

VILLAGE OF TELKWA

WATER DISTRIBUTION SYSTEM

LEAKAGE STUDY

March 2002

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1. INTRODUCTION

The Feasibility Study for a Second Reservoir prepared by Dayton & Knight Ltd. in July 1997 identified the need for a leak detection program to locate potential leaks, faulty appurtenances and to quantify the leakage rate.

This report summarizes the findings of the leak detection program carried out in April and July 2001, makes recommendations for the required repair work and provides estimated costs to complete the recommended repair work.

A Draft report was presented to the Village in March 2002. The Village located and repaired three leaking service connections in the summer of 2002. The Village completed another draw down test in November 2002 which showed that the leakage had been reduced to 2.1 L/s. Details of the work completed by the Village in 2002 has been added to this report in italics.

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2. BACKGROUND

The 1996 census recorded the population of Telkwa as 1,194. The 2001 census recorded the population as 1,371 people living in 479 dwellings.

Leakage in the distribution system is believed to be higher than acceptable and a leak detection program was undertaken to locate and quantify the leakage. Repair of these leaks will make the distribution system more efficient.

2.1 Existing Water System

2.1.1 Water Source

The Village currently has two water sources; a drilled well and the Bulkley River. The well is located east of Highway 16 in the northern end of the community. This well is the primary water source for the Village. The Bulkley River source consists of an infiltration gallery alongside the river and a direct pipe intake from the river. The infiltration gallery was constructed in 1999 and is used to supplement the well supply in high demand periods. Water flows from the infiltration gallery into a wet well in the pump house adjacent to the municipal office. The water is pumped into the system as required. The direct intake from the river is not used under normal operating conditions.

2.1.2 Water Storage

A 1,035,000 L concrete reservoir located on Morris Hill provides storage for the community. The New Reservoir Feasibility Study completed in 1997 concluded that the existing storage is insufficient to meet the commercial fire flow requirement under maximum day demand conditions. Construction of a second reservoir was recommended. Construction of the second reservoir has not proceeded yet due to funding constraints.

2.1.3 Water Distribution System

The distribution system is comprised of approximately 18.4 km of main with pipes ranging in diameter from 50mm to 300mm. Pipe materials include asbestos cement and PVC. The distribution system is within a single pressure zone.

A computer model of the Telkwa water distribution system was developed and run under a previous assignment. The model provides a method to evaluate distribution system pressures under different water demand situations and the ability to evaluate improvements where problems are observed.

The system model was run with the existing and future average day demand, maximum day demand, and maximum day demand plus fire flow. Various fire flow scenarios were modelled by appointing fire flows to various nodes throughout the network.

The modelling indicated the system can supply the average and maximum day demands to the community but can not meet the peak hour or fire demands to parts of the community. Water distribution system improvements were recommended to enable the system to provide adequate peak hour and fire protection flows.

2.2 Flow Monitoring

Meters at the well and river sources record the flow of water to the community. The meters are read and recorded daily by the maintenance staff.

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3. LEAKAGE STUDY

Based on assumed leakage and low flow rates in similar systems in other communities, a low flow rate of 1.0 L/s in Telkwa would be reasonable.

A step testing program was recommended to locate major leaks and faulty appurtenances in order to reduce the total water demand and consequently water supply costs.

3.1 Workplan

A workplan was prepared based on existing knowledge of the water distribution system and discussions with present members of the Village maintenance staff. The existing as-built information for the distribution system was compiled to determine valve and hydrant locations needed for the testing program.

The field work included;

- a draw down test on the reservoir to determine the overnight low flow,
- identification of any missing or inoperable valves,
- testing of all watermains to identify leak locations and rates.

The field work, with the exception of the draw down tests, was carried out by Mr. Tom Havard of Canyon Creek Contracting with the assistance of the Village of Telkwa maintenance staff.

3.2 Draw down Testing

The overnight low flow from the reservoir was determined through a draw down test at the existing 1,035,000 L concrete reservoir. The well pumps were shut off and the drop in the water level in the reservoir was measured at regular intervals and recorded. This information enables calculation of the low flow rate from the reservoir during this time.

Two draw down tests were carried out by the Village Works staff. The first test was completed on July 22, 2000, the second on April 12, 2001.

The test completed in July 2000 recorded an overnight low flow of 7.1 L/s. The recorded low flow was considered excessive and likely not an accurate representation of the low flow for the system. The Village could not identify any large users at the time of the test. The results of this test were deemed inaccurate and a new draw down test was recommended.

The second draw down test was conducted in April 2001. The recorded water levels and calculated flows are shown on the following table.

**TABLE 1
RESERVOIR DRAWDOWN TEST INFORMATION**

Time	Measurement	Drop	Time Diff (min.)	Volume Used (m3)	Flow Rate (L/s)
12:00 AM	1.41				
1:00 AM	1.49	0.08	60	17.106	4.8
2:00 AM	1.56	0.07	60	14.968	4.2
2:20 AM	1.58	0.02	20	4.276	3.6
2:40 AM	1.6	0.02	20	4.276	3.6
3:00 AM	1.62	0.02	20	4.276	3.6
3:20 AM	1.64	0.02	20	4.276	3.6
3:40 AM	1.67	0.03	20	6.415	5.3
4:00 AM	1.7	0.03	20	6.415	5.3
5:00 AM	1.75	0.05	60	10.691	3.0
6:00 AM	1.83	0.08	60	17.106	4.8

The overnight low flow was measured at 3.0 L/s, higher than the normally acceptable rate for a community of this size of 1.0 L/s. The low flow of 3.0 L/s represents approximately 32% of the average daily demand.

Since the Leakage Study was completed, the Village has located and repaired three leaking service connections in Test Sections 19 and 26. The mains have not been retested to confirm the extent of leakage reduction achieved in each section. A reservoir draw down test was carried out on November 26, 2002 to determine the overnight low flow. This test identified the low flow as 2.1 L/s, a reduction of

0.9 L/s since repairing the leaking services. It is likely that the three service repairs have only eliminated a portion of the leakage in Test Sections 19 and 26. Further work should proceed as detailed in Section 4 of this report.

3.3 Watermain Testing

The watermain leak testing was completed by locating service shutoffs and valves in order to isolate sections of the watermain for testing. Water was pumped, via a metered connection to a fire hydrant, from a water truck into the isolated section of main at the typical operating pressure for that section of main. The flow into the isolated section of main was monitored to determine the total amount of leakage in the isolated main. Homeowners were requested not to use water during the tests. Non-compliance was generally able to be detected and services retested to identify leakage or domestic use. Individual service connections were shut off if leakage in the section was suspected to be on private property.

A total of 26 tests were performed to locate and quantify the leaks in the distribution system. The field work reporting included in Appendix A provides the details of each test conducted. The leakage shown in the field reporting can not be totalled as a number of the tests are of overlapping areas and are identifying the same leak. The table on the following page shows the total leakage found as represented by the test that best isolates the leak. The location and extent of each of the leaking sections is shown on Figure 1, in Appendix B.

**TABLE 2
FIELD LEAKAGE TESTING RESULTS**

Test No.	Location	Approx. Length of Test Section (m)	Measured Leakage (L/s)	Comments from Field Test Reporting
6	Walnut (between Poplar and Woodland)	185	0.17	Constant flow indicates small leak
8	Woodland and Cedar	500	0.17	
9	End of Willow	200	?	Could not properly isolate.
19	Cottonwood	660	1.16	Test confirms large leak is on Cottonwood.
26	Hankin, Hill, 2 nd , 5 th , 3 rd from Hope to Hankin, Hwy 16 south of Hill	1,770	1.75	Large leak but can not confine due to lack of valves or valves not found.
	TOTAL		3.25	

The total leakage identified in the field for the entire distribution system is 3.25 L/s. This is higher than the overnight low flow of 3.0 L/s identified in the draw down test. The remaining flow recorded with the draw down test can be attributed to small continuous consumption, such as leaking cisterns, during testing.

The acceptable leakage and low flow demand for a system of this size is estimated to be 1.0 L/s.

A repair program is required to reduce leakage.

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4. DETAILS OF IDENTIFIED LEAKAGE

This section elaborates on the test results where leakage was measured. The work required to repair or further isolate the leaks is also detailed and the associated costs presented.

4.1 DISCUSSION AND RECOMMENDATIONS

Test No.6 - The tested section runs along Walnut Street between Poplar Street and Woodland Street. The main comprises approximately 185m of 150mm A.C. main. Leakage of 0.17 L/s was identified in this section.

The valve spacing on this section of main meets the requirements of the Village's Subdivision and Development Servicing Bylaw. The next step to identify the exact location of this leak is to expose the valves and service connections on the main and visually check for leaks. This would be a costly exercise for a relatively small leak. Also the asbestos cement pipe used for this main is sensitive to disturbance and any excavation of the fittings could cause cracks in the pipe and result in more leakage.

We recommend no further work be carried out on this section of main at this time. The main should be tested periodically to monitor the leakage rate. Further investigation and repair work should be considered in the future if the leakage rate increased.

Test No.8 - The tested section includes the main along Woodland Street between Walnut Street and Willow Street and the main from the intersection of Woodland and Willow Streets west along Cedar Street to Coalmine Road. The main comprises approximately 500m of 150mm main. We assume this main was constructed with

asbestos cement pipe similar to the adjoining mains. Leakage of 0.17 L/s was identified in this section.

An existing valve located at the south-west end of Willow Street is shown on asbuilt drawings but was unable to be located at the time of the investigation. The valving at the intersection of Woodland and Willow Streets does not allow the Willow Street and Woodland Street main to be tested separately.

The existing valve at the south-west end of Willow Street should be located and repaired if necessary and a new valve should be installed on the 150mm main west of the intersection of Woodland and Willow Streets. This would allow the main to be tested separately in three sub-sections. This will also provide more flexibility for operation of the system in this area. The tee and adjoining valve on Willow Street should be visually inspected for leakage during installation of the new valve.

The estimated cost for this work is as follows:

<u>Locate valve, install valve and retest (2 days)</u>	
Site supervision	\$ 1,000
Labour (1)	\$ 750
Equipment (excavator, packer)	\$ 2,000
Materials (misc.)	\$ <u>1,500</u>
Sub-total	\$ 5,250

This work will repair or further isolate the leak. If the leak is not repaired, further investigation would consist of exposing the valves and service connections on the main and visually checking for leaks. This level of effort is not warranted given the relatively small leak identified. The main should be tested periodically to monitor the leakage rate. Further investigation and repair work should be considered in the future if the leakage rate increased.

Test No.9 - The tested section is a branch running east along Willow Street from the intersection with Spruce Street. The main comprises approximately 200m of 150mm asbestos cement main. Operation of the existing valves at the intersection with Spruce Street do not allow this section of main to be isolated for testing so no leakage rate was determined.

The existing valving needs to be investigated further to identify which main each valve is actually located on and establish they are operating correctly. This is important from an operation and maintenance perspective as well as to facilitate the leak testing. The estimated cost for this work is as follows:

<u>Inspect valves and retest (1 day)</u>		
Site supervision	\$	500
Labour (1)	\$	300
Equipment (excavator, packer)	\$	500
Materials (misc.)	\$	<u>500</u>
Sub-total	\$	1,800

Comparing the draw down low flow and the total leakage found in other sections, we assume the leakage in this section of main will be minimal or non existent. However this work should be completed to ensure the valves are operable for maintenance and emergency purposes.

Test No. 19 - This test section includes the mains along Cottonwood Street from the alley north of Pine Street, across Coal Mine Road to the intersection with Dogwood Street. The main comprises approximately 660m of 150mm asbestos cement main. Leakage of 1.16 L/s was identified in this section. This is a significant leak and must be addressed.

Since completion of the leak detection work, the Village has competed repair of a leaking service in this section. A 19mm

service connection was found to be leaking on private property. This leak has been repaired but no testing has been carried out to confirm the leakage reduction matches that found during the leak detection program. Based on the November 2002 drawdown test results, this repair has likely not eliminated the measured leakage from this section. This section should be retested to determine the need for further work. Further work should proceed as described in the following paragraphs..

Plans from the sanitary sewer project show two valves on this section of main that would allow the main to be tested in three sub-sections. These valves could not be located during the field investigation. The distance between valves on two of the sub-sections exceed the requirements of the Village's Subdivision and Development Servicing Bylaw by approximately 50m. If the leak is isolated into one of these subsections, an additional valve should be installed to further isolate the leak and provide better operational flexibility.

The plans also show a 25mm copper service supplying several houses along Coal Mine Road east of the Cottonwood Street intersection. We can not determine if a valve exists to isolate this service. If the leak is isolated to the sub-section of main that feeds the copper service, a valve should be installed on the copper pipe to facilitate further testing.

Once the leak has been isolated to a smaller section of main, further investigation can continue. This investigation will comprise of excavating down to the valves and service connections on the main and visually checking for leaks. Visual inspection for wet areas and discussions with local residents may provide some insight on which valves or services should be investigated first. The Village service records should be checked to identify any services on the

main that have been abandoned in the past. Abandoned services are often capped at the property line and not shut off at the main. These old services, sometimes of galvanized pipe, deteriorate over time and are a likely source of leakage.

The extent of work required to locate this leak could vary greatly. An allowance of 4 days work for excavation, inspection, backfilling and reinstatement of valves and fittings on the leaking main should be made initially. The estimated cost for this work is as follows:

<u>Locate valves and retest (4 days)</u>	
Site supervision	\$ 2,000
Labour (1)	\$ 1,500
Equipment (excavator, packer, pumps)	\$ 4,000
Materials (misc.)	\$ 3,000
Sub-total	\$ 10,500

Test No. 26 - This test section includes a large number of the mains in the downtown area of the Village. This section includes approximately 1,770m of 150mm and 200mm asbestos cement mains. Leakage of 1.75 L/s was identified in this section. This is a significant leak and must be addressed.

Approximately 13 existing valves could not be located or were inoperable in the downtown area resulting in the large test section. This leak must be isolated further by locating and repairing the existing valves and resting the smaller sections of main. The field crew reported that some valves were buried under asphalt, some had risers filled with gravel and some valves were seized.

Since completion of the leak detection work, the Village has repaired two leaking services in this test section. One 19mm service connection and one 12mm service connection were found to be leaking. These leaks have been repaired but no testing has been carried out to confirm the leakage eliminated matches that found

during the leak detection program. Based on the November 2002 drawdown test results, this repair has likely not eliminated the measured leakage from this section. This section should be retested to determine the need for further work. Further work should proceed as described in the following paragraphs.. The valve location and repair work should be completed to allow proper operation of the system.

The extent of work required in this section could vary greatly. An allowance of 5 days work for excavation, inspection, backfilling and reinstatement of valves and fittings should be made. The estimated cost for this work is as follows:

<u>Locate and repair valves and retest (5 days)</u>	
Site supervision	\$ 2,500
Labour (1)	\$ 1,750
Equipment (excavator, packer, pumps)	\$ 5,000
Materials (misc.)	\$ 5,000
Sub-total	\$ 14,250

This work may repair or reduce any remaining leakage if any of the existing valves are leaking. Once any leakage is isolated into one or several smaller sections of main, further investigation can continue. This investigation will comprise of excavating down to the fittings and service connections on the main and visually checking for leaks. Visual inspection for wet areas and discussions with local residents may provide some insight on which fittings or services should be investigated first. The Village service records should be checked to identify any services on the main that have been abandoned in the past. Abandoned services are often capped at the property line and not shut off at the main. These old services, sometimes of galvanized pipe, deteriorate over time and are a likely source of leakage.

It is difficult to estimate a final repair cost for this section until the scope of the repairs required is defined by the valve repair and retesting work described above. The repair work could range from a single point repair to replacement of a section of main. A contingency amount of \$10,000 should be budgeted to complete a relatively simple repair. A large scale replacement of mains would need to be funded separately at a later time if required.

4.2 COST SUMMARY

The following sections show the estimated costs for the repair and retesting field work and the associated engineering services.

4.2.1 Repair and Retesting

The estimated costs associated with the recommended repair and retesting work is summarised on the following table.

**TABLE 3
ESTIMATED REPAIR COSTS**

Test Section	Location	Estimated Cost
6	Walnut Street (between Poplar and Woodland)	\$ 0
8	Woodland and Cedar Streets	\$ 5,250
9	End of Willow Street	\$ 1,800
19	Cottonwood Street	\$ 10,500
26	Hankin, Hill, 2 nd , 5 th , 3 rd from Hope to Hankin, Hwy 16 south of Hill	\$ 14,250
26	Contingency for additional repairs on Hankin, Hill, 2 nd , 5 th , 3 rd from Hope to Hankin, Hwy 16 south of Hill	\$ 10,000
Sub-total		\$ 41,800
10% Contingencies		\$ 4,200
Total		\$ 46,000

4.2.2 Engineering

Engineering services will be required during the repair and retesting program to provide direction for installation of new valves etc., quality control and gathering as-built information.

The recommended budget required to complete this project is summarised as follows:

Repairs and retesting	\$	46,000
Engineering during repairs and retesting	\$	<u>9,300</u>
TOTAL	\$	55,300

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5. CONCLUSION

The detailed discussion and recommendations in Section 4 present the recommended method to reduce or repair the leakage measured. Repairs and retesting are recommended for all the leaking sections except Test No. 6; a portion of the main along Walnut Street. Locating the minimal amount of leakage in this section is not considered cost effective.

The estimated leakage reduction that could be achieved by successful completion of the recommended repairs is shown on the following table.

**TABLE 5
POTENTIAL LEAKAGE REDUCTION**

Test Section	Location Description	Estimated Leak Reduction (L/s)
6	Walnut Street (between Poplar and Woodland)	0
8	Woodland and Cedar Streets	0.17
9	End of Willow Street	0
19	Cottonwood Street	1.16
26	Hankin, Hill, 2 nd , 5 th , 3 rd from Hope to Hankin, Hwy 16 south of Hill	1.75
Total		3.08

The theoretical leakage reduction from a completely successful repair program is approximately 3.0 L/s. The actual leakage reduction that would be achieved from this program would likely be less than 3.0 L/s. However, successful completion of the recommended repair program would reduce the overnight low flow to within acceptable limits. The 3.0 L/s leakage represents approximately 30% of the current average daily demand in the community.

The Village has eliminated some of the recorded leakage by repairing three leaking service connections in 2002. Further work is still required as detailed in this report to reduce the leakage to within acceptable limits.

The total estimated cost for the recommended repair and retesting program is \$55,300. The Village may be able to achieve some savings by utilising the Village maintenance crew for portions of the work.

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Appendix A

Field Work Reporting

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Appendix B

Figure 1 – Leak Location Plan