250	PVC	130	26	1995
P-39B	J-219	J-27	250	PVC	130	93	1995
P-40	J-12	J-28	150	PVC	130	111	1984
P-41	J-28	J-29	150	PVC	130	76	1984
P-42	J-28	J-30	150	PVC	130	87	1984
P-44A	J-31	J-211	150	PVC	130	112	1984
P-44B	J-211	J-32	150	PVC	130	10	1984
P-45	J-32	J-33	150	PVC	130	47	1984
P-46	J-33	J-34	150	PVC	130	74	1984
P-47	J-32	J-34	150	PVC	130	65	1984
P-48	J-35	J-34	150	PVC	130	47	1984
P-49	J-30	J-31	150	PVC	130	157	1984
P-49	J-35	J-36	150	PVC	130	156	1984
P-50	J-36	J-37	150	PVC	130	49	1984
P-51A	J-37	J-213	200	PVC	130	92	1984

Appendix C - Pipe Table
(2014 Existing Water Supply Distribution System)

P-51B	J-213	J-38	200	PVC	130	92	1984
P-52A	J-212	J-38	150	PVC	130	68	1984
P-52B	J-231	J-212	150	PVC	130	96	1984
P-52C	J-30	J-231	150	PVC	130	72	1984
P-53	J-38	J-39	150	PVC	130	61	1984
P-54	J-39	J-40	350	Ductile Iron	130	168	1992
P-54A	J-8	J-39	350	Ductile Iron	130	260	1992
P-55A	J-37	J-210	150	PVC	130	31	1984
P-55B	J-210	J-40	150	PVC	130	20	1984
P-56	J-40	J-41	350	Ductile Iron	130	189	1992
P-57	J-41	J-42	250	PVC	130	75	1995
P-58A	J-41	J-209	250	PVC	130	20	1992
P-58B	J-209	J-43	250	PVC	130	95	1992
P-59	J-43	J-44	250	PVC	130	67	1992
P-60A	J-201	J-45	300	PVC	130	18	1992
P-60B	J-44	J-201	300	PVC	130	62	1992
P-61	J-45	J-51	200	PVC	130	137	1992
P-62	J-45	J-46	150	PVC	130	104	1992
P-66A	J-50	J-202	200	PVC	130	62	1992
P-67	J-51	J-50	200	PVC	130	84	1992
P-68	J-50	J-52	200	PVC	130	62	1992
P-69A	J-52	J-203	200	PVC	130	18	1989
P-69B	J-203	J-53	200	PVC	130	200	1989
P-70	J-54	J-53	150	PVC	130	105	1994
P-71	J-91	J-92	200	PVC	130	66	2005
P-71A	J-53	J-204	150	PVC	130	17	1994
P-71B	J-204	J-55	200	PVC	130	136	1994
P-72	J-55	J-56	200	PVC	130	138	1994
P-73	J-93	J-94	200	PVC	130	38	2006
P-73A	J-56	J-205	200	PVC	130	67	1994
P-73B	J-205	J-57	200	PVC	130	30	1994
P-74	J-22	J-91	200	PVC	130	144	2005
P-74A	J-57	J-206	200	PVC	130	91	1994
P-74B	J-206	J-58	200	PVC	130	23	1994
P-75A	J-207	J-59	200	PVC	130	96	1989
P-75B	J-207	J-230	200	PVC	130	9	1989
P-75C	J-230	J-53	200	PVC	130	112	1989
P-76	J-59	J-60	150	PVC	130	152	1984
P-77A	J-60	J-208	150	PVC	130	146	1984
P-77B	J-208	J-61	150	PVC	130	16	1984
P-78	J-61	J-62	150	PVC	130	113	1984
P-79	J-62	J-63	150	PVC	130	35	1984
P-80	J-63	J-64	150	PVC	130	147	1984
P-81	J-64	J-65	150	PVC	130	144	1984
P-82	J-59	J-65	200	PVC	130	84	1984
P-82	J-1A	PMP-3	150	PVC	130	5	2000
P-83	PMP-3	J-1	150	PVC	130	5	2000
P-84	J-65	J-67	200	PVC	130	93	1984
P-85	J-15	J-67	200	PVC	130	140	1984
P-86	J-67	J-68	150	PVC	130	67	1984
P-88	J-65	J-66	150	PVC	130	68	1984
P-270	H-53	J-25	150	PVC	130	23	

Appendix C - Pipe Table
(Future System - 2014 Existing System PLUS Unserviced Properties)

HARRISON HOT SPRINGS
Naturally Refreshed

Label	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Length (m)	Installation Year
E-1	J-97	J-90	250	PVC	130	30	2011
E-2	J-90	J-241	250	PVC	130	111	2003
E-3	J-242	J-241	250	PVC	130	74	1992
E-4	J-240	J-242	250	PVC	130	79	1992
E-5	J-240	J-45	200	PVC	130	11	1992
E-6	J-46	J-47	150	PVC	130	141	
E-7	J-46	J-48	50	PVC	130	221	
E-8	J-48	J-49	50	PVC	130	253	
E-9	J-69	J-229	150	PVC	130	109	2009
E-10	J-229	J-230	150	PVC	130	95	2009
E-11	J-231	J-232	150	PVC	130	43	
E-12	J-232	J-233	150	PVC	130	14	
E-13	J-233	J-234	150	PVC	130	90	
E-14	J-234	J-235	150	PVC	130	57	
E-15	J-235	J-236	150	PVC	130	63	
E-15	J-238	J-235	150	PVC	130	31	
E-16	J-236	J-237	150	PVC	130	87	
E-17	J-237	J-232	150	PVC	130	74	
E-18	J-16	J-215	200	PVC	130	147	2005
E-19	J-215	J-216	200	PVC	130	143	2005
E-20	J-216	J-91	200	PVC	130	157	2005
E-21	J-27	J-220	250	PVC	130	119	2010
E-22	J-220	J-221	250	PVC	130	192	2010
E-23	J-221	J-222	350	PVC	130	89	2010
E-24	J-222	J-223	350	PVC	130	128	2010
E-25	J-223	J-224	350	PVC	130	158	2010
E-26	J-95	J-225	200	PVC	130	21	2010
E-27	J-225	J-226	200	PVC	130	154	2010
E-28	J-226	J-96	200	PVC	130	223	2010
E-30	J-227	J-93	200	PVC	130	198	2006
E-31	J-224	J-228	250	PVC	130	123	2010
E-32	J-228	J-95	250	PVC	130	218	2010
E-33	J-92	J-25	200	PVC	130	48	2006
L-1	H-1	J-90	150	PVC	130	7	
L-2	J-241	H-2	150	PVC	130	13	
L-3	J-242	H-3	150	PVC	130	11	
L-4	H-4	J-201	150	PVC	130	6	
L-5	H-5	J-51	150	PVC	130	12	
L-6	H-6	J-202	150	PVC	130	6	
L-7	H-7	J-203	150	PVC	130	8	
L-8	H-8	J-54	150	PVC	130	12	
L-9	H-9	J-204	150	PVC	130	7	
L-10	H-10	J-55	150	PVC	130	9	
L-11	H-11	J-56	150	PVC	130	10	
L-12	H-12	J-205	150	PVC	130	8	
L-13	H-13	J-206	150	PVC	130	4	
L-14	H-14	J-207	150	PVC	130	6	
L-15	H-15	J-59	150	PVC	130	5	
L-16	H-16	J-60	150	PVC	130	8	
L-17	H-17	J-208	150	PVC	130	8	
L-18	H-18	J-63	150	PVC	130	9	
L-19	H-19	J-64	150	PVC	130	8	
L-20	H-20	J-65	150	PVC	130	8	
L-21	H-21	J-68	150	PVC	130	7	
L-22	H-22	J-69	150	PVC	130	12	
L-23	H-23	J-42	150	PVC	130	7	
L-24	H-24	J-209	150	PVC	130	11	
L-25	H-25	J-43	150	PVC	130	10	
L-26	H-26	J-210	150	PVC	130	8	
L-27	H-27	J-36	150	PVC	130	9	
L-28	H-28	J-35	150	PVC	130	10	
L-29	H-29	J-211	150	PVC	130	7	
L-30	H-30	J-31	150	PVC	130	15	
L-31	H-31	J-30	150	PVC	130	19	
L-32	H-32	J-212	150	PVC	130	16	
L-33	H-33	J-39	150	PVC	130	20	
L-34	H-34	J-213	150	PVC	130	11	
L-35	H-35	J-28	150	PVC	130	9	
L-36	H-36	J-12	150	PVC	130	15	
L-37	J-13	H-37	150	PVC	130	11	
L-38	H-38	J-16	150	PVC	130	17	
L-39	J-17	H-39	150	PVC	130	19	
L-40	H-40	J-18	150	PVC	130	16	
L-41	J-9	H-41	150	PVC	130	14	
L-42	H-42	J-10	150	PVC	130	8	

L-43	H-43	J-7	150	PVC	130	10	
L-44	H-44	J-214	150	PVC	130	14	
L-45	H-45	J-19	150	PVC	130	15	
L-46	J-20	H-46	150	PVC	130	12	
L-47	H-47	J-215	150	PVC	130	7	
L-48	H-48	J-216	150	PVC	130	13	
L-49	H-49	J-217	150	PVC	130	11	
L-50	H-50	J-91	150	PVC	130	14	
L-51	H-51	J-23	150	PVC	130	16	
L-52	J-92	H-52	150	PVC	130	11	
L-54	H-54	J-219	150	PVC	130	12	
L-55	J-27	H-55	150	PVC	130	12	
L-56	J-220	H-56	150	PVC	130	10	
L-57	J-221	H-57	150	PVC	130	10	
L-58	J-222	H-58	150	PVC	130	10	
L-59	J-223	H-59	150	PVC	130	12	
L-60	J-224	H-60	150	PVC	130	10	
L-61	J-225	H-61	150	PVC	130	17	
L-62	J-226	H-62	150	PVC	130	12	
L-63	H-63	J-94	150	PVC	130	16	
L-64	J-227	H-64	150	PVC	130	9	
L-65	H-65	J-228	150	PVC	130	9	
L-66	H-66	J-237	150	PVC	130	10	
L-67	J-233	H-67	150	PVC	130	8	
L-68	H-68	J-235	150	PVC	130	10	
P-1	R-1	J-1A	350	PVC	130	1,050	2000
P-2	J-1A	PMP-1	150	PVC	130	5	2000
P-3	J-1A	PMP-2	150	PVC	130	5	2000
P-4	PMP-2	J-1	150	PVC	130	5	2000
P-5	PMP-1	J-1	150	PVC	130	5	2000
P-6	J-1	J-2	250	PVC	130	789	2000
P-7	J-2	J-3	250	PVC	130	134	1984
P-8	T-1	J-3	200	Ductile Iron	130	165	1984
P-9	T-1	J-4	300	Ductile Iron	130	199	1984
P-17	J-7	J-4	350	PVC	130	50	1984
P-18	J-8	J-7	350	PVC	130	27	1984
P-19	J-8	J-9	200	PVC	130	67	1984
P-20	J-9	J-10	200	PVC	130	133	1984
P-21	J-10	J-11	150	PVC	130	71	1984
P-22	J-10	J-12	200	PVC	130	152	1984
P-23	J-12	J-13	200	PVC	130	87	1984
P-24	J-13	J-14	150	PVC	130	62	1984
P-25	J-13	J-15	200	PVC	130	89	1984
P-26	J-15	J-16	150	PVC	130	120	1985
P-28	J-17	J-18	150	PVC	130	146	1984
P-29	J-18	J-9	150	PVC	130	164	1984
P-30A	J-8	J-214	250	PVC	130	172	1995
P-30B	J-214	J-19	250	PVC	130	160	1995
P-31	J-19	J-20	250	PVC	130	151	1995
P-32	J-20	J-21	250	PVC	130	147	1995
P-33A	J-21	J-217	150	PVC	130	12	1995
P-33B	J-217	J-22	150	PVC	130	45	1995
P-34	J-22	J-23	150	PVC	130	154	1995
P-35	J-23	J-24	150	PVC	130	39	1995
P-36	J-24	J-25	200	PVC	130	68	1995
P-37	J-24	J-26	200	PVC	130	116	1995
P-38	J-21	J-26	250	PVC	130	117	1995
P-39A	J-26	J-219	250	PVC	130	26	1995
P-39B	J-219	J-27	250	PVC	130	93	1995
P-40	J-12	J-28	150	PVC	130	111	1984
P-41	J-28	J-29	150	PVC	130	76	1984
P-42	J-28	J-30	150	PVC	130	87	1984
P-44A	J-31	J-211	150	PVC	130	112	1984
P-44B	J-211	J-32	150	PVC	130	10	1984
P-45	J-32	J-33	150	PVC	130	47	1984
P-46	J-33	J-34	150	PVC	130	74	1984
P-47	J-32	J-34	150	PVC	130	65	1984
P-48	J-35	J-34	150	PVC	130	47	1984
P-49	J-30	J-31	150	PVC	130	157	1984
P-49	J-35	J-36	150	PVC	130	156	1984
P-50	J-36	J-37	150	PVC	130	49	1984
P-51A	J-37	J-213	200	PVC	130	92	1984
P-51B	J-213	J-38	200	PVC	130	92	1984
P-52A	J-212	J-38	150	PVC	130	68	1984
P-52B	J-231	J-212	150	PVC	130	96	1984
P-52C	J-30	J-231	150	PVC	130	72	1984

HARRISON HOT SPRINGS
Naturally Refreshed

P-53	J-38	J-39	150	PVC	130	61	1984
P-54	J-39	J-40	350	Ductile Iron	130	168	1992
P-54A	J-8	J-39	350	Ductile Iron	130	260	1992
P-55A	J-37	J-210	150	PVC	130	31	1984
P-55B	J-210	J-40	150	PVC	130	20	1984
P-56	J-40	J-41	350	Ductile Iron	130	189	1992
P-57	J-41	J-42	250	PVC	130	75	1995
P-58A	J-41	J-209	250	PVC	130	20	1992
P-58B	J-209	J-43	250	PVC	130	95	1992
P-59	J-43	J-44	250	PVC	130	67	1992
P-60A	J-201	J-45	300	PVC	130	18	1992
P-60B	J-44	J-201	300	PVC	130	62	1992
P-61	J-45	J-51	200	PVC	130	137	1992
P-62	J-45	J-46	150	PVC	130	104	1992
P-66A	J-50	J-202	200	PVC	130	62	1992
P-67	J-51	J-50	200	PVC	130	84	1992
P-68	J-50	J-52	200	PVC	130	62	1992
P-69A	J-52	J-203	200	PVC	130	18	1989
P-69B	J-203	J-53	200	PVC	130	200	1989
P-70	J-54	J-53	150	PVC	130	105	1994
P-71	J-91	J-92	200	PVC	130	66	2005
P-71A	J-53	J-204	150	PVC	130	17	1994
P-71B	J-204	J-55	200	PVC	130	136	1994
P-72	J-55	J-56	200	PVC	130	138	1994
P-73	J-93	J-94	200	PVC	130	38	2006
P-73A	J-56	J-205	200	PVC	130	67	1994
P-73B	J-205	J-57	200	PVC	130	30	1994
P-74	J-22	J-91	200	PVC	130	144	2005
P-74A	J-57	J-206	200	PVC	130	91	1994
P-74B	J-206	J-58	200	PVC	130	23	1994
P-75A	J-207	J-59	200	PVC	130	96	1989
P-75B	J-207	J-230	200	PVC	130	9	1989
P-75C	J-230	J-53	200	PVC	130	112	1989
P-76	J-59	J-60	150	PVC	130	152	1984
P-77A	J-60	J-208	150	PVC	130	146	1984
P-77B	J-208	J-61	150	PVC	130	16	1984
P-78	J-61	J-62	150	PVC	130	113	1984
P-79	J-62	J-63	150	PVC	130	35	1984
P-80	J-63	J-64	150	PVC	130	147	1984
P-81	J-64	J-65	150	PVC	130	144	1984
P-82	J-59	J-65	200	PVC	130	84	1984
P-82	J-1A	PMP-3	150	PVC	130	5	2000
P-83	PMP-3	J-1	150	PVC	130	5	2000
P-84	J-65	J-67	200	PVC	130	93	1984
P-85	J-15	J-67	200	PVC	130	140	1984
P-86	J-67	J-68	150	PVC	130	67	1984
P-88	J-65	J-66	150	PVC	130	68	1984
P-270	H-53	J-25	150	PVC	130	23	
P-500	J-19	J-500	150	PVC	130	144	2040
P-501	J-500	J-501	150	PVC	130	121	2040
P-502	J-502	J-501	100	PVC	130	60	2040
P-503	J-501	J-215	150	PVC	130	72	2040
P-504	F16	J-500	150	PVC	130	6	2040
P-505	J-220	J-503	150	PVC	130	109	2040
P-506	J-503	J-504	150	PVC	130	91	2040
P-507	J-504	F18	150	PVC	130	6	2040
P-508	J-503	J-227	150	PVC	130	95	2040
P-509	J-221	J-505	200	PVC	130	85	2040
P-510	J-505	J-506	200	PVC	130	38	2040
P-511	J-506	J-507	200	PVC	130	83	2040
P-512	J-507	J-94	200	PVC	130	68	2040
P-513	J-510	J-507	100	PVC	130	51	2040
P-514	J-94	J-511	200	PVC	130	135	2040
P-515	J-511	J-512	200	PVC	130	72	2040
P-516	J-512	J-513	150	PVC	130	48	2040
P-517	J-513	J-514	100	PVC	130	31	2040
P-518	J-512	J-515	150	PVC	130	37	2040
P-519	J-508	J-516	100	PVC	130	25	2040
P-520	J-516	J-505	150	PVC	130	78	2040
P-521	F19	J-516	150	PVC	130	6	2040
P-522	J-509	J-517	100	PVC	130	32	2040
P-523	J-517	J-506	150	PVC	130	35	2040
P-524	J-517	F21	150	PVC	130	6	2040
P-525	F20	J-507	150	PVC	130	6	2040
P-526	F23	J-511	150	PVC	130	6	2040
P-527	F24	J-515	150	PVC	130	6	2040

P-528	F22	J-513	150	PVC	130	6	2040
P-529	F11	J-518	150	PVC	130	6	2040
P-530	F10	J-519	150	PVC	130	6	2040
P-531	F9	J-520	150	PVC	130	6	2040
P-532	J-520	J-519	200	PVC	130	119	2040
P-533	J-519	J-518	200	PVC	130	113	2040
P-534	J-518	J-230	200	PVC	130	128	2040
P-535	J-57	J-520	200	PVC	130	116	2040
P-538	J-526	J-525	200	PVC	130	85	2040
P-539	J-525	J-524	200	PVC	130	157	2040
P-540	J-524	J-522	200	PVC	130	115	2040
P-541	J-522	J-521	200	PVC	130	71	2040
P-542	J-521	J-52	200	PVC	130	92	2040
P-543	F4	J-521	150	PVC	130	6	2040
P-544	J-523	J-522	150	PVC	130	115	2040
P-545	F6	J-524	150	PVC	130	6	2040
P-546	F7	J-525	150	PVC	130	6	2040
P-547	F8	J-526	150	PVC	130	6	2040
P-548	J-97	J-527	250	PVC	130	57	2040
P-549	J-527	J-528	250	PVC	130	70	2040
P-550	J-528	J-42	250	PVC	130	121	2040
P-551	F1	J-527	150	PVC	130	12	2040
P-552	F2	J-528	150	PVC	130	6	2040
P-554	J-61	J-520	200	PVC	130	117	2040
P-556	J-529	J-504	100	PVC	130	53	2040
P-582	F5	J-522	150	PVC	130	6	2040
P-584	F15	J-501	150	PVC	130	6	2040
P-585	F12	J-229	150	PVC	130	6	2040
P-586	J-68	J-530	150	PVC	130	80	1984
P-587	J-530	J-69	150	PVC	130	80	1984
P-588	F13	J-530	150	PVC	130	6	2040
P-589	J-25	J-531	200	PVC	130	136	2040
P-590	J-531	J-227	200	PVC	130	117	2040
P-591	F17	J-531	150	PVC	130	6	2040
P-592	J-523	F3	150	PVC	130	6	2040
P-593	J-16	J-532	150	PVC	130	98	1984
P-594	J-532	J-17	150	PVC	130	89	1984
P-595	F14	J-532	150	PVC	130	6	2040
P-596	J-58	J-533	200	PVC	130	27	2040
P-597	J-533	J-526	200	PVC	130	40	2040
P-598	F25	J-534	150	PVC	130	6	2040
P-599	F26	J-535	150	PVC	130	6	2040
P-600	F27	J-536	150	PVC	130	6	2040
P-601	F28	J-537	150	PVC	130	6	2040
P-602	J-533	J-534	250	PVC	130	245	2040
P-603	J-534	J-535	250	PVC	130	90	2040
P-604	J-535	J-536	350	PVC	130	92	2040
P-605	J-536	J-537	350	PVC	130	96	2040
P-606	J-537	J-538	350	PVC	130	87	2040
P-607	F29	J-538	150	PVC	130	6	2040
P-610	F30	J-29	150	PVC	130	6	2040
P-611	F31	J-11	150	PVC	130	6	2040

Appendix C - Pipe Table
(Future System - Full Development)

Label	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C	Length (m)	Installation Year
E-1	J-97	J-90	250	PVC	130	30	2011
E-2	J-90	J-241	250	PVC	130	111	2003
E-3	J-242	J-241	250	PVC	130	74	1992
E-4	J-240	J-242	250	PVC	130	79	1992
E-5	J-240	J-45	200	PVC	130	11	1992
E-6	J-46	J-47	150	PVC	130	141	
E-7	J-46	J-48	50	PVC	130	221	
E-8	J-48	J-49	50	PVC	130	253	
E-9	J-69	J-229	150	PVC	130	109	2009
E-10	J-229	J-230	150	PVC	130	95	2009
E-11	J-231	J-232	150	PVC	130	43	
E-12	J-232	J-233	150	PVC	130	14	
E-13	J-233	J-234	150	PVC	130	90	
E-14	J-234	J-235	150	PVC	130	57	
E-15	J-235	J-236	150	PVC	130	63	
E-15	J-238	J-235	150	PVC	130	31	
E-16	J-236	J-237	150	PVC	130	87	
E-17	J-237	J-232	150	PVC	130	74	
E-18	J-16	J-215	200	PVC	130	147	2005
E-19	J-215	J-216	200	PVC	130	143	2005
E-20	J-216	J-91	200	PVC	130	157	2005
E-21	J-27	J-220	250	PVC	130	119	2010
E-22	J-220	J-221	250	PVC	130	192	2010
E-23	J-221	J-222	350	PVC	130	89	2010
E-24	J-222	J-223	350	PVC	130	128	2010
E-25	J-223	J-224	350	PVC	130	158	2010
E-26	J-95	J-225	200	PVC	130	21	2010
E-27	J-225	J-226	200	PVC	130	154	2010
E-28	J-226	J-96	200	PVC	130	223	2010
E-30	J-227	J-93	200	PVC	130	198	2006
E-31	J-224	J-228	350	PVC	130	123	2010
E-32	J-228	J-95	250	PVC	130	218	2010
E-33	J-92	J-25	200	PVC	130	48	2006
L-1	H-1	J-90	150	PVC	130	7	
L-2	J-241	H-2	150	PVC	130	13	
L-3	J-242	H-3	150	PVC	130	11	
L-4	H-4	J-201	150	PVC	130	6	
L-5	H-5	J-51	150	PVC	130	12	
L-6	H-6	J-202	150	PVC	130	6	
L-7	H-7	J-203	150	PVC	130	8	
L-8	H-8	J-54	150	PVC	130	12	
L-9	H-9	J-204	150	PVC	130	7	
L-10	H-10	J-55	150	PVC	130	9	
L-11	H-11	J-56	150	PVC	130	10	
L-12	H-12	J-205	150	PVC	130	8	
L-13	H-13	J-206	150	PVC	130	4	
L-14	H-14	J-207	150	PVC	130	6	
L-15	H-15	J-59	150	PVC	130	5	
L-16	H-16	J-60	150	PVC	130	8	
L-17	H-17	J-208	150	PVC	130	8	
L-18	H-18	J-63	150	PVC	130	9	
L-19	H-19	J-64	150	PVC	130	8	
L-20	H-20	J-65	150	PVC	130	8	
L-21	H-21	J-68	150	PVC	130	7	
L-22	H-22	J-69	150	PVC	130	12	
L-23	H-23	J-42	150	PVC	130	7	
L-24	H-24	J-209	150	PVC	130	11	
L-25	H-25	J-43	150	PVC	130	10	
L-26	H-26	J-210	150	PVC	130	8	
L-27	H-27	J-36	150	PVC	130	9	
L-28	H-28	J-35	150	PVC	130	10	
L-29	H-29	J-211	150	PVC	130	7	
L-30	H-30	J-31	150	PVC	130	15	
L-31	H-31	J-30	150	PVC	130	19	
L-32	H-32	J-212	150	PVC	130	16	
L-33	H-33	J-39	150	PVC	130	20	
L-34	H-34	J-213	150	PVC	130	11	
L-35	H-35	J-28	150	PVC	130	9	
L-36	H-36	J-12	150	PVC	130	15	
L-37	J-13	H-37	150	PVC	130	11	
L-38	H-38	J-16	150	PVC	130	17	
L-39	J-17	H-39	150	PVC	130	19	
L-40	H-40	J-18	150	PVC	130	16	

L-41	J-9	H-41	150	PVC	130	14	
L-42	H-42	J-10	150	PVC	130	8	
L-43	H-43	J-7	150	PVC	130	10	
L-44	H-44	J-214	150	PVC	130	14	
L-45	H-45	J-19	150	PVC	130	15	
L-46	J-20	H-46	150	PVC	130	12	
L-47	H-47	J-215	150	PVC	130	7	
L-48	H-48	J-216	150	PVC	130	13	
L-49	H-49	J-217	150	PVC	130	11	
L-50	H-50	J-91	150	PVC	130	14	
L-51	H-51	J-23	150	PVC	130	16	
L-52	J-92	H-52	150	PVC	130	11	
L-54	H-54	J-219	150	PVC	130	12	
L-55	J-27	H-55	150	PVC	130	12	
L-56	J-220	H-56	150	PVC	130	10	
L-57	J-221	H-57	150	PVC	130	10	
L-58	J-222	H-58	150	PVC	130	10	
L-59	J-223	H-59	150	PVC	130	12	
L-60	J-224	H-60	150	PVC	130	10	
L-61	J-225	H-61	150	PVC	130	17	
L-62	J-226	H-62	150	PVC	130	12	
L-63	H-63	J-94	150	PVC	130	16	
L-64	J-227	H-64	150	PVC	130	9	
L-65	H-65	J-228	150	PVC	130	9	
L-66	H-66	J-237	150	PVC	130	10	
L-67	J-233	H-67	150	PVC	130	8	
L-68	H-68	J-235	150	PVC	130	10	
P-1	R-1	J-1A	350	PVC	130	1,050	2000
P-2	J-1A	PMP-1	150	PVC	130	5	2000
P-3	J-1A	PMP-2	150	PVC	130	5	2000
P-4	PMP-2	J-1	150	PVC	130	5	2000
P-5	PMP-1	J-1	150	PVC	130	5	2000
P-6	J-1	J-2	250	PVC	130	789	2000
P-7	J-2	J-3	250	PVC	130	134	1984
P-8	T-1	J-3	200	Ductile Iron	130	165	1984
P-9	T-1	J-4	300	Ductile Iron	130	199	1984
P-17	J-7	J-4	350	PVC	130	50	1984
P-18	J-8	J-7	350	PVC	130	27	1984
P-19	J-8	J-9	200	PVC	130	67	1984
P-20	J-9	J-10	200	PVC	130	133	1984
P-21	J-10	J-11	150	PVC	130	71	1984
P-22	J-10	J-12	200	PVC	130	152	1984
P-23	J-12	J-13	200	PVC	130	87	1984
P-24	J-13	J-14	150	PVC	130	62	1984
P-25	J-13	J-15	200	PVC	130	89	1984
P-26	J-15	J-16	150	PVC	130	120	1985
P-28	J-17	J-18	150	PVC	130	146	1984
P-29	J-18	J-9	150	PVC	130	164	1984
P-30A	J-8	J-214	250	PVC	130	172	1995
P-30B	J-214	J-19	250	PVC	130	160	1995
P-31	J-19	J-20	250	PVC	130	151	1995
P-32	J-20	J-21	250	PVC	130	147	1995
P-33A	J-21	J-217	150	PVC	130	12	1995
P-33B	J-217	J-22	150	PVC	130	45	1995
P-34	J-22	J-23	150	PVC	130	154	1995
P-35	J-23	J-24	150	PVC	130	39	1995
P-36	J-24	J-25	200	PVC	130	68	1995
P-37	J-24	J-26	200	PVC	130	116	1995
P-38	J-21	J-26	250	PVC	130	117	1995
P-39A	J-26	J-219	250	PVC	130	26	1995
P-39B	J-219	J-27	250	PVC	130	93	1995
P-40	J-12	J-28	150	PVC	130	111	1984
P-41	J-28	J-29	150	PVC	130	76	1984
P-42	J-28	J-30	150	PVC	130	87	1984
P-44A	J-31	J-211	150	PVC	130	112	1984
P-44B	J-211	J-32	150	PVC	130	10	1984
P-45	J-32	J-33	150	PVC	130	47	1984
P-46	J-33	J-34	150	PVC	130	74	1984
P-47	J-32	J-34	150	PVC	130	65	1984
P-48	J-35	J-34	150	PVC	130	47	1984
P-49	J-30	J-31	150	PVC	130	157	1984
P-49	J-35	J-36	150	PVC	130	156	1984
P-50	J-36	J-37	150	PVC	130	49	1984
P-51A	J-37	J-213	200	PVC	130	92	1984

P-51B	J-213	J-38	200	PVC	130	92	1984
P-52A	J-212	J-38	150	PVC	130	68	1984
P-52B	J-231	J-212	150	PVC	130	96	1984
P-52C	J-30	J-231	150	PVC	130	72	1984
P-53	J-38	J-39	150	PVC	130	61	1984
P-54	J-39	J-40	350	Ductile Iron	130	168	1992
P-54A	J-8	J-39	350	Ductile Iron	130	260	1992
P-55A	J-37	J-210	150	PVC	130	31	1984
P-55B	J-210	J-40	150	PVC	130	20	1984
P-56	J-40	J-41	350	Ductile Iron	130	189	1992
P-57	J-41	J-42	250	PVC	130	75	1995
P-58A	J-41	J-209	250	PVC	130	20	1992
P-58B	J-209	J-43	250	PVC	130	95	1992
P-59	J-43	J-44	250	PVC	130	67	1992
P-60A	J-201	J-45	300	PVC	130	18	1992
P-60B	J-44	J-201	300	PVC	130	62	1992
P-61	J-45	J-51	200	PVC	130	137	1992
P-62	J-45	J-46	150	PVC	130	104	1992
P-66A	J-50	J-202	200	PVC	130	62	1992
P-67	J-51	J-50	200	PVC	130	84	1992
P-68	J-50	J-52	200	PVC	130	62	1992
P-69A	J-52	J-203	200	PVC	130	18	1989
P-69B	J-203	J-53	200	PVC	130	200	1989
P-70	J-54	J-53	150	PVC	130	105	1994
P-71	J-91	J-92	200	PVC	130	66	2005
P-71A	J-53	J-204	150	PVC	130	17	1994
P-71B	J-204	J-55	200	PVC	130	136	1994
P-72	J-55	J-56	200	PVC	130	138	1994
P-73	J-93	J-94	200	PVC	130	38	2006
P-73A	J-56	J-205	200	PVC	130	67	1994
P-73B	J-205	J-57	200	PVC	130	30	1994
P-74	J-22	J-91	200	PVC	130	144	2005
P-74A	J-57	J-206	200	PVC	130	91	1994
P-74B	J-206	J-58	200	PVC	130	23	1994
P-75A	J-207	J-59	200	PVC	130	96	1989
P-75B	J-207	J-230	200	PVC	130	9	1989
P-75C	J-230	J-53	200	PVC	130	112	1989
P-76	J-59	J-60	150	PVC	130	152	1984
P-77A	J-60	J-208	150	PVC	130	146	1984
P-77B	J-208	J-61	150	PVC	130	16	1984
P-78	J-61	J-62	150	PVC	130	113	1984
P-79	J-62	J-63	150	PVC	130	35	1984
P-80	J-63	J-64	150	PVC	130	147	1984
P-81	J-64	J-65	150	PVC	130	144	1984
P-82	J-59	J-65	200	PVC	130	84	1984
P-82	J-1A	PMP-3	150	PVC	130	5	2000
P-83	PMP-3	J-1	150	PVC	130	5	2000
P-84	J-65	J-67	200	PVC	130	93	1984
P-85	J-15	J-67	200	PVC	130	140	1984
P-86	J-67	J-68	150	PVC	130	67	1984
P-88	J-65	J-66	150	PVC	130	68	1984
P-270	H-53	J-25	150	PVC	130	23	
P-500	J-19	J-500	150	PVC	130	144	2040
P-501	J-500	J-501	150	PVC	130	121	2040
P-502	J-502	J-501	100	PVC	130	60	2040
P-503	J-501	J-215	150	PVC	130	72	2040
P-504	F16	J-500	150	PVC	130	6	2040
P-505	J-220	J-503	150	PVC	130	109	2040
P-506	J-503	J-504	150	PVC	130	91	2040
P-507	J-504	F18	150	PVC	130	6	2040
P-508	J-503	J-227	150	PVC	130	95	2040
P-509	J-221	J-505	200	PVC	130	85	2040
P-510	J-505	J-506	200	PVC	130	38	2040
P-511	J-506	J-507	200	PVC	130	83	2040
P-512	J-507	J-94	200	PVC	130	68	2040
P-513	J-510	J-507	100	PVC	130	51	2040
P-514	J-94	J-511	200	PVC	130	135	2040
P-515	J-511	J-512	200	PVC	130	72	2040
P-516	J-512	J-513	150	PVC	130	48	2040
P-517	J-513	J-514	100	PVC	130	31	2040
P-518	J-512	J-515	150	PVC	130	37	2040
P-519	J-508	J-516	100	PVC	130	25	2040
P-520	J-516	J-505	150	PVC	130	78	2040
P-521	F19	J-516	150	PVC	130	6	2040

P-522	J-509	J-517	100	PVC	130	32	2040
P-523	J-517	J-506	150	PVC	130	35	2040
P-524	J-517	F21	150	PVC	130	6	2040
P-525	F20	J-507	150	PVC	130	6	2040
P-526	F23	J-511	150	PVC	130	6	2040
P-527	F24	J-515	150	PVC	130	6	2040
P-528	F22	J-513	150	PVC	130	6	2040
P-529	F11	J-518	150	PVC	130	6	2040
P-530	F10	J-519	150	PVC	130	6	2040
P-531	F9	J-520	150	PVC	130	6	2040
P-532	J-520	J-519	200	PVC	130	119	2040
P-533	J-519	J-518	200	PVC	130	113	2040
P-534	J-518	J-230	200	PVC	130	128	2040
P-535	J-57	J-520	200	PVC	130	116	2040
P-538	J-526	J-525	200	PVC	130	85	2040
P-539	J-525	J-524	200	PVC	130	157	2040
P-540	J-524	J-522	200	PVC	130	115	2040
P-541	J-522	J-521	200	PVC	130	71	2040
P-542	J-521	J-52	200	PVC	130	92	2040
P-543	F4	J-521	150	PVC	130	6	2040
P-544	J-523	J-522	150	PVC	130	115	2040
P-545	F6	J-524	150	PVC	130	6	2040
P-546	F7	J-525	150	PVC	130	6	2040
P-547	F8	J-526	150	PVC	130	6	2040
P-548	J-97	J-527	250	PVC	130	57	2040
P-549	J-527	J-528	250	PVC	130	70	2040
P-550	J-528	J-42	250	PVC	130	121	2040
P-551	F1	J-527	150	PVC	130	12	2040
P-552	F2	J-528	150	PVC	130	6	2040
P-554	J-61	J-520	200	PVC	130	117	2040
P-556	J-529	J-504	100	PVC	130	53	2040
P-582	F5	J-522	150	PVC	130	6	2040
P-584	F15	J-501	150	PVC	130	6	2040
P-585	F12	J-229	150	PVC	130	6	2040
P-586	J-68	J-530	150	PVC	130	80	1984
P-587	J-530	J-69	150	PVC	130	80	1984
P-588	F13	J-530	150	PVC	130	6	2040
P-589	J-25	J-531	200	PVC	130	136	2040
P-590	J-531	J-227	200	PVC	130	117	2040
P-591	F17	J-531	150	PVC	130	6	2040
P-592	J-523	F3	150	PVC	130	6	2040
P-593	J-16	J-532	150	PVC	130	98	1984
P-594	J-532	J-17	150	PVC	130	89	1984
P-595	F14	J-532	150	PVC	130	6	2040
P-596	J-58	J-533	200	PVC	130	27	2040
P-597	J-533	J-526	200	PVC	130	40	2040
P-598	F25	J-534	150	PVC	130	6	2040
P-599	F26	J-535	150	PVC	130	6	2040
P-600	F27	J-536	150	PVC	130	6	2040
P-601	F28	J-537	150	PVC	130	6	2040
P-602	J-533	J-534	350	PVC	130	245	2040
P-603	J-534	J-535	350	PVC	130	90	2040
P-604	J-535	J-536	350	PVC	130	92	2040
P-605	J-536	J-537	350	PVC	130	96	2040
P-606	J-537	J-538	350	PVC	130	87	2040
P-607	F29	J-538	150	PVC	130	6	2040
P-609	J-540	J-15	200	PVC	130	6	2040
P-610	F30	J-29	150	PVC	130	6	2040
P-611	F31	J-11	150	PVC	130	6	2040

Appendix C - Junction Table
(2014 Existing Water Supply Distribution System)

HARRISON HOT SPRINGS
Naturally Refreshed

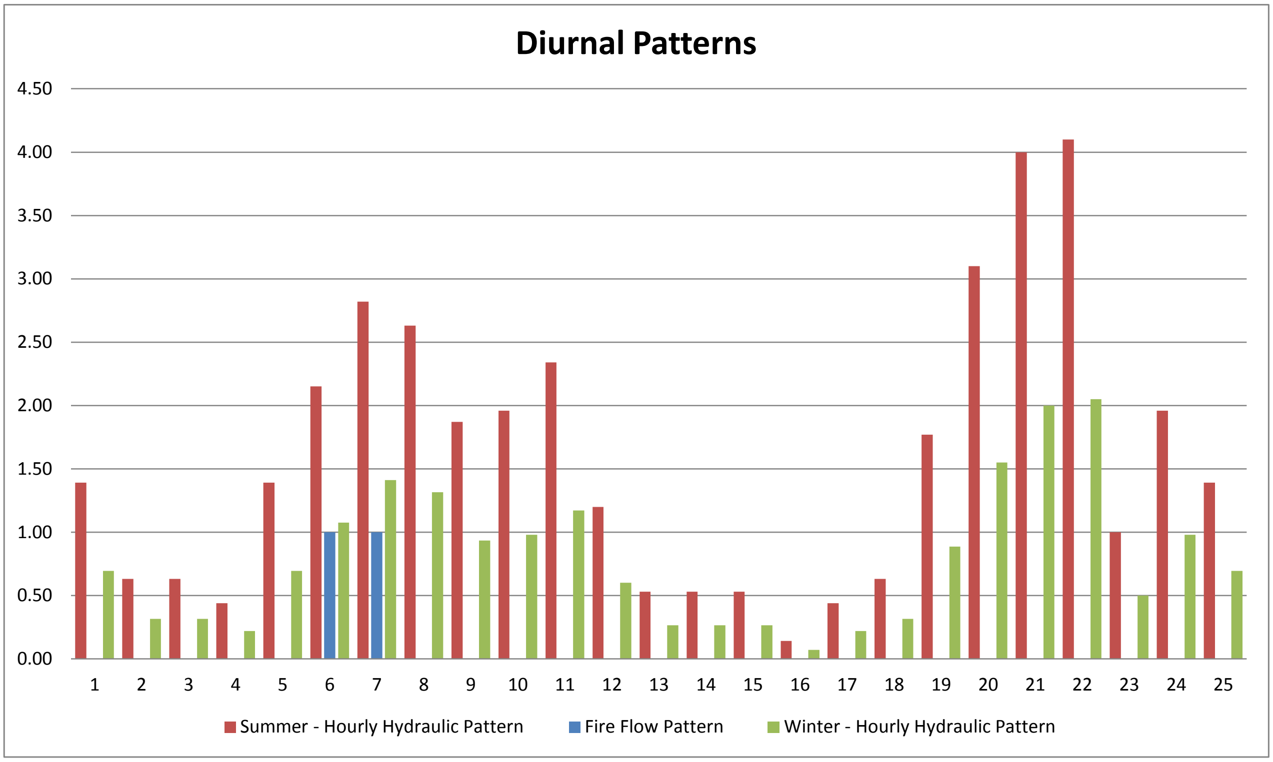
Label	Elevation (m)	X (m)	Y (m)	Label	Elevation (m)	X (m)	Y (m)
J-1	7.30	588305.68	5461894.43	J-95	14.00	588506.6	5459345.71
J-1A	7.30	588304.99	5461918.59	J-96	12.67	588903.72	5459350.89
J-2	13.61	588398.14	5461115.43	J-97	13.16	588178.08	5461809.91
J-3	20.00	588287.06	5461090.83	J-201	13.15	588483.54	5461777.77
J-4	20.00	588318.35	5461102.74	J-202	12.83	588704.68	5461860.88
J-7	13.60	588366.22	5461110.38	J-203	13.15	588778.39	5461787.32
J-8	14.08	588393.09	5461109.89	J-204	12.87	588893.32	5461623.18
J-9	13.53	588460.2	5461110.39	J-205	13.59	589183.59	5461802.48
J-10	12.90	588593.31	5461115.51	J-206	14.00	589206.86	5461908.3
J-11	13.23	588580.3	5461178.2	J-207	13.31	588942.7	5461512.32
J-12	13.24	588704.78	5461189.33	J-208	12.80	589238.49	5461583.84
J-13	13.53	588786.07	5461160.5	J-209	12.89	588320.98	5461714.31
J-14	13.43	588769.18	5461100.39	J-210	13.35	588322.63	5461533.33
J-15	12.67	588872.12	5461136.33	J-211	12.78	588652.96	5461633.24
J-16	12.92	588874.89	5461016.45	J-212	12.62	588470.95	5461365.31
J-17	12.77	588687.24	5461014.45	J-213	12.77	588379.25	5461455.04
J-18	12.95	588540.77	5461012.38	J-214	14.63	588445.72	5460949.14
J-19	14.21	588556.26	5460833.48	J-215	13.26	588878.14	5460869.62
J-20	13.92	588639.02	5460709.45	J-216	14.51	588880.73	5460726.28
J-21	14.31	588681.34	5460568.83	J-217	14.27	588693.56	5460569.51
J-22	14.04	588738.99	5460568.95	J-219	14.31	588703.29	5460429.27
J-23	13.94	588819.95	5460494.2	J-220	14.49	588699.15	5460218.59
J-24	14.15	588819.93	5460455.38	J-221	14.09	588666.45	5460031.15
J-25	13.84	588887.7	5460455.49	J-222	14.15	588663.19	5459941.85
J-26	14.37	588704.34	5460455.19	J-223	14.51	588654.7	5459814.3
J-27	14.10	588703.1	5460336.7	J-224	13.88	588600.33	5459667.75
J-28	12.92	588642.82	5461278.96	J-225	13.87	588527.47	5459345.98
J-29	13.17	588567.54	5461271.44	J-226	12.67	588681.2	5459347.98
J-30	12.97	588638.67	5461365.54	J-227	13.92	588894.2	5460202.12
J-31	13.30	588658.15	5461521.18	J-228	14.28	588546.59	5459556.97
J-32	12.78	588652.49	5461642.9	J-229	12.95	588855.97	5461469.42
J-33	12.91	588633.88	5461680.02	J-230	13.47	588936.94	5461519.2
J-34	12.69	588590.99	5461622.48	J-231	12.82	588566.76	5461365.5
J-35	12.70	588546.51	5461607.83	J-232	13.13	588567.45	5461408.87
J-36	13.03	588398.33	5461559.13	J-233	13.18	588570.18	5461422.21
J-37	13.29	588351.91	5461543.07	J-234	13.60	588585.48	5461511.26
J-38	13.13	588403.42	5461365.99	J-235	13.79	588529.57	5461503.08
J-39	13.97	588342.85	5461365.07	J-236	13.38	588466.99	5461492.73
J-40	13.50	588303.81	5461527.18	J-237	13.07	588493.9	5461410
J-41	12.93	588301.6	5461716.58	J-238	13.84	588534.9	5461472.88
J-42	12.47	588227.67	5461730.11	J-240	13.12	588470.99	5461794.84
J-43	13.47	588415.81	5461715	J-241	13.08	588317.83	5461792.63
J-44	13.21	588482.63	5461716.01	J-242	13.43	588392.14	5461794.22
J-45	13.22	588481.77	5461795.5	J-530	12.81	588790.35	5461318.13
J-46	14.00	588480.65	5461899.49	J-531	13.89	588890.87	5460319.36
J-47	14.00	588341.36	5461914.47	J-532	12.84	588776.4	5461015.4
J-48	14.00	588701.93	5461902.04				
J-49	14.00	588948.67	5461943.35				
J-50	13.38	588703.03	5461798.85				
J-51	13.44	588619.05	5461797.57				
J-52	13.09	588764.98	5461799.79				
J-53	12.86	588878.59	5461614.41				
J-54	12.11	588789.52	5461559.72				
J-55	13.89	589009.1	5461695.09				
J-56	13.83	589127.28	5461767.06				
J-57	14.00	589209.74	5461817.7				
J-58	14.00	589204.02	5461930.88				
J-59	13.05	588985.37	5461427.06				
J-60	13.02	589114.35	5461507.15				
J-61	12.80	589251.55	5461592.55				
J-62	12.95	589254.32	5461479.43				
J-63	12.95	589224.88	5461460.99				
J-64	13.13	589099.15	5461384.62				
J-65	13.16	588969.14	5461345.65				
J-66	12.86	588909.73	5461378.03				
J-67	13.03	588924.46	5461263.96				
J-68	12.69	588861.25	5461286.79				
J-69	12.92	588790.44	5461393.57				
J-90	13.07	588207.61	5461804.89				
J-91	13.37	588883.15	5460568.97				
J-92	13.68	588883.97	5460503.01				
J-93	13.38	588892.83	5460003.64				
J-94	13.63	588855.32	5460004.36				

Label	Elevation (m)	X (m)	Y (m)	Label	Elevation (m)	X (m)	Y (m)
J-1	7.30	588305.68	5461894.43	J-95	14.00	588506.6	5459345.71
J-1A	7.30	588304.99	5461918.59	J-96	12.67	588903.72	5459350.89
J-2	13.61	588398.14	5461115.43	J-97	13.16	588178.08	5461809.91
J-3	20.00	588287.06	5461090.83	J-201	13.15	588483.54	5461777.77
J-4	20.00	588318.35	5461102.74	J-202	12.83	588704.68	5461860.88
J-7	13.60	588366.22	5461110.38	J-203	13.15	588778.39	5461787.32
J-8	14.08	588393.09	5461109.89	J-204	12.87	588893.32	5461623.18
J-9	13.53	588460.2	5461110.39	J-205	13.59	589183.59	5461802.48
J-10	12.90	588593.31	5461115.51	J-206	14.00	589206.86	5461908.3
J-11	13.23	588580.3	5461178.2	J-207	13.31	588942.7	5461512.32
J-12	13.24	588704.78	5461189.33	J-208	12.80	589238.49	5461583.84
J-13	13.53	588786.07	5461160.5	J-209	12.89	588320.98	5461714.31
J-14	13.43	588769.18	5461100.39	J-210	13.35	588322.63	5461533.33
J-15	12.67	588872.12	5461136.33	J-211	12.78	588652.96	5461633.24
J-16	12.92	588874.89	5461016.45	J-212	12.62	588470.95	5461365.31
J-17	12.77	588687.24	5461014.45	J-213	12.77	588379.25	5461455.04
J-18	12.95	588540.77	5461012.38	J-214	14.63	588445.72	5460949.14
J-19	14.21	588556.26	5460833.48	J-215	13.26	588878.14	5460869.62
J-20	13.92	588639.02	5460709.45	J-216	14.51	588880.73	5460726.28
J-21	14.31	588681.34	5460568.83	J-217	14.27	588693.56	5460569.51
J-22	14.04	588738.99	5460568.95	J-219	14.31	588703.29	5460429.27
J-23	13.94	588819.95	5460494.2	J-220	14.49	588699.15	5460218.59
J-24	14.15	588819.93	5460455.38	J-221	14.09	588666.45	5460031.15
J-25	13.84	588887.7	5460455.49	J-222	14.15	588663.19	5459941.85
J-26	14.37	588704.34	5460455.19	J-223	14.51	588654.7	5459814.3
J-27	14.10	588703.1	5460336.7	J-224	13.88	588600.33	5459667.75
J-28	12.92	588642.82	5461278.96	J-225	13.87	588527.47	5459345.98
J-29	13.17	588567.54	5461271.44	J-226	12.67	588681.2	5459347.98
J-30	12.97	588638.67	5461365.54	J-227	13.92	588894.2	5460202.12
J-31	13.30	588658.15	5461521.18	J-228	14.28	588546.59	5459556.97
J-32	12.78	588652.49	5461642.9	J-229	12.95	588855.97	5461469.42
J-33	12.91	588633.88	5461680.02	J-230	13.47	588936.94	5461519.2
J-34	12.69	588590.99	5461622.48	J-231	12.82	588566.76	5461365.5
J-35	12.70	588546.51	5461607.83	J-232	13.13	588567.45	5461408.87
J-36	13.03	588398.33	5461559.13	J-233	13.18	588570.18	5461422.21
J-37	13.29	588351.91	5461543.07	J-234	13.60	588585.48	5461511.26
J-38	13.13	588403.42	5461365.99	J-235	13.79	588529.57	5461503.08
J-39	13.97	588342.85	5461365.07	J-236	13.38	588466.99	5461492.73
J-40	13.50	588303.81	5461527.18	J-237	13.07	588493.9	5461410
J-41	12.93	588301.6	5461716.58	J-238	13.84	588534.9	5461472.88
J-42	12.47	588227.67	5461730.11	J-240	13.12	588470.99	5461794.84
J-43	13.47	588415.81	5461715	J-241	13.08	588317.83	5461792.63
J-44	13.21	588482.63	5461716.01	J-242	13.43	588392.14	5461794.22
J-45	13.22	588481.77	5461795.5	J-500	13.64	588685.41	5460869.14
J-46	14.00	588480.65	5461899.49	J-501	13.38	588806.22	5460869.99
J-47	14.00	588341.36	5461914.47	J-502	13.04	588805.06	5460929.85
J-48	14.00	588701.93	5461902.04	J-503	13.81	588800.04	5460204.57
J-49	14.00	588948.67	5461943.35	J-504	13.88	588798.05	5460295.92
J-50	13.38	588703.03	5461798.85	J-505	14.01	588723.95	5460061.31
J-51	13.44	588619.05	5461797.57	J-506	13.93	588761.44	5460061.91
J-52	13.09	588764.98	5461799.79	J-507	13.62	588844.57	5460064.31
J-53	12.86	588878.59	5461614.41	J-508	14.08	588775.14	5460117.65
J-54	12.11	588789.52	5461559.72	J-509	13.89	588762.2	5459994.79
J-55	13.89	589009.1	5461695.09	J-510	13.68	588843.41	5460114.94
J-56	13.83	589127.28	5461767.06	J-511	13.53	588822.81	5459881.51
J-57	14.00	589209.74	5461817.7	J-512	13.93	588767	5459840.99
J-58	14.00	589204.02	5461930.88	J-513	14.09	588772.71	5459887.86
J-59	13.05	588985.37	5461427.06	J-514	14.05	588788.27	5459914.63
J-60	13.02	589114.35	5461507.15	J-515	13.80	588762.47	5459803.87
J-61	12.80	589251.55	5461592.55	J-516	14.14	588750.63	5460117.27
J-62	12.95	589254.32	5461479.43	J-517	13.80	588762.16	5460027.29
J-63	12.95	589224.88	5461460.99	J-518	13.45	589046.55	5461585.56
J-64	13.13	589099.15	5461384.62	J-519	13.33	589142.92	5461644.28
J-65	13.16	588969.14	5461345.65	J-520	13.40	589243.91	5461706.42
J-66	12.86	588909.73	5461378.03	J-521	13.69	588857	5461800.56
J-67	13.03	588924.46	5461263.96	J-522	13.95	588927.69	5461802.19
J-68	12.69	588861.25	5461286.79	J-523	13.58	588844.64	5461730.4
J-69	12.92	588790.44	5461393.57	J-524	14.49	589027.8	5461853.68
J-90	13.07	588207.61	5461804.89	J-525	15.34	589095.33	5461896.87
J-91	13.37	588883.15	5460568.97	J-526	14.00	589167.53	5461939
J-92	13.68	588883.97	5460503.01	J-527	13.00	588122.02	5461817.45
J-93	13.38	588892.83	5460003.64	J-528	13.00	588108.03	5461748.45
J-94	13.63	588855.32	5460004.36	J-529	13.88	588796.79	5460348.6

J-530	12.83	588790.35	5461318.13
J-531	13.87	588890.87	5460319.36
J-532	12.84	588776.4	5461015.4
J-533	14.00	589202.64	5461957.39
J-534	12.50	589207.38	5462201.47
J-535	12.50	589207.15	5462291.72
J-536	12.50	589206.18	5462383.29
J-537	12.50	589184.47	5462475.08
J-538	12.50	589169.89	5462559.24

Label	Elevation (m)	X (m)	Y (m)	Label	Elevation (m)	X (m)	Y (m)
J-1	7.30	588305.68	5461894.43	J-95	14.00	588506.6	5459345.71
J-1A	7.30	588304.99	5461918.59	J-96	12.67	588903.72	5459350.89
J-2	13.61	588398.14	5461115.43	J-97	13.16	588178.08	5461809.91
J-3	20.00	588287.06	5461090.83	J-201	13.15	588483.54	5461777.77
J-4	20.00	588318.35	5461102.74	J-202	12.83	588704.68	5461860.88
J-7	13.60	588366.22	5461110.38	J-203	13.15	588778.39	5461787.32
J-8	14.08	588393.09	5461109.89	J-204	12.87	588893.32	5461623.18
J-9	13.53	588460.2	5461110.39	J-205	13.59	589183.59	5461802.48
J-10	12.90	588593.31	5461115.51	J-206	14.00	589206.86	5461908.3
J-11	13.23	588580.3	5461178.2	J-207	13.31	588942.7	5461512.32
J-12	13.24	588704.78	5461189.33	J-208	12.80	589238.49	5461583.84
J-13	13.53	588786.07	5461160.5	J-209	12.89	588320.98	5461714.31
J-14	13.43	588769.18	5461100.39	J-210	13.35	588322.63	5461533.33
J-15	12.67	588872.12	5461136.33	J-211	12.78	588652.96	5461633.24
J-16	12.92	588874.89	5461016.45	J-212	12.62	588470.95	5461365.31
J-17	12.77	588687.24	5461014.45	J-213	12.77	588379.25	5461455.04
J-18	12.95	588540.77	5461012.38	J-214	14.63	588445.72	5460949.14
J-19	14.21	588556.26	5460833.48	J-215	13.26	588878.14	5460869.62
J-20	13.92	588639.02	5460709.45	J-216	14.51	588880.73	5460726.28
J-21	14.31	588681.34	5460568.83	J-217	14.27	588693.56	5460569.51
J-22	14.04	588738.99	5460568.95	J-219	14.31	588703.29	5460429.27
J-23	13.94	588819.95	5460494.2	J-220	14.49	588699.15	5460218.59
J-24	14.15	588819.93	5460455.38	J-221	14.09	588666.45	5460031.15
J-25	13.84	588887.7	5460455.49	J-222	14.15	588663.19	5459941.85
J-26	14.37	588704.34	5460455.19	J-223	14.51	588654.7	5459814.3
J-27	14.10	588703.1	5460336.7	J-224	13.88	588600.33	5459667.75
J-28	12.92	588642.82	5461278.96	J-225	13.87	588527.47	5459345.98
J-29	13.17	588567.54	5461271.44	J-226	12.67	588681.2	5459347.98
J-30	12.97	588638.67	5461365.54	J-227	13.92	588894.2	5460202.12
J-31	13.30	588658.15	5461521.18	J-228	14.28	588546.59	5459556.97
J-32	12.78	588652.49	5461642.9	J-229	12.95	588855.97	5461469.42
J-33	12.91	588633.88	5461680.02	J-230	13.47	588936.94	5461519.2
J-34	12.69	588590.99	5461622.48	J-231	12.82	588566.76	5461365.5
J-35	12.70	588546.51	5461607.83	J-232	13.13	588567.45	5461408.87
J-36	13.03	588398.33	5461559.13	J-233	13.18	588570.18	5461422.21
J-37	13.29	588351.91	5461543.07	J-234	13.60	588585.48	5461511.26
J-38	13.13	588403.42	5461365.99	J-235	13.79	588529.57	5461503.08
J-39	13.97	588342.85	5461365.07	J-236	13.38	588466.99	5461492.73
J-40	13.50	588303.81	5461527.18	J-237	13.07	588493.9	5461410
J-41	12.93	588301.6	5461716.58	J-238	13.84	588534.9	5461472.88
J-42	12.47	588227.67	5461730.11	J-240	13.12	588470.99	5461794.84
J-43	13.47	588415.81	5461715	J-241	13.08	588317.83	5461792.63
J-44	13.21	588482.63	5461716.01	J-242	13.43	588392.14	5461794.22
J-45	13.22	588481.77	5461795.5	J-500	13.64	588685.41	5460869.14
J-46	14.00	588480.65	5461899.49	J-501	13.38	588806.22	5460869.99
J-47	14.00	588341.36	5461914.47	J-502	13.04	588805.06	5460929.85
J-48	14.00	588701.93	5461902.04	J-503	13.81	588800.04	5460204.57
J-49	14.00	588948.67	5461943.35	J-504	13.88	588798.05	5460295.92
J-50	13.38	588703.03	5461798.85	J-505	14.01	588723.95	5460061.31
J-51	13.44	588619.05	5461797.57	J-506	13.93	588761.44	5460061.91
J-52	13.09	588764.98	5461799.79	J-507	13.62	588844.57	5460064.31
J-53	12.86	588878.59	5461614.41	J-508	14.08	588775.14	5460117.65
J-54	12.11	588789.52	5461559.72	J-509	13.89	588762.2	5459994.79
J-55	13.89	589009.1	5461695.09	J-510	13.68	588843.41	5460114.94
J-56	13.83	589127.28	5461767.06	J-511	13.53	588822.81	5459881.51
J-57	14.00	589209.74	5461817.7	J-512	13.93	588767	5459840.99
J-58	14.00	589204.02	5461930.88	J-513	14.09	588772.71	5459887.86
J-59	13.05	588985.37	5461427.06	J-514	14.05	588788.27	5459914.63
J-60	13.02	589114.35	5461507.15	J-515	13.80	588762.47	5459803.87
J-61	12.80	589251.55	5461592.55	J-516	14.14	588750.63	5460117.27
J-62	12.95	589254.32	5461479.43	J-517	13.80	588762.16	5460027.29
J-63	12.95	589224.88	5461460.99	J-518	13.45	589046.55	5461585.56
J-64	13.13	589099.15	5461384.62	J-519	13.33	589142.92	5461644.28
J-65	13.16	588969.14	5461345.65	J-520	13.40	589243.91	5461706.42
J-66	12.86	588909.73	5461378.03	J-521	13.69	588857	5461800.56
J-67	13.03	588924.46	5461263.96	J-522	13.95	588927.69	5461802.19
J-68	12.69	588861.25	5461286.79	J-523	13.58	588844.64	5461730.4
J-69	12.92	588790.44	5461393.57	J-524	14.49	589027.8	5461853.68
J-90	13.07	588207.61	5461804.89	J-525	15.34	589095.33	5461896.87
J-91	13.37	588883.15	5460568.97	J-526	14.00	589167.53	5461939
J-92	13.68	588883.97	5460503.01	J-527	13.00	588122.02	5461817.45
J-93	13.38	588892.83	5460003.64	J-528	13.00	588108.03	5461748.45
J-94	13.63	588855.32	5460004.36	J-529	13.88	588796.79	5460348.6

J-530	12.83	588790.35	5461318.13
J-531	13.87	588890.87	5460319.36
J-532	12.84	588776.4	5461015.4
J-533	14.00	589202.64	5461957.39
J-534	12.50	589207.38	5462201.47
J-535	12.50	589207.15	5462291.72
J-536	12.50	589206.18	5462383.29
J-537	12.50	589184.47	5462475.08
J-538	12.50	589169.89	5462559.24
J-540	12.67	588902.16	5461136.02


Diurnal Patterns
4.50
4.00
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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Summer - Hourly Hydraulic Pattern
Fire Flow Pattern
Winter - Hourly Hydraulic Pattern

Appendix C - Meter Reading Data
July 1,2012 - Sept 30,2012 (91 Days)

HARRISON HOT SPRINGS
Naturally Refreshed

July 1,2012 - Sept 30,2012 (91 Days)

Commerical Services	Reading (m^3)	Last (m^3)	Total (m^3)	Total (L)	Total (L/day)	Total (L/sec)
Black Forest Restaurant	10,727	9,282	1,445	1,445,000	15,879	0.184
Post Office	298	288	10	10,000	110	0.001
Harrison Beach Hotel	19,057	17,977	1,080	1,080,000	11,868	0.137
Echo Beach	121,007	117,245	3,762	3,762,000	41,341	0.478
Laguana Beach	79,497	77,269	2,228	2,228,000	24,484	0.283
The Cascades	44,818	44,201	617	616,900	6,779	0.078
Heritage House	9,870	9,640	230	230,000	2,527	0.029
Harrison Springs RV & Campground	11,479	11,056	423	423,000	4,648	0.054
Harrison Lake Estates	12,050	11,673	377	377,100	4,144	0.048
Cedar Springs Apts	9,698	9,519	179	179,000	1,967	0.023
Riverwynd Apts	22,798	22,422	376	376,000	4,132	0.048
Old Settler Pub	44,468	42,833	1,635	1,635,000	17,967	0.208
Ramada Inn	219,142	211,724	7,418	7,418,000	81,516	0.943
Harrison on the Lake	55,309	54,907	401	401,400	4,411	0.051
Hot Springs Villa	9,844	9,216	628	627,600	6,897	0.080
Inkman's Mall	29,611	25,389	4,222	4,222,000	46,396	0.537
RV Springs	21,411	17,706	3,705	3,705,000	40,714	0.471
Hot Springs Campground	538	405	133	133,000	1,462	0.017
Casia Developments	697	353	344	344,000	3,780	0.044
Tugboat Junction	960	955	5	5,000	55	0.001
Harrison Village Motel	1,019	570	449	449,000	4,934	0.057
Hungry Chef	590	323	267	267,000	2,934	0.034
Village Owned Facilities	**Reading (m^3)**	**Last (m^3)**	**Total (m^3)**	**Total (L)**	**Total (L/day)**	**Total (L/sec)**
Boat Launch Bathrooms	31,592	31,440	152	152,300	1,674	0.019
Fire Hall	2,471	2,418	53	53,000	582	0.007
Memorial Hall	15,187	15,007	180	180,000	1,978	0.023
Village Office/Public Works	7,558	7,452	106	106,000	1,165	0.013
Beach Washrooms	21,168	19,875	1,294	1,293,600	14,215	0.165
Plaza	16,846	16,599	247	247,200	2,778	0.032
				Total	351,336.87	4.066

These Average Daily Demands from July 1,2012 - Sept 30,2012 are used in the existing water model for Summer Demands.
Mutiplier of 0.5 times is used for Winter Demands.

Appendix C - Meter Reading Data
April 1,2013 - June 30,2013 (90 Days)

HARRISON HOT SPRINGS
Naturally Refreshed

April 1,2013 - June 30,2013 (90 Days)

Commerical Services	Reading (m^3)	Last (m^3)	Total (m^3)	Total (L)	Total (L/day)	Total (L/sec)
Black Forest Restaurant	11,916	11,462	454	454,000	5,044	0.058
Post Office	323	315	8	8,000	89	0.001
Harrison Beach Hotel	21,347	20,371	976	976,000	10,844	0.126
Echo Beach	127,060	125,029	2,031	2,031,000	22,567	0.261
Laguana Beach	86,112	83,519	2,593	2,593,000	28,811	0.333
The Cascades	46,405	45,905	500	500,000	5,556	0.064
Heritage House	10,234	10,101	133	133,000	1,478	0.017
Harrison Springs RV & Campground	12,061	11,628	433	433,000	4,811	0.056
Harrison Lake Estates	124,300	122,790	1,510	1,510,000	16,778	0.194
Cedar Springs Apts	10,261	10,076	185	185,000	2,056	0.024
Riverwynd Apts	23,870	23,507	363	363,000	4,033	0.047
Old Settler Pub	48,119	46,707	1,412	1,412,000	15,689	0.182
Ramada Inn	228,710	225,384	3,326	3,326,000	36,956	0.428
Harrison on the Lake	56,796	56,066	730	730,000	8,111	0.094
Hot Springs Villa	10,394	10,111	283	282,600	3,140	0.036
Inkman's Mall	38,363	32,610	5,753	5,753,000	63,922	0.740
RV Springs	25,042	22,846	2,196	2,196,000	24,400	0.282
Hot Springs Campground	807	695	112	112,000	1,244	0.014
Casia Developments	816	761	55	55,000	611	0.007
Tugboat Junction	960	960	0	0	-	-
Harrison Village Motel	1,690	1,382	308	308,000	3,422	0.040
350 Eagle St	1,804	1,529	275	275,000	3,056	0.035
Hungry Chef	1,222	943	279	279,000	3,100	0.036
215 Miami River Drive	167	134	33	33,000	367	0.004
Comai Building	278	0	278	278,000	3,089	0.036
Village Owned Facilities	**Reading (m^3)**	**Last (m^3)**	**Total (m^3)**	**Total (L)**	**Total (L/day)**	**Total (L/sec)**
Boat Launch Bathrooms	31,831	31,654	176	176,400	1,960	0.023
Fire Hall	2,533	2,512	21	21,000	233	0.003
Memorial Hall	15,345	15,253	92	92,000	1,022	0.012
Village Office/Public Works	7,821	7,736	85	85,100	946	0.011
Beach Washrooms	22,076	21,479	597	597,000	6,633	0.077
Plaza	16,964	16,861	103	102,800	1,142	0.013
				Total	281,110.00	3.25

Appendix C - Meter Reading Data
Jan 1,2013 - March 31,2013 (89 Days)

HARRISON HOT SPRINGS
Naturally Refreshed

Jan 1,2013 - March 31,2013 (89 Days)

Commerical Services	Reading (m^3)	Last (m^3)	Total (m^3)	Total (L)	Total (L/day)	Total (L/sec)
Black Forest Restaurant	11,462	11,146	316	316,000	3,551	0.041
Post Office	315	306	9	9,000	101	0.001
Harrison Beach Hotel	20,371	19,745	626	626,000	7,034	0.081
Echo Beach	125,029	123,047	1,982	1,982,000	22,270	0.258
Laguana Beach	83,519	81,409	2,110	2,110,000	23,708	0.274
The Cascades	45,905	45,402	504	503,500	5,657	0.065
Heritage House	10,101	10,090	11	11,000	124	0.001
Harrison Springs RV & Campground	11,628	11,626	2	2,000	22	0.000
Harrison Lake Estates	122,790	121,706	1,084	1,084,000	12,180	0.141
Cedar Springs Apts	10,076	9,854	222	222,000	2,494	0.029
Riverwynd Apts	23,507	23,142	365	365,000	4,101	0.047
Old Settler Pub	46,707	45,681	1,026	1,026,000	11,528	0.133
Ramada Inn	225,384	222,478	2,906	2,906,000	32,652	0.378
Harrison on the Lake	56,066	55,610	456	455,600	5,119	0.059
Hot Springs Villa	10,111	10,001	110	110,100	1,237	0.014
Inkman's Mall	32,610	31,787	823	823,000	9,247	0.107
RV Springs	22,846	22,375	471	471,000	5,292	0.061
Hot Springs Campground	695	571	124	124,000	1,393	0.016
Casia Developments	761	742	19	19,000	213	0.002
Tugboat Junction	960	960	0	0	-	-
Harrison Village Motel	1,382	1,142	240	240,000	2,697	0.031
350 Eagle St	1,529	1,230	299	299,000	3,360	0.039
Hungry Chef	943	706	237	237,000	2,663	0.031
215 Miami River Drive	134	91	43	43,000	483	0.006
Comai Building	0	0	0	0	-	-
Village Owned Facilities	**Reading (m^3)**	**Last (m^3)**	**Total (m^3)**	**Total (L)**	**Total (L/day)**	**Total (L/sec)**
Boat Launch Bathrooms	31,654	31,636	19	18,800	211	0.002
Fire Hall	2,512	2,498	14	14,000	157	0.002
Memorial Hall	15,253	15,228	25	25,000	281	0.003
Village Office/Public Works	7,736	7,647	89	89,200	1,002	0.012
Beach Washrooms	21,479	21,260	219	218,600	2,456	0.028
Plaza	16,861	16,861	0	0	-	-
				Total	161,233.71	1.87

HARRISON HOT SPRINGS
Naturally Refreshed

Junction #	Number of Unit Demands	Unit Demand	Average Day Demand (Base) (L/s)
J-8	3	R-1	0.062
J-8	Water Meter Data	Fire Hall	0.007
J-9	13	R-1	0.270
J-10	13	R-1	0.270
J-11	6	R-1	0.125
J-12	13	R-1	0.270
J-13	6	R-1	0.125
J-14	5	R-1	0.104
J-15	3	R-1	0.062
J-16	8	R-1	0.166
J-16	1	R-2	0.042
J-17	16	R-1	0.333
J-18	13	R-1	0.270
J-19	1	R-2	0.042
J-20	2	R-1	0.042
J-20	Water Meter Data	RV Springs	0.471
J-21	2	C-5 (Ex House)	0.042
J-21	1	C-5 (Ex House)	0.021
J-22	4	R-1	0.083
J-22	7	R-3	0.098
J-23	7	R-3	0.098
J-24	Water Meter Data	Harrison Lake Estates	0.048
J-27	Water Meter Data	Tugboat Junction	0.001
J-28	8	R-1	0.166
J-29	4	R-1	0.083
J-30	15	R-1	0.312
J-31	13	R-1	0.270
J-32	2	R-1	0.042
J-33	4	R-1	0.083
J-34	5	R-1	0.104
J-35	11	R-1	0.229
J-36	10	R-1	0.208
J-37	2	R-1	0.042
J-38	Water Meter Data	Village Office	0.013
J-42	1	R-1	0.021
J-42	Water Meter Data	Cedar Springs Apts	0.023
J-42	Water Meter Data	Riverwynd Apts	0.048
J-42	Water Meter Data	Ramada Inn	0.943
J-43	1	R-2	0.042
J-43	Water Meter Data	Hot Springs Campground	0.017
J-44	Water Meter Data	Casia Developments	0.044
J-45	Water Meter Data	Echo Beach	0.478
J-47	Water Meter Data	Beach Washroom	0.165
J-47	Water Meter Data	Plaza	0.032
J-49	Water Meter Data	Boat Launch Bathrooms	0.019
J-50	Water Meter Data	The Cascades	0.078
J-51	Water Meter Data	Laguna Beach	0.283
J-52	1	R-2	0.042
J-52	Water Meter Data	Harrison on the Lake	0.051
J-53	6	R-2	0.252
J-54	4	R-2	0.168
J-55	10	R-2	0.420
J-56	8	R-2	0.336
J-59	8	R-1	0.166
J-60	12	R-1	0.250

J-62	1	R-1	0.021
J-63	10	R-1	0.208
J-64	11	R-1	0.229
J-65	8	R-1	0.166
J-66	6	R-1	0.125
J-67	6	R-1	0.125
J-68	11	R-1	0.229
J-69	9	R-1	0.187
J-90	Water Meter Data	Harrison Beach Hotel	0.137
J-90	Water Meter Data	Post Office	0.001
J-90	Water Meter Data	Black Forrest Restaurant	0.184
J-91	2	R-1	0.042
J-95	3	R-1	0.062
J-95	1	R-2	0.042
J-97	Water Meter Data	Hungry Chef	0.034
J-201	Water Meter Data	Heritage House	0.029
J-203	6	R-1	0.125
J-204	2	R-2	0.084
J-205	2	R-2	0.084
J-207	3	R-1	0.062
J-208	8	R-1	0.166
J-209	Water Meter Data	Old Settler Pub	0.208
J-211	5	R-1	0.104
J-214	2	R-2	0.084
J-215	3	R-1	0.062
J-216	1	R-1	0.021
J-219	Water Meter Data	Harrison Springs RV & Campground	0.054
J-220	1	R-2	0.042
J-221	3	R-2	0.126
J-221	1	R-1	0.021
J-222	2	R-2	0.084
J-223	1	R-2	0.042
J-224	1	R-2	0.042
J-225	1	R-1	0.021
J-226	1	R-1	0.021
J-228	1	R-2	0.042
J-228	1	C-7 - Holiday Park	0.007
J-229	6	R-1	0.125
J-230	4	R-1	0.083
J-232	6	R-3	0.084
J-233	6	R-3	0.084
J-234	7	R-3	0.098
J-235	8	R-3	0.112
J-236	8	R-3	0.112
J-237	8	R-3	0.112
J-238	3	R-3	0.042
J-240	Water Meter Data	Memorial Hall	0.023
J-241	Water Meter Data	Inkman's Mall	0.537
J-242	Water Meter Data	Hot Springs Villa	0.080
J-242	Water Meter Data	Harrison Village Motel	0.057
	Total Aveage Average Day Demand (Base) (L/s)		**13.354**

Junction #	Number of Unit Demands	Unit Demand	Average Day Demand (Base) (L/s)
J-8	3	R-1	0.062
J-8	Water Meter Data	Fire Hall	0.007
J-9	13	R-1	0.270
J-10	13	R-1	0.270
J-11	6	R-1	0.125
J-12	13	R-1	0.270
J-13	6	R-1	0.125
J-14	5	R-1	0.104
J-15	3	R-1	0.062
J-16	8	R-1	0.166
J-16	1	R-2	0.042
J-17	16	R-1	0.333
J-18	13	R-1	0.270
J-19	1	R-2	0.042
J-20	2	R-1	0.042
J-20	Water Meter Data	RV Springs	0.471
J-20	2	House (Scenario 2)	0.042
J-21	2	C-5 (Ex House)	0.042
J-21	1	C-5 (Ex House)	0.021
J-22	4	R-1	0.083
J-22	7	R-3	0.098
J-23	7	R-3	0.098
J-24	Water Meter Data	Harrison Lake Estates	0.048
J-26	2	House (Scenario 2)	0.042
J-27	Water Meter Data	Tugboat Junction	0.001
J-28	8	R-1	0.166
J-29	4	R-1	0.083
J-30	15	R-1	0.312
J-31	13	R-1	0.270
J-32	2	R-1	0.042
J-33	4	R-1	0.083
J-34	5	R-1	0.104
J-35	11	R-1	0.229
J-36	10	R-1	0.208
J-37	2	R-1	0.042
J-38	Water Meter Data	Village Office	0.013
J-38	0.86	School	0.298
J-40	1.33	C-5 (Scenario 2)	0.923
J-41	0.15	C-1 (Scenario 2)	0.208
J-41	0.10	C-1 (Scenario 2)	0.139
J-41	0.18	C-1 (Scenario 2)	0.250
J-42	1	R-1	0.021
J-42	Water Meter Data	Cedar Springs Apts	0.023
J-42	Water Meter Data	Riverwynd Apts	0.048
J-42	Water Meter Data	Ramada Inn	0.943
J-43	1	R-2	0.042
J-43	Water Meter Data	Hot Springs Campground	0.017
J-43	1	House (Scenario 2)	0.021
J-44	Water Meter Data	Casia Developments	0.044
J-45	Water Meter Data	Echo Beach	0.478
J-47	Water Meter Data	Beach Washroom	0.165
J-47	Water Meter Data	Plaza	0.032
J-49	Water Meter Data	Boat Launch Bathrooms	0.019
J-50	Water Meter Data	The Cascades	0.078
J-51	Water Meter Data	Laguna Beach	0.283
J-51	2	House (Scenario 2)	0.042

J-52	1	R-2	0.042
J-52	Water Meter Data	Harrison on the Lake	0.051
J-52	4	House (Scenario 2)	0.083
J-53	6	R-2	0.252
J-54	4	R-2	0.168
J-55	10	R-2	0.420
J-55	1	House (Scenario 2)	0.021
J-56	8	R-2	0.336
J-56	1	House (Scenario 2)	0.021
J-59	8	R-1	0.166
J-60	12	R-1	0.250
J-62	1	R-1	0.021
J-63	10	R-1	0.208
J-64	11	R-1	0.229
J-65	8	R-1	0.166
J-66	6	R-1	0.125
J-67	6	R-1	0.125
J-68	11	R-1	0.229
J-69	9	R-1	0.187
J-69	1	House (Scenario 2)	0.021
J-90	Water Meter Data	Harrison Beach Hotel	0.137
J-90	Water Meter Data	Post Office	0.001
J-90	Water Meter Data	Black Forrest Restaurant	0.184
J-91	2	R-1	0.042
J-91	3	House (Scenario 2)	0.062
J-92	2	House (Scenario 2)	0.042
J-94	5	House (Scenario 2)	0.104
J-95	3	R-1	0.062
J-95	1	R-2	0.042
J-95	1	House (Scenario 2)	0.021
J-97	Water Meter Data	Hungry Chef	0.034
J-201	Water Meter Data	Heritage House	0.029
J-203	6	R-1	0.125
J-204	2	R-2	0.084
J-204	1	House (Scenario 2)	0.021
J-205	2	R-2	0.084
J-207	3	R-1	0.062
J-208	8	R-1	0.166
J-209	Water Meter Data	Old Settler Pub	0.208
J-209	0.40	C-1 (Scenario 2)	0.556
J-211	5	R-1	0.104
J-214	2	R-2	0.084
J-214	2	House (Scenario 2)	0.042
J-214	1.25	C-5 (Scenario 2)	0.868
J-215	3	R-1	0.062
J-215	4	House (Scenario 2)	0.083
J-216	1	R-1	0.021
J-219	Water Meter Data	Harrison Springs RV & Campground	0.054
J-220	1	R-2	0.042
J-220	3	House (Scenario 2)	0.062
J-220	0.06	C-4 (Scenario 2)	0.038
J-221	3	R-2	0.126
J-221	1	R-1	0.021
J-221	3	House (Scenario 2)	0.062
J-222	2	R-2	0.084
J-222	1	CS (Scenario 2)	0.194
J-222	4	House (Scenario 2)	0.083
J-223	1	R-2	0.042
J-223	5	House (Scenario 2)	0.104

J-223	0.24	C-4 (Scenario 2)	0.150
J-224	1	R-2	0.042
J-224	1	House (Scenario 2)	0.021
J-225	1	R-1	0.021
J-226	1	R-1	0.021
J-226	2	House (Scenario 2)	0.042
J-228	1	R-2	0.042
J-227	4	House (Scenario 2)	0.083
J-228	2	House (Scenario 2)	0.042
J-228	411	C-7 - Holiday Park (Scenario 2)	2.877
J-229	6	R-1	0.125
J-229	3	House (Scenario 2)	0.062
J-230	4	R-1	0.083
J-232	6	R-3	0.084
J-233	6	R-3	0.084
J-234	7	R-3	0.098
J-235	8	R-3	0.112
J-236	8	R-3	0.112
J-237	8	R-3	0.112
J-238	3	R-3	0.042
J-240	Water Meter Data	Memorial Hall	0.023
J-241	Water Meter Data	Inkman's Mall	0.537
J-241	0.27	C-1 (Scenario 2)	0.375
J-242	Water Meter Data	Hot Springs Villa	0.080
J-242	Water Meter Data	Harrison Village Motel	0.057
J-241	0.13	C-1 (Scenario 2)	0.181
J-500	5	House (Scenario 2)	0.104
J-501	9	House (Scenario 2)	0.187
J-502	4	House (Scenario 2)	0.083
J-503	5	House (Scenario 2)	0.104
J-504	5	House (Scenario 2)	0.104
J-505	6	House (Scenario 2)	0.125
J-506	3	House (Scenario 2)	0.062
J-507	4	House (Scenario 2)	0.083
J-508	2	House (Scenario 2)	0.042
J-509	4	House (Scenario 2)	0.083
J-510	5	House (Scenario 2)	0.104
J-511	3	House (Scenario 2)	0.062
J-512	2	House (Scenario 2)	0.042
J-513	3	House (Scenario 2)	0.062
J-514	2	House (Scenario 2)	0.042
J-515	2	House (Scenario 2)	0.042
J-516	3	House (Scenario 2)	0.062
J-518	12	House (Scenario 2)	0.250
J-519	5	House (Scenario 2)	0.104
J-520	2	House (Scenario 2)	0.042
J-521	2	House (Scenario 2)	0.042
J-522	4	House (Scenario 2)	0.083
J-522	0.15	Church (Scenario 2)	0.052
J-523	2	House (Scenario 2)	0.042
J-524	9	House (Scenario 2)	0.187
J-525	10	House (Scenario 2)	0.208
J-526	0.22	C-2 (Scenario 2)	0.306
J-526	0.21	C-2 (Scenario 2)	0.292
J-527	4	House (Scenario 2)	0.083
J-528	8	House (Scenario 2)	0.166
J-529	4	House (Scenario 2)	0.083
J-531	5	House (Scenario 2)	0.104
	Total Average Average Day Demand (Base) (L/s)		**25.076**

Appendix C - Junction Demands
(Future System - Full Developement)

HARRISON HOT SPRINGS
Naturally Refreshed

Junction #	Number of Unit Demands	Unit Demand	Average Day Demand (Base) (L/s)
J-8	3	R-1	0.062
J-8	Water Meter Data	Fire Hall	0.007
J-9	14	R-1	0.291
J-10	13	R-1	0.270
J-11	6	R-1	0.125
J-12	13	R-1	0.270
J-13	8	R-1	0.166
J-14	5	R-1	0.104
J-15	3	R-1	0.062
J-16	9	R-1	0.187
J-16	1	R-2	0.042
J-17	18	R-1	0.374
J-18	16	R-1	0.333
J-19	1	R-2	0.042
J-20	57	Condo Unit (Scenario 3)	0.798
J-20	117	Campsite (Scenario 3)	0.819
J-20	2	R-1	0.042
J-20	Water Meter Data	RV Springs	0.471
J-20	108	Condo Unit (Scenario 3)	1.512
J-21	2	C-5 (Ex House)	0.042
J-21	1	C-5 (Ex House)	0.021
J-22	7	R-1	0.146
J-22	7	R-3	0.098
J-23	7	R-3	0.098
J-24	Water Meter Data	Harrison Lake Estates	0.048
J-26	23	Condo Unit (Scenario 3)	0.322
J-26	47	Campsite (Scenario 3)	0.329
J-27	Water Meter Data	Tugboat Junction	0.001
J-27	10	Small House (Scenario 3)	0.140
J-28	8	R-1	0.166
J-29	4	R-1	0.083
J-30	15	R-1	0.312
J-31	13	R-1	0.270
J-32	2	R-1	0.042
J-33	5	R-1	0.104
J-34	7	R-1	0.146
J-35	11	R-1	0.229
J-36	11	R-1	0.229
J-37	3	R-1	0.062
J-38	Water Meter Data	Village Office	0.013
J-38	0.86	School	0.298
J-39	16	Condo Unit (Scenario 3)	0.224
J-40	1.33	C-5 (Scenario 2)	0.923
J-40	1	Small House (Scenario 3)	0.014
J-41	0.15	C-1 (Scenario 2)	0.208
J-41	0.10	C-1 (Scenario 2)	0.139
J-41	0.18	C-1 (Scenario 2)	0.250
J-42	Water Meter Data	Cedar Springs Apts	0.023
J-42	Water Meter Data	Riverwynd Apts	0.048
J-42	Water Meter Data	Ramada Inn	0.943
J-43	78	Condo Unit (Scenario 3)	1.092
J-43	0.28	C-1 (Scenario 3)	0.389
J-44	Water Meter Data	Casia Developments	0.044
J-45	Water Meter Data	Echo Beach	0.478
J-47	Water Meter Data	Beach Washroom	0.165

J-47	Water Meter Data	Plaza	0.032
J-49	Water Meter Data	Boat Launch Bathrooms	0.019
J-50	Water Meter Data	The Cascades	0.078
J-51	Water Meter Data	Laguna Beach	0.283
J-51	2	House (Scenario 2)	0.042
J-52	35	Condo Unit (Scenario 3)	0.490
J-52	Water Meter Data	Harrison on the Lake	0.051
J-52	0.10	C-2 (Scenario 3)	0.139
J-53	6	R-2	0.252
J-53	4	Small House (Scenario 3)	0.056
J-54	*3*	*R-2*	*0.126*
J-54	9	Small House (Scenario 3)	0.126
J-55	10	R-2	0.420
J-55	1	House (Scenario 2)	0.021
J-56	8	R-2	0.336
J-56	1	House (Scenario 2)	0.021
J-57	31	Condo Unit (Scenario 3)	0.434
J-59	10	R-1	0.208
J-60	14	R-1	0.291
J-62	1	R-1	0.021
J-63	10	R-1	0.208
J-64	11	R-1	0.229
J-65	*11*	*R-1*	*0.229*
J-66	6	R-1	0.125
J-67	6	R-1	0.125
J-68	11	R-1	0.229
J-69	9	R-1	0.187
J-69	1	House (Scenario 2)	0.021
J-90	Water Meter Data	Harrison Beach Hotel	0.137
J-90	Water Meter Data	Post Office	0.001
J-90	Water Meter Data	Black Forrest Restaurant	0.184
J-91	2	R-1	0.042
J-91	3	House (Scenario 2)	0.062
J-92	2	House (Scenario 2)	0.042
J-94	5	House (Scenario 2)	0.104
J-95	3	R-1	0.062
J-95	1	R-2	0.042
J-95	1	House (Scenario 2)	0.021
J-97	89	Condo Unit (Scenario 3)	1.246
J-97	0.30	C-1 (Scenario 3)	0.417
J-201	Water Meter Data	Heritage House	0.029
J-203	6	R-1	0.125
J-204	2	R-2	0.084
J-204	1	House (Scenario 2)	0.021
J-207	4	Small House (Scenario 3)	0.056
J-205	1	R-2	0.042
J-205	4	Small House (Scenario 3)	0.056
J-206	31	Condo Unit (Scenario 3)	0.434
J-207	*2*	*R-1*	*0.042*
J-207	4	Small House (Scenario 3)	0.056
J-208	8	R-1	0.166
J-209	Water Meter Data	Old Settler Pub	0.208
J-209	0.40	C-1 (Scenario 2)	0.556
J-211	5	R-1	0.104
J-214	2	R-2	0.084
J-214	2	House (Scenario 2)	0.042
J-214	1.25	C-5 (Scenario 2)	0.868
J-215	3	R-1	0.062
J-215	4	House (Scenario 2)	0.083

J-216	1	R-1	0.021
J-219	Water Meter Data	Harrison Springs RV & Campground	0.054
J-220	1	R-2	0.042
J-220	3	House (Scenario 2)	0.062
J-220	0.06	C-4 (Scenario 2)	0.038
J-220	41	Condo Unit (Scenario 3)	0.574
J-220	84	Campsite (Scenario 3)	0.588
J-221	3	R-2	0.126
J-221	1	R-1	0.021
J-221	5	House (Scenario 2)	0.104
J-222	2	R-2	0.084
J-222	1	CS (Scenario 2)	0.194
J-222	4	House (Scenario 2)	0.083
J-223	1	R-2	0.042
J-223	*4*	*House (Scenario 2)*	*0.083*
J-223	0.24	C-4 (Scenario 2)	0.150
J-223	15	Small House (Scenario 3)	0.210
J-224	1	R-2	0.042
J-224	1	House (Scenario 2)	0.021
J-225	1	R-1	0.021
J-226	1	R-1	0.021
J-226	2	House (Scenario 2)	0.042
J-228	1	R-2	0.042
J-227	4	House (Scenario 2)	0.083
J-228	1	C-7 - Holiday Park	0.007
J-228	2	House (Scenario 2)	0.042
J-228	411	C-7 - Holiday Park (Scenario 2)	2.877
J-229	6	R-1	0.125
J-229	3	House (Scenario 2)	0.062
J-230	2	R-1	0.042
J-230	4	Small House (Scenario 3)	0.056
J-232	6	R-3	0.084
J-233	6	R-3	0.084
J-234	7	R-3	0.098
J-235	8	R-3	0.112
J-236	8	R-3	0.112
J-237	8	R-3	0.112
J-238	3	R-3	0.042
J-240	Water Meter Data	Memorial Hall	0.023
J-241	Water Meter Data	Inkman's Mall	0.537
J-241	0.27	C-1 (Scenario 2)	0.375
J-242	Water Meter Data	Hot Springs Villa	0.080
J-242	Water Meter Data	Harrison Village Motel	0.057
J-242	16	Condo Unit (Scenario 3)	0.224
J-242	0.05	C-1 (Scenario 3)	0.069
J-241	0.13	C-1 (Scenario 2)	0.181
J-500	7	House (Scenario 2)	0.146
J-501	9	House (Scenario 2)	0.187
J-502	4	House (Scenario 2)	0.083
J-503	5	House (Scenario 2)	0.104
J-504	5	House (Scenario 2)	0.104
J-505	6	House (Scenario 2)	0.125
J-506	3	House (Scenario 2)	0.062
J-507	6	House (Scenario 2)	0.125
J-508	2	House (Scenario 2)	0.042
J-509	5	House (Scenario 2)	0.104
J-510	5	House (Scenario 2)	0.104
J-511	6	House (Scenario 2)	0.125
J-512	5	House (Scenario 2)	0.104
J-513	3	House (Scenario 2)	0.062

J-514	2	House (Scenario 2)	0.042
J-515	3	House (Scenario 2)	0.062
J-516	3	House (Scenario 2)	0.062
J-518	12	House (Scenario 2)	0.250
J-519	8	House (Scenario 2)	0.166
J-520	2	House (Scenario 2)	0.042
J-520	4	Small House (Scenario 3)	0.056
J-521	70	Condo Unit (Scenario 3)	0.980
J-521	0.24	C-2 (Scenario 3)	0.333
J-522	14	Condo Unit (Scenario 3)	0.196
J-522	0.05	C-2 (Scenario 3)	0.069
J-522	0.15	Church (Scenario 2)	0.052
J-523	2	House (Scenario 2)	0.042
J-524	14	Condo Unit (Scenario 3)	0.196
J-524	0.05	C-2 (Scenario 3)	0.069
J-524	9	House (Scenario 2)	0.187
J-525	21	Condo Unit (Scenario 3)	0.294
J-525	0.05	C-2 (Scenario 3)	0.069
J-526	0.22	C-2 (Scenario 2)	0.306
J-526	0.21	C-2 (Scenario 2)	0.292
J-527	43	Condo Unit (Scenario 3)	0.602
J-527	0.14	C-1 (Scenario 3)	0.194
J-528	64	Condo Unit (Scenario 3)	0.896
J-528	0.23	C-1 (Scenario 3)	0.319
J-529	4	House (Scenario 2)	0.083
J-531	5	House (Scenario 2)	0.104
J-534	18	Condo Unit (Scenario 3)	0.252
J-534	0.02	C-1 (Scenario 3)	0.028
J-535	18	Condo Unit (Scenario 3)	0.252
J-535	0.02	C-1 (Scenario 3)	0.028
J-536	18	Condo Unit (Scenario 3)	0.252
J-536	0.02	C-1 (Scenario 3)	0.028
J-537	18	Condo Unit (Scenario 3)	0.252
J-537	0.02	C-1 (Scenario 3)	0.028
J-538	18	Condo Unit (Scenario 3)	0.252
J-538	0.02	C-1 (Scenario 3)	0.028
J-540	322.00	Kingma Lands R-3 (Scenario 3)	4.508
	Total Average Average Day Demand (Base) (L/s)		**45.889**

Appendix C
Civic Addresses for Non Conforming Hydrant Coverage
(2014 Existing Water Supply Distribution System)

HARRISON HOT SPRINGS

Naturally Refreshed

Civic Address	Future Hydrant #	Civic Address	Future Hydrant #	Civic Address	Future Hydrant #
100 Esplande Avenue	F1	555 Naismith Avenue	F9	602 Lakberg Crescent	F15
120 Esplande Avenue	F1	565 Naismith Avenue	F9	603 Lakberg Crescent	F15
114 Cedar Avenue	F2	560 Naismith Avenue	F9	604 Lakberg Crescent	F15
140 Cedar Avenue	F2	535 Naismith Avenue	F10	606 Lakberg Crescent	F15
330 Eagle Street	F3	539 Naismith Avenue	F10	606 Lakberg Crescent	F15
340 Eagle Street	F3	545 Naismith Avenue	F10	608 Lakberg Crescent	F15
339 Bear Avenue	F3	549 Naismith Avenue	F10	609 Lakberg Crescent	F15
410 Bear Avenue	F3	540 Naismith Avenue	F10	637 Hot Springs Road	F16
420 Bear Avenue	F3	546 Naismith Avenue	F10	389 Pine Avenue	F16
430 Bear Avenue	F3	550 Naismith Avenue	F10	395 Pine Avenue	F16
498 Bear Avenue	F3	556 Naismith Avenue	F10	415 Pine Avenue	F16
470 Lilloet Avenue	F4	506 Naismith Avenue	F11	435 Pine Avenue	F16
480 Lilloet Avenue	F4	513 Naismith Avenue	F11	455 Pine Avenue	F16
490 Lilloet Avenue	F4	515 Naismith Avenue	F11	473 Pine Avenue	F16
511 Lilloet Avenue	F5	519 Naismith Avenue	F11	442 Pine Avenue	F16
231 Lilloet Avenue	F5	525 Naismith Avenue	F11	464 Pine Avenue	F16
500 Lilloet Avenue	F5	529 Naismith Avenue	F11	470 Pine Avenue	F16
520 Lilloet Avenue	F5	510 Naismith Avenue	F11	478 Pine Avenue	F16
526 Lilloet Avenue	F5	516 Naismith Avenue	F11	750 McCombs Drive	F17
519 Lilloet Avenue	F6	520 Naismith Avenue	F11	760 McCombs Drive	F17
527 Lilloet Avenue	F6	526 Naismith Avenue	F11	770 McCombs Drive	F17
531 Lilloet Avenue	F6	530 Naismith Avenue	F11	780 McCombs Drive	F17
538 Lilloet Avenue	F6	536 Naismith Avenue	F11	750 Diamond Street	F18
544 Lilloet Avenue	F6	479 Cottonwood Place	F12	755 Diamond Street	F18
550 Lilloet Avenue	F6	480 Cottonwood Place	F12	760 Diamond Street	F18
553 Lilloet Avenue	F7	449 Cottonwood Place	F13	765 Diamond Street	F18
549 Lilloet Avenue	F7	451 Cottonwood Place	F13	770 Diamond Street	F18
553 Lilloet Avenue	F7	345 Chestnut Avenuenue	F14	775 Diamond Street	F18
556 Lilloet Avenue	F7	347 Chestnut Avenuenue	F14	780 Diamond Street	F18
562 Lilloet Avenue	F7	350 Chestnut Avenuenue	F14	785 Diamond Street	F18
568 Lilloet Avenue	F7	352 Chestnut Avenuenue	F14	790 Diamond Street	F18
574 Lilloet Avenue	F7	601 Lakberg Crescent	F15	795 Diamond Street	F18
565 Lilloet Avenue	F8	602 Lakberg Crescent	F15	808 Ramona Place	F19
811 Ramona Place	F19	850 Angus Place	F21	881 Hope Place	F24
812 Ramona Place	F19	856 Hope Place	F22	884 Hope Place	F24
816 Ramona Place	F19	858 Hope Place	F22	885 Hope Place	F24
820 Ramona Place	F19	868 Hope Place	F22	892 Hope Place	F24
822 Ramona Place	F19	872 Hope Place	F22	Rockwell Drive	F25
826 Ramona Place	F19	856 Myng Crescent	F23	Rockwell Drive	F26
401 Hadway Drive	F19	857 Myng Crescent	F23	Rockwell Drive	F27
425 Hadway Drive	F19	860 Myng Crescent	F23	Rockwell Drive	F28
822 Myng Crescent	F20	861 Myng Crescent	F23	Rockwell Drive	F29
826 Myng Crescent	F20	866 Myng Crescent	F23	310 Fern Place	F30
835 Angus Place	F21	865 Myng Crescent	F23	315 Fern Place	F30
841 Angus Place	F21	870 Myng Crescent	F23	315 Clover Place	F-31
847 Angus Place	F21	871 Myng Crescent	F23	320 Clover Place	F31
848 Angus Place	F21	875 Myng Crescent	F23	325 Clover Place	F31
849 Angus Place	F21	878 Hope Place	F24		

*If text is red the address may be incorrect.

Table 1: Existing Model - Hydrant Requirements - Fire Flow + Max Day Demand

Note: Minimum system pressure under Fire Flow Conditions is a 22 PSI as per MMCD Guidelines. Any Failed Hydrants don't meet this requirement. The Fire Flow Flows are based on zone. The following criteria was used:

R-1, R-2, & R-3 minimum fire flow of 60 L/s
P-1 minimum fire flow of 60 L/s
R-4 & R-5 minimum fire flow of 90 L/s
C Zone and P-1* (Existing School and Public Works Building) minimum fire flow of 150 L/s

Label	Zone	Hydrant Elevation (m)	Static Pressure (psi)	Fire Flow (Required) (L/s)	Residual Pressure (psi)	Fire Flow (Available) (L/s) at 22psi Residual Pressure	Velocity of Pipe (m/s) at Fire Flow	Location of highest record velocity in the system	Hydrant Spacing Yes/No (Max space R-1, R-2, R-3 = 180m, all other zones = 90m)	Distribution Main Section Affected	Upgrade Required - Pipe Velocity under 3.5m/s	Upgrade Pipe Length Required (m)
H-1	C-1	13.02	86	150	46	201	4.87	J-240 to J45 (200mm)	No	Between H-1 and H-2	J-240 to J45 (250mm)	11
H-2	C-1	13.15	86	150	48	208	4.87	J-240 to J45 (200mm)	No	Between H-2 and H-1	J-240 to J45 (250mm)	11
H-3	C-1	13.22	86	150	52	224	4.87	J-240 to J45 (200mm)	Yes		J-240 to J45 (250mm)	11
H-4	P-1, C-1, C-2, C-3	13.36	86	150	61	276	2.32		No	Between H-4 and H-5		
H-5	C-2, C-3	13.47	86	150	50	215	2.32		No	Between H-5 and H-4, H-6, H-7		
H-6	C-2	12.76	87	150	42	189	4.77	J-50 to J-202 (200mm)	No	Between H-6 and H-5, H-7	J-50 to J-202 (250mm)	62
H-7	R-2	13.09	86	60	72	189	2.32		No	Between H-7 and H-9		
H-7	C-2	13.09	86	150	47	205	2.32		No	Between H-7 and H-6		
H-8	R-2	12.22	87	60	61	109	2.32		Yes			
H-9	R-2, R-3	12.67	87	60	70	161	2.32		No	Between H-9 and H-7		
H-10	R-2	13.82	85	60	64	129	2.32		Yes			
H-11	R-2	13.75	85	60	60	112	2.32		Yes			
H-12	R-2	13.58	86	60	59	107	2.32		Yes			
H-12	R-4	13.58	86	90	37	107	5.24	J-53 to J-204 (150mm)	No	Between H-12 and H-13	J-53 to J-204 (200mm)	17
H-13	R-4	14	85	90	31	99	5.24	J-53 to J-204 (150mm)	No	Between H-13 and H-12	J-53 to J-204 (200mm)	17
H-14	R-1, R-2	13.17	86	60	72	187	2.32		Yes			
H-15	R-1	12.98	86	60	72	188	2.32		Yes			
H-16	R-1	13.07	86	60	63	121	2.32		Yes			
H-17	R-1	12.83	87	60	61	111	2.32		Yes			
H-18	R-1	12.96	86	60	60	110	2.32		Yes			
H-19	R-1	13.05	86	60	64	122	2.32		Yes			
H-20	R-1	13.11	86	60	72	185	2.32		Yes			
H-21	R-1	12.73	87	60	70	154	2.32		Yes			
H-22	R-1	12.75	87	60	66	133	2.32		Yes			
H-23	C-1, C-3	12.44	87	150	64	294	3.12		Yes			
H-24	C-1	13.33	86	150	64	300	2.68		No	Between H-24 and H-25		
H-25	C-1	13.63	86	150	61	276	2.68		No	Between H-25 and H-24		
H-26	R-1	13.34	86	60	78	268	2.32		Yes			
H-26	C-5	13.34	86	150	62	285	5.54	J-212 to J-38 (150mm)	Yes		J-210 to J-40 (250mm)	20
H-27	R-1	13.09	86	60	74	183	2.32		Yes			
H-27	P-1	13.09	86	150	43	192	5.54	J-210 to J-40 (150mm)	Yes		J-37 to J-40 (200mm) J-37 to J-36 (250mm)	51 & 50
H-28	R-1	12.84	87	60	68	139	2.32		Yes			
H-29	R-1	12.81	87	60	68	136	2.32		Yes			
H-30	R-1	13.31	86	60	67	135	2.32		Yes			
H-31	R-1	13.11	86	60	72	169	2.32		Yes			
H-32	R-1	12.58	87	60	74	178	2.32		Yes			
H-32	P-1	12.58	87	150	41	186	5.54	J-212 to J-38 (150mm)	No	Between H-32 and H-31, H-33	J-39 to J-38 (200mm) J-38 to J-212 (250mm)	61 & 68
H-33	R-1	14.14	85	60	77	260	2.32		Yes			
H-33	P-1	14.14	85	150	60	273	2.65		No	Between H-33 and H-32		
H-34	P-1	12.92	87	150	57	247	3.77	J-37 to J-40 (150mm)	No	Between H-34 and H-33	J-37 to J-40 (200mm) J-38 to J-39 (200mm)	51 & 61
H-35	R-1	12.99	87	60	73	180	2.32		Yes			
H-36	R-1	13.24	86	60	75	224	2.32		Yes			
H-37	R-1	13.53	86	60	75	223	2.32		Yes			
H-38	R-1	12.84	87	60	75	194	2.32		Yes			
H-39	R-1	12.89	87	60	69	142	2.32		Yes			
H-40	R-1	12.81	87	60	71	150	2.32		Yes			
H-41	R-1	13.38	86	60	78	269	2.32		Yes			
H-42	R-1	12.89	87	60	77	249	2.32		Yes			
H-43	CD-2, P-1	13.4	86	150	70	300	2.32		Yes			
H-44	R-2	14.66	84	60	76	259	2.32		Yes			
H-44	C-5	14.66	84	150	59	270	2.65		No	Between H-44 and H-43, H-45		
H-45	R-2	14.07	85	60	76	233	2.32		Yes			
H-45	C-5	14.07	85	150	56	244	2.65		No	Between H-45 and H-44, H-46		
H-46	RSR	13.57	86	60	76	225	2.32		Yes			
H-46	C-5	13.57	86	150	55	236	2.65		No	Between H-46 and H-45, H-49		
H-47	R-2	13.17	86	60	75	205	2.32		Yes			

H-48	RSR	13.68	86	60	74	192	2.32		Yes			
H-49	R-1, R-3	14.24	85	60	74	204	2.32		Yes			
H-49	C-5	14.24	85	150	49	214	5.93	J-21 to J-217 (150mm)	No	Between H-49 and H-46, H-54	J-21 to J-217 (250mm)	12
H-50	R-1	13.28	86	60	75	200	2.32		Yes			
H-51	R-3	13.89	85	60	72	170	2.32		Yes			
H-52	R-1	13.56	86	60	74	198	2.32		Yes			
H-53	R-4	13.8	86	90	63	178	2.24		No	Between H-53 and H-64		
H-54	R-4	14.43	85	90	66	199	2.24		No	Between H-54 and H-55, H-49		
H-54	C-5	14.43	85	150	48	209	2.32		No	Between H-54 and H-55, H-49		
H-55	R-1	14.01	85	60	73	187	2.32		Yes			
H-55	C-5	14.01	85	150	44	196	2.32		No	Between H-55 and H-54, H-56		
H-56	R-1	14.53	84	60	71	173	2.32		Yes			
H-56	C-4, C-5	14.53	84	150	39	181	2.32		No	Between H-56 and H-55, H-57		
H-57	R-1, R-2	13.96	85	60	70	157	2.32		Yes			
H-58	R-1	14.24	85	60	69	149	2.32		Yes			
H-58	CS	14.24	85	150	26	155	2.32		Yes			
H-59	R-1, R-2	14.85	84	60	67	139	2.32		Yes			
H-59	C-4	14.85	84	150	18	144	3.09		Yes			
H-60	R-2	13.63	86	60	67	134	2.32		Yes			
H-60	C-4, C-7	13.63	86	150	13	139	3.09		Yes			
H-61	R-1	13.87	85	60	63	114	2.32		Yes			
H-62	R-1	12.57	87	60	61	106	2.32		Yes			
H-63	R-1	13.57	86	60	61	108	2.32		No	Between H-63 and H-64		
H-64	R-1	13.89	85	60	68	136	2.32		No	Between H-64 and H-63		
H-65	R-2	14.28	85	60	65	127	2.32		Yes			
H-65	C-7	14.28	85	150	7	132	3.09		Yes			
H-66	R-3	13.14	86	60	63	115	2.32		Yes			
H-67	R-3	13.28	86	60	66	127	2.32		Yes			
H-68	R-3	13.79	85	60	60	108	2.32		Yes			

Table 2: Scenario 2 - Hydrant Requirements - Fire Flow + Max Day Demand

Note: Minimum system pressure under Fire Flow Conditions is a 22 PSI as per MMCD Guidelines. Any Failed Hydrants don't meet this requirement. The Fire Flow Flows are based on zone. The following criteria was used:

R-1, R-2, & R-3 minimum fire flow of 60 L/s
P-1 minimum fire flow of 60 L/s
R-4 & R-5 minimum fire flow of 90 L/s
C Zone and P-1* (Existing School and Public Works Building) minimum fire flow of 150 L/s

Label	Zone	Hydrant Elevation (m)	Static Pressure (psi)	Fire Flow (Required) (L/s)	Residual Pressure (psi)	Fire Flow (Available) (L/s) at 22psi Residual Pressure	Velocity of Pipe (m/s) at Fire Flow	Location of highest record velocity in the system
F1	CD-1, C-1	13.00	88	150	57	252	3.12	
F2	C-1, C-3	13.00	88	150	61	282	3.12	
F3	R-2	13.58	87	60	59	107	2.29	
F4	R-2	13.78	86	60	71	193	2.29	
F4	C-2	13.78	86	150	42	193	3.12	
F5	R-2	13.95	86	60	70	183	2.29	
F5	C-2	13.95	86	150	39	183	3.12	
F6	R-2	14.55	85	60	69	174	2.29	
F6	C-2	14.55	85	150	35	174	3.12	
F7	R-2	15.34	84	60	68	170	2.29	
F7	C-2	15.34	84	150	33	170	3.12	
F8	R-4	14.00	86	90	61	176	2.27	
F8	C-2	14.00	86	150	36	176	3.12	
F9	R-1	13.40	87	60	72	197	2.29	
F10	R-1	13.40	87	60	71	188	2.29	
F11	R-1	13.49	87	60	71	190	2.29	
F12	R-1	12.95	88	60	69	156	2.29	
F13	R-1	12.84	88	60	68	148	2.29	
F14	R-1	12.84	88	60	71	170	2.29	
F15	R-2	13.38	87	60	71	180	2.29	
F16	R-2	13.57	87	60	70	169	2.29	
F17	R-1	13.83	86	60	70	186	2.29	
F18	R-1	13.90	86	60	58	106	2.29	
F19	R-1	14.17	86	60	60	115	2.29	
F20	R-1	13.68	87	60	69	166	2.29	
F21	R-1	13.79	86	60	65	137	2.29	
F22	R-1	14.19	86	60	60	120	2.29	
F23	R-1	13.40	87	60	66	137	2.29	
F24	R-1	12.50	88	60	59	110	2.29	
F25	CD	12.50	88	150	27	158	2.29	
F26	CD	12.50	88	150	23	151	2.29	
F27	CD	12.50	88	150	22	150	2.29	
F28	CD	12.50	88	150	21	149	2.29	
F29	CD	12.50	88	150	20	148	2.29	
F30	R-1	13.17	87	60	64	200	2.29	
F31	R-1	13.23	87	60	67	156	2.29	
H-1	C-1	13.02	86	150	59	269	3.12	
H-2	C-1	13.15	86	150	56	248	3.12	
H-3	C-1	13.22	86	150	57	255	3.12	
H-4	P-1, C-1, C-2, C-3	13.36	86	150	61	292	3.12	
H-5	C-2, C-3	13.47	86	150	50	220	3.35	
H-6	C-2	12.76	87	150	42	192	4.77	J-50 to J-202 (200mm)
H-7	R-2	13.09	86	60	73	209	2.29	
H-7	C-2	13.09	86	150	47	209	3.34	
H-8	R-2	12.22	87	60	62	114	2.29	
H-9	R-2, R-3	12.67	87	60	73	194	2.29	
H-10	R-2	13.82	85	60	70	178	2.29	
H-11	R-2	13.75	85	60	70	180	2.29	
H-12	R-2	13.58	86	60	71	188	2.29	
H-12	R-4	13.58	86	90	63	188	2.29	
H-13	R-4	14.00	85	90	62	185	2.29	
H-14	R-1, R-2	13.17	86	60	73	210	2.29	
H-15	R-1	12.98	86	60	73	211	2.29	
H-16	R-1	13.07	86	60	68	149	2.29	
H-17	R-1	12.83	87	60	71	174	2.29	
H-18	R-1	12.96	86	60	67	139	2.29	
H-19	R-1	13.05	86	60	67	142	2.29	
H-20	R-1	13.11	86	60	73	207	2.29	
H-21	R-1	12.73	87	60	70	165	2.29	
H-22	R-1	12.75	87	60	67	140	2.29	
H-23	C-1, C-3	12.44	87	150	63	296	3.12	
H-24	C-1	13.33	86	150	61	288	2.68	
H-25	C-1	13.63	86	150	59	276	2.68	
H-26	R-1	13.34	86	60	76	274	2.29	
H-26	C-5	13.34	86	150	60	274	6.60	J-210 to J-40 (150mm)
H-27	R-1	13.09	86	60	72	186	2.29	
H-27	P-1	13.09	86	150	41	186	6.60	J-210 to J-40 (150mm)

H-28	R-1	12.84	87	60	68	142	2.29	
H-29	R-1	12.81	87	60	68	139	2.29	
H-30	R-1	13.31	86	60	67	138	2.29	
H-31	R-1	13.11	86	60	71	174	2.29	
H-32	R-1	12.58	87	60	73	180	2.29	
H-32	P-1	12.58	87	150	38	180	5.54	J-212 to J-38 (150mm)
H-33	R-1	14.14	85	60	75	263	2.29	
H-33	P-1	14.14	85	150	58	263	2.65	
H-34	P-1	12.92	87	150	55	239	3.77	J-37 to J-40 (150mm)
H-35	R-1	12.99	87	60	72	185	2.29	
H-36	R-1	13.24	86	60	75	234	2.29	
H-37	R-1	13.53	86	60	74	235	2.29	
H-38	R-1	12.84	87	60	74	207	2.29	
H-39	R-1	12.89	87	60	68	145	2.29	
H-40	R-1	12.81	87	60	70	152	2.29	
H-41	R-1	13.38	86	60	76	274	2.29	
H-42	R-1	12.89	87	60	76	257	2.29	
H-43	CD-2, P-1	13.40	86	150	68	300	2.65	
H-44	R-2	14.66	84	60	74	259	2.29	
H-44	C-5	14.66	84	150	56	259	2.65	
H-45	R-2	14.07	85	60	73	235	2.29	
H-45	C-5	14.07	85	150	53	235	2.65	
H-46	RSR	13.57	86	60	73	223	2.29	
H-46	C-5	13.57	86	150	50	223	2.65	
H-47	R-2	13.17	86	60	74	230	2.29	
H-48	RSR	13.68	86	60	72	200	2.29	
H-49	R-1, R-3	14.24	85	60	71	201	2.29	
H-49	C-5	14.24	85	150	44	201	2.65	
H-50	R-1	13.28	86	60	72	201	2.29	
H-51	R-3	13.89	85	60	69	167	2.29	
H-52	R-1	13.56	86	60	72	199	2.29	
H-53	R-4	13.80	86	90	62	179	2.29	
H-54	R-4	14.43	85	90	63	198	2.29	
H-54	C-5	14.43	85	150	43	198	2.65	
H-55	R-1	14.01	85	60	70	191	2.29	
H-55	C-5	14.01	85	150	41	191	2.65	
H-56	R-1	14.53	84	60	69	184	2.29	
H-56	C-4, C-5	14.53	84	150	38	184	2.65	
H-57	R-1, R-2	13.96	85	60	69	172	2.29	
H-58	R-1	14.24	85	60	68	169	2.29	
H-58	CS	14.24	85	150	33	169	2.65	
H-59	R-1, R-2	14.85	84	60	67	164	2.29	
H-59	C-4	14.85	84	150	30	164	2.65	
H-60	R-2	13.63	86	60	69	165	2.29	
H-60	C-4, C-7	13.63	86	150	31	165	3.09	
H-61	R-1	13.87	85	60	64	131	2.29	
H-62	R-1	12.57	87	60	62	117	2.29	
H-63	R-1	13.57	86	60	68	156	2.29	
H-64	R-1	13.89	85	60	70	177	2.29	
H-65	R-2	14.28	85	60	66	153	2.29	
H-65	C-7	14.28	85	150	24	153	3.09	
H-66	R-3	13.14	86	60	63	117	2.29	
H-67	R-3	13.28	86	60	65	130	2.29	
H-68	R-3	13.79	85	60	60	110	2.29	

Table 3: Scenario 3 - Hydrant Requirements - Fire Flow + Max Day Demand

Note: Minimum system pressure under Fire Flow Conditions is a 22 PSI as per MMCD Guidelines. Any Failed Hydrants don't meet this requirement. The Fire Flow Flows are based on zone. The following criteria was used:

R-1, R-2, & R-3 minimum fire flow of 60 L/s
P-1 minimum fire flow of 60 L/s
R-4 & R-5 minimum fire flow of 90 L/s
C Zone and P-1* (Existing School and Public Works Building) minimum fire flow of 150 L/s

Label	Zone	Hydrant Elevation (m)	Static Pressure (psi)	Fire Flow (Required) (L/s)	Residual Pressure (psi)	Fire Flow (Available) (L/s) at 22psi Residual Pressure	Velocity of Pipe (m/s) at Fire Flow	Location of highest record velocity in the system	Upgrade Required - Pipe Velocity under 3.5m/s	Upgrade Pipe Length Required (m)
F1	CD-1, C-1	13.00	88	150	49	228	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F2	C-1, C-3	13.00	88	150	53	253	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F3	R-2	13.58	87	60	52	98	3.40			
F4	R-2	13.78	86	60	64	169	2.62			
F4	C-2	13.78	86	150	31	169	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F5	R-2	13.95	86	60	63	161	2.62			
F5	C-2	13.95	86	150	28	161	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F6	R-2	14.55	85	60	62	153	2.62			
F6	C-2	14.55	85	150	24	153	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F7	R-2	15.34	84	60	61	149	2.62			
F7	C-2	15.34	84	150	22	149	3.88	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F8	R-4	14.00	86	90	52	155	3.04			
F8	C-2	14.00	86	150	25	155	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F9	R-1	13.40	87	60	65	174	2.62			
F10	R-1	13.40	87	60	65	167	2.62			
F11	R-1	13.49	87	60	65	169	2.62			
F12	R-1	12.95	88	60	63	141	2.62			
F13	R-1	12.84	88	60	62	134	2.62			
F14	R-1	12.84	88	60	66	157	2.62			
F15	R-2	13.38	87	60	66	165	2.62			
F16	R-2	13.57	87	60	65	155	2.62			
F17	R-1	13.83	86	60	65	168	2.62			
F18	R-1	13.90	86	60	52	99	3.42			
F19	R-1	14.17	86	60	54	106	3.41			
F20	R-1	13.68	87	60	63	150	2.62			
F21	R-1	13.79	86	60	59	126	3.41			
F22	R-1	14.19	86	60	52	98	3.41			
F23	R-1	13.40	87	60	60	126	2.62			
F24	R-1	12.50	88	60	53	102	3.40			
F25	CD	12.50	88	150	25	156	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F26	CD	12.50	88	150	24	154	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F27	CD	12.50	88	150	24	153	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F28	CD	12.50	88	150	23	151	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F29	CD	12.50	88	150	22	150	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
F30	R-1	13.17	87	60	64	200	2.29			
F31	R-1	13.23	87	60	67	156	2.29			
H-1	C-1	13.02	86	150	51	242	3.95	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-2	C-1	13.15	86	150	48	224	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-3	C-1	13.22	86	150	49	230	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-4	P-1, C-1, C-2, C-3	13.36	86	150	54	261	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-5	C-2, C-3	13.47	86	150	41	196	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-6	C-2	12.76	87	150	33	172	4.77	J-50 to J-202 (200mm)	T-1 to J-4 (350mm) J-50 to J-202 (250mm)	199 & 66
H-7	R-2	13.09	86	60	66	184	2.62			
H-7	C-2	13.09	86	150	37	184	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-8	R-2	12.22	87	60	56	105	3.43			
H-9	R-2, R-3	12.67	87	60	66	172	2.62			
H-10	R-2	13.82	85	60	63	158	2.62			
H-11	R-2	13.75	85	60	64	159	2.62			
H-12	R-2	13.58	86	60	64	166	2.62			
H-12	R-4	13.58	86	90	55	166	3.04			
H-13	R-4	14.00	85	90	54	162	3.10			
H-14	R-1, R-2	13.17	86	60	66	185	2.62			
H-15	R-1	12.98	86	60	67	186	2.62			
H-16	R-1	13.07	86	60	62	135	2.62			
H-17	R-1	12.83	87	60	64	155	2.62			
H-18	R-1	12.96	86	60	60	126	2.62			
H-19	R-1	13.05	86	60	61	129	2.62			
H-20	R-1	13.11	86	60	66	183	2.62			
H-21	R-1	12.73	87	60	64	149	2.62			
H-22	R-1	12.75	87	60	61	128	2.62			
H-23	C-1, C-3	12.44	87	150	55	267	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-24	C-1	13.33	86	150	54	260	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-25	C-1	13.63	86	150	52	248	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199

Appendix C - Table 3: Future System - Full Developement Hydrant Requirements - Fire Flow + Max Day Demand

HARRISON HOT SPRINGS

Naturally Refreshed

H-26	R-1	13.34	86	60	71	251	2.62			
H-26	C-5	13.34	86	150	53	251	5.79	J-210 to J-40 (150mm)	T-1 to J-4 (350mm) J-210 to J-40 (250mm)	199 & 20
H-27	R-1	13.09	86	60	68	174	2.72			
H-27	P-1	13.09	86	150	34	174	6.61	J-210 to J-40 (150mm)	T-1 to J-4 (350mm) J-37 to J-40 (200mm) J-37 to J-36 (250mm)	199, 51, & 50
H-28	R-1	12.84	87	60	63	133	2.62			
H-29	R-1	12.81	87	60	63	131	2.62			
H-30	R-1	13.31	86	60	62	129	2.62			
H-31	R-1	13.11	86	60	67	162	2.62			
H-32	R-1	12.58	87	60	68	168	2.62			
H-32	P-1	12.58	87	150	32	168	5.57	J-212 to J-38 (150mm)	T-1 to J-4 (350mm) J-38 to J-39 (200mm) J-38 to J-212 (250mm)	199, 61, & 68
H-33	R-1	14.14	85	60	70	242	2.62			
H-33	P-1	14.14	85	150	52	242	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-34	P-1	12.92	87	150	48	220	3.89	J-37 to J-40 (150mm)	T-1 to J-4 (350mm) J-37 to J-40 (200mm) J-38 to J-39 (200mm)	199, 51, & 61
H-35	R-1	12.99	87	60	67	172	2.62			
H-36	R-1	13.24	86	60	69	212	2.62			
H-37	R-1	13.53	86	60	68	211	2.62			
H-38	R-1	12.84	87	60	68	189	2.62			
H-39	R-1	12.89	87	60	64	135	2.62			
H-40	R-1	12.81	87	60	65	142	2.62			
H-41	R-1	13.38	86	60	71	251	2.62			
H-42	R-1	12.89	87	60	71	235	2.62			
H-43	CD-2, P-1	13.40	86	150	63	300	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-44	R-2	14.66	84	60	69	235	2.62			
H-44	C-5	14.66	84	150	50	235	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-45	R-2	14.07	85	60	68	212	2.62			
H-45	C-5	14.07	85	150	45	212	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-46	RSR	13.57	86	60	68	201	2.62			
H-46	C-5	13.57	86	150	42	201	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-47	R-2	13.17	86	60	69	208	2.62			
H-48	RSR	13.68	86	60	66	181	3.40			
H-49	R-1, R-3	14.24	85	60	66	181	2.62			
H-49	C-5	14.24	85	150	36	181	5.93	J-21 to J-217 (150mm)	T-1 to J-4 (350mm) J-21 to J-217 (250mm)	199 & 12
H-50	R-1	13.28	86	60	67	182	3.40			
H-51	R-3	13.89	85	60	64	152	2.62			
H-52	R-1	13.56	86	60	66	179	3.40			
H-53	R-4	13.80	86	90	55	163	3.04			
H-54	R-4	14.43	85	90	57	178	3.04			
H-54	C-5	14.43	85	150	35	178	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-55	R-1	14.01	85	60	65	171	2.62			
H-55	C-5	14.01	85	150	32	171	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-56	R-1	14.53	84	60	63	165	2.62			
H-56	C-4, C-5	14.53	84	150	29	165	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-57	R-1, R-2	13.96	85	60	63	155	2.62			
H-58	R-1	14.24	85	60	62	153	2.62			
H-58	CS	14.24	85	150	24	153	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-59	R-1, R-2	14.85	84	60	61	148	2.62			
H-59	C-4	14.85	84	150	21	148	3.86	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-60	R-2	13.63	86	60	63	150	2.62			
H-60	C-4, C-7	13.63	86	150	22	150	3.89	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-61	R-1	13.87	85	60	59	125	2.62			
H-62	R-1	12.57	87	60	57	112	2.62			
H-63	R-1	13.57	86	60	62	142	2.62			
H-64	R-1	13.89	85	60	64	160	2.62			
H-65	R-2	14.28	85	60	62	146	2.62			
H-65	C-7	14.28	85	150	20	146	3.84	T-1 to J-4 (300mm)	T-1 to J-4 (350mm)	199
H-66	R-3	13.14	86	60	58	111	3.49			
H-67	R-3	13.28	86	60	61	123	3.49			
H-68	R-3	13.79	85	60	55	104	3.49			

Appendix D - Project Cost Estimates

2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project:	HOT SPRINGS ROAD "A"		
Location:	Hadway Road to South Miami		
	River Crossing	Priority:	
Date of Estimate:	December 15, 2014	Target Year:	

Project Name: **HOT SPRINGS ROAD "A"**

Location:

Project Description: Upgrade 375m of existing distribution main from 250mm to 350mm in order to provide required 150 L/s fire flow to commercial zoned properties along Hot Springs Road.

DCC Eligible: PARTIAL

Existing Zoning: C-4, C-7, CS, R-2

Project Limits/Address: Hadway Road to South Miami River Crossing
798 - 950 Hot Springs Road

Project Details:

Pipe Length:	375	m
Pipe Size:	350	mm
Tie-ins:	2	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Site Photograph:

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Cost Estimate Summary

Construction:	$	222,250.00
Contingency (Level C):	$	55,562.50
Engineering & CA	$	33,337.50
Specialists:	$	66,675.00
Subtotal:	**$**	**377,825.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**377,825.00**

Notes:

1. 2014 water model indicates inadequate Fire Flows (residual pressures) available for zoning
2. Dewatering & geotechnical specialists may be required
3. Suitable subgrade and imported bedding material assumed
4. Area currently serviced by private wells or VHS Utility
5. Ministry of Transportation permitting and Traffic Management Plan required for work on Hot Springs Road

Village of Harrison Hot Springs
Watermain Upgrade - Hot Springs Road - Part A
Requirements to address current (2014) system deficiency
Class 'C' Cost Estimate

December 15, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 25,000.00	$ 25,000.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 25,000.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 23 01		**Excavating, Trenching and Backfilling Underground Utility**				
2.1		1.10.4	**Removal and Disposal of Existing 250mm Watermain**	Lineal Meter	375	$ 80.00	$ 30,000.00
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.2		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	1125	$ 10.00	$ 11,250.00
Section 2 Sub-Total							**$ 41,250.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	750	$ 7.50	$ 5,625.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	1125	$ 45.00	$ 50,625.00
	32 17 23		**Painted Pavement Markings**				
3.3		1.5.2	**Permanent Painted Pavement Markings**	Lump Sum	1	$ 750.00	$ 750.00
Section 3 Sub-Total							**$ 57,000.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**350mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	375	$ 200.00	$ 75,000.00
4.2		1.8.3	**350mm Gate Valve**	Each	1	$ 2,500.00	$ 2,500.00
4.3		1.8.3	**Tee -** 350mm X 350mm X 150mm (includes Hydrant tie-in)	Each	2	$ 1,500.00	$ 3,000.00
4.4		1.8.4	**Water Service Re-Connections**	Each	14	$ 750.00	$ 10,500.00
4.5		1.8.13	**Watermain Tie-In -** Pipe work by Contractor	Each	2	$ 4,000.00	$ 8,000.00
Section 4 Sub-Total							**$ 99,000.00**
Sub-Total of Section 1 to 4							**$ 222,250.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 33,337.50
5.2			**Contingency**	C		25%	$ 55,562.50
5.3			**Provisonal for Dewatering Cost**			30%	$ 66,675.00
5.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 155,575.00**
Total (not including taxes)							**$ 377,825.00**

ASSUMPTIONS:

1. Proposed watermain replacement to be installed on Hot Springs Road from Hadway Drive, South to Miami River

2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project:	HOT SPRINGS ROAD "B"		
Location:	South Miami River Crossing		
	to Holiday Park Entrance	Priority:	
Date of Estimate:	December 16, 2014	Target Year:	

Project Name: **HOT SPRINGS ROAD "B"**

Location:

Project Description: Upgrade 125m of existing distribution main from 250mm to 350mm in order to provide required 150 L/s fire flow to commercial zoned properties along Hot Springs Road.

DCC Eligible: PARTIAL

Existing Zoning: C-4, C-7, R-2

Project Limits/Address: South Miami River Crossing to Holiday Park Entrance
950 - 962 Hot Springs Road

Project Details:

Pipe Length:	125	m
Pipe Size:	350	mm
Tie-ins:	2	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Site Photograph:

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Cost Estimate Summary

Construction:	$	125,250.00
Contingency (Level C):	$	31,312.50
Engineering & CA	$	18,787.50
Specialists:	$	50,100.00
Subtotal :	**$**	**225,450.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**225,450.00**

Notes:

1. Assumes directional drilling at Miami River
2. Future water model indicates inadequate Fire Flows (residual pressures) available for zoning
3. Dewatering, environmental & geotechnical specialists may be required
4. Suitable subgrade and imported bedding material assumed
5. Ministry of Transportation permitting and Traffic Management Plan required for work on Hot Springs Road

Village of Harrison Hot Springs
Watermain Upgrade - HOT SPRINGS ROAD "B"
Requirements to service full buildout/ development (future)
Class 'C' Cost Estimate

December 15, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 12,500.00	$ 12,500.00
1.2	**01 57 01**	1.6.1	**Environmental Protection** (River Crossing)	Lump Sum	1	$ 10,000.00	$ 10,000.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 22,500.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 23 01		**Excavating, Trenching and Backfilling Underground Utility**				
2.1		1.10.4	**Removal and Disposal of Existing 250mm Watermain**	Lineal Meter	75	$ 80.00	$ 6,000.00
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.2		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	300	$ 10.00	$ 3,000.00
Section 2 Sub-Total							**$ 9,000.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	200	$ 7.50	$ 1,500.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	300	$ 45.00	$ 13,500.00
	32 17 23		**Painted Pavement Markings**				
3.3		1.5.2	**Permanent Painted Pavement Markings**	Lump Sum	1	$ 250.00	$ 250.00
Section 3 Sub-Total							**$ 15,250.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**350mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	75	$ 200.00	$ 15,000.00
4.2		1.8.1, 1.8.2	**350mm HDPE Watermain -** Maimi River Crossing (including all bends and fittings)	Lineal Meters	50	$ 1,000.00	$ 50,000.00
4.3		1.8.3	**350mm Gate Valve**	Each	1	$ 2,500.00	$ 2,500.00
4.4		1.8.3	**Tee -** 350mm X 350mm X 150mm (includes Hydrant tie-in)	Each	1	$ 1,500.00	$ 1,500.00
4.5		1.8.4	**Water Service Re-Connections**	Each	2	$ 750.00	$ 1,500.00
4.6		1.8.13	**Watermain Tie-In -** Pipe work by Contractor	Each	2	$ 4,000.00	$ 8,000.00
Section 4 Sub-Total							**$ 78,500.00**
Sub-Total of Section 1 to 4							**$ 125,250.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 18,787.50
5.2			**Contingency**	C		25%	$ 31,312.50
5.3			**Environmental Management Plan, Monitoring and Permitting**			10%	$ 12,525.00
5.4			**Provisonal for Dewatering Cost**			30%	$ 37,575.00
5.5			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 100,200.00**
Total (not including taxes)							**$ 225,450.00**

ASSUMPTIONS:

1 Proposed watermain replacement to be installed on Hot Springs Road from Miami River to Harrison Holiday Park entrance

2014 Water Projects Cost Estimate

Project:	VILLAGE CENTRE LOOP
Location:	Lilloet Ave., St. Alice Street, & Cedar Ave.
Priority:	
Date of Estimate:	December 15, 2014
Target Year:	

Project Name: **VILLAGE CENTRE LOOP**

Location:

Project Description: Construct 250m of 250mm watermain to service and provide adequate fire protection to Lillooet Avenue, Cedar and St. Alice and loop the system

DCC Eligible: PARTIAL (Development Dependent)

Existing Zoning: C-1, C-2, C-3

Project Limits/Address: Lilloet Ave., St. Alice Street, & Cedar Ave
114 -160 Cedar Ave.
140 Lillooet Ave.

Project Details:

Pipe Length:	250	m
Pipe Size:	250	mm
Tie-ins:	2	each
Fire Hydrants:	2	each
Water Services:	10	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Site Photograph:

Cost Estimate Summary

Construction:	$	99,200.00
Contingency (Level C):	$	24,800.00
Engineering & CA	$	14,880.00
Specialists:	$	34,720.00
Subtotal A:	**$**	**173,600.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**173,600.00**

Notes:

1. Hydrant work to be completed as soon as possible to provide adequate fire protection
2. Dewatering and geotechnical specialists may be required
3. Suitable subgrade and imported bedding material assumed
4. Area currently serviced by private wells

Village of Harrison Hot Springs
Village Center Loop
Requirements to service all properties (future)
Class 'C' Cost Estimate

December 15, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 1,000.00	$ 1,000.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 1,000.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.1		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	750	$ 10.00	$ 7,500.00
Section 2 Sub-Total							**$ 7,500.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	500	$ 7.50	$ 3,750.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	750	$ 35.00	$ 26,250.00
Section 3 Sub-Total							**$ 30,000.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**250mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	250	$ 150.00	$ 37,500.00
4.2		1.8.3	**250mm Gate Valve**	Each	2	$ 1,800.00	$ 3,600.00
4.3			**Hydrant Assembly -** Standard Drawing W4	Each	1	$ 5,600.00	$ 5,600.00
4.4		1.8.4	**Water Services**	Each	10	$ 1,100.00	$ 11,000.00
4.5		1.8.13	**Watermain Tie-In -** Pipe work by Contractor	Each	2	$ 1,500.00	$ 3,000.00
Section 4 Sub-Total							**$ 60,700.00**
Sub-Total of Section 1 to 4							**$ 99,200.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 14,880.00
5.2			**Contingency**	C		25%	$ 24,800.00
5.3			**Provisonal for Dewatering Cost**			35%	$ 34,720.00
5.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 74,400.00**
Total (not including taxes)							**$ 173,600.00**

ASSUMPTIONS:

1. Proposed watermain to be installed on the following streets: Lillooet Avenue (West), ST. Alice Street, and Cedar Ave.

2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project:	LAKESHORE RESIDENTIAL
Location:	Lillooet Ave. & Bear Ave.
	Priority:
Date of Estimate:	December 15, 2014 — Target Year:

Project Name: **LAKESHORE RESIDENTIAL**

Location:

Project Description: Construct 705m of 150/200mm watermain to service and provide adequate fire protection to Lillooet Avenue and Bear Avenue

DCC Eligible: PARTIAL (Development Dependent)

Existing Zoning: C-2, R-1, R-4

Project Limits/Address: 440 - 574 Lillooet Ave
339 - 430 Bear Ave

Project Details:

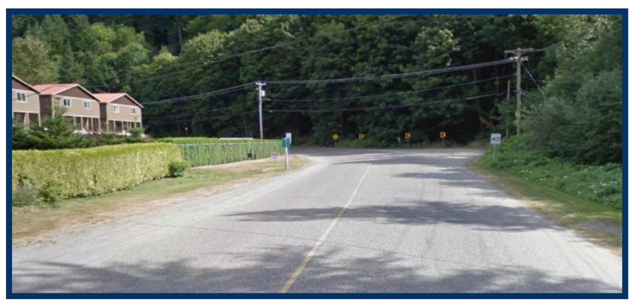
Pipe Length:	115/590	m
Pipe Size:	150/200	mm
Tie-ins:	0	each
Fire Hydrants:	27	each
Water Services:	0	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Site Photograph:



Cost Estimate Summary

Construction:	$	266,650.00
Contingency (Level C):	$	66,662.50
Engineering & CA	$	39,997.50
Specialists:	$	53,330.00
Subtotal:	**$**	**426,640.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**426,640.00**

Notes:

1. Hydrant work to be completed as soon as possible to provide adequate fire protection
2. Dewatering and geotechnical specialists may be required
3. Suitable subgrade and imported bedding material assumed
4. Area currently serviced by private wells
5. Ministry of Transportation permitting required for work on Lillooet

Village of Harrison Hot Springs
Lakeshore Residential
Requirements to service all properties (future)
Class 'C' Cost Estimate

December 15, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 1,000.00	$ 1,000.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 1,000.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.1		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	2115	$ 10.00	$ 21,150.00
Section 2 Sub-Total							**$ 21,150.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	1410	$ 7.50	$ 10,575.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	2115	$ 35.00	$ 74,025.00
Section 3 Sub-Total							**$ 84,600.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**200mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	590	$ 125.00	$ 73,750.00
4.2		1.8.1, 1.8.2	**150mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	115	$ 100.00	$ 11,500.00
4.3		1.8.3	**200mm Gate Valve**	Each	3	$ 1,300.00	$ 3,900.00
4.4		1.8.3	**150mm Gate Valve**	Each	1	$ 1,200.00	$ 1,200.00
4.5		1.8.3	**Tee - 20**0mm X 200mm X 150mm	Each	1	$ 800.00	$ 800.00
4.6		1.8.3	**Tee - 20**0mm X 200mm X 200mm	Each	1	$ 950.00	$ 950.00
4.7		1.8.3	**Blind Flange** 200mm diameter	Each	1	$ 500.00	$ 500.00
4.8			**Hydrant Assembly -** Standard Drawing W4	Each	6	$ 5,600.00	$ 33,600.00
4.9		1.8.5	**Blow-Off Assembly -** Standard Drawing W8	Each	1	$ 1,000.00	$ 1,000.00
4.10		1.8.4	**Water Services**	Each	27	$ 1,100.00	$ 29,700.00
4.11		1.8.13	**Watermain Tie-In -** Pipe work by Contractor	Each	2	$ 1,500.00	$ 3,000.00
Section 4 Sub-Total							**$ 159,900.00**
Sub-Total of Section 1 to 4							**$ 266,650.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 39,997.50
5.2			**Contingency**	C		25%	$ 66,662.50
5.3			**Provisonal for Dewatering Cost**			20%	$ 53,330.00
5.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 159,990.00**
Total (not including taxes)							**$ 426,640.00**

ASSUMPTIONS:
1 Proposed watermain to be installed on the following streets: Lillooet Avenue (East), Bear Avenue, & Mount Street

2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project:	NAISMITH AND MOUNT	
Location:	Naismith Ave & Mount Street	
		Priority:
Date of Estimate:	December 15, 2014	Target Year:

Project Name: **NAISMITH AND MOUNT**

Location:

Project Description: Construct 595m of 200mm watermain to service and provide adequate fire protection to Naismith Avenue and Mount Street and loop the system

DCC Eligible: NO

Existing Zoning: R-1

Project Limits/Address: 505 -565 Naismith Ave

Project Details:

Pipe Length:	595	m
Pipe Size:	200	mm
Tie-ins:	3	each
Fire Hydrants:	3	each
Water Services:	25	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Site Photograph:

Cost Estimate Summary		
Construction:	$	213,525.00
Contingency (Level C):	$	53,381.25
Engineering & CA	$	32,028.75
Specialists:	$	42,705.00
Subtotal:	**$**	**341,640.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**341,640.00**

Notes:

1. Hydrant work to be completed as soon as possible to provide adequate fire protection
2. Dewatering and geotechnical specialists may be required
3. Suitable subgrade and imported bedding material assumed
4. Area currently serviced by private wells

Village of Harrison Hot Springs
Naismith and Mount
Requirements to service all properties (future)
Class 'C' Cost Estimate

December 15, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 500.00	$ 500.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 500.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.1		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	1785	$ 10.00	$ 17,850.00
Section 2 Sub-Total							**$ 17,850.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	1190	$ 7.50	$ 8,925.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	1785	$ 35.00	$ 62,475.00
Section 3 Sub-Total							**$ 71,400.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**200mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	595	$ 125.00	$ 74,375.00
4.2		1.8.3	**200mm Gate Valve**	Each	3	$ 1,300.00	$ 3,900.00
4.3		1.8.3	**Tee -** 200mm X 200mm X 200mm	Each	1	$ 950.00	$ 950.00
4.4			**Hydrant Assembly -** Standard Drawing W4	Each	3	$ 5,600.00	$ 16,800.00
4.5		1.8.4	**25mm Water Service Connections**	Each	25	$ 850.00	$ 21,250.00
4.6		1.8.11	**200mm Hot Tapping c/w valve**	Each	1	$ 3,500.00	$ 3,500.00
4.7		1.8.13	**Watermain Tie-In -** Pipe work by Contractor	Each	2	$ 1,500.00	$ 3,000.00
Section 4 Sub-Total							**$ 123,775.00**
Sub-Total of Section 1 to 4							**$ 213,525.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 32,028.75
5.2			**Contingency**	C		25%	$ 53,381.25
5.3			**Provisonal for Dewatering Cost**			20%	$ 42,705.00
5.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 128,115.00**
Total (not including taxes)							**$ 341,640.00**

ASSUMPTIONS:

1. Proposed watermain to be installed on the following streets: Naismith Avenue & Mount Street

2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project: DIAMOND AND EMERALD
Location: Emerald Ave & Diamond Street
Priority:
Date of Estimate: December 15, 2014
Target Year:

Project Name:

DIAMOND AND EMERALD

Project Description: Construct 350m of 100/150 mm watermain to service and provide adequate fire protection to Emerald Ave and Diamond Street and loop the system

DCC Eligible: NO

Existing Zoning: R-1

Project Limits/Address: 400 - 470 Emerald Ave
750 -795 Diamond Street

Project Details:

Pipe Length:	295/55	m
Pipe Size:	150/100	mm
Tie-ins:	2	each
Fire Hydrants:	1	each
Water Services:	23	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Location:

Site Photograph:

Cost Estimate Summary

Construction:	$	129,300.00
Contingency (Level C):	$	32,325.00
Engineering & CA	$	19,395.00
Specialists:	$	25,860.00
Subtotal:	**$**	**206,880.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**206,880.00**

Notes:

1. Hydrant work to be completed as soon as possible to provide adequate fire protection
2. Dewatering and geotechnical specialists may be required
3. Suitable subgrade and imported bedding material assumed
4. Area currently serviced by private wells

Village of Harrison Hot Springs
Emerald and Diamond
Requirements to service all properties (future)
Class 'C' Cost Estimate

December 15, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 500.00	$ 500.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 500.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.1		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	1050	$ 10.00	$ 10,500.00
Section 2 Sub-Total							**$ 10,500.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	700	$ 7.50	$ 5,250.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	1050	$ 35.00	$ 36,750.00
Section 3 Sub-Total							**$ 42,000.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**150mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	295	$ 100.00	$ 29,500.00
4.2		1.8.1, 1.8.2	**100mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	55	$ 90.00	$ 4,950.00
4.3		1.8.3	**150mm Gate Valve**	Each	2	$ 1,000.00	$ 2,000.00
4.4		1.8.3	**100mm Gate Valve**	Each	1	$ 850.00	$ 850.00
4.5		1.8.3	**Tee - 15**0mm X 150mm X 100mm	Each	1	$ 600.00	$ 600.00
4.6			**Hydrant Assembly -** Standard Drawing W4	Each	1	$ 5,600.00	$ 5,600.00
4.7		1.8.3	**Reducer** - 150mm x 100mm diameter	Each	1	$ 500.00	$ 500.00
4.8		1.8.5	**Blow-Off Assembly -** Standard Drawing W8	Each	1	$ 1,000.00	$ 1,000.00
4.9		1.8.4	**Water Services**	Each	23	$ 1,100.00	$ 25,300.00
4.10		1.8.11	**150mm Hot Tapping c/w valve**	Each	2	$ 3,000.00	$ 6,000.00
Section 4 Sub-Total							**$ 76,300.00**
Sub-Total of Section 1 to 4							**$ 129,300.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 19,395.00
5.2			**Contingency**	C		25%	$ 32,325.00
5.3			**Provisonal for Dewatering Cost**			20%	$ 25,860.00
5.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 77,580.00**
Total (not including taxes)							**$ 206,880.00**

ASSUMPTIONS:

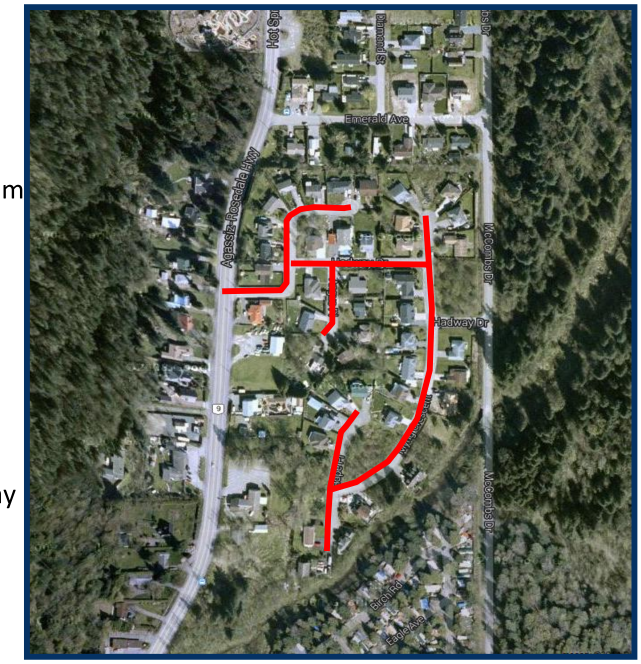
1. Proposed watermain to be installed on the following streets: Emerald Avenue & Diamond Street

2014 Water Projects Cost Estimate

Project:	ANGUS ESTATES
Location:	Angus Estates
	Priority:
Date of Estimate:	December 16, 2014
	Target Year:

Project Name: **ANGUS ESTATES**

Location:



Project Description: Construct 875m of 100/150/200 mm watermain to service and provide adequate fire protection to the Angus Estates subdivision and loop the system

DCC Eligible: NO

Existing Zoning: R-1

Project Limits/Address: Angus Estates - Ramona Place, Hadway Drive, Angus Place, Myng Cres., Hope Place

Project Details:

Pipe Length:	140/205/530	m
Pipe Size:	100/150/200	mm
Tie-ins:	2	each
Fire Hydrants:	6	each
Water Services:	56	each

Land Acquisiton Req'd: None

Total Land Cost: $0.00

Site Photograph:

Design Consultants: N/A

Drawing Number: N/A

Related Road Projects: TBD

Related Sanitary Sewer Projects: TBD

Related Drainage Projects: TBD

Cost Estimate Summary

Construction:	$	347,250.00
Contingency (Level C):	$	86,812.50
Engineering & CA	$	52,087.50
Specialists:	$	69,450.00
Subtotal:	**$**	**555,600.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**555,600.00**

Notes:

1. Hydrant work to be completed as soon as possible to provide adequate fire protection
2. Dewatering and geotechnical specialists may be required
3. Ministry of Transportation permitting required for tie in on Hot Springs Road
4. Suitable subgrade and imported bedding material assumed
5. Area currently serviced by private wells

Village of Harrison Hot Springs
ANGUS ESTATES
Requirements to service all properties (future)
Class 'C' Cost Estimate

December 16, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 2,500.00	$ 2,500.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 2,500.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.1		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	2700	$ 10.00	$ 27,000.00
Section 2 Sub-Total							**$ 27,000.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	1800	$ 7.50	$ 13,500.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	2700	$ 35.00	$ 94,500.00
Section 3 Sub-Total							**$ 108,000.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**200mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	530	$ 100.00	$ 53,000.00
4.2		1.8.1, 1.8.2	**150mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	205	$ 100.00	$ 20,500.00
4.3		1.8.1, 1.8.2	**100mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	140	$ 90.00	$ 12,600.00
4.4		1.8.3	**200mm Gate Valve**	Each	5	$ 1,300.00	$ 6,500.00
4.5		1.8.3	**150mm Gate Valve**	Each	2	$ 1,000.00	$ 2,000.00
4.6		1.8.3	**100mm Gate Valve**	Each	3	$ 850.00	$ 2,550.00
4.7		1.8.3	**Tee - 20**0mm X 200mm X 200mm	Each	3	$ 950.00	$ 2,850.00
4.8		1.8.3	**Tee - 20**0mm X 200mm X 150mm	Each	1	$ 800.00	$ 800.00
4.9		1.8.3	**Tee - 15**0mm X 150mm X 200mm	Each	1	$ 775.00	$ 775.00
4.10			**Hydrant Assembly -** Standard Drawing W4	Each	6	$ 5,600.00	$ 33,600.00
4.11		1.8.3	**Reducer** - 200mm x 150mm diameter	Each	1	$ 750.00	$ 750.00
4.12		1.8.3	**Reducer** - 200mm x 100mm diameter	Each	1	$ 725.00	$ 725.00
4.13		1.8.3	**Reducer** - 150mm x 100mm diameter	Each	3	$ 500.00	$ 1,500.00
4.14		1.8.5	**Blow-Off Assembly -** Standard Drawing W8	Each	5	$ 1,000.00	$ 5,000.00
4.15		1.8.4	**Water Services**	Each	56	$ 1,100.00	$ 61,600.00
4.16		1.8.13	**Watermain Tie-In -** Pipe work by Contractor	Each	1	$ 1,500.00	$ 1,500.00
4.17		1.8.11	**200mm Hot Tapping c/w valve**	Each	1	$ 3,500.00	$ 3,500.00
Section 4 Sub-Total							**$ 209,750.00**
Sub-Total of Section 1 to 4							**$ 347,250.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 52,087.50
5.2			**Contingency**	C		25%	$ 86,812.50
5.3			**Provisonal for Dewatering Cost**			20%	$ 69,450.00
5.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 208,350.00**
Total (not including taxes)							**$ 555,600.00**

ASSUMPTIONS:

1. Proposed watermain to be installed on the following streets: Hope Place, Ramon Place, Hadway Crive, Angus Place, & Myng Crescent

HARRISON HOT SPRINGS
Naturally Refreshed

2014 Water Projects Cost Estimate

Project:	PINE AND LAKBERG
Location:	Pine Ave & Lakberg Crescent
	Priority:
Date of Estimate:	December 16, 2014 — Target Year:

Project Name: **PINE AND LAKBERG**

Location:

Project Description: Construct 340m of 150mm watermain on Pine and 60m of 100mm watermain on Lakberg to service and provide adequate fire protection for existing development

DCC Eligible: NO

Existing Zoning: R-2

Project Limits/Address: Pine Ave & Lakberg Crescent
389 - 480 Pine Ave
601 - 608 Lakberg Crescent

Project Details:

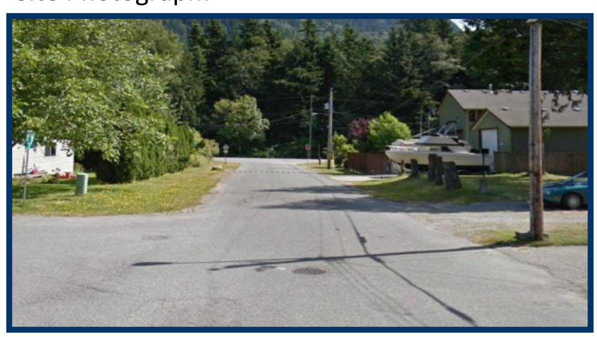
Pipe Length:	340/60	m
Pipe Size:	150/100	mm
Tie-ins:	2	each
Fire Hydrants:	2	each
Water Services:	23	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects:	TBD
Related Sanitary Sewer Projects:	TBD
Related Drainage Projects:	TBD

Site Photograph:



Cost Estimate Summary

Construction:	$	143,850.00
Contingency (Level C):	$	35,962.50
Engineering & CA	$	21,577.50
Specialists:	$	28,770.00
Subtotal:	**$**	**230,160.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**230,160.00**

Notes:

1. Hydrant work to be completed as soon as possible to provide adequate fire protection
2. Dewatering and geotechnical specialists may be required
3. Ministry of Transportation permitting required for tie in on Hot Springs Road
4. Suitable subgrade and imported bedding material assumed
5 Area currently serviced by private wells

Village of Harrison Hot Springs
PINE AND LAKBERG
Requirements to service all properties (future)
Class 'C' Cost Estimate

CTQ

December 16, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 500.00	$ 500.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 500.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.1		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	1200	$ 10.00	$ 12,000.00
Section 2 Sub-Total							**$ 12,000.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	800	$ 7.50	$ 6,000.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	1200	$ 35.00	$ 42,000.00
Section 3 Sub-Total							**$ 48,000.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**150mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	340	$ 100.00	$ 34,000.00
4.2		1.8.1, 1.8.2	**100mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	60	$ 90.00	$ 5,400.00
4.3		1.8.3	**150mm Gate Valve**	Each	2	$ 1,000.00	$ 2,000.00
4.4		1.8.3	**100mm Gate Valve**	Each	1	$ 850.00	$ 850.00
4.5		1.8.3	**Tee - 15**0mm X 150mm X 100mm	Each	1	$ 600.00	$ 600.00
4.6			**Hydrant Assembly -** Standard Drawing W4	Each	2	$ 5,600.00	$ 11,200.00
4.7		1.8.5	**Blow-Off Assembly -** Standard Drawing W8	Each	1	$ 1,000.00	$ 1,000.00
4.8		1.8.4	**Water Services**	Each	23	$ 1,100.00	$ 25,300.00
4.9		1.8.13	**Watermain Tie-In -** Pipe work by Contractor	Each	2	$ 1,500.00	$ 3,000.00
Section 4 Sub-Total							**$ 83,350.00**
Sub-Total of Section 1 to 4							**$ 143,850.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 21,577.50
5.2			**Contingency**	C		25%	$ 35,962.50
5.3			**Provisonal for Dewatering Cost**			20%	$ 28,770.00
5.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 86,310.00**
Total (not including taxes)							**$ 230,160.00**

ASSUMPTIONS:

1 Proposed watermain to be installed on the following streets: Pine Avenue & Lakberg Crescent

2014 Water Projects Cost Estimate

Project:	MARINE TOURISM 'A'
Location:	Rockwell Drive
Priority:	
Date of Estimate:	December 16, 2014
Target Year:	

Project Name: **MARINE TOURISM 'A'**

Location:

Project Description: Construct 610m of 350mm watermain on Rockwell Drive to service future development

DCC Eligible: YES

Existing Zoning: C-6, RR, P-1

Project Limits/Address: Rockwell Drive

Project Details:

Pipe Length:	610	m
Pipe Size:	350	mm
Tie-ins:	1	each
Fire Hydrants:	5	each
Water Services:	7	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Site Photograph:

Cost Estimate Summary

Construction:	$	310,900.00
Contingency (Level C):	$	77,725.00
Engineering & CA	$	46,635.00
Specialists:	$	77,725.00
Subtotal:	**$**	**512,985.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**512,985.00**

Notes:

1. Dewatering and traffic control will be required for the duration of construction
2. Ministry of Transportation permitting required for access to and construction on Rockwell Drive
3. Suitable subgrade and imported bedding material assumed

Village of Harrison Hot Springs
MARINE TOURISM 'A'
Requirements to service full buildout/development (future)
Class 'C' Cost Estimate

December 16, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 General MMCD Contract Requirements							
	01 33 01	1.8.1	**Project Record Documents**	Note		Incidental	
1.1	**01 55 00**	1.5.1	**Traffic Control, Vehicle Access and Parking**	Lump Sum	1	$ 25,000.00	$ 25,000.00
	01 58 01	1.3.1	**Project Identification**	Note		Incidental	
Section 1 Sub-Total							**$ 25,000.00**
2.0 Earthworks and Site Preparation (MMCD Section 31)							
	31 24 13		**Roadway Excavation, Embankment and Compaction**				
2.1		1.8.4	**Remove Existing Asphalt, Curbs and Gutters, Sidewalks, Utility Strips, Driveways**	Square Meter	1830	$ 10.00	$ 18,300.00
Section 2 Sub-Total							**$ 18,300.00**
3.0 Roads and Site Improvement (MMCD Section 32)							
	32 12 16		**Hot-Mix Asphalt Concrete Paving**				
3.1		1.5.7	**Saw Cut Asphalt**	Lineal Meters	1220	$ 7.50	$ 9,150.00
3.2		1.5.8	**Permanent Pavement Restoration (including all base gravels and subgrade prep.)**	Square Meters	1830	$ 45.00	$ 82,350.00
	32 17 23		**Painted Pavement Markings**				
3.3		1.5.2	**Permanent Painted Pavement Markings**	Lump Sum	1	$ 1,000.00	$ 1,000.00
Section 3 Sub-Total							**$ 92,500.00**
4.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
4.1		1.8.1, 1.8.2	**350mm DR18 PVC Watermain** - Native Backfill	Lineal Meters	610	$ 200.00	$ 122,000.00
4.2		1.8.3	**350mm Gate Valve**	Each	3	$ 2,500.00	$ 7,500.00
4.3		1.8.3	**Reducer** - 200mm x 350mm diameter	Each	1	$ 1,500.00	$ 1,500.00
4.4			**Hydrant Assembly** - Standard Drawing W4	Each	5	$ 5,600.00	$ 28,000.00
4.5		1.8.5	**Blow-Off Assembly -** Standard Drawing W8	Each	1	$ 1,000.00	$ 1,000.00
4.6		1.8.4	**Water Services**	Each	7	$ 2,000.00	$ 14,000.00
4.7		1.8.13	**Watermain Tie-In -** Pipe work by Contractor	Each	1	$ 1,100.00	$ 1,100.00
Section 4 Sub-Total							**$ 175,100.00**
Sub-Total of Section 1 to 4							**$ 310,900.00**
5.0 Soft Costs							
			Soft Costs				
5.1			**Engineering & CA**			15%	$ 46,635.00
5.2			**Contingency**	C		25%	$ 77,725.00
5.3			**Provisonal for Dewatering Cost**			25%	$ 77,725.00
5.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 5 Sub-Total							**$ 202,085.00**
Total (not including taxes)							**$ 512,985.00**

ASSUMPTIONS:

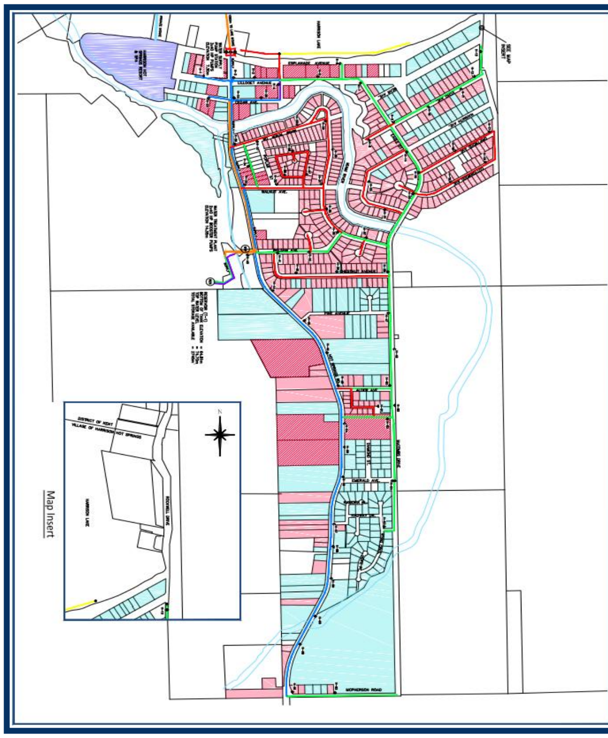
1 Proposed watermain to be installed on Rockwell Drive

2014 Water Projects Cost Estimate

Project:	WATER SERVICES AND HYDRANTS
Location:	Throughout Village
	Priority:
Date of Estimate:	December 16, 2014
	Target Year:

Project Name: **WATER SERVICES AND HYDRANTS**

Location:



Project Description: To provide water service to all properties that currently have a watermain frontage but are unserviced and/or on private well system, and to install hydrants F12, F13, F14, F17, F30 and F31 order to provide adequate fire protection to all fronted properties

DCC Eligible: NO

Existing Zoning: Varies

Project Limits/Address: Throughout Village

Project Details:

Fire Hydrants:	6	each
Water Services:	57	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Cost Estimate Summary

Construction:	$	241,500.00
Contingency (Level C):	$	60,375.00
Engineering & CA	$	36,225.00
Specialists:	$	24,150.00
Subtotal:	**$**	**362,250.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**362,250.00**

Notes:

1. Hydrant work to be completed as soon as possible to provide adequate fire protection
2. Dewatering and geotechnical specialists may be required
3. Ministry of Transportation permitting required for work on Hot Springs Road
4. Suitable subgrade and imported bedding material assumed

Village of Harrison Hot Springs
WATER SERVICES AND HYDRANTS
Class 'C' Cost Estimate

December 16, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
1.1			**Hydrant Assembly -** Standard Drawing W4	Each	6	$ 7,000.00	$ 42,000.00
1.2		1.8.4	**Water Services**	Each	57	$ 3,500.00	$ 199,500.00
Section 1 Sub-Total							**$ 241,500.00**
Sub-Total of Section 1							**$ 241,500.00**
2.0 Soft Costs							
			Soft Costs				
2.1			**Engineering & CA**			15%	$ 36,225.00
2.2			**Contingency**	C		25%	$ 60,375.00
2.3			**Provisonal for Dewatering Cost**			10%	$ 24,150.00
2.4			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 2 Sub-Total							**$ 120,750.00**
Total (not including taxes)							**$ 362,250.00**

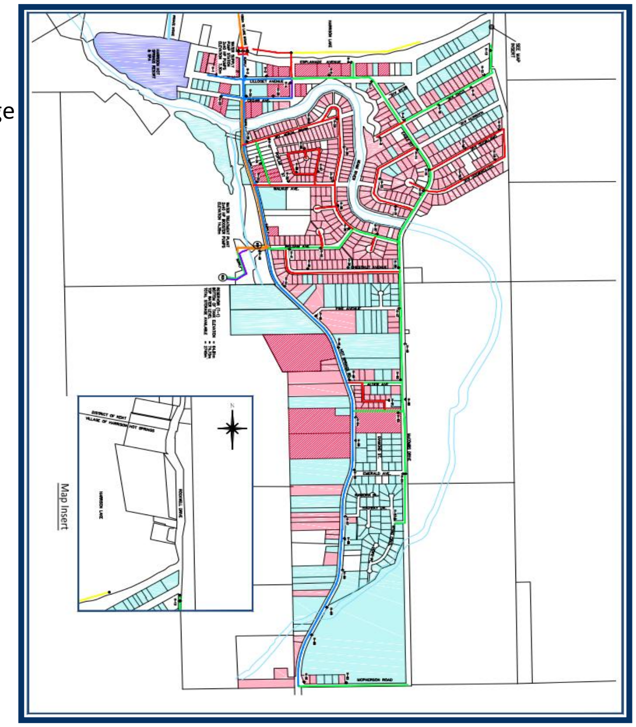
2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project: UNIVERSAL METERING
Location: Throughout Village
Priority:
Date of Estimate: December 16, 2014
Target Year:

Project Name: **UNIVERSAL METERING**

Location:



Project Description: To provide universal meters to all properties that are currently on the Village of Harrison Hot Springs water system.

DCC Eligible: NO

Existing Zoning: Varies

Project Limits/Address: Throughout Village

Project Details:

Universal Meters: 443 each

Land Acquisition Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Cost Estimate Summary

Construction:	$	461,815.00
Contingency (Level C):	$	115,453.75
Engineering & CA	$	69,272.25
Specialists:	$	49,181.50
Subtotal:	**$**	**695,722.50**
Land Acquisition:	$	-
Total Project Cost:	**$**	**695,722.50**

Notes:

1. Universal Meters to be completed as soon as possible to provide adequate metered readings.
2. Dewatering and geotechnical specialists may be required

Village of Harrison Hot Springs
UNIVERSAL METERING
Class 'C' Cost Estimate

CTQ

December 16, 2014

Item	MMCD Section	Payment Item	Specification Title - Item Description	Unit	Quantity	Unit Price	Amount
1.0 Utilities (MMCD Section 33)							
	33 11 01		**Waterworks**				
1.1			Supply and Install 3/4" T-10 E-Coder) R900i meter in Plastic Pit (includes fittings, pit, R900 RF Transmitter, Antenna) onto Existing 3/4" or 1" line	Each	379	$ 895.00	$ 339,205.00
1.2			Pit Provisional Allocation (Concrete H20 static pit, deep excavation, asphalt or concrete cut & restore, sod, etc)	Lump Sum	1	$ 55,000.00	$ 55,000.00
1.3			Intermediate Meter Cut-In (Condominium). Unknown Size & Location.	Each	1	$ 4,500.00	$ 4,500.00
1.4			Change Out 3/4" T-10 E-Coder) R900i meter c/w pit antenna in existing meter pit - Average Cost	Each	21	$ 395.00	$ 8,295.00
1.5			Change Out Intermediate Meter 1" thru 2" (Inside or Pit) - Average Cost	Each	15	$ 875.00	$ 13,125.00
1.6			Retrofit Existing Meters to Radio (pit or inside) Allocation - Average Cost	Each	38	$ 255.00	$ 9,690.00
1.7			Public Education/Communication	Lump Sum	1	$ 5,000.00	$ 5,000.00
1.8			CE Handheld Reading Device (HandHeld Unit, Software, and On Site Training & Implementation)	Each	1	$ 12,000.00	$ 12,000.00
1.9			Option: MRX Drive By Unit in addition to above for increased reading efficiency. Unit Operates with Village's Supplied Laptop.	Each	1	$ 15,000.00	$ 15,000.00
Section 1 Sub-Total							**$ 461,815.00**
Sub-Total of Section 1							**$ 461,815.00**
2.0 Soft Costs							
			Soft Costs				
2.1			**Engineering & CA**			15%	$ 69,272.25
2.2			**Contingency**	C		25%	$ 115,453.75
2.3			**Laptop & Software Upgrade**	Lump Sum	1	$ 3,000.00	$ 3,000.00
2.4			**Provisonal for Dewatering Cost**			10%	$ 46,181.50
2.5			**Land Acquisition**	Square Meters	0	$ -	$ -
Section 2 Sub-Total							**$ 233,907.50**
Total (not including taxes)							**$ 695,722.50**

ASSUMPTIONS:

1. Pricing is for budgetary purposes only. When more information, scope of work and other project details are available, this budgetary quotation can be refined.
2. The preferred location is a pit immediately downstream of the existing curb stop.
3. All meters to be radio technology through either retrofitting or new meter installations. Neptune E-Coder R900i meter provides leak, no flow/tamper, backflow detection, and 96
4. "Contingency" is to allow for funding for project "unknowns" (e.g. Extraordinary plumbing, larger meters required, misapplied meters requiring full change-out, re-plumbing, higher
5. Project is to be run as a continuous project (i.e. no stop and re-start at a later date).
6. Curb-stops are visible and or accessible via location measurements.
7. Existing meter pit lids have a 45mm diameter hole to accommodate an antenna.
8. Public Education/Communication comprises of an open house, booklets, web site, etc
9. For reading system, Harrison Hot Springs is responsible for costs associated to the "transfer file" that is provided by their Utility Billing Software provider, MAIS. Please contact
10. An option to add an MRX drive-by unit has been provided (item 9). This reading unit would provide further reading efficiencies. This unit works with a lap-top computer supplied
11. For phases II & III (properties not currently on village water system), it is assumed water meters will be added by a contractor at the same time as new service connections or
12. Pricing is for properties currently serviced by Water Utility. It is assumed that properties not serviced will be metered as they are connected

2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project: TEE REPLACEMENT
Location: Cedar Ave & Hot Springs Road
Priority:
Date of Estimate: December 16, 2014
Target Year:

Project Name: **TEE REPLACEMENT**

Location:

Project Description: Damage to the existing tee causing a flow restriction has been noted. The restriction limits available fire flows in the Village Center area.

DCC Eligible: NO

Existing Zoning: C-1

Project Limits/Address: Cedar Ave & Hot Springs Road

Details:

Replace Existing Tee	1	each

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: TBD
Related Sanitary Sewer Projects: TBD
Related Drainage Projects: TBD

Site Photograph:

Cost Estimate Summary

Construction:	$	17,500.00
Contingency (Level C):	$	4,375.00
Engineering & CA	$	2,625.00
Specialists:	$	1,750.00
Subtotal:	**$**	**26,250.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**26,250.00**

Notes:

1. Dewatering and traffic control will be required for the duration of construction
2. Ministry of Transportation permitting required for access to and construction on Hot Springs Road

2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project: WATER TREATMENT CAPACITY INCREASE
Location: Water Treatment Plant
Priority:
Date of Estimate: December 16, 2014
Target Year:

Project Name: **WATER TREATMENT CAPACITY INCREASE**

Location:

Project Description:

Increase flow and treatment capacity for the VHS system when Max Day Demand exceeds 31.5 L/sec

DCC Eligible:

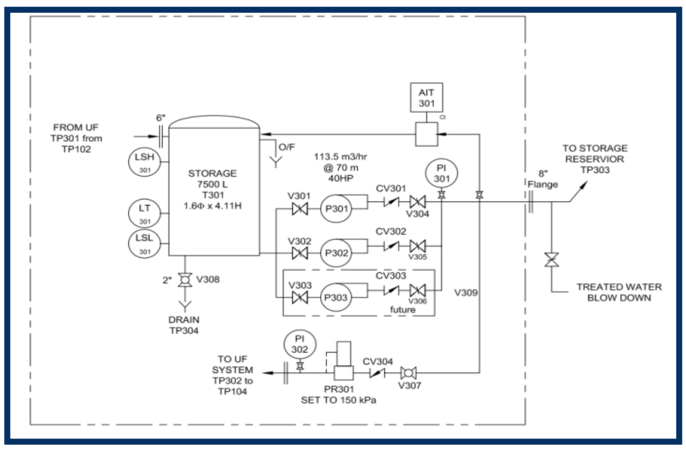
Existing Zoning: N/A

Project Limits/Address: Water Treatment Plant

Details:

Membranes (11 pairs, $10,000 ea) $ 110,000.00
Addition of pump and VFD (supply and install) $ 50,000.00

Site Photograph:



Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: None
Related Sanitary Sewer Projects: None
Related Drainage Projects: None

Cost Estimate Summary

Construction	$	160,000.00
Contingency (Level C)	$	40,000.00
Engineering & CA	$	24,000.00
Subtotal:	**$**	**224,000.00**
Land Acquisition:	$	-
Total Project Cost:	**$**	**224,000.00**

Notes:

1. Membranes can be installed one pair at a time as required.

2. The pump should be budgeted for with the installation of the first pair of membranes.

2014 Water Projects Cost Estimate

HARRISON HOT SPRINGS
Naturally Refreshed

Project: Above-Ground Piping Replacement
Location: Between Water Treatment Plant & Reservoir
Priority:
Date of Estimate: June 29, 2015
Target Year:

Project Name: **Above-Ground Piping Replacement**

Project Description: Relocate or upgrade the exisitng above ground supply lines for post disaster system and security.

Location:

DCC Eligible: No

Existing Zoning: N/A

Project Limits/Address: Between Water Treatment Plant & Reservoir

Details:

Preliminary design complete with cost estimate to be completed by June 2015.

Site Photograph:

Land Acquisiton Req'd: None
Total Land Cost: $0.00

Design Consultants: N/A
Drawing Number: N/A

Related Road Projects: None
Related Sanitary Sewer Projects: None
Related Drainage Projects: None

Cost Estimate Summary		
Construction	$	-
Contingency (Level C)	$	-
Engineering & CA	$	-
Subtotal:	**$**	**-**
Land Acquisition:	$	-
Total Project Cost:	**$**	**-**

Notes:

Appendix E – Above Ground Piping Report

ELBURY CONSULTING LTD
STRUCTURAL ENGINEERS

July 29, 2014 **BY EMAIL**

File: 14121

CTQ Consultants Ltd.
1334 St. Paul Street
Kelowna, BC V1Y 2E1

Attention: Michelle Sorensen, P.Eng.

Dear Madame:

Harrison Hot Springs Water Reservoir
Pipe Support System Inspection
Harrison Hot Springs, BC

At your request, we have completed a visual inspection of the inclined pipe support system feeding the main town water reservoir. Our inspection was conducted on June 13, 2014 in the accompaniment of Mr. Brian Jones of Canada West Mountain School. Mr. Jones provided the necessary equipment and expertise to safely rappel the steep cliff face to complete our inspection.

1. REFERENCE DRAWINGS

A copy of the structural drawings for the original pipe support structure was provided for our reference. These drawings were prepared by Gordon Spratt and Associates Ltd. and are dated June 1984 and we assume the pipe support structure was constructed sometime shortly thereafter. This pipe, which is now approximately 30 years old, is referred to herein as the "north pipe". The second pipe, which was installed sometime in the mid 1990's, runs parallel to and just south of the north pipe. No drawings of this structure were available for our review.

2. OBSERVATIONS

A visual inspection was conducted on the above pipe support structures by rappelling down the cliff face with mountain climbing equipment. The support frames were visually inspected but no material sampling or testing was performed. We were unable to inspect the actual water pipe and their connection to the support frames as the piping was encased in insulation and a protective sleeve.

The following issues were noted during our inspection (refer to Photographs in Appendix A):

a) The north (oldest) support structure has significant superficial corrosion and is in need of paint resurfacing in order to prevent further corrosion.
b) Both structures have several baseplates that are completely buried in organic matter which will contribute to more rapid steel corrosion.
c) Several frames on the north pipe have support legs and diagonal bracing that have been bent from rock falls which decreases the strength of the frames.

4163 Mahonia Drive South, Kelowna, B.C. V1W 4T1
p: 250.448.3944 f: 250.448.3945

d) Both structures have a significant amount of vegetation growing in and around the support frames. Left unattended, it is possible that the vegetation will damage the support bents.

3. SEISMIC CONSIDERATIONS

This initial report is focused mainly on the immediate condition of the structure. We have not completed any seismic analyses of these structures, although it is important to note that the BC Building Code requires all components in water supply system be designed as Post Disaster. It is expected that Post Disaster structures remain functional with little or no damage after a seismic event. In this case, the primary concern would be the ability for the Village to provide adequate supply for expected fire flows.

Based on our cursory review of this section of piping, it is our opinion that these support structures would no meet current day seismic standards and it is more probable than not that the system would receive some sort of damage after even a moderate seismic event.

There are two options to consider in upgrading this portion to a post disaster system. The first option would be to complete a detailed structural seismic assessment of the existing support frames. This would involve obtaining accurate as-built drawings of the system including all geometry, member sizes and connection details. With this information, a detailed seismic review could be completed and retrofit plans and details prepared. Retrofit details may include installing additional anchor bolts and strengthening structural elements as required to meet seismic force demands. We expect the repairs will be costly and difficult to implement given the steep working environment.

The second option would be for the Village to consider decommissioning the existing piping and installing new two new pipes alongside the existing access road to the reservoir. Given the roadway is mostly founded on bedrock, it is likely the most cost effective solution would be to surface mount the pipes on concrete piers anchored into the bedrock. While the pipe distance would be significantly longer than the existing route, the installation would be significantly simpler. In the event that damage did occur after an earthquake, repairs to piping in this location would be significantly easier than in the existing location.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on our visual inspection of the supply and return pipe support structures we provide the following conclusions and recommendations:

1. In the short term, the cliff face should be scrubbed of all loose rock, debris and vegetation.
2. The support bases and anchor bolts should have all loose debris and soil removed, as this contributes to the steel corrosion of the baseplates and anchor bolts.
3. The north pipe support structure is in considerably worse condition than the south structure. Several legs have been damaged by falling debris and the complete structure requires paint protection.
4. It is very likely a failure would occur in this section of the water delivery system in the event of a moderate to severe earthquake which would seriously compromise the Village's ability to provide adequate supply of water for firefighting and emergency purposes.
5. Two options have been presented to upgrade the piping to a post disaster system. The first option would be to retrofit the existing supports which would require a detailed structural seismic assessment. The second option would be to decommission the existing section running

up the cliff face and install two new supply lines running alongside the existing reservoir access roadway.

If you have any questions in regard to this matter, please feel free to contact the undersigned at your convenience.

ELBURY CONSULTING LTD.
Per:

Kevin Elbury, M.A.Sc., P.Eng.

Appendix A
Photographs

Photograph 1
Looking down pipe lines. North pipe is the left.

Photograph 2
Top concrete abutments. Concrete work is in average condition.

Photograph 3
Typical support bent. North pipe is to the right.

Photograph 4
North bent baseplate and anchor bolts.

Photograph 5
South pipe support anchor bolts.

Photograph 6
Baseplates buried in organic matter.

Photograph 7
Typical support frame – north pipe.

Photograph 8
Bent support leg from falling debris.

Photograph 9
Diagonal members damaged from falling debris.

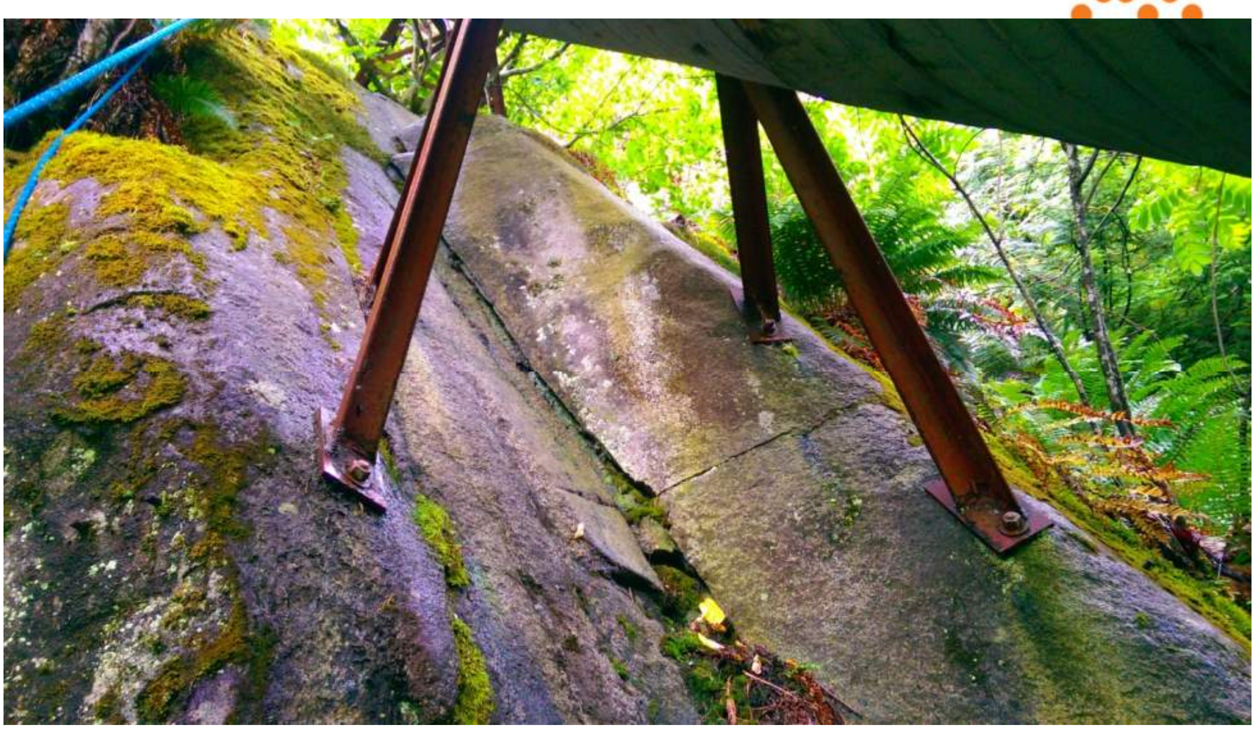
Photograph 10
Heavy vegetation in and around bents.

Photograph 11
Vegetation growth is deforming the bent diagonals. Baseplates should have all vegetation removed.

Photograph 12
Looking up, north pipe is on the left.

Photograph 13
Bent leg likely from falling rocks from above. Axial load capacity will be significantly reduced.

Photograph 14
South pipe bent.



Photograph 15
North pipe bent – no diagonals are present.

Appendix F – Development Projections

Water Master Plan
June 2015

Village of Harrison Hot Springs

Development Projections

Summer 2014

Development Projections – Harrison Hot Springs

9 sub-areas

Density projections will be based on OCP land use designations, except in cases where a zoning was amended to a Comprehensive Development Zone. Generally there are few sites in the Village that may experience significant growth. The majority of the community is developed and the move forward with the east land sector Regional Park will impact development and population growth in Harrison Hot Springs.

In sub-areas where commercial space is built out, development projections will not identify existing commercial space. Only future commercial space will be identified.

Lot size is based on BC assessment data provided by the Regional District.

Summary of development projections:

Area	Commercial	New Lots	Residential Infill
1	5,035 m^2	130 units	-----
2	9,941 m^2	289 units	-----
3	-----	84 units	-----
4	-----	59 units	43 units
5	-----	128 units	2 units
6	*246	138 units	-----
7	1,000 m^2	90 units	-----
8	-----	322 units	-----
9	-----	-----	-----
Total	**1,5976 m^2**	**1,240 units**	**45 units**

*New commercial in this area is campsites and/or accommodation rooms.

Area 1: Waterfront Commercial

The OCP designates this area as Waterfront Commercial. Tourist commercial is the focus of this area. Permitted uses include: accommodation uses (hotels, motels, and resorts), restaurants, and speciality retail oriented toward tourist based services. Densities in the area are similar to Area 2 allowing up to 150 units per hectare and a maximum floor space ratio of 1.75 for commercial uses. The intention of this designation is to achieve a strong tourism area. While residential development is permissible, the focus should be on the tourism component. The ground floor should be oriented toward tourism commercial uses.

Area 2: Village Centre

The OCP designates this area as "Village Centre Area". The following uses are permitted: commercial, residential and public uses. Emphasis is on mixed commercial – residential uses. Commercial uses may include: personal service establishments, banks, business and professional offices, retail and grocery stores. The focus of this area is to provide community-oriented services. Density thresholds are: commercial maximum floor space ratio of 1.5, up to a maximum of 2.0. Residential density is 150 units per hectare.

Generally this area can be characterized as built-out. There is one parcel located at 120 Esplanade Avenue that is currently vacant and may be re-developed. Council adopted a bylaw amendment to allow a seven storey building to be constructed with retail on the ground floor. There are a few other properties that are currently occupied with single family dwellings and are protected with legal non-conforming status. Some type of re-development may take place on these lots. Maximum floor space ratios are based on a figure of 2.0, which is the maximum achievable under the OCP which includes density bonusing.

Area 3: Lakeshore Residential

The OCP designates this area as Lakeshore Residential. Medium density multi-family residential is the focus of this designation. Uses will be related to residential uses and will have a maximum density of 35 units per hectare. Consideration must be given to height, form and character, on-site parking and access.

Area 4: Low Density Residential

The OCP designates these lands as Low Density Residential. This is a low density designation that envisions single family and duplex dwellings. The maximum density threshold is 20 units per hectare. Creation of new lots is limited to a few larger parcels that can accommodate subdivision into conventional smaller lots. The majority of additional dwelling units will come in the form of construction of a dwelling unit on a vacant lot. This will not yield additional DCCs because the charge was likely paid at the time of original subdivision.

Area 5: Neighbourhood Planning Area – Pine Avenue (Low Density Residential)

A Neighbourhood Planning Area guides future land use for this area. It has been identified as an area for small lot subdivision or multi-family residential development in the form of townhomes or other medium density uses. This area is comprised of three large lots (2 of which are vacant) and 14 large single family lots that range in size from 0.2 ha (0.5 acre) to 0.4 ha (1 acre). While these lots could be re-developed if a land assembly were successful, without strong market forces this sub-area is unlikely to generate new subdivisions. These lands generally have no development constraints such as RAR or geotechnical hazards etc.

Area 6: Tourist Commercial

The OCP designates this area as Tourist Commercial. It is an area that is in transition with recent applications for OCP and Zoning Bylaw amendments that, if adopted, could allow medium density residential development (townhomes). Other uses in this area include RV camping developments and single family dwellings. The OCP envisioned this as a tourist commercial area that would provide tourism amenities. However, the past uses including a mini golf course were not successful. Because the area is in flux, development projections will utilize both commercial and residential development.

Area 7: Marine Tourist Commercial

The OCP designates these lands, located at the northern boundary of the Village, as Marine Tourist Commercial. Uses permitted in this designation are oriented toward marine tourisms uses and may include: marina, marina accommodation, restaurants and related retail uses. Council recently amended the zoning for one site to permit a multi-family residential use that will include a mixed-use commercial/retail building, and houseboat development. The other properties have limited development potential. They are comprised of an art gallery (property is Village owned) and water lot leases that the Village holds.

Area 8: Resource

The OCP designates this land as Resource. The intention of this designation is to maintain undeveloped lands in their natural state for uses that include both public and private recreation, public use and agriculture. These lands are also located in the Agricultural Land Reserve and are therefore pursuant to Agricultural Land Commission Act, able to be used for farm use. This permits a broad number of uses that fall within the definition of farming. Any change to the OCP designation would require approval from the Agricultural Land Commission, which adds a level of uncertainty for re-development. Should these privately owned lands be re-developed, it is likely that a clustered development would take place that would leave a large portion of the lands in their natural state and develop only one portion of the site. Applying a density calculation consistent with Low Density Residential.

Area 9: Public Uses

The OCP designate these lands as public use. A wide range of uses comprise the Public Use designation, including but not limited to: Municipal land and facilities, Fire Hall, School, Water Treatment Facility, etc. For obvious reasons, these lands do not have development potential. They will simply be highlighted on mapping.

Appendix G – VHS Water Conservation Plan

	VILLAGE OF HARRISON HOT SPRINGS **POLICY**
POLICY NAME	POLICY NUMBER 6.3
WATER CONSERVATION PLAN	DATE ADOPTED April 28, 2011

1. PURPOSE

The Village is committed to becoming a complete sustainable community with attention to climate change to ensure the Village's carbon footprint meets or exceeds provincial guidelines.

One aspect of the sustainability program is a focus on water conservation and this policy will be incorporated into the overall sustainable plan. The purpose of the policy is to minimize water usage by developing a new way of doing business in terms of water management and conservation.

The Village's water conservation plan will concentrate on reduction in water use, water loss and waste and develop water management practices that include the efficient use of the water source to the benefit of residents, business and the environment.

To realize success in the water conservation program it is paramount to encourage the residents, the business community as well as the visitors to Harrison Hot Springs to reduce their demand on the Village's water sources.

Until recently water supply has been a key issue in the Village and a detriment to the proper management of growth and development. However, with the recently constructed reservoir the Village is in a position to entertain development projects but in doing so must also be cognizant of the demands on the water system and ensure proper conservation matters are addressed through the building process.

In essence this policy, through the adoption of the Water Conservation Plan, will incorporate "Water Efficiency" programs and develop the best practice management plan to prevent waste and overuse. The fundamental object is to do more with less without impacting the public comfort of these requirements or jeopardizing the water systems performance.

2. WATER CONSERVATION PLAN

INTRODUCTION

Objective:

The objectives of the water conservation plan are;

a) To reduce water consumption from the prevailing levels. Currently the consumption in the Village of Harrison Hot Springs was 207, 861 cubic meters in 2009 and 267,821 cubic meters in 2010.

b) To reduce the loss and waste of water.

c) To improve the efficiency and the use of water.

d) To measure the level of recycling and reuse in the water supply.

e) Through effective growth management and new technologies reduce the rate of growth and demand on the water system.

GENERAL

In keeping with council's commitment to sustainability and addressing climate change to reduce the Villages carbon footprint goals of the water conservation plan will include;

a) Using the consumption figure of 2010 (267,821 cubic meters) as the base line to reduce water consumption over the next 5 years by 10%.
b) Develop a program over the next 10 years to ensure the level of unaccounted water in the system is below 10% from a current high of an estimated 35%.
c) Implement and maintain a program of universal metering over the next 10 years in the residential community.
d) Implement a program for meter testing, replacement and repair.
e) Increase efficient water usage through water conservation program.
f) Raise resident awareness of water conservation and encourage responsible behavior through a public education and information program and;
g) Develop a strategy to conserve water during peak demands during prolonged hot weather.

METERING

Currently all commercial and institutional users connected to the Village water system are metered and pay on metered use. Until recently, residential users were not metered but rather paid a flat fee on their taxes for the use of Village water. In the past two years the Village has begun a program of ensuring that all new residential development is metered. Although these residents will be metered, their consumption is still billed on a flat rate basis on their annual taxes. This approach does create inefficiencies within the system and also allows for misuse/abuse of water supply.

Currently 95% of residential properties are not metered which leads to higher demand with an increased risk of potential waste and/or misuse.

Goals:

1. That the Village continue with its practice to ensure that all commercial, institutional and residential development is metered.
2. That a ten year program be developed to ensure that all existing residential properties are metered within ten years.
3. That, in the development of a business case to meter existing residents, a consideration is given to P3 opportunities.

4. That the Village continues to practice the billing of commercial and institutional users on “metered consumption” and that plans be developed to also incorporate residential meter reading as a basis for billing.
5. That the Village develop a financial analysis of the cost of water supply in relation to consumption with a price point being established to encourage conservation.
6. That the Village institute quarterly billing for all utility accounts.

CONTROL OF ALL UNACCOUNTED WATER SUPPLY

An ongoing challenge facing the Village is that the vast majority of residents are not metered and therefore there is a potential loss of water through leakage and waste. Unaccounted water can also happen through inaccuracy in meters; developments connected to the water system but not yet billed, losses to the grates in the water main and water distribution system, loss due to firefighting and losses due to illegal connections and theft. Currently the Village has no method of monitoring or controlling unaccounted water.

Unaccounted water, in addition to unexplained excessive use of water supply, also has financial implications to the Village in terms of both lost revenue and increased operating costs through pumping etc.

While it is difficult to measure unaccounted water due to a lack of universal metering it is an issue that the Village must come to terms with, effective programs can be developed with the aim of reducing the unaccounted water.

Goals

1. Operations crews, when in the field, will test for, observe for and report evidence of leaks in the water distribution system. They will also observe private residence and report any suspected leaks on private property to the Village office and follow up with the owner.
2. The Village will develop a leak detection and repair program by the summer of 2013.
3. The operations crew will watch for and report signs of water loss and illegal connections to the office so they can be addressed quickly.
4. In 2012 the Village will develop a policy, program and procedures for the testing of meters; both residential and commercial usage.

COMMUNITY PROGRAMS

Although there is a growing awareness of water conservation an effective water conservation program will provide information to the general public on how they can participate in the program to assist in achieving “a greener and sustainable community”.

The initial approach will be to encourage public participation in the conservation program which will be measured to determine success. Eventually, the volunteer program will evolve into a mandatory program through a series of amendments to Village bylaws. It is also imperative to develop a water conservation strategy at the elementary school level to create an awareness of the need and importance of a water conservation program and encourage the youth to engage their parents in an open discussion about water conservation.

Water conservation success is a community endeavor and must be embraced and supported by the residents to ensure that the desired outcomes are achieved.

Goals:

1. Develop pamphlets on water conservation to be included in mail outs commencing with the 2012 tax year providing “hints” on water conservation.
2. Develop information pamphlets outlining water conservation technology, their benefits and potential payback to the user, such as two and low flow toilets and shower heads.
3. Encourage developers to pursue green building technologies incorporating water conservation technologies within their buildings.
4. Develop incentive programs to encourage residents to purchase low flow or two flow toilet replacement and low flow shower heads, pressure reducing valves within the next two to five years.
5. Prepare amendments to regulatory bylaws by 2013 to incorporate mandatory requirements for water conservation technology and green buildings.

3. WATER CONSERVATION MANAGEMENT

It is important to look beyond the normally accepted practices to curb water consumption in developing the water conservation plan. Consideration will be given to developing a program to reuse and recycle waste water, the use of grey water from roof drains and the implementation of a landscape water management program. The cost of water supply can also be reduced, thus increasing the efficiency of the system by upgrading the wastewater treatment plant and associated pumps. The Village is currently committed to an upgrading program of its wastewater treatment plant involving several phases each producing an added benefit through the reduction of operating costs in pumping, treatment, disinfecting and general maintenance and repair.

Goal:

1. During the reconstruction of the wastewater treatment plant every effort is made to capture a reduction in costs for treating (chlorination and filtration) with polymel water, cost of pumping sewage (lift station), cost of treating sewage, cost of disinfecting and discharging the affluent, cost of wear and tear on water piping network and sanitary collection network, and overall cost savings and maintenance. It is expected that when the upgrades are completed the plant will be 60% more efficient.
2. Commence a program to retrofit existing facilities and equipment to environmentally friendly materials and technologies to minimize the impact on the carbon footprint.
3. That the Village adopt a water management program that details the how’s, when’s, where’s for watering Village parks and landscape and hanging baskets and flower barrels in 2012.
4. In 2011 implement and enforce a residential water action plan as follows:
    a. Stage 1 – effective June 1 – September 30 of each year residents and businesses are to practice water conservation and minimize or discontinue water use for non-essential purposes. For residents watering will only be allowed for even numbered houses on Tuesdays and Saturdays between the hours of 5am – 8am or 7 pm – 10pm and for odd numbered houses on Wednesdays and Sundays for the same hours as noted above.
    b. Stage 2
        i. Residents must limit watering of landscape barriers with hose and sprinklers to one day per week Tuesdays for even house numbers and Wednesdays for odd house numbers with the hours of watering to be restricted to the times noted in Stage 1.
        ii. The washing of motor vehicles will be restricted to the designated watering days as noted in stage 1, when such washing when allowed shall be done with

a hand held bucket or a hand held hose equipped with a positive shut off nozzle for quick rinses. This will not apply to licensed commercial car wash or service station facilities.

iii. Use fire hydrants for firefighting or related activities only or for construction purposes under special permit from the Village; and

iv. Not to wash down hard surface areas such as driveways, patios, decks etc. or use water for dust control or wash down buildings.

c. Stage 3 – Residents and businesses in addition to the above noted restrictions must comply with any other regulations that council may impose to enhance the water conservation program from time to time.

5. Develop a program within the next two years to provide water and energy audits to residential properties and small businesses.
6. Develop a program to ensure water conservation designed principles and technologies are included in an all new capital works projects and maintenance practices undertaken by the Village by 2013.
7. Develop a program in 2012 to progressively retrofit Village owned buildings with water efficient fixtures and fittings.