BOWSER WATERWORKS DISTRICT

WATER SYSTEM EVALUATION

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EXECUTIVE SUMMARY

The last comprehensive study on the water distribution system was completed in 1996 by C4 Engineering Ltd, although smaller water supply reports have been undertaken up to March 2000.

This Water System Evaluation was commissioned to review previous reports and data, estimate future growth, provide existing system analysis, update the Capital Works Plan, update the Capital Expenditure Cost Bylaw and recommend further studies and steps to be taken to ensure the system will satisfy a growing population.

The ground water supply appears to be sufficient to supply water to a larger population. However, during some summer months wells 1 & 2 do no contribute to the system. To ensure reliability of the system additional well development should be explored. The existing storage volume is sufficient to store Maximum Day Demands for the existing and immediate future population; however, as demand increases additional storage will be required. Currently, the existing storage facility does not have adequate storage for fire flows.

The distribution system has been constructed in stages over the years. The older areas have smaller diameter pipes (100mm to 150mm diameter) and are constructed of Asbestos Cement (AC) pipe. Upgrades have been completed over the years replacing portions of the AC pipe with newer larger diameter Polyvinyl Chloride (PVC) pipe. However, the majority of the system still consists of smaller diameter AC piping. Newer developments have been installing PVC pipe and Fire Hydrants to current Bowser Waterworks District (BWD) standards. The level of fire protection for residential and commercial buildings is poor to non existent in the majority of the District. An upgrade programme has been identified in order to achieve continued domestic demand and if required, to achieve residential fire protection in most areas of the Waterworks District. If the larger commercial fire protection is contemplated, further study would be needed.

This report includes cost estimates to implement the recommendations and a Capital Expenditure breakdown. The total value of Capital Works that would serve existing customers is $1,462,329. The total value of Capital Works that would serve Future Development is $766,183. The Capital Expenditure Charge for a single family residential unit has been recalculated from $2,500 per unit to $4,367 per unit.

This report provides a program to develop the water distribution system over the next 10 to 20 years. Recommended Capital Work projects estimated costs are significant but they need to be addressed to ensure the continued reliable supply of water to the Bowser Water District customers.

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DRAWINGS

1 INTRODUCTION

Bowser is a seaside community located on the east coast of Vancouver Island approximately 75 km north of Nanaimo. The unincorporated community lies within the Regional District of Nanaimo and forms part of Electoral Area "H".

Water to the community is currently supplied by the Bowser Waterworks District (BWD). The BWD borders the Qualicum Bay / Horne Lake Water District to the east and the Deep bay Water District to the west. The water system serves approximately 293 residential and 15 commercial customers. The water system takes its supplies from the Quadra Sand Aquifer (which underlies most of the Bowser Area) by a series of four (4) wells (two dug and two drilled). Refer to Figure 1.1- Computer Model and Node Plan for existing system information and Water District Boundaries.

The last comprehensive study on the water distribution system was completed in 1996 by C4 Engineering Ltd. A ground water hydrology study was completed in 1998 by Pacific Hydrology Consultants Ltd to evaluate the capacity of the existing well sources. Most of the recommendations made by these studies have been implemented.

The Bowser area has experienced growth over the last several years. Further growth in water service connections are anticipated in the future.

As part of planning for the future, the Bowser Waterworks District has commissioned McElhanney Consulting Services Ltd to complete a Water System Evaluation. This study provides a review of previous reports and data, estimates on future growth, existing system analysis, updates to the Capital Works Plan, updates to the Capital Expenditure Cost Bylaw and recommendations for further studies and steps to be taken to ensure the system will satisfy a growing population.

2 PREVIOUS REPORTS

The following is a list of known studies or reports that have been prepared for the BWD over the years:

- Water Study, C4 Engineering Ltd, September 1996
- Groundwater Hydrology Study of the Bowser Area, Pacific Hydrology Consultants Ltd, March 1998.
- Analysis of March 2000 Tests On Well No.3, Payne Engineering Geology, March 2000.
- Design Standards & Construction Specifications Manual, McElhanney Consulting Services Ltd, July 2005 (updated 2008).

3 EXISTING SYSTEM

3.1 WATER SUPPLY

Water supply for the Bowser Water System is provided by four (4) wells that are located on the south side of Crosley Road (approx. 520m west of Crosley and Jamieson Rd intersection). The BWD has installed fencing around the reservoir and wells for protection; however, due to the location the wells and reservoir are still easily accessible by foot. Water from these wells is either gravity fed or pumped into an existing below ground concrete storage facility.

Wells are summarized in Table 3.1 below.

Table 3.1 – Bowser Water District – Water Wells

Description	Location	Year	Yield (l/sec)
Well #1 & 2	± 15m south of Crosley Rd	1963	10.8 (205,257 Igpd)
Well #3	± 95m south of Crosley Road	1991	13.25* (251,821 Igpd)
Well #4	± 220m south of Crosley Road	2003	9.09* (172,758 Igpd)

*Yield based on recent (2008) pumping tests performed by BWD staff.

In April 2008 Well # 3 was redeveloped by Anderson Water Wells. During summer months wells #1 & 2 have inconsistent production. Generally the artesian characteristics of these wells is absent during dry summer months.

Since wells #1 & 2 may not contribute water during certain periods, they have been removed from the total yield of the system for the purpose of calculation during peak demand. The total combined yield of the system during the "worst case" conditions is therefore estimated as 22.34 l/sec (424,579 Igpd).

Refer to Figure 1.1 –Computer Model Pipe and Node Plan for existing system information.

3.2 WATER TREATMENT

Currently, the raw water supplied to the Bowser Water System is untreated. As part of the Groundwater Hydrology Study prepared in 1998 by Pacific Hydrology Consultants Ltd (PHCL) some chemical analysis was performed on a sample taken from Well #3 and compared with existing samples from the surrounding areas. PHCL found that *"All of the of these analyses show that the groundwater from the Quadra Sand aquifer in the Bowser- Deep Bay area is soft and relatively low in dissolved mineralization. The groundwater is of generally excellent chemical quality for its intended use as a source of domestic water and the water can be used without treatment".*

The BWD samples water from the system twice month for Bacteriological Indicators. Samples are generally taken from locations on north and south sides of the system. Chemical and Physical parameters are tested on a yearly basis.

3.3 WATER STORAGE

The existing water storage system consists of a single 409,150 litre (90,000 Igal) below ground concrete reservoir. The structure is located on the south side of Crosley Road approximately 520m west of the intersection of Crosley and Jamieson Road. The future storage requirements of the existing reservoir are outlined in Section 5.1 of this study. As previously mentioned a fence has been constructed around the reservoir and pump house limiting access to the storage area.

3.4 WATER DISTRIBUTION SYSTEM

The Bowser Waterworks District monitors its water consumption with a totalizing meter that is located on the downstream side of the storage reservoir. In addition individual meters are installed on the service connections.

The current distribution system consists mainly of a combination of Polyvinyl Chloride (PVC) and Asbestos Cement (AC) pipe. The majority of the pipes are in the 100mm to 150 mm diameter range. Newer subdivision development has incorporated 200mm diameter pipe and recent upgrades to the Crosley Road supply line consists of 250mm diameter.

PVC pipe is commonly used in modern water system distribution networks. AC pipe went out of common use with the introduction of PVC pipe in the mid 1970's. Many distribution systems still consist of AC pipe and failures tend to be located in these sections due to the age and deterioration of the pipe.

Based on dates of enacted bylaws and the use of AC pipe it is estimated that portions of distribution system are greater than 40 yeas old, however minor upgrades have continued throughout the years "strengthening" parts of the system.

The existing network includes a series of standpipes and fire hydrants. Existing fire hydrant spacing does not generally comply with typically recommend spacing requirements (with the exception of the newly created subdivisions). C4 Engineering Ltd found that *"Many existing standpipes throughout the network are reported to be inoperable, or their shut-off valves inaccessible. The fire chief has stated that they do not use any of the standpipes on this system since they are considered unreliable"*.

3.5 PREVOUSLY IDENTIFIED CAPITAL PROJECTS

The previous 1996 water study prepared by C4 Engineering recommended six (6) capital projects to satisfy future domestic demand requirements and to improve residential fire demand. The following C4 recommendations have not been completed to date:

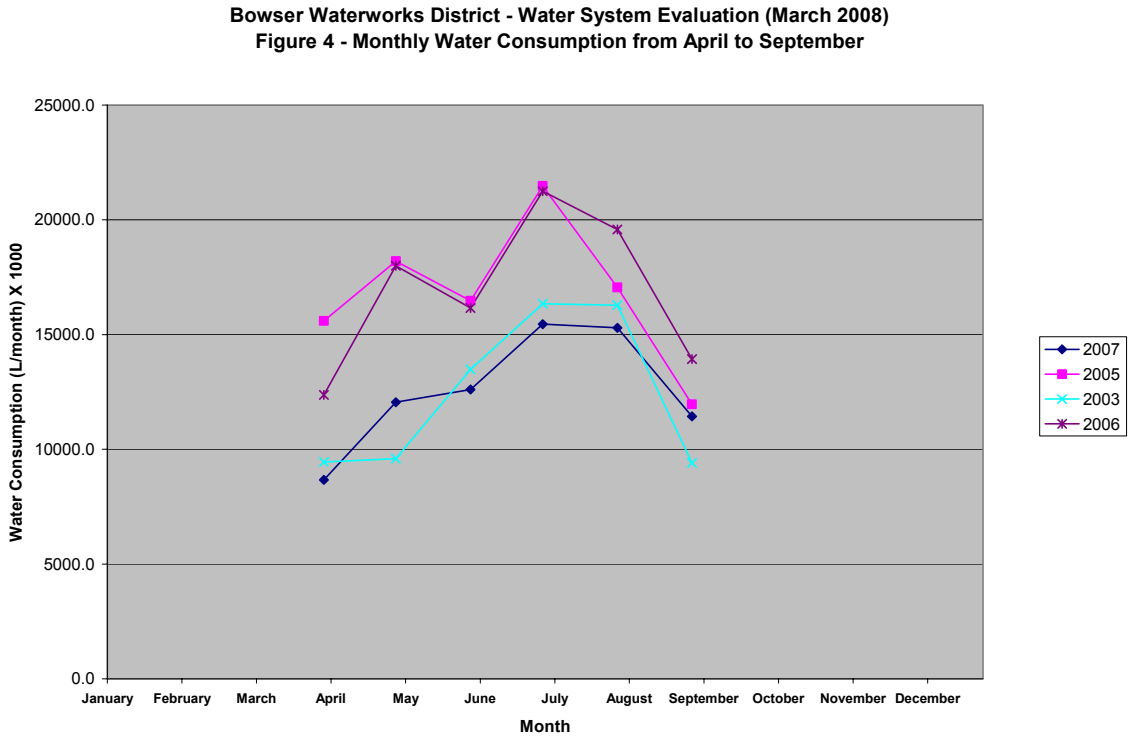
1. Replace existing undersized mains at the following location:
    a. Approx. 230m on Bovanis Rd from Noonday Rd to Henson Rd.
2. Construct a Balancing reservoir with a capacity of 23,000 Igpd and 200mm trunk main.

4 WATER CONSUMPTION

4.1 HISTORICAL WATER USE

All water passes through a meter downstream of the reservoir located on Crosley Road. Flows are recorded daily by a totalizer and manually logged by BWD staff. To determine the existing water consumption pattern of Bowser, flow records were analysed for the following years: 2003, 2005, 2006 and 2007. 2007 was the only year with a complete 12 month record. Previous years records were not complete however, the majority of summer months were available (Individual service connection meter records were not available at the time of this writing). Refer to Appendix "C" for a summary totalizer records.

The manual records for the four years were entered into a spreadsheet for analysis. For the four years of records, daily values were entered for peak months. The results of the analysis are displayed on Figure 4 – Monthly Water Consumption from April to September.



Generally, consumption is lowest from October to May each year. June, July and August have the highest consumption rates due to the increase in lawn and garden water, and increase in tourist traffic.

The maximum daily consumption of 1,016,100 L (223,555 Igal.) was recorded on July 24, 2006. Commercial consumption during July 2006 represents approximately 8.24% of the total. Therefore residential usage was approximately 932,400 L (205,093 Igal.) and commercial was approximately 83,700 L (18,411 Igal.).

System leakage has not been estimated in this study. Estimates can be made by comparing individual service meter readings to the totalizer meter readings.

The population currently served by the Bowser Water District was calculated based on the 2006 Canada Census results. The total population in Electoral Area H (includes Deep Bay, Bowser and adjacent areas to the east) is 3474 persons and total private dwellings (occupied by usual residents) is 1573. The resulting population density for the area is 2.2 persons per dwelling unit. The Bowser Water District currently has 298 residential and 15 commercial customers. We estimate the current population serviced as approximately 689 persons.

Water demand rates in this report have been defined as follows:

Average Day Demand (ADD) is the average daily rate of consumption in a given year. This was calculated based on the daily totalizer records for 2003, 2007 and their estimated populations (2003 and 2007 were the only years with enough recorded data for estimates).

2003: Total consumption = 120,634.6m^3 / 365days / 617persons = 0.5356m^3/c/d
(536 L/c/d)
2007: Total consumption = 132,880.6m^3 /365days / 674persons = 0.540m^3/c/d
(540 L/c/d)
Due to the limited number of complete data years, verification by additional data was not possible. However, based on the calculated results ADD appears to have remained consistent throughout those years.

Maximum Day Demand (MDD) is the rate of consumption for the single highest demand day of the year. This was calculated based on the daily totalizer records for 2006 and subsequent population estimates (July 24, 2006 had the highest record of recorded meter results). Due to the small amount of commercial development, commercial consumption has been added to residential.

2006: Highest daily consumption = 1016.1m^3 / 659 persons = 1.542m^3/c/d
(1542 L/c/d)

MDD provides a good indicator of what the source wells should be able to supply. Generally, communities that rely on groundwater should at a minimum be able to supply MDD with a least one of its wells out of service. It is common to meet Peak Hour Demands with the additional supply coming from storage.

Peak Hour Demand (PHD) is the rate of consumption during the highest demand hour of any day during the year. The BWD does not record hourly water consumption. Therefore, PHD was estimated based on ADD results and then applying peaking factor of 4.0 (as referenced from the BWD Design Standards & Specifications Manual).

PHD = 540 L/c/d (2007) x 4.0 = **2160 L/c/d**

Table 4.1 summarizes current per capita residential demands for the system and the minimum demands as specified by BWD Design Standards and Specifications Manual.

Table 4.1 – Per Capita Residential Demands

Demand Type	Calculated	BWD Standard
ADD	540 L	455 L
MDD	1,542 L	1,135 L
PHD	2,160 L *	1,820 L
* Estimated		

For comparison, the following Table 4.2 shows the typical design standards for municipal water systems on Vancouver Island.

Table 4.2 – Typical Municipal Design Standards

	ADD	MDD	PHD
City of Nanaimo	455 L	1,135 L	1,820 L
Master Municipal Construction Documents	600 L	1,200 L	1,800 L
Capital Regional District	545 L	1,363 L	1,908 L
BWD Calculated Demands	***540 L***	***1,542 L***	***2,160 L***
City of Campbell River	635 L	2,100 L	3,000 L

Calculated BWD demands are generally higher in comparison with typical design standards with the exception of the City of Campbell River (note the City of Campbell River currently does not meter individual service connections). Un-metered connections generally have higher rates of consumption.

The larger BWD MDD could be a result of system leakage or a general higher consumption for the area. If individual service records are evaluated this could refine the consumption rates as well as peaking factors.

4.2 PROJECTED DOMESTIC WATER DEMAND

Projected domestic water demand is based on the growth potential for the Bowser area. Potential for growth is identified by the Regional District of Nanaimo's (RDN) Official Community Plan (Bylaw No. 1335). This bylaw provides a comprehensive set of guidelines and policies for managing existing and future uses of land. Table 4.3 shows the future maximum projected population within the BWD boundaries based on current RDN zoning:

Table 4.3 – Future Population at Current Zoning

Description	Zoning	Area (ha)	Min Site Area (with water & sewer) ha	Project Lots (each)	Pop. Per Unit	Pop. Per Ha	Projected Population (persons)
Residential 2	RS2M	125.395	0.20	627	2.2		1379
Residential 4	RS4M	2.564	0.07	37	1.7		62
Commercial 2	CM2M	1.436	0.05	29		36	52
Commercial 2	CM2D	0.217	0.10	4		36	8
Commercial 4	CM4M	1.802	0.04	18		36	65
Commercial 5	CM5M	7.692	0.40	192		36	277
Rural 1	RU1D	25.210	0.40	63	2.2		139
Rural 1	RU1V	6.643	0.40	17	2.2		37
Public Use	PU1M	5.398	0.04	135	1.7		229
Comprehensive	CD6Z	2.365	0.05	47		36	85
Roads, Rail & Undevelopable	N/A	46.971					
Totals		**225.69**		**1169**			**2333**

Based on the Census Canada historical growth rate of 2.25% the maximum "build out" population would be reached by approximately 2064 (56 years). The number of service connections would be 1,169 (a 380% increase over existing connections).

The date by which future populations will be reached is hard to predict. Targets may be achieved earlier or later, but the projection is considered typical over the long term. However, such development could not be reached without the incorporation of Bowser or the installation of Sanitary Sewers. Additional growth could be seen if the BWD boundaries are expanded. Such analysis is outside the scope of this study. Refer to Figure 1.2 – Zoning Plan for current area zoning.

Projected domestic water demand for the next 20 years has been calculated based on current zoning, current rates of consumption, projected growth and peaking factors.

Population projections are as follows:

- 2008 (Existing) = 689 persons
- 2013 (5yr) = 770 persons
- 2018 (10yr) = 861 persons
- 2028 (20yr) = 1075 persons
- 2048 (40yr) = 1678 persons.

Future total daily domestic water demand is presented in Table 4.4 and includes combined residential and commercial usage.

Table 4.4 – Existing and Future Demand Requirements

Demand Type	**Existing L/day**	**5 YR L/day**	**10 YR L/day**	**20 YR L/day**
ADD	372,060 (81,842 Igal)	415,800 (91,463 Igal)	464,940 (102,273 Igal)	580,500 (127,692 Igal)
MDD	1,062,438 (233,703 Igal)	1,187,340 (261,178 Igal)	1,327,662 (292,045 Igal)	1,657,650 (364,632 Igal)
PHD	1,488,240 (327,367 Igal)	1,663,200 (365,853 Igal)	1,859,760 (409,090 Igal)	2,322,000 (510,769 Igal)

4.3 FIRE PROTECTION

We are advised that historically, the BWD has no mandate to supply fire flow to their customers. The recent BWD design standards indicate new water system distribution piping shall be designed to accommodate fire flow in anticipation that fire flow may be provided in the future.

In the event that the BWD decides to provide fire flows in the future, upgrades to the system should reflect this. Fire flow requirements are typically calculated in accordance with the latest edition of the "Water Supply for Public Fire Protection", published by the Fire Underwriters Survey (FUS). FUS fire flows vary widely depending on building size, construction, exposure etc. As a guide, typical minimum fire flows have been referenced from the Master Municipal Construction Documents Association (MMCD) and generally conform to that of the FUS. They are as follows:

Developments (without sprinklers)	Minimum Fire Flow (l/sec)
Single Family Residential	60
Apartments, Townhouses	90
Commercial	150
Institutional	150
Industrial	225

5 SYSTEM ANALYSIS

5.1 WATER SUPPLY AND STORAGE

Reservoirs or storage facilities are generally designed to accommodate domestic demands, emergency storage and where required fire protection. The total effective storage is based on the following formula:

Total Storage Volume = A+B+C

Where: A = Fire Storage (from Fire Underwrites Survey guide)
B = Equalization Storage (25% of Maximum Day Demand)
C = Emergency Storage (25% of A+B)

The following table lists the required amount of storage based future MDD and fire flow. Current RDN zoning allows for commercial development, therefore fire flows have been separated into Residential and Commercial. A recommended minimum of 150 l/sec at 2.0hr duration was used for commercial storage requirements and a recommended 60l/sec at 1.4hr for residential.

Table 5.1 – Future Storage Requirements

Storage	Existing (L)	5 YR	10 YR	20 YR
Domestic	332,010 (73,032 Igal)	371,043 (81,618 Igal)	414,894 (91,264 Igal)	518,013 (113,947 Igal)
Domestic + Residential Fire	710,013 (156,181 Igal)	749,046 (164,767 Igal)	792,893 (174,412 Igal)	896,016 (197,096 Igal)
Domestic + Commercial Fire	1,682,012 (369,991 Igal)	1,721,045 (378,577 Igal)	1,764,892 (388,222 Igal)	1,868,016 (410,906 Igal)

As seen from the table the existing 409,150 L (90,000 Igal) storage facility is capable of providing sufficient domestic storage for approximately 9 years (2017) before additional storage is needed (based on assumed growth rate of 2.25%). The existing storage facility does not currently have sufficient capacity to satisfy FUS recommended fire flows for residential or commercial developments.

5.2 DISTRIBUTION SYSTEM – COMPUTER MODEL

A water model of the existing BWD distribution system was created in 1996 by C4 Engineering Ltd as part of their original Water Study report. Subsequent to a merge with McElhanney Consulting Services Ltd (MCSL) the model has been maintained and operated by MCSL on behalf of BWD. This computer model was created using a software program called "Water".

The original "Water" software used to create this model is no longer in common use and software support and maintenance is unavailable. The data base was therefore imported into WATSYS for Water Supply version 6.07 by CivilSystems and updated with the most recent subdivision additions and pipes sizes in the system (Refer to Figure 1.1 – Computer Model Pipe and Node Plan).

The water model is a mathematical representation of the distribution system. The accuracy of the model is dependant on the calibration process. Generally, calibration can be performed by on-site flow and pressure test results. The original C4 model was calibrated this way in conjunction with the BOW HORN BAY Volunteer fire department. These results were used to verify the updated model.

The model allows simulation of a variety of different scenarios under several boundary conditions. The system was simulated using "steady state" conditions. Steady state models are generally used to analyze specific "worst-case" conditions and do not take into account reservoir water levels and pump cycling etc.

5.2.1 MODEL SCENARIOS

A series of operational scenarios were modelled to assess the existing system and potential system upgrades. The system conditions were essentially "broken" into two different categories.

The first was to analyze only the supply of domestic water within the BWD boundaries. The following are a list of those model scenarios:

1. Existing Peak Hour Demands (2008)
2. Existing Peak Hour Demands with recommended upgrades
3. Future Peak Hour Demands for 5yr, 10yr and 20yr with recommended upgrades.

The second was to analyze the supply of domestic water and fire flows within the BWD boundaries. The following is a list of those model scenarios:

1. Existing Maximum Day Demands and Residential Fire Flows
2. Existing Maximum Day Demands and Commercial Fire Flows
3. Future (20yr) Maximum Day Demands and Residential Fire Flows

Criteria within the "Bowser Water District Design Standards and Construction Specifications Manual (2005)" were used to determine conditions of the water system. Based on these design guidelines:

- The system must be able to handle the peak hour demand with a minimum allowable pressure in the system of 275 kpa (40 psi) and a maximum velocity of 1.5 m/s in any pipe.
- The system must be able to handle a maximum day demand plus the required fire flow with a minimum allowable pressure in the system of 135 kpa (20 psi) and a maximum velocity of 3.0 m/s.

5.2.1.1 EXISTING PEAK HOUR DEMANDS

The results of the existing domestic Peak Hour Demand (PHD) analysis indicate the residual pressures in the system are generally above the 275 kpa (40 psi) minimum with the exception of the following:

1. The North West portions of the water district (West of Sundry Road) have residual pressures ranging from 11.0 psi to 41.8 psi. These lower pressures are a result of the higher elevation of the area and proximity to the water reservoir.
2. The South End of Noon Day (node 405) has a pressure of 34.8 psi.
3. The South End of Stead Road (node 432) has a pressure of 39.5 psi.

Except for the areas noted above, the overall residual system pressures east of Sundry Road range (node 125 to 434) from 41.2 psi to 74.9psi. For reference refer to Figure 1.1 – Computer Model Pipe and Node Plan.

The Velocities in the trunk main are within the acceptable limits (maximum 1.5 m/s) under existing peak demands with the exception of the following locations:

1. The intersection of Crosley Road and the Island Highway West to the Intersection of Midland Road and the Island Highway West (node 122 to 210). Velocities range from 1.51 m/s to 1.77 m/s. This section of pipe is a 150 mm diameter AC main. As a result, high head losses have been noted in this section during peak flows.

5.2.1.2 EXISTING PEAK HOUR DEMANDS (With recommended upgrades)

The remaining distribution system upgrades recommended in 1996 by C4, have been incorporated into the existing water model with the assumption they are to be completed. The remaining upgrades include:

- Replace existing undersized mains on Bovanis Rd from Noonday Rd to Henson Rd
- Construct a Balancing reservoir and trunk main.

The results of the existing domestic PHD analysis indicate the residual pressures in the system at the North West portion of the Water District (West of Sundry Road) have residual pressures ranging from 11.0 psi to 55.1 psi with the majority still below 40 psi. A minimal increase is noted as a result of the additional reservoir and pipe upgrades; however, due to the higher elevations of the area no signification benefits will be seen. The remaining residual system pressures east of Sundry Road will be increased and range from 46.7 psi to 102.7 psi. This area therefore receives the benefits of the proposed upgrades.

With these improvements, velocities in the trunk main will be within the acceptable limits during peak hour demands.

5.2.1.3 FUTURE PEAK HOUR DEMANDS 5YR

The 5yr potential service population increase for the BWD has been identified in Section 4.2 as approximately 81 persons. With current Regional District Zoning; Bowser has the potential to develop properties throughout the current BWD boundaries. Therefore the potential population service growth has been distributed thought the system at various potential development areas. Refer to Appendix “E” for nodal distribution.

The results of the 5yr PHD generally reflect those of Section 5.2.1.2 and do not indicate any significant residual pressure drops or increases in velocities.

5.2.1.4 FUTURE PEAK HOUR DEMANDS 10YR

The 10yr potential service population has been distributed throughout the area as indicated above. Refer to Appendix “E” for nodal distribution.

The results of the 10yr PHD generally reflect section 5.2.1.3 and do not indicate any significant residual pressure drops or increases in velocity. However, low pressures continue to affect the area west of Sundry Road (Refer to 1.1 Computer Model Pipe and Node Plan).

5.2.1.5 FUTURE PEAK HOUR DEMANDS 20YR

The 20yr potential service population has been distributed throughout the area as indicated above. Refer to Appendix "E" for nodal distribution.

The results of the 20yr PHD indicate a continued minor pressure drop throughout the system and a minor increase in pipe velocities. Residual pressures in the system at the North West portion of the Water District (West of Sundry Road) have residual pressures ranging from 11.0 psi to 54.4 psi with the majority still below 40 psi. The remaining residual system pressures east of Sundry Road vary from 54.8 psi to 98.7 psi.

5.2.1.6 EXISTING MAXIMUM DAY DEMANDS AND RESIDENTIAL FIRE FLOWS

Simulations were conducted to assess the system with the existing service population to determine what fire flows are available.

The existing storage and distribution system cannot supply adequate fire flows throughout the service area. The proposed balancing reservoir will dramatically increase the capability of the system to supply fire flows. Therefore, the fire flow simulations are only considered with the addition of the balancing reservoir. Simulations were completed with fire flows at 30 l/s and the Fire Underwriters Survey target of 60 l/s.

The system was modelled for MDD and Residential Fire Flows at ten (10) locations. Refer to Appendix "E" for a summary of observations. Generally areas where fire flows are available are limited to less than 30 l/s with the balancing reservoir in service.

5.2.1.7 EXISTING MAXIMUM DAY DEMANDS AND COMMERCIAL FIRE FLOWS

Currently, the majority of commercially zoned areas are West of East Downe Road with several small parcels to the East. The system was modelled for MDD and Commercial Fire Flows at six (6) locations through out the system. Refer to Appendix "E" for a summary of observations noted.

The model indicates that fire flows available for the areas are insufficient to meet the MMCD and FUS target of 150 l/s for commercial zoning. Major trunk mains and branch upgrades to the system would be required from the existing and proposed reservoirs to the potential commercial development areas. Depending on the type of structure having sprinkler requirements for commercial types of buildings could reduce the required fire flow by up to 50%.

5.2.2 MODEL SUMMARY

The system can provide some existing Peak Hour Demands. However, there are low pressures and high velocities in areas of the distribution system. Future 20 yr domestic service can be supplied with some upgrades to the system.

The addition of the Balancing reservoir and 250mm distribution main near the south end of the BWD dramatically improves the domestic residual pressures and reduces the velocities for the majority of the distribution system (refer to Figure 1.3 – Proposed Distribution System Upgrades).

The West portion of the distribution system (west of Sundry Road / node 124) is a low pressure area due to the topography and proximity to the existing reservoir.

The system cannot currently deliver FUS target residential or commercial fire flows. The addition of the balancing reservoir helps, but major upgrades are required to the distribution system to meet minimum FUS requirements.

6 CONCLUSIONS

1. Based on recent Bowser Waterworks pumping results and information provided in the 1998 Pacific Hydrology Consultants Ltd (PHCL) study, the ground water supply appears to be adequate for the foreseeable future. Currently, the demand is at 55% of the yield of wells 3 & 4.

2. Well 3 has sufficient yield to provide MDD for the community, however it would be operating at 93% capacity. Should well 3 not be in service due to repair, power outage or maintenance, demand could not be met with only well 4 in service. Pump hours indicate that during certain peak periods both wells are in operation. Within 5years well 3 will not have sufficient yield to supply the increase in domestic demand. This may be accelerated due to unknown system leakage, yet to be determined.

3. The wells and reservoir are easily accessible to the public. However, they are protected by chain link fencing.

4. PHCL found water quality to be good. BWD has not indicated any negative sampling results. No water treatment currently is being applied or deemed required.

5. Average water consumption per user is comparable to other communities however consumption is higher during peak periods. This is likely due to larger lots and irrigation demand.

6. Existing totalizer data records are inconsistent. Improvement is needed in recording and reporting in order to assist in evaluating system losses and other system characteristics.

7. Based on the storage equation in Section 5, there is sufficient storage in the existing reservoir for domestic use. Currently, approximately 81% of the reservoir is being utilized for domestic storage. Should a well pump become inoperable, there may not be sufficient emergency storage in the tank to continue to supply peak demand. Emergency storage will decrease as future demand continues to increase.

8. Approximately 40% of the existing distribution piping is AC. The majority of which is located in the primary distribution main running parallel to Hwy 19A. High maintenance sections have not been reported to date however; this may become an issue in the future as the pipe continues to deteriorate with age.

9. Computer modelling of the existing distribution system has indicated relatively high velocities and large head losses in some areas due to small pipe diameters and minimal looping.

10. Residual pressures during peak demands west of Sundry Road and near Stead Road are recorded as being below the desired minimum 276 kpa (40 psi). These are generally due to the higher elevation. In these localized areas, a small booster pump could be considered if pressures become undesirable. Some properties in the Callow Road currently have individual booster pumps to address these issues.

11. The water system is linear in nature, meaning a single main distributes most of the water to the eastern most end of the water district. Shut down of the main for maintenance or repairs could disrupt service for a large portion of the users downstream.

12. Generally, the BWD cannot achieve sufficient flow for residential or commercial fire protection in accordance with the FUS guidelines.

13. The existing storage is insufficient for fire protection or emergency use. Additional storage at the south west portion of the BWD could address these issues.

14. The last study of the aquifer and well performance was completed 10 years ago and well and aquifer performance may have changed since that time. An updated investigation would provide some level of assurance of long range performance of the aquifer and wells to meet anticipated demands.

7 RECOMMENDATIONS

Based on our observations and computer modelling of the system, the following improvements to the system are recommended:

1. Continue to record totalizer readings on a daily basis through out the year. All metre readings (totalizer and individual services) need to be recorded in such a manner that they can be easily used and reviewed. This can be accomplished by using a digital spreadsheet type system. A review of system demands and leakage needs to be performed once several years of complete data has been recorded.

2. Undertake a preliminary design of a balancing reservoir at the south end of the water district with the capacity for residential fire flow (**Project G-1**). Projects have been denoted with a "G" indicating general upgrades. The addition of a balancing reservoir would benefit the system in the following ways:
   - Provide additional emergency storage.
   - Provide storage for fire protection.
   - Increase pressures for the majority of the system.
   - Minimize disruption of service to users due to repair or maintenance, since water can be fed from reservoirs at each end of the system.

   A detailed topographic survey of the proposed area will determine a preferred location of the reservoir for acquisition of the property. In addition, reservoir cost estimates can be refined from the preliminary design.

   To receive the full benefits of the balancing reservoir the following distribution system upgrades are suggested:

   - **Project G-2:** Upgrade Bovanis Road. Replace the existing 100 diam. AC main on Bovanis Road from Noonday Road to Henson Road with a 200 diam. PVC main (approximate length 230m)
   - **Project G-3:** Upgrade Noonday Road. Replace the existing150 diam. PVC main on Noonday Road to Highway 19A with a 250 diam. PVC main (approximate length 330m).

   Refer to Figure 1.3 – Proposed Distribution System Upgrades.

3. Upgrade the distribution system to provide residential fire protection where feasible. If commercial fire protection is required, additional study is recommend. The balancing reservoir and Noonday Road upgrades would need to be installed for storage and distribution. The following additional upgrades would be required to achieve residential fire flows in the majority of

the system (projects have been denoted with a "F" indicating fire flow related):

- **Distribution System Upgrades (south)**
  - **Project F-1:** Upgrade existing 150mm to 200mm diameter piping at the intersection of Noonday Road and Highway 19A (approximate length 65m).
  - **Project F-2:** Upgrade existing 150mm to 200mm diameter piping on Stead Road from Noonday to Islewood Place (approximate length 420m).
  - **Project F-3:** Add new 200mm diameter on Noonday Road from Highway 19A to Bovanis Road (approximate length 80m).

- **Distribution System Upgrades (middle of BWD)**
  - **Project F-4:** Upgrade existing 100mm to 200mm diameter piping on McColl Road from Highway 19A to Wildwood Road (approximate length 200m).
  - **Project F-5:** Upgrade existing 150mm to 250mm diameter piping on Crosley Road under Highway 19A (recommend upsizing to 250mm diameter to ensure no future crossing of Highway is required). Approximate length 80m.
  - **Project F-6:** Upgrade existing 150mm to 200mm diameter piping on Highway 19A from Crosley Road to Sundry Road (approximate length 120m).
  - **Project F-7:** Upgrade existing 150mm to 200mm diameter piping on Highway 19A from Sundry Road to Esary Road (approximate length 470m).
  - **Project F-8:** Loop existing 150mm PVC on Lambert Lane to proposed 200mm diameter piping on McColl Road (approximate length 130m).
  - **Project F-9:** Upgrade existing 150mm to 200mm diameter piping on Highway 19A from Coburn Road to Midland Road (approximate length 200m).
  - **Project F-10:** Upgrade existing 100mm to 200mm diameter piping on Bowser Road from Highway 19A to Garrod Road (approximate length 185m).

Refer to Figure 1.3 – Proposed Distribution System Upgrades.

4. Adopt a policy of looping of the distribution system where feasible as development continues.

5. Replace troublesome AC mains as funds are available.

6. Revise By-Law No.100 (Capital Expenditure Charges) to incorporate recommended system upgrades. Refer to Section 9 for cost estimates and updated land use charges.

7. Retain a groundwater hydrologist to review well performance, aquifer performance and development of additional wells (**Project G-4**). There is some risk that during summer months wells 1 & 2 would not contribute to the system and well 3 could out of service for repair. If this combination of events were to happen, the lone well #4 could not supply peak day demand.

8 SCHEDULING

Scheduling for upgrades has been focused on maintaining and strengthening the system to continue to supply domestic water and move towards improving residential fire flows.

Priority (1-5 years)

PROJECT G-1: Balancing Reservoir. The construction of the balancing reservoir will provide the following immediate system improvements:

- Increase pressures during peak demand.
- Provide emergency supply during a well pump malfunction.
- Significantly improve service during shut down of watermain during a main break or maintenance.
- Improve the ability to supply fire flows and improve residual pressures during a fire event.

PROJECT G-2: Upgrade Bovanis Road (200mm). The upgrade of the Bovanis will improve overall system looping and performance as well as providing the infrastructure for fire flows in the eastern portion of the water district.

PROJECT G-3: Upgrade of Noonday Road (200mm). The upgrade of the Noonday Road main will maximize the benefits of the Balancing Reservoir as this will be the main feeder line for the eastern area.

PROJECT G-4: Aquifer and Well Study. It has been 10 years since the original PHCL Groundwater Hydrology Study has been completed. Since this time well #3 has been redeveloped and the addition of a fourth well has been incorporated into the system. As development increases an updated Groundwater Hydrology Study needs to be completed to ensure continued integrity of the aquifer and wells.

Priority (5-10 years)

Distribution System Upgrades (east end of BWD). Fire upgrades should be implemented after the construction of the Balancing Reservoir. However, any upgrades will ultimately

benefit system performance. Projects to be constructed in the following priority (refer to Section 7 for detailed description):

- **Project F-1:** Noonday Road and Highway 19A – 65m of 200mm diameter.
- **Project F-2:** Stead Road to Islewood Plc. – 420m of 200mm diameter.
- **Project F-3:** Noonday to Bovanis – 80m of 200mm diameter.

Distribution System Upgrades (Middle of BWD). Projects to be constructed in the following priority (refer to Section 7 for detailed description):

- **Project F-5:** Crosley Road under Highway 19A – 80m of 250mm diameter.
- **Project F-6:** Crosley Road to Sundry Road – 120m of 200mm diameter.
- **Project F-7:** Sundry Road to Esary Road – 470m of 200mm diameter.
- **Project F-9:** Coburn Road to Midland Road – 200m of 200mm diameter.
- **Project F-10:** Bowser Road – 185m of 200mm diameter.
- **Project F-4:** McColl Road – 200m of 200mm diameter.
- **Project F-8:** Lambert Lane Loop – 130m of 150mm diameter.

9 CAPITAL EXPENDITURE PROGRAM

A local improvement district has several options to fund Capital Works projects (refer to Appendix "B" for a summary of funding options available). Funding options are generally divided into two types of projects:

- Type "A" – Projects required to serve existing customers; and,
- Type "B" – Projects required to serve future development

The following Table 9.1 shows a summary, and Cost Estimate appropriation:

Table 9.1 – Cost Estimate Appropriation

Project Description	Type "A" Existing	Type "B" Growth
G-1: Balancing Reservoir & Feeder Line	$ 513,257	$ 287,543
G-2: Undersized Mains Upgrades	$ 121,394	
G-3: Upgrade of Noonday Road	$ 80,680	$ 45,199
G-4: Aquifer and Well Study		$ 14,950
Distribution System Upgrades (east) **F-1:** Noonday & Highway 19A **F-2:** Stead Road (Noonday to Islewood) **F-3:** Noonday Road (Hwy 19A to Bovanis)	 $ 25,996 $ 120,608 $ 34,112	 $ 14,563 $ 67,568 $ 19,110
Distribution System Upgrades (middle) **F-4:** McColl Road **F-5:** Crosley Road (under Hwy 19A)	 $ 50,832 $ 44,364	 $ 28,478 $ 24,855

Project Description	Type "A" Existing	Type "B" Growth
F-6: Highway 19A (Crosley to Sundry)	$ 45,802	$ 25,659
F-7: Highway 19A (Sundry to Esary)	$ 195,097	$ 109,300
F-8: Lambert Lane Loop	$ 58,575	$ 32,815
F-9: Highway 19A (Coburn to Midland)	$ 95,532	$ 53,520
F-10: Bowser Road (Hwy 19A to Garrod)	$ 76, 080	$ 42,623
Total	**$ 1,462,329**	**$766,183**

A detailed cost "break down" has been included in Appendix "B". Please note that land acquisition costs have not been included in the cost estimate for project G-1. It is assumed at this stage that BWD will secure a "License to Occupy" from the Crown.

Table 9.2 below shows the detailed 5yr Capital Plan breakdown for the initial recommended works.

Table 9.2 – 5yr Capital Plan

Project	2008	2009	2010	2011	2012
G-1: Balancing Reservoir • Design & Engineering • Construction	$85,800	$715,000			
G-2: Bovanis Road • Design & Engineering • Construction			$15,834	$105,560	
G-3: Noonday Road • Design & Engineering • Construction				$16,419	$109,460
G-4: Aquifer & Well Study					$14,950
Total:	**$85,800**	**$715,000**	**$15,834**	**$121,979**	**$124,410**

The above 5yr capital plan identifies a typical design and construction plan however; it can be revised to suit the availability of funds.

Proposed Capital Expenditure Charges (CEC) have been prepared to suit each development type as defined in By-law No. 100 Schedule "A". Similar logic was followed when calculating the categories as originally used.

Proposed CEC fees incorporate the 20yr development population and are as follows:

Population 2008 = 689 persons
Population 2028 = 1075 persons
Population Increase = 386 persons

CEC per person = $766,183 / 386 persons = $1985 per person

Residential

Single Family = $1985 x 2.2ppu = **$4367 per unit**

Residential Strata = $1985 x 1.8ppu = **$3573per unit**

Multiple unit residential = $4367 / 2500* = increase of 75%
= $15sqm* x 1.75 = $26.25 per sqm. **Say $27.00 per sqm.**

Commercial

Mobile Home Park = $1985 x 1.8ppu = **$3573 per unit**

Resort Condominium or Co-op occupied on seasonal basis
= $1985 x 2.2ppu x 50% = **$2184 per unit**

Campground or Recreational Vehicle Park
= $1985 x 2.2ppu x 25% = **$1092 per site**

Commercial building or shopping centre
= $4367 / $2500* = increase of 75%
= $10sqm* x 1.75 = $17.50 per sqm**. Say $18.00 per sqm.**

Industrial = $4367 / $2500* = increase of 75%
= $6sqm* x 1.75 = $10.50 per sqm. **Say $11.00 per sqm.**

Institutional = $4367 / $2500* = increase of 75%
= $8sqm* x 1.75 = **$14.00 per sqm.**

Note: " * " denotes original value as per Schedule "A" By-Law No. 100

10 CLOSURE

This report has been prepared by McElhanney Consulting Services Ltd (the Consultant) for use by the Bowser Waterworks District. The material in it reflects the best judgement of the Consultant in light of the information available to the Consultant at the time of preparation. Any use that any third party makes of the report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. The Consultant accepts no responsibly for damages, if any, suffered by any third party as a result of the decisions made or actions taken based on this report.

Chris Pogson, P.Eng.
Project Engineer

Bob Hoffstrom, P.Eng.
Review Engineer

APPENDIX A

Bowser Water District referenced Bylaws

APPENDIX B

Capital Cost Estimates

&

Summary of Funding Options

Bowser Waterworks District — **McElhanney Consulting Services Ltd**
Water System Evaluation Upgrades — **2231-12820-1**
25-Aug-08

Description	Quantity	Unit	Rate	Extension	
G-1 Balancing Reservoir					
Bolted Steel Reservoir					
Bolted Steel Reservoir	102,000	Igal	$ 2	$ 204,000	
Site Preparation	1	LS	$ 25,000	$ 25,000	
Tank Pipe Pipework	1	LS	$ 25,000	$ 25,000	
250mm Feeder Line	900	LM	$ 260	$ 234,000	
Fittings, Bends, Valve etc	10	Each	$ 2,400	$ 24,000	
Tie-into existing main	1	Each	$ 2,000	$ 2,000	
Railway Crossing	1	Each	$ 30,000	$ 30,000	
Clear & Grubbing	0.4	ha	$ 15,000	$ 6,000	
			Sub total	$ 550,000	
** note land aquistion costs have			Contingency (30%)	$ 165,000	
not been included.			Sub total	$ 715,000	
			Engineering (12%)	$ 85,800	
			Total	**$ 800,800**	**$ 800,800**
G-2 Bovanis Road Upgrade (200mm)					
Sawcut Asphalt	460	m.	$ 7	$ 3,220	
Remove Asphalt	460	s.q.m	$ 8	$ 3,680	
Remove Existing Main	230	m.	$ 10	$ 2,300	
Remove Existing Fittings, valves etc.	1	ea	$ 200	$ 200	
Provide Temporary Service	1	LS	$ 5,000	$ 5,000	
200 mm main	230	m.	$ 200	$ 46,000	
200 mm Gate Valve	2	ea	$ 1,500	$ 3,000	
Asphalt Paving	460	s.q.m	$ 30	$ 13,800	
Tie to existing main	2	each	$ 2,000	$ 4,000	
			Sub total	$ 81,200	
			Contingency (30%)	$ 24,360	
			Sub total	$ 105,560	
			Engineering (15%)	$ 15,834	
			Total	**$ 121,394**	**$ 121,394**

Description	Quantity	Unit	Rate	Extension	
G-3 Distribution System					
Upgrade of Noonday Road					
Remove Existing Main	330	m.	$ 10	$ 3,300	
Sawcut Asphalt	40	m.	$ 7	$ 280	
Remove Asphalt	40	s.q.m	$ 8	$ 320	
Remove Existing Fittings, valves etc.	2	ea	$ 200	$ 400	
Provide Temporary Service	0.5	LS	$ 5,000	$ 2,500	
250 mm main	330	m.	$ 220	$ 72,600	
250 mm Gate Valve	3	each	$ 1,800	$ 5,400	
Asphalt Paving	40	s.q.m	$ 30	$ 1,200	
Tie to existing main	1	ea	$ 5,000	$ 5,000	
Shoulder Gravel	16	cu.m.	$ 60	$ 960	
			Sub total	$ 84,200	
			Contingency (30%)	$ 25,260	
			Sub total	$ 109,460	
			Engineering (15%)	$ 16,419	
			Total	**$ 125,879**	**$ 125,879**
G-4 Aquifer and Well Study					
Ground Water Hydrologist Report	1	LS	$ 5,000	$ 5,000	
On-site Field Equipment	1	LS	$ 5,000	$ 5,000	
			Sub total	$ 10,000	
			Contingency (30%)	$ 3,000	
			Sub total	$ 13,000	
			Engineering (15%)	$ 1,950	
			Total	**$ 14,950**	**$ 14,950**
				Total Cost of Capital Works	**$ 1,063,023**

Estimated costs are derived from recent experience locally, but there is no warranty that actual costs will not vary. McElhanney accepts no liability for actual costs which may vary from the estimated construction costs provided herein.

Bowser Waterworks District — **McElhanney Consulting Services Ltd**
Water System Evaluation Upgrades — **2231-12820-1**
25-Aug-08

Description	Quantity	Unit	Rate	Extension	
F-1 Distribution System Upgrades (south end)					
Noonday & Highway 19A					
Remove Existing Main	65	m.	$ 10	$ 650	
Sawcut Asphalt	40	m.	$ 7	$ 280	
Remove Asphalt	50	s.q.m	$ 8	$ 400	
200 mm main	65	ea.	$ 200	$ 13,000	
200 mm Gate Valve	3	ea.	$ 1,500	$ 4,500	
Asphalt Paving	50	s.q.m	$ 30	$ 1,500	
Tie to existing main	2	ea.	$ 2,000	$ 4,000	
Shoulder Gravel	5	cu.m.	$ 60	$ 300	
Traffic Control	1	LS	$ 2,500	$ 2,500	
			Sub total	$ 27,130	
			Contingency (30%)	$ 8,139	
			Sub total	$ 35,269	
			Engineering (15%)	$ 5,290	
			Total	**$ 40,559**	**$ 40,559**
Stead Road (Noonday to Islewood Place)					
Remove Existing Main	420	m.	$ 10	$ 4,200	
Sawcut Asphalt	406	m.	$ 7	$ 2,842	
Remove Asphalt	406	s.q.m	$ 8	$ 3,248	
Remove Existing Fittings, valves etc.	3	ea	$ 200	$ 600	
200 mm main	420	ea.	$ 200	$ 84,000	
200 mm Gate Valve	4	ea.	$ 1,500	$ 6,000	
Fire Hydrant Assembly	1	ea.	$ 2,500	$ 2,500	
Asphalt Paving	406	s.q.m	$ 30	$ 12,180	
Tie to existing main	3	ea.	$ 2,000	$ 6,000	
Shoulder Gravel	30	cu.m.	$ 60	$ 1,800	
Traffic Control	1	LS	$ 2,500	$ 2,500	
			Sub total	$ 125,870	
			Contingency (30%)	$ 37,761	
			Sub total	$ 163,631	
			Engineering (15%)	$ 24,545	
			Total	**$ 188,176**	**$ 188,176**

	Noonday Road(Hwy 19A to Bovanis Road)						
	Sawcut Asphalt	160	m.	$	7	$ 1,120	
	Remove Asphalt	160	s.q.m	$	8	$ 1,280	
	Remove Existing Fittings, valves etc.	1	ea.	$	200	$ 200	
	Tee - 200mm	1	ea.	$	1,500	$ 1,500	
	200 mm main	80	m.	$	200	$ 16,000	
	200 mm Gate Valve	2	ea.	$	1,500	$ 3,000	
	Asphalt Paving	160	s.q.m	$	30	$ 4,800	
	Tie to existing main	2	ea.	$	2,000	$ 4,000	
	Shoulder Gravel	20	cu.m.	$	60	$ 1,200	
	Traffic Control	1	LS	$	2,500	$ 2,500	
					Sub total	$ 35,600	
					Contingency (30%)	$ 10,680	
					Sub total	$ 46,280	
					Engineering (15%)	$ 6,942	
					Total	**$ 53,222**	**$ 53,222**
F-2	**Distribution System Upgrades (middle)**						
	McColl Road						
	Sawcut Asphalt	10	m.	$	7	$ 70	
	Remove Asphalt	10	s.q.m	$	8	$ 80	
	Remove Existing Main	200	m.	$	10	$ 2,000	
	Remove Existing Fittings, valves etc.	1	ea.	$	200	$ 200	
	200 mm main	200	m.	$	200	$ 40,000	
	200 mm Gate Valve	2	ea.	$	1,500	$ 3,000	
	Asphalt Paving	10	s.q.m	$	30	$ 300	
	Tie to existing main	2	ea.	$	2,000	$ 4,000	
	Shoulder Gravel	15	cu.m.	$	60	$ 900	
	Traffic Control	1	LS	$	2,500	$ 2,500	
					Sub total	$ 53,050	
					Contingency (30%)	$ 15,915	
					Sub total	$ 68,965	
					Engineering (15%)	$ 10,345	
					Total	**$ 79,310**	**$ 79,310**

Crosley Road (under Highway 19A)

Sawcut Asphalt	160	m.	$ 7	$	1,120	
Remove Asphalt	160	s.q.m	$ 8	$	1,280	
Remove Existing Main	80	m.	$ 10	$	800	
Remove Existing Fittings, valves etc.	2	ea.	$ 200	$	400	
250 mm main	80	m.	$ 280	$	22,400	
250 mm Gate Valve	2	ea.	$ 2,000	$	4,000	
Wye Fitting	1	ea.	$ 1,500	$	1,500	
Asphalt Paving	160	s.q.m	$ 30	$	4,800	
Tie to existing main	2	ea.	$ 2,500	$	5,000	
Traffic Control	1	LS	$ 5,000	$	5,000	
			Sub total	$	46,300	
			Contingency (30%)	$	13,890	
			Sub total	$	60,190	
			Engineering (15%)	$	9,029	
			Total	**$**	**69,219**	**$ 69,219**

Highway 19A (Crosley to Sundry)

Sawcut Asphalt	120	m.	$ 7	$	840	
Remove Asphalt	240	s.q.m	$ 8	$	1,920	
Remove Existing Main	120	m.	$ 25	$	3,000	
Remove Existing Fittings, valves etc.	1	ea.	$ 200	$	200	
200 mm main	120	m.	$ 200	$	24,000	
200 mm Gate Valve	1	ea.	$ 1,500	$	1,500	
Tie to existing main	2	ea.	$ 2,000	$	4,000	
Asphalt Paving	240	s.q.m	$ 50	$	12,000	
Shoulder Gravel	10	cu.m.	$ 60	$	600	
Traffic Control	1	LS	$ 2,500	$	2,500	
			Sub total	$	47,800	
			Contingency (30%)	$	14,340	
			Sub total	$	62,140	
			Engineering (15%)	$	9,321	
			Total	**$**	**71,461**	**$ 71,461**

Highway 19A (Sundry to Esary)

Sawcut Asphalt	470	m.	$ 7	$ 3,290		
Remove Asphalt	940	s.q.m	$ 8	$ 7,520		
Remove Existing Main	420	m.	$ 25	$ 10,500		
Remove Existing Fittings, valves etc.	2	ea.	$ 200	$ 400		
200 mm main	470	m.	$ 200	$ 94,000		
200 mm Gate Valve	3	ea.	$ 1,500	$ 4,500		
Fire Hydrant Assembly	2	ea.	$ 2,500	$ 5,000		
Tie to existing main	2	ea.	$ 2,000	$ 4,000		
Asphalt Paving	940	s.q.m	$ 50	$ 47,000		
Shoulder Gravel	40	cu.m.	$ 60	$ 2,400		
Railway Crossing	1	LS	$ 20,000	$ 20,000		
Traffic Control	1	LS	$ 5,000	$ 5,000		
			Sub total	$ 203,610		
			Contingency (30%)	$ 61,083		
			Sub total	$ 264,693		
			Engineering (15%)	$ 39,704		
			Total	**$ 304,397**	**$**	**304,397**

Lambert Lane Loop

Sawcut Asphalt	60	m.	$ 7	$ 420		
Remove Asphalt	45	s.q.m	$ 8	$ 360		
150 mm main	130	m.	$ 150	$ 19,500		
150 mm Gate Valve	2	ea.	$ 1,500	$ 3,000		
Property Restoration	1	LS	$ 5,000	$ 5,000		
Asphalt Paving	45	s.q.m	$ 30	$ 1,350		
Tie to existing main	2	ea.	$ 2,000	$ 4,000		
Property Acquisition	1	LS	$ 10,000	$ 10,000		
Traffic Control	1	LS	$ 2,500	$ 2,500		
			Sub total	$ 46,130		
			Contingency (30%)	$ 13,839		
			Sub total	$ 59,969		
			Engineering (15%)	$ 8,995		
			Total	**$ 68,964**	**$**	**68,964**

Highway 19A (Coburn to Midland Road)

Sawcut Asphalt	400	m.	$ 7	$ 2,800		
Remove Asphalt	600	s.q.m	$ 8	$ 4,800		
Remove Existing Main	200	m.	$ 25	$ 5,000		
Remove Existing Fittings, valves etc.	2	ea.	$ 200	$ 400		
200 mm main	200	m.	$ 200	$ 40,000		
200 mm Gate Valve	1	ea.	$ 1,500	$ 1,500		
Fire Hydrant Assembly	2	ea.	$ 2,500	$ 5,000		
Tie to existing main	2	ea.	$ 2,000	$ 4,000		
Asphalt Paving	600	s.q.m	$ 50	$ 30,000		
Shoulder Gravel	20	cu.m.	$ 60	$ 1,200		
Traffic Control	1	LS	$ 5,000	$ 5,000		
			Sub total	$ 99,700		
			Contingency (30%)	$ 29,910		
			Sub total	$ 129,610		
			Engineering (15%)	$ 19,442		
			Total	**$ 149,052**	**$**	**149,052**

Bowser Road (Highway 19A to Garrod Rd)

Remove Existing Main	185	m.	$	10	$	1,850
Sawcut Asphalt	370	m.	$	7	$	2,590
Remove Asphalt	370	s.q.m	$	8	$	2,960
Remove Existing Fittings, valves etc.	2	ea.	$	200	$	400
200 mm main	185	ea.	$	200	$	37,000
200 mm Gate Valve	4	ea.	$	1,500	$	6,000
Tee Fitting	3	ea.	$	1,500	$	4,500
Fire Hydrant Assembly	1	ea.	$	2,500	$	2,500
Asphalt Paving	370	s.q.m	$	30	$	11,100
Tie to existing main	4	ea.	$	2,000	$	8,000
Traffic Control	1	LS	$	2,500	$	2,500
				Sub total	$	79,400
				Contingency (30%)	$	23,820
				Sub total	$	103,220
				Engineering (15%)	$	15,483
				Total	**$**	**118,703**

	Total Cost of Capital Works	**$ 1,143,062**

Estimated costs are derived from recent experience locally, but there is no warranty that actual costs will not vary. McElhanney accepts no liability for actual costs which may vary from the estimated construction costs provided herein.

SUMMARY OF FUNDING OPTIONS

FUNDING FOR PROJECTS THAT SERVE EXISTING CUSTOMERS

Renewal Reserve Fund

A Renewal Reserve Fund is used primarily for the upgrading, replacement or renewal of existing capital works. The Local Government Act allows these funds to be established under bylaw passed by the Board of Trustees and registered with the Inspector of Municipalities. Funding sources typically include the following:

1. Operating surpluses
2. Budgeted annual contributions
3. Miscellaneous revenue items
4. Sale of assets.

Short Term Borrowing (Temporary)

Short term borrowing is used primarily when unexpected or unplanned expenditures arise that cannot be met with existing funds. In addition, it can be used to interim finance capital projects. The Local Government Act allows the board of trustees to create bylaws for borrowing. The repayment of a loan is secured by the toll and taxing powers of the improvement district. The bylaw is required to be registered with the Inspector of Municipalities.

Long Term Borrowing

Long term borrowing is primarily used to "pay out" interim financing for capital projects approved under short term borrowing. In practice this method of borrowing is arranged through the Municipal Finance Authority (MFA). The Ministry of Community Services will prepare borrowing bylaws and other documentation required by the MFA.

FUNDING FOR PROJECTS THAT SERVE FUTURE DEVELOPMENT

Capital Expenditure Charges

Capital Expenditure Charges CEC are primarily used to fund projects that are required to meet future demand. These types of projects are generally related to growth. The bylaw must be passed by the board of trustees and registered with the Inspector of Municipalities. Bowser Waterworks District has in place CEC By-law No. 100 a copy of which is attached in Appendix "A".

Subdivision Regulation Bylaw

Bowser Waterworks has had in place since 1964 By-law No. 3 "Subdivision Water Regulations By-law". This bylaw requires that any waterworks deemed necessary for subdivision be paid for by the owner of the subdivision. A copy of this bylaw is included in Appendix "A".

Latecomer Charges

If a developer is required to construct oversize works that will benefit adjacent properties a Latecomer's Bylaw may be introduced. This will allow the developer to recoup that additional costs related to the over sizing of those works, however, the process is cumbersome and difficult to administer.

McElhanney

McElhanney Consulting Services Ltd.

SUITE #1, 1351 ESTEVAN RD. PH (250) 716-3336
NANAIMO, BC V9S 3Y3 FAX (250) 716-3339

LEGEND

- WATER DISTRICT BOUNDARY
- 120 WATSYS NODE NUMBER
- (1023) WATSYS PIPE NUMBER

SCALE : 1:5000

0 50 100 200 300 400 m

(ALL DIMENSIONS ARE IN METRES)

BOWSER WATERWORKS DISTRICT

WATER SYSTEM EVALUATION - SEPT 2008

FIGURE 1.1 - COMPUTER MODEL PIPE AND NODE PLAN

Designed: CMP	Checked: –	Date: SEPT 2008	Drawing No. 12820-1
Drawn: CMP	Surveyed: –		
MCSL Project No. 2231-12820-1			Revision: A

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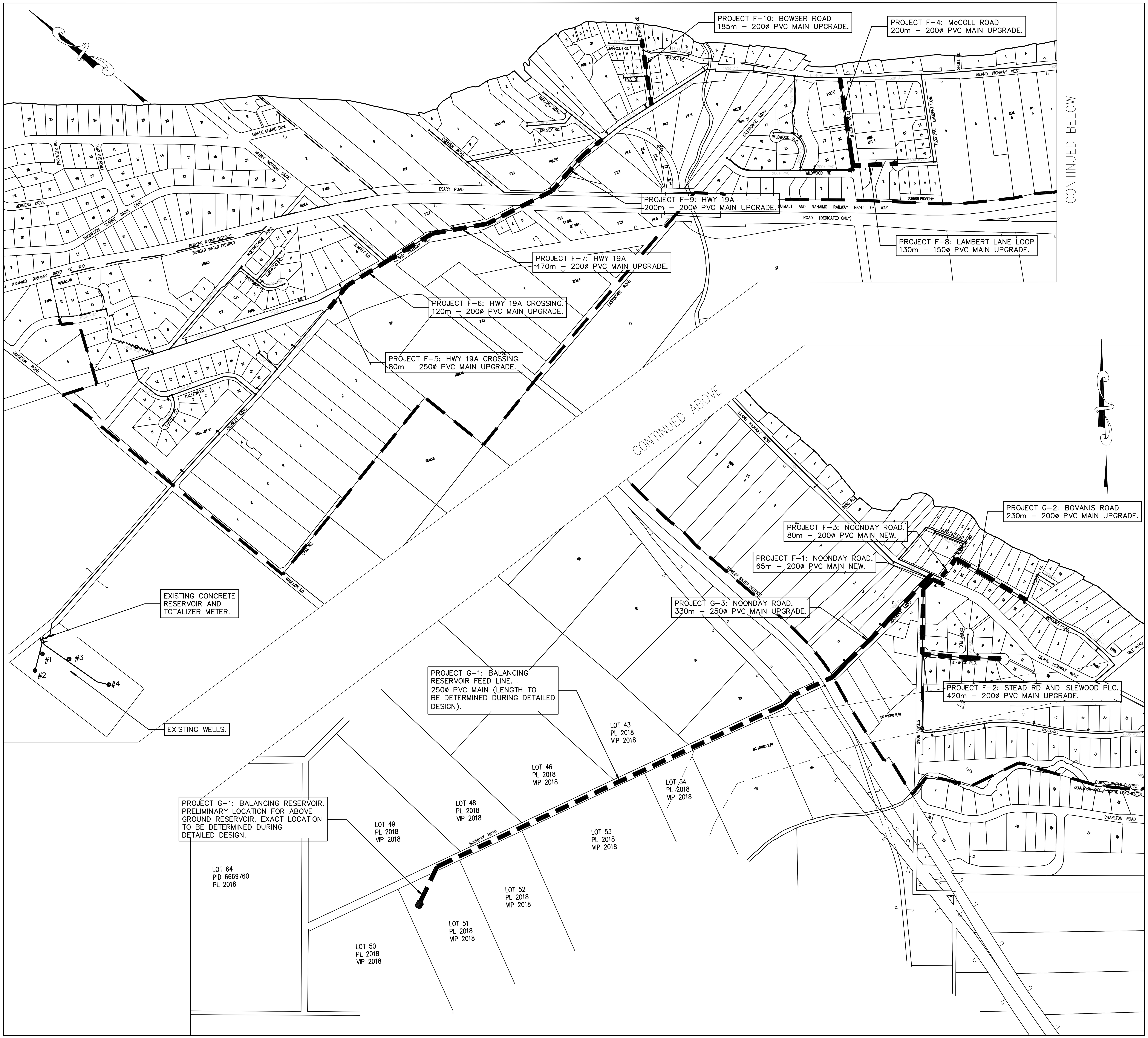
WATER DISTRICT BOUNDARY

ZONING:	DESCRIPTION:
RS2M	RESIDENTIAL 2
RS4M	RESIDENTIAL 4
CM2M	COMMERCIAL 2
CM2D	COMEMRCIAL 2
CM4M	COMMERCIAL 4
CM5M	COMMERCIAL 5
RU1D	RURAL 1
PU1M	PUBLIC USE
CD6Z	COMPREHENSIVE
RU1V	RURAL 1

SCALE : 1:5000
0 50 100 200 300 400m
(ALL DIMENSIONS ARE IN METRES)

BOWSER WATERWORKS DISTRICT
WATER SYSTEM EVALUATION - SEPT 2008
FIGURE 1.2 - ZONING PLAN

Designed: CMP	Checked: –	Date: SEPT 2008	Drawing No. 12820-2
Drawn: RJA	Surveyed: –		
MCSL Project No. 2231–12820–1			Revision: A



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WATER DISTRICT BOUNDARY

SCALE : 1:5000

0 50 100 200 300 400m

(ALL DIMENSIONS ARE IN METRES)

BOWSER WATERWORKS DISTRICT

WATER SYSTEM EVALUATION - SEPT 2008

FIGURE 1.3 - PROPOSED DISTRIBUTION SYSTEM UPGRADES

Designed: CMP	Checked: –	Date: SEPT 2008	Drawing No. 12820-3
Drawn: RJA	Surveyed: –		
MCSL Project No. 2231-12820-1			Revision: A