Asset Management Plan
Water Distribution

CLINTON
Where History
SINCE 1863
MEETS ADVENTURE

August 2016

Project No. 675-362

TRUE CONSULTING

ENGINEERING ■ PLANNING ■ URBAN DESIGN

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Revision Log

Revision #	Revised by	Date	Issue / Revision Description
1	DPG	2016-02-12	Issued for Submission
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Report Submission

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TRUE	TRUE Consulting
PRV	Pressure Reducing Valve
PSAB	Public Sector Accounting Board
GI	Galvanized Iron
AC	Asbestos Concrete
PVC	Polyvinyl Chloride

Executive Summary

The update to this document represents the Village's efforts to continue implementing long-term Asset Management practices. This revision updates the Water System Capital Works Plan, started in 2015, to the Village's Asset Management Plan for Water Distribution.

The 2015 Water System Capital Works Plan represented the initial efforts of the Village of Clinton to produce a long-term planning document for the guidance of the upkeep and replacement of the water distribution system. That report comprised of the initial review and evaluation of the Village's water distribution system, outlining the currently known information: age, materials of construction, and recent history of maintenance. That report also provided a preliminary evaluation of the system in regards to criticality of various distribution mains.

This Asset Management Plan expands on the efforts of the Village to include a summary of relevant information and documentation, and an explanation as to how the system assets have been prioritized.

It is expected that the Village will regularly maintain and update this document and it's results as updated information is made available, or as the social priorities of the community change.

1.0 Introduction

In 2015, TRUE Consulting was retained by the Village of Clinton to complete two projects: a Capital Works Program for the community water system and the planning towards implementing formal Asset Management practices for the community.

In 2016, TRUE was again retained to merge the two previous efforts into a single long-term Asset Management Plan for Water Distribution. This document represents the first version of that Asset Management Plan.

The purpose of this document is to outline all of the information and studies that relate to the long-term management of the Village's Water Distribution assets. This Plan will also outline the criteria behind how various derived attributes, such as Risk and Criticality, were developed so that those processes may be repeated in the future as necessary.

The goal of Asset Management is to provide the basis for sound lifecycle management decisions by providing a broad strategic framework for the application of sound technical, social, and economic principles that considers present and future needs of the end users.

1.1 Scope

The scope of this Asset Management Plan is to cover all assets related to the distribution of potable water from the Village's Water Facilities (Water Treatment Plant, Reservoir, and PRV Station). This includes all distribution piping, valves, bend, hydrants, and services.

The purpose of this document is to provide a basis of decision making criteria that the Village can use to plan the life cycle management of their assets in a fiscally and operationally efficient matter.

This Asset Management Plan has been developed based on the best available information as it relates to the Village's water distribution assets. TRUE is aware that there are *gaps* in this information which could further refine the decision making process. The final sections of this document discuss areas of information that could be developed to further Village's understanding of their water distribution assets.

2.0 Background

This section contains a review and discussion of the information regarding the current and previous studies and works that are relevant to the efficient upkeep and management of the Village's water distribution system.

2.1 Inventory

In 2008, an inventory of the Village of Clinton water distribution system was completed by TRUE. As a result, the Village has a detailed database (Excel Spreadsheet) outlining the pipes by size, material, and installation date. This historical information, as well as the most current base mapping of the water system, was compared against a record of the water projects performed since 2008. These water system improvement projects are summarized following:

- An existing 50mm GI pipe along Kellow Lane was decommissioned (Asset ID: WAT.036) and replaced with a new 150mm diameter PVC pipe was installed in 2009 (Asset ID: WAT.081).
- The watermain along Lebourdais Avenue was upgraded in 2010 with a 150mm diameter PVC. (new Asset IDs: WAT.082, WAT.083, WAT.084, WAT.085, WAT.086, WAT.087 and WAT.088). The existing 100mm AC was abandoned (Asset IDs: WAT.014, WAT.015, WAT.016, WAT.017, WAT.018 and WAT.019)
- An extension of the watermain along Tingley Street was completed, a new 150mm diameter PVC pipe was installed in 2010 (Asset ID: WAT.089). Hydrant #41 was decommissioned, and a new hydrant was installed at the end of Tingley Street (Asset ID: HYD.051).

In 2010, a leak detection survey was completed for the Village of Clinton Water System. At that time only a few minor leaks were identified and TRUE understands that these have subsequently been addressed by the Village. No additional considerations for leaks have been included in this Asset Management Plan, however, it is recommended that water leakage repair records be maintained by Public Works staff such that further refinement of system improvement priorities can be made over time.

The 2008 infrastructure inventory of the Village of Clinton's water system comprises of a pipe network inventory, a fire hydrant inventory and water supply facilities inventory. The water distribution system comprises a total of approximately 9,845 m of piping, including piping at the water treatment plant, 51 fire hydrants, a treated water storage reservoir and the recently constructed water treatment plant. A breakdown of the water system pipe network by pipe diameter can be found in Table 2-1 following. The majority of the Village's water distribution system is made up of 150mm diameter supply mains.

TABLE 2-1: BREAKDOWN OF WATER SYSTEM PIPE NETWORK BY DIAMETER

Diameter (mm)	Total (m)
50	605
100	970
150	6,680
200	1,515
300	65
Unknown	10
Grand Total	**9,845**

A breakdown of the water distribution system, by material and year installed can be found in Table 2-2, Figure 2-1, and Figure 2-2 following.

TABLE 2-2: SUM OF LENGTH (M) OF PIPE INSTALLED, BY YEAR AND MATERIAL

Year Installed	Material					Grand Total
	AC	GI	PVC	Steel	Unknown	
Unknown	1870				50	1,920
1950		530				530
1960	2,850					2,850
1966	265					265
1967	800					800
1970	1,705	75				1,780
1986	170					170
1990			310			310
1996			225			225
2003			225	5		230
2005			200			200
2009			125			125
2010			385			385
2014			55			55
Grand Total	**7,660**	**605**	**1,525**	**5**	**50**	**9,845**

FIGURE 2-1: WATER DISTRIBUTION SYSTEM PIPES – BY AGE

FIGURE 2-2: WATER DISTRIBUTION SYSTEM PIPES – BY MATERIAL

The Village of Clinton's water distribution system is primarily comprised of Asbestos Cement (AC) pipe installed in the 1960s to 1980s, with approximately half of this pipe installed in the 1960s. A small amount of the water distribution network is comprised of Galvanized Iron (GI) pipe, representing approximately 6% of the total length of pipe, all of which is 50mm diameter pipe installed in the 1950s and some in the 1970s. The AC and GI pipe is aging, and a plan for eventual replacement must be prepared.

2.1.1 Truvian

On the completion of the 2015 Asset Management Planning Program, completed by the Village with the assistance of TRUE and through funding by the UBCM, TRUE was able to migrate much of the Village's asset inventory information to the Truvian online mapping system. This simple GIS system has allowed the Village to merge their tabular information with existing drawings and as-builts for ease of access.

2.2 Water Facilities

In 2014, a water treatment plant and treated water reservoir were constructed. The piping for the water treatment plant and treated water reservoir has been included in the pipe network inventory. Also included is approximately 1100m of 200mm diameter AC water supply main from the treated water reservoir to the PRV Station located at the intersection of McDonald Avenue and Cariboo Highway. This pipe was installed around 1965, and will likely be in need of replacement as the pipe ages. The Water Capital Works Plan identifies this pipe to have a very high criticality, and thus represents the Village's highest priority. Further discussion on the water supply main from the water treatment plant to the distribution system follows later in this document.

The Village also owns and operates the PRV Station at the intersection of McDonald Avenue and Cariboo Highway.

These facilities are currently not considered under the scope of this plan.

2.3 Studies and Evaluations

The Village has had various studies, plans, and evaluations conducted over the course of owning and maintaining the water distribution system.

2.3.1 Water Model

In 2016, TRUE prepared and updated the model of the Village's water distribution system. This model has taken into consideration:

- Current water demands
- Estimated water demand projections (based on OCP growth predictions)
- Fire flow requirements

The primary outcome from this model was the identification of moderate to significant deficiencies in fire flow at several locations around the Village. The model identifies two tasks that are necessary to rectify these deficiencies. These tasks are the construction of additional looping in the system and the upgrade of key watermains to larger sizes. The details of these tasks are outlined in "Water Distribution System Hydraulic Model Assessment" (TRUE 2016).

2.3.2 Dual Pressure Zone System

In February 2015, a study was completed for the Village of Clinton, entitled "Feasibility Assessment of Infrastructure Expansion within Municipal Boundary," (TRUE, 2015). The 2015 Feasibility Assessment identified the creation of a dual pressure zone as a high priority for the Village of Clinton in order to gain the potential to extend the community water system to un-serviced lands in the municipality. This Asset Management Plan recognizes these future proposed upgrades and the associated implications to the Village's existing water systems, such as pipe diameter size increases required to ensure that the capacity within future infrastructure expansion is not limited.

There is potential to construct improvements to the existing system in conjunction with the dual pressure zone system construction works.

This potential project has also been included in the 2016 water model.

2.3.3 Pipe Criticality

Pipe criticality within the existing community water system was identified as part of the 2015 Water Capital Works Plan. Pipe criticality, for the purposes of this Asset Management Plan, is defined as the *measure of impact to the system and end users should the service of the asset be lost*. Pipe criticality was determined based on three factors; the size of the service population, whether or not the watermain provides fire flow, and whether or not the service area benefits from redundant pipe looping. Figure 2-3 following outlines a flow chart that was used for the determination of the pipe criticality within the existing water distribution system. Additionally, water distribution network mapping, categorized by pipe criticality can be found on Figure 2-4. This information can also be viewed on the Village's Truvian mapping.

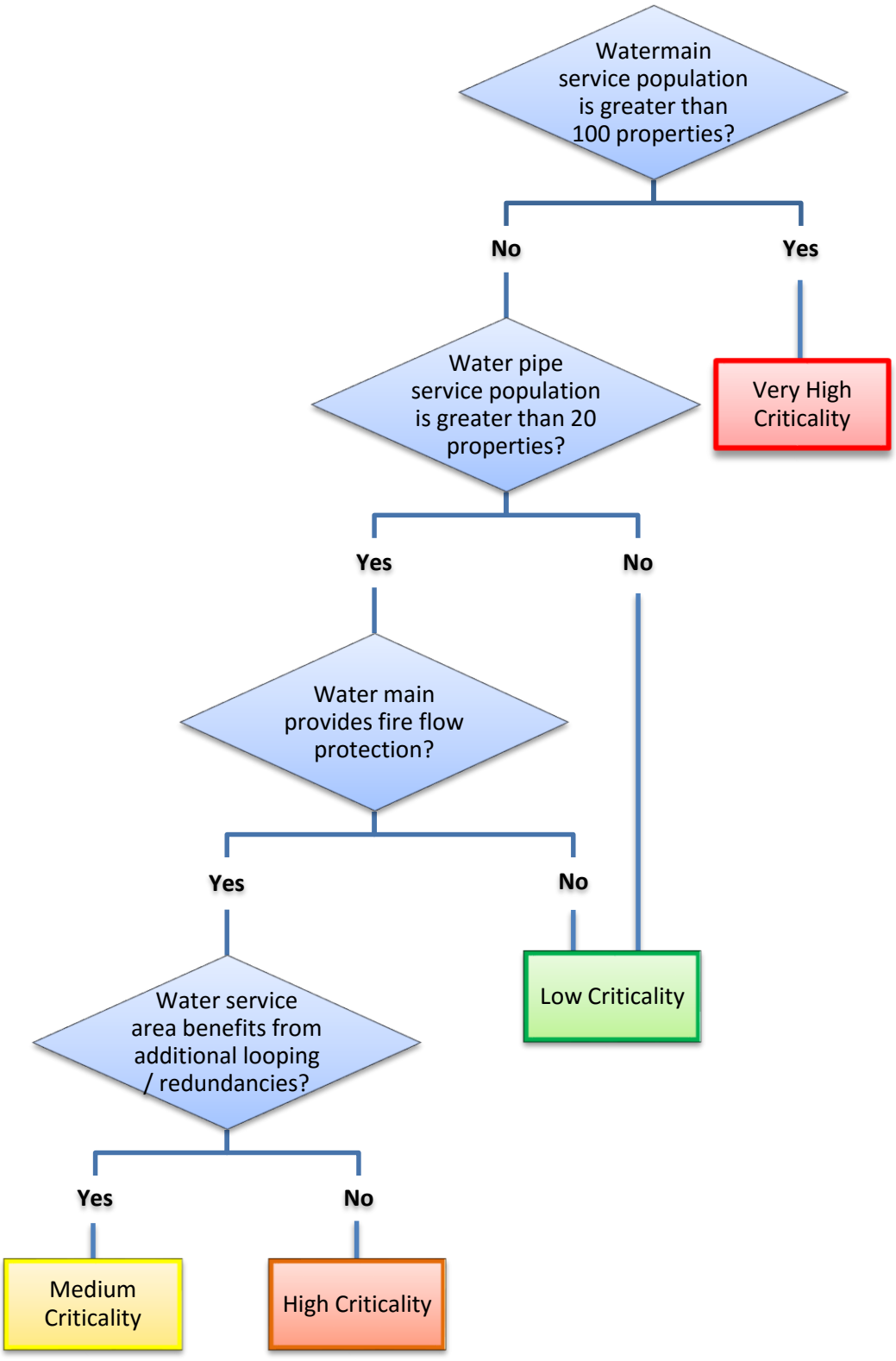

FIGURE 2-3: FLOW CHART FOR WATER PIPE CRITICALITY

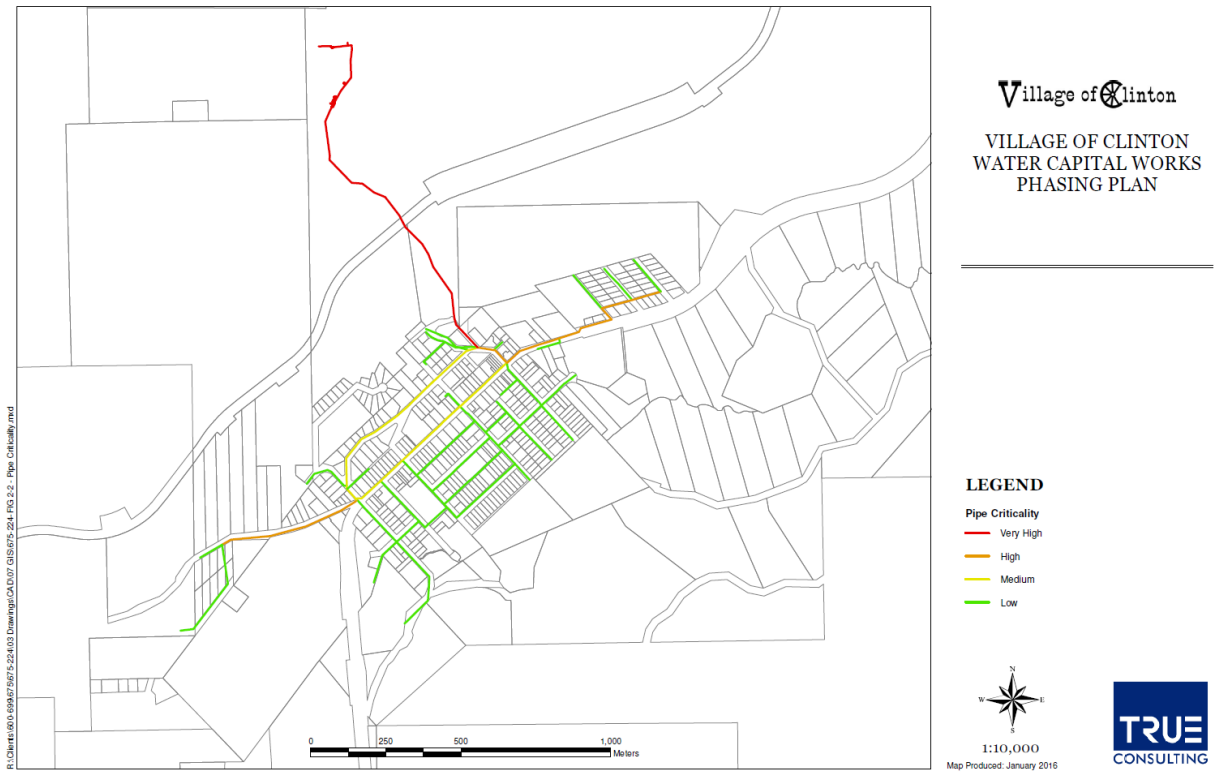

FIGURE 2-4: PIPE CRITICALITY

2.3.4 Pipe Priority

Pipe priority for the existing system was evaluated in 2016 under the second round of UBCM Asset Management Planning funding. For the purposes of this Asset Management Plan, pipe priority, sometimes referred to as “risk”, is a measure of the importance of that asset to be maintained or replaced sooner rather than later. Simply put, the higher priority or risk an asset carries, the more likely it is expected to fail with serious impact. This attribute is derived from two other attributes, probability for failure and consequence of failure.

Probability for failure is currently estimated based on the known age of the assets and their estimated remaining lifespans. Those assets with a greater estimated longevity are assigned lower priority values than those expected to expire sooner. In the future, this attribute may be further refined with testing of in place conditions of the assets.

Consequence of failure is provided by the criticality of the asset. This attribute is described in detail in a previous section.

The determination of the overall priority for each asset is defined according the to following decision matrices.

The results of the priority assessment can be viewed in Truvian.

TABLE 2-3 -DETERMINATION OF PROBABILITY OF FAILURE

	Remaining Life			
	0 - 10	10 - 30	30 - 50	50+
Probability	High	Med	Low	None

TABLE 2-4 - DETERMINATION OF PRIORITY

	Criticality			
Probability	Low	Med	High	Very High
High	Med	High	Very High	Very High
Med	Med	Med	High	Very High
Low	Low	Low	Med	High
None	Low	Low	Med	Med

The current failure in this method is that some assets, such as those with Low Criticality, will never rank higher than a Medium Priority. In contrast, assets that are considered Very High Criticality cannot be less than Medium Priority. In the future, this situation can be correct by including the physical condition of the asset in the evaluation. Currently, the condition information for the system is not complete enough to allow for it to be included.

3.0 Asset Management Plan

The process of making Asset Management decisions requires a balance between deciding which assets to renew, which assets to upgrade, and where capital expansion should occur to add new assets. Generally, these three typical scenarios are driven by:

- Aging and failing assets require replacement or renewal
- Assets providing deficient services, although not near the end of life, require upgrades or replacements
- Areas where the community may grow requires expansion of service networks

The challenge is to balance the needs of these three factors with the available time and resources of the Village in order to produce the most fiscally and socially responsible decisions.

The purpose of this section is to summarize the conclusions drawn from the available asset attribute information. As stated previously, this information is known to be incomplete. As this information is updated and expanded upon, the conclusions found in this section will be subject to change.

During the development of the 2015 Water System Capital Works Plan, this section was developed based on criticality, material, and install year. Priority was given to first to Galvanized Iron pipe, then to the highest criticality pipes from oldest to newest. Under this methodology not all pipes were assigned to one of the seven phases, and none of the upgrades or expansions were considered.

The current methodology builds on the previous process, but also attempts to simplify it. The attributes of criticalilty and install year have been used, as described, to generate the attribute of priority / risk. To simplify the results, it is simply recommended that the Village focus on those assets with the highest priority / risk. The following figure depicts the Priority / Risk map available in Truvian.

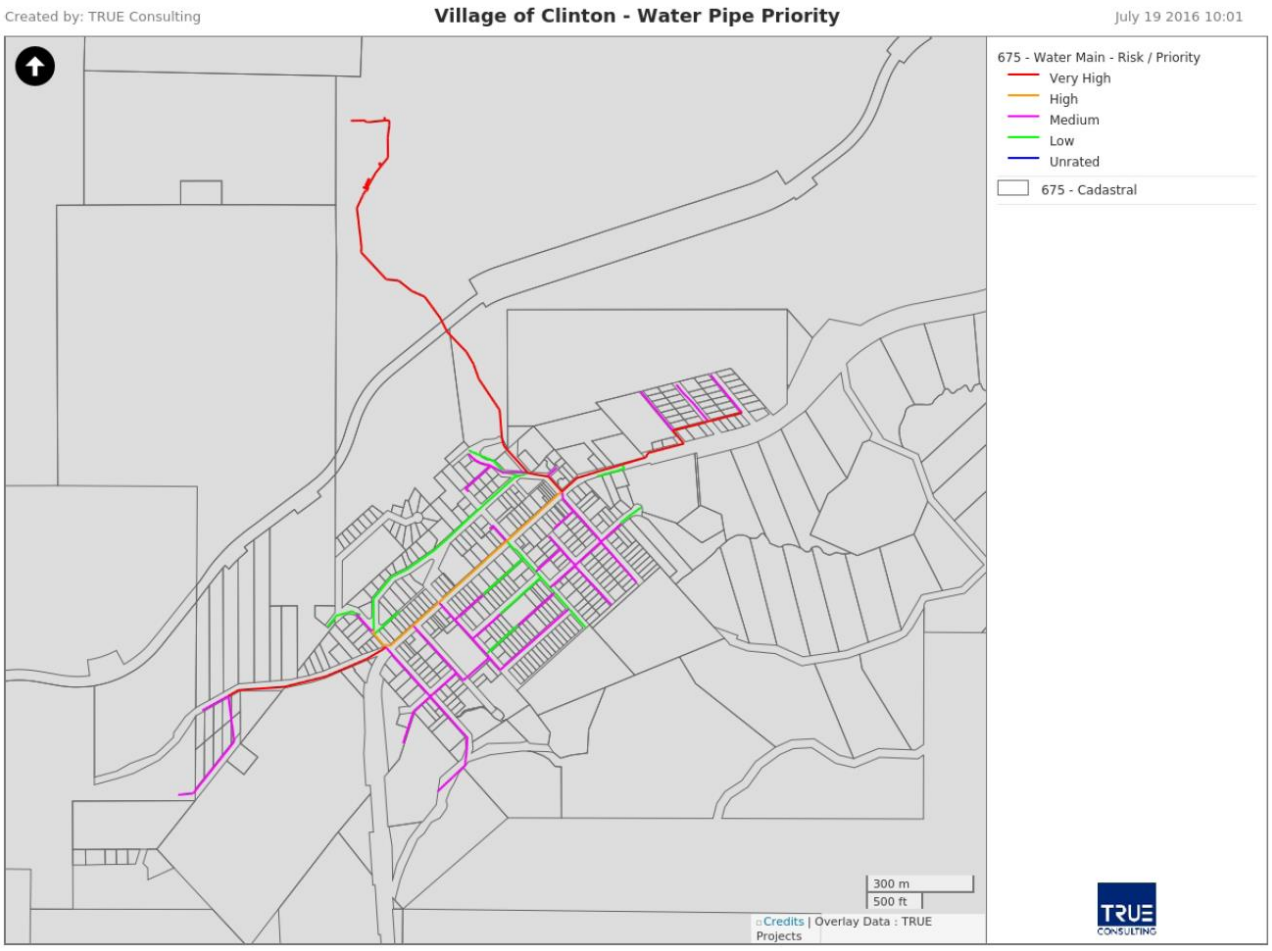

FIGURE 3-1 - PIPE PRIORITY / RISK

3.1 Very High Priority

The Very High Priority assets suggest that they are at or past the end of their expected lifespans and may have substantial consequences if allowed to fail before replacement. These assets should ideally be addressed in the next five years.

Based on the current analysis, there are three lengths of watermain that are considered to be of Very High Priority:

- Supply main from the raw water reservoir, thru treatment, to the PRV station
- Branch main from McDonald Ave to the Hugo Subdivision
- Branch main along Kelly Lake Road out to Teal Street

These pipes all share similar attributes which assign them the Very High Priority, including:

- These pipes have no redundancy in the system
- These pipes are near or beyond their estimated service life spans
- These pipes have criticality ratings of High or Very High

The supply main from the raw water reservoir should be considered as the top priority. The true age, location, and condition of this pipe is not 100% known, although it is believed to have been installed in the 1960s. Due to the Very High Criticality of this pipe (services the entire system) and the extreme level of missing information, it is recommended that it is renewed or replaced before a failure is realized.

3.2 High Priority

The High Priority assets suggest that they are near or at the end of their expected lifespans and may have substantial consequences if allowed to fail. These assets should ideally be addressed in the next five to ten years. Ongoing monitoring of their condition is highly suggested.

The current analysis only identifies one pipe length as being of High Priority. That pipe is the 150mm main along the Cariboo Highway between McDonald Avenue and Cariboo Avenue, with a small portion extending north along Cariboo Avenue. This pipe is past its expected lifespan. Due to having redundant paths for water to flow without this pipe in service, this pipe is only considered a Medium Criticality.

3.3 Medium and Low Priority

Medium and Low Priority assets either still have a substantial amount of their life left, or simply are not critical to the overall system. These assets are not expected to require attention within the next ten years. However, it would be advantageous for the Village to begin a process of ongoing monitoring of the condition of these assets in order to further refine their decision matrix.

The majority of the Village's system, approximately half, falls under either Medium or Low Priority. These assets are either relatively new, or in most cases, of a Low Criticality rating. The loss of a Low Criticality asset is not expected to impact the overall system.

4.0 Conclusion

This Asset Management Plan is a live working document that will evolve as more information is made available. This additional information may take the form of condition assessments, level of service measurements, or leakage reports. As such there are no concrete conclusions on the existing state of the water distribution system. Instead, the following section outlines the recommended next steps to allow the Village to begin to work on the replacement/improvement of the aging pipe, while incorporating additional information to the existing dataset which will further determine the next iteration of the phasing plan.

4.1 Recommended Next Steps

The following next steps are recommended on the basis of gathering additional information on the existing conditions of the water system. As more information is included in the water system dataset, it will be easier to draw conclusions on the anticipated useful life and replacement dates for the water pipe. The main benefits from the additional information is that the actual useful life can be used rather than the theoretical useful life. The actual useful life incorporates real life data such as environmental settings, usage, water system pressures and cyclic loading. From this, the Village can better predict the actual useful life of similar pipes.

The additional information that is recommended to be collected or developed to strengthen the decision making process for the water system replacement/improvements include:

1. ~~Creation and calibration of a water model of the water distribution system~~ (Completed in 2016 under UBCM Planning Program)
2. ~~Completion of a looping analysis of the water distribution system to determine if looping pipe size increases are required.~~ (Completed in 2016 under UBCM Planning Program)
3. ~~Completion of a criticality assessment through the water system modeling to identify and confirm the higher risk pipes.~~ (Completed in 2016 under UBCM Planning Program)
4. Documentation of completed condition assessments, as additional information becomes available.
5. Review of information on any leakages or repairs completed on the system

Upon completion of the recommended next steps, the Village of Clinton will be in a better position to further refine the phasing strategy for the Asset Management Plan. It is recommended that the Village:

- Upkeep the working model/database of the water distribution system, complete with attribute information such as; pipe material, year installed, size (diameter),
- Continually add information into the model, i.e., leakage information, etc.
- ~~Transition from a static Capital Works Plan (single time report) and use the working model to query conditions for multiple snapshots in time to show the evolution of the~~

~~water system as more information is incorporated into the decision matrix.~~ (Completed with this revision / update)

- Continually add information into the living model/database, on a regular basis.
- Use information of condition and age to determine actual useful life as opposed to materials type for textbook useful life.
- Further refine the phasing strategy based on the additional information, as it becomes available.

5.0 References

TRUE Consulting. (February 2015). *Village of Clinton: Feasibility Assessment of Infrastructure Expansion.* Kamloops, B.C,: TRUE.

TRUE Consulting. (July 2016). *Village of Clinton: Water Distribution System Hydraulic Model Assessment.* Kamloops, B.C.: TRUE.

TRUE Consulting. (September 2014). *Village of Clinton: Municipal Road Network Phasing Plan (Revision 2).* Kamloops, B.C.: TRUE.