SUMMARY REPORT

North Okanagan Water Authority

A Service of the Regional District of North Okanagan

Master Water Plan

April 2002

Final Report

EXECUTIVE SUMMARY

The potential advantages of a regional approach to water supply have been discussed for many years. In 1994, this vision was brought to fruition with signing of a Memorandum of Understanding between the three water utilities in the Greater Vernon area – the City of Vernon, the District of Coldstream and the Vernon Irrigation District. Shortly after, the Vernon Irrigation District was dissolved and the assets transferred to a new regional water commission, entitled the North Okanagan Water Authority. In the eight years since the signing of the MOU, work has continued to develop the governance structure and responsibilities for a regional water system strategy – culminating in the completion of this Master Water Plan.

Arriving at this point has not been without its challenges. In addition to the technical and financial issues normally encountered in a master water planning process, the integration of three existing water utilities into a single governance structure was required. It was originally envisioned that the North Okanagan Water Authority would be the body responsible for the supply of bulk water and long-term water system planning for the region. In the latter stages of the MWP, following the redrafting of the Statement of Principles, a new entity that would own all of the water supply and distribution systems was identified.

This entity would be a new agency, termed the Greater Vernon Water Utility (GVWU), operating under the Greater Vernon Services Commission.

1 THE STARTING POINT

Three independent water supply utilities have operated in the Greater Vernon area for nearly a century. The City of Vernon and the District of Coldstream have both operated piped municipal water systems, serving primarily domestic customers within their respective boundaries. The Vernon Irrigation District originally operated an open flume agricultural irrigation system. This was converted to a piped system, supplying both agricultural and domestic customers, in the 1960s.

In the 1970s and 1980s, the Greater Vernon area experienced significant development. The capacity and the availability of piped water to both the valley and upper hillsides allowed water to be supplied at a relatively low cost. In particular, the domestic customer base on the VID system continued to expand through the servicing of new suburban development. In the late 1980s, concerns regarding long-term water quality and the ability of the supplies to meet the future needs of the region were identified. A series of engineering studies concluded that approaching water management on a regional basis would offer a number of synergies and would allow the region to tackle the domestic water quality issue on a more cost effective basis.

2 THE WATER QUALITY QUESTION

The most significant issue facing the water utilities in the Greater Vernon area is the question of domestic water quality. For decades, the water from the main valley lakes and the creeks was considered to be excellent quality – low in colour and turbidity – that only required chlorination to be considered potable. The construction of the piped VID system in the 1960s offered the potential to serve additional domestic customers at low cost. While the water suffered from moderately high colour and occasional high turbidity, it was accepted by the customers and only chlorination was required to meet the regulatory standards of the time for drinking water use.

Unfortunately, this is no longer the case. With increasing development and activity in the watersheds, the levels of pathogenic cysts such as *Cryptosporidium* and *Giardia* in the raw water will likely increase. This is not simply a problem in the Vernon area, but a North American wide problem. While more vigilant watershed management can reduce the problem, the ultimate solution is a higher level of drinking water treatment.

The problem is complicated in the Vernon area by the variety and number of water sources. The fact that the NOWA system provides both irrigation and domestic water adds to difficulty of cost effective water treatment. What appeared to be a low cost supply of domestic water is turning out to be a costly problem. NOWA, however, is not alone. Both the City of Vernon and the District of Coldstream are served by intakes and pumping stations on the shore of Kalamalka Lake. Insufficient space is available for additional water treatment at the existing facilities. Sites for water treatment plants need to obtained and water supply systems reconstructed to allow raw water to be pumped to the water treatment plant sites and treated water to be returned to the distribution systems.

The question to be addressed in the MWP was – how can additional water treatment be provided on a cost-effective basis?

3 THE DO-NOTHING ALTERNATIVE – DOES IT EXIST?

The answer is no – for several reasons.

The first is the issue of domestic water quality. While the risk may be acceptable at the present time, the water quality of the sources will likely continue to decline. If additional water treatment is not implemented, there is a real risk of a water-borne public health problem, such as a *Crypotosporadiasis* outbreak in the coming years.

The second is increasing water demand. The need to increase the capacity of the Kalamalka Lake supply source that serves both the City and the District of Coldstream was identified in the late 1980s. This work has not been carried out due to slower than anticipated growth in the region, the offsetting gains made due to water conservation and the uncertainty due to discussions on regional water. As a result, with water demands now increasing due to growth, the supply capability in the summer months is severely stretched – to the point where a breakdown of pumping equipment during peak summer demand periods could lead to a severe water shortage from the Kalamalka Lake source.

The third reason is the aging of the water system components, particularly in the City of Vernon and the District of Coldstream systems. System replacement or upgrading has been put on hold in a number of instances due to the lack of a long-term plan. Dollars now need to be spent on upgrading water pumping stations and reservoirs and increasing distribution capacity to ensure that the systems meet expected municipal performance and reliability standards.

4 PROJECTED WATER DEMANDS

The serviced residential population of the Greater Vernon area is expected to increase from the current figure of approximately 42,000 to approximately 121,000 over the next 40 years. This tripling of the population will have a significant impact on water management planning. The irrigation land base, on the other hand, will likely see only a slight increase over the 40-year planning horizon.

The annual domestic water use is expected to increase from 8,821 ML to 20,651 ML, over the 40-year period. Maximum day domestic day demands will increase from the current amount of about 56 ML/d, to in the order of 113 ML/d in 2041.

While irrigated land area is expected to increase slightly over the planning horizon, more efficient irrigation practice will keep overall annual irrigation water use at about 14,000 ML. The portion of overall water used for irrigation in the region will decrease from the current level of 55% to 36% by 2041. Maximum day irrigation demands are expected to drop from the current figure of 209 ML/d to about 180 ML/d by 2011. The demand is then expected to rise slightly over the remainder of the planning horizon. This drop reflects the impact of water use efficiency and changing land use.

5 THE REGIONAL WATER CONCEPT

On an average annual basis, about 80% of the water use in the existing NOWA combined system goes to irrigation. The remainder is for domestic use. The quality of water used for potable purposes must be improved to meet the water quality goals. The question is therefore – is it better to treat all of the water or is it better to separate the irrigation and domestic functions and treat only the domestic supply?

The major factor in this decision is cost. This was investigated using an economic analysis technique known as "life cycle costing". The results clearly show that water system separation, to create a domestic water system and an irrigation water system, has a clear economic advantage over the long-term. Based on a 50-year lifecycle cost analysis, the cost to implement and operate a separated water system is about $149 million. The cost for a combined water system, over the same period and providing the same domestic water quality, is about $198 million – some $49 million higher!

The regional water strategy, that has been adopted, is to separate the existing combined water system over the next five years and construct a new water treatment plant in the Middleton Mountain area in the same time frame. This water treatment plant would be supplied by both raw Kalamalka Lake water and raw Duteau Creek water. It will ultimately supply all of the domestic water demands in the Vernon region.

6 WATER SOURCE DEVELOPMENT

Kalamalka Lake and Duteau Creek will be the major water sources over the next 40-years. Kalamalka Lake will serve as a domestic water source only. Duteau Creek will provide both irrigation water and raw water to the treatment plant, primarily during the non-irrigation season.

Deer Creek and groundwater in the Coldstream Valley will continue to be utilized as irrigation sources and as supplemental sources of raw water to the water treatment plant. Other local creeks, where licenses are currently in place, may also play a role in providing local irrigation water. Reclaimed water from the City of Vernon's wastewater system offers a significant potential irrigation water source to offset other irrigation supplies. This would free up additional raw water from the Duteau Creek source to supply the water treatment plant.

The development of Okanagan Lake, as a domestic water supply source, may be required by the end of the 40-year planning horizon.

7 WATER TREATMENT

Domestic water supply to the region will come from a new water treatment plant, termed the Middleton Mountain water treatment plant, located near the Regional District office, on a site yet to be determined. The treatment processes will be housed entirely in a building with clearwell storage provided beneath the process units.

This plant will be in place by 2006. The initial treatment processes will likely include high-rate clarification and ultraviolet/chlorination disinfection. Activated carbon addition and filtration will be added by about 2021 to provide an increased level of treatment and additional process robustness. Final process selection will occur following pilot-testing. The plant capacity will be expanded in stages over the remainder of the planning period to meet the growth needs of the region.

8 DOMESTIC WATER SYSTEM

There are currently over 50 pressure zones in the Greater Vernon area. The Master Water Plan identifies primary and secondary zones. Primary zones are intended to be the long-term pressure zone development goal. Secondary zones exist due to a local topographic constraint or an existing water system component. It is intended that these zones be consolidated with the primary zones over time, based on the zone development strategy contained in the plan.

9 IRRIGATION SYSTEM

The future irrigation system will function in a very similar manner to the original VID irrigation system, constructed in the 1960s. The primary difference is that surplus water will be used as a raw water supply to the new Middleton Mountain water treatment plant.

Based on the low operating cost for the system and the generally good condition of the components, the GVWU should be able to meet the goal of providing irrigation water at a competitive rate. Long term financial planning, however, needs to consider the eventual replacement of irrigation system components.

Reclaimed water will continue to play a role in irrigation in the Greater Vernon area. Additional work and discussion needs to be carried out to explore the degree of integration of reclaimed water with the GVWU system.

10 CAPITAL PROGRAM

Implementation of the Master Water Plan will have a capital cost of $72 million over the next six years. A further $24 million will be spend in the period from 2008 to 2041.

A public information program, pilot-testing of water treatment activities, and preliminary engineering will commence in mid-2002. Design and construction of water treatment works, supply and transmission improvements and water system separation will occur between 2003 and the end of 2007.

A Program Management approach is proposed to implement the new capital works.

11 THE GREATER VERNON WATER UTILITY

The GVWU is proposed as a stand-alone water utility that will service the entire Greater Vernon region (including the City of Vernon, District of Coldstream, and parts of Electoral Areas B, C, and D). GVWU will also provide bulk water under contract to parts of the Township of Spallumcheen. It is proposed that the utility be established as a service of NORD and governed under the Greater Vernon Services Commission. The GVWU will assume the responsibility of supplying and distributing water to both domestic and irrigation customers within the designated service area.

Initially, NORD will enter into contract arrangements with the City of Vernon and the District of Coldstream to perform all operation and maintenance services required on the water system. Current NOWA operations and maintenance staff will transfer their employment to one of the two organizations, based upon criteria to be determined. In the future, other organizational and service delivery strategies may be examined and selected based upon the regional needs that can be evaluated over the long term.

12 FINANCIAL MANAGEMENT

The required capital program creates a significant impact on domestic water rates over the next six years. The actual impact will depend upon the availability of senior government grants. As an example, a "low-moderate" water consumer, such as reflected by a smaller single-family dwelling, currently pays (2002) about $21 per month. With the proposed capital program, this will rise to between $32 and $43 per month by 2007, depending upon the level of senior government funding that is received. The higher value reflects zero grant dollars. After 2007, the rates will tend to flatten out.

The GVWU needs to establish operating, capital and DCC and Regrade reserves. A significant portion (approximately 65%) of the capital program over the next four decades years will be eligible for DCC contributions. It will be a number of years, however, before the DCCs can be collected and, in the interim, carrying charges will be incurred.

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WHAT IS A MASTER WATER PLAN?

A Master Water Plan (MWP), such as this one, is intended to outline in broad terms the long-term strategy for the development and operation of the water supply and distribution system. A Master Water Plan is a planning document that identifies the improvements that are required to meet current and future needs and objectives. Options for water sources, water treatment and transmission system improvements are developed and discussed. The feasibility of these options, from both a technical and economic point of view, is assessed and recommendations as to the best long-term strategy are presented.

1.1 THE STEPS

The exercise to develop a Master Water Plan starts with an inventory of the existing water system. Factors such as capacity and quality of supply, capacity of the transmission system, and age and condition of components are reviewed.

Population projections and official community plans and policies are used to determine population growth and distribution. Existing water demands are determined, and the potential impacts of conservation measures and other factors are used to project future unit demands. From these, the future water demands faced by the utility are estimated. With future water demands known, the adequacy of the existing supply, treatment and transmission system can be assessed for its ability to meet these demands. This assessment can consider many factors including:

- Are existing sources adequate to meet future demands, or will additional sources be required? What opportunities for expanding sources exist?

- Do water supply facilities have sufficient capacity to meet current and future demands?
- Does the water quality adequately protect public health? Is additional water treatment required and what is the timing?
- Does the transmission system have adequate hydraulic capacity; can it get water to where it is needed at sufficient pressure and in sufficient quantity?

Finally, the objectives of the water utility must also be incorporated in the planning process. These objectives may be relatively simple, such as demand management through implementation of water metering, or complex, such as the integration of separate utilities into a new governance structure.

The final product is the Master Water Plan. This will provide direction for all subsequent preliminary engineering work and implementation of projects.

1.2 THE NORTH OKANAGAN WATER AUTHORITY MASTER WATER PLAN

The potential advantages of a regional approach to water supply have been discussed for many years. In 1994, this vision was brought to fruition with signing of a Memorandum of Understanding (MOU) between the three water utilities in the Greater Vernon area – the City of Vernon, the District of Coldstream and the Vernon Irrigation District. Shortly after, the Vernon Irrigation District was dissolved and the assets transferred to a new regional water commission, entitled the North Okanagan Water Authority. In the eight years since the signing of the MOU, work has continued to develop the governance structure and responsibilities for a regional water system strategy – culminating in the completion of this Master Water Plan.

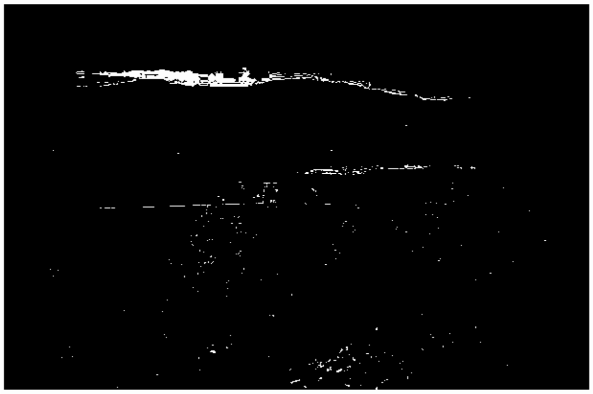
Arriving at this point has not been without its challenges. In addition to the technical and financial issues normally encountered in a master water planning process, the integration of three existing water utilities into a single governance structure was required. Prior to undertaking the development of the Master Water Plan, a number of governance models were developed and debated. Decisions were made and a Statement of Principles developed. Work then started on the Master Water Plan. Part way through the process, however, it became evident that the proposed governance structure was complex and unworkable. Progress on the plan then stopped until a new approach was determined and the Statement of Principles redrafted. The Master Water Plan was then completed.

It was originally envisioned that the North Okanagan Water Authority would be the body responsible for the supply of bulk water and long-term water system planning for the region. The MWP was thus entitled the NOWA Master Water Plan. In the latter stages of the MWP, following the redrafting of the Statement of Principles, a new entity, that would own all of the water supply and distribution systems, was identified. This entity would be new agency, termed the Greater Vernon Water Utility (GVWU), operating under the Greater Vernon Services Commission. The reader should thus be aware of the evolution in the governance structure and the use of the terms, NOWA and GVWU, in the Master Water Plan.

The key objective of the Master Water Plan, is that stated in the original 1994 MOU:

> *To ensure the economical supply and distribution of a sufficient quantity and quality of water in the interests of both the agricultural and non-agricultural users in the Greater Vernon community.*

The Master Water Plan describes the proposed strategy to meet the above objective. This strategy has been developed over a period of about 16 months of technical and financial analysis and considerable discussion with the three water utilities. The issues involved in reaching the end point are very complex. It is not simply a matter of developing a number of options and selecting the best one. Various aspects of water supply planning needed to be examined and interim decisions made in order to build the basis for more detailed technical and economic analysis. The final strategy is thus not a single decision – but a series of informed decisions along the way that leads to a long-term direction.



The Master Water Plan uses the terms "domestic water system, irrigation water system and combined water system". In the context of this plan, "domestic water system" refers to a water system whose primary purpose is to deliver water for domestic or municipal purposes. This type of system thus serves primarily residential, industrial, commercial and institutional customers. A portion of the water in the system is used for lawn watering and other non-potable uses. An "irrigation water system" is defined as a non-potable water system whose primary function is to supply irrigation water to agricultural customers. A "combined water system" is one that combines the functions of a domestic water system and an irrigation water system.

1.3 THE PLANNING HORIZON

The planning horizon for the Master Water Plan is from 2001 to 2041 – a period of forty years. This time frame was selected, as it is sufficiently long to look at the longer-term issues of water supply capacity yet it is still within a reasonable projection period for community development.

Economic analyses for decision making is based on the 40-year period, taking into account the appropriate salvage value of the asset at the end of the period. Financial rate projections are focused on a shorter time frame, 10-years, due to the uncertainty of projections beyond this time frame.

1.4 THE FORMAT

This report is the Summary Report. It accompanies 14 technical working papers that have been developed during the course of the Master Water Plan preparation. The entire volume is termed the Master Water Plan. The working papers are summarized below:

Technical Working Paper No. 1 – Inventory of Existing Systems and Water Demands

Technical Working Paper No. 2 – Review of Financial Considerations and Strategies

Technical Working Paper No. 3 – Community Development and Land Use

Technical Working Paper No. 4 – Water Conservation and Reuse

Technical Working Paper No. 5 – Projection of Water Demands

Technical Working Paper No. 6 – Water Quality Goals

Technical Working Paper No. 7 – Evaluation of Water Supply Sources

Technical Working Paper No. 8 – Evaluation of Water Treatment Needs and Alternatives

Technical Working Paper No. 9 – Development of a Separated Water System Concept

Technical Working Paper No. 10 – Domestic Water System Development

Technical Working Paper No. 11 – Irrigation System Development

Technical Working Paper No. 12 – Options for Long Term Water System Development

Technical Working Paper No. 13 – Implementation

Technical Working Paper No. 14 – Water Rate Strategy

The Summary Report is intended to give the reader a concise overview of the contents of the Master Water Plan. It provides a background discussion and a selected direction on the various water system strategic planning issues. It refers the reader to the appropriate technical working paper for a more in-depth discussion or for technical details.

A chapter synopsis is included in bold, italic font at the end of each of the subsequent chapters. These synopses summarize the key discussion or conclusions of the chapter.

1.5 THE CONSULTANT TEAM

The technical and financial evaluations, the facilitation of meetings and the preparation of the Master Water Plan were carried out by a team of consultants. The principal contributors were:

Rick Corbett - Associated Engineering	Team Leader
Ian Wright - Associated Engineering	Water Treatment Planning
David Main – Earth Tech Inc.	Financial Planning
Bob Hrasko – Earth Tech Inc.	Water Distribution Planning
Mike Nolan – Kerr Wood Leidel Associates	Water Demand Projections

1.6 ACKNOWLEDGEMENT

The preparation and completion of the Master Water Plan has involved ongoing consultation with elected representatives, trustees and senior staff from the various stakeholder groups. Their interest and contributions throughout the process have been both useful and greatly appreciated.

Special thanks go to the Technical Steering Committee and the NOWA Committee for their many hours of review and discussion. The progress meetings provided the opportunity to debate the many issues and provided the opportunity to gain a better

understanding of the sensitivities and concerns of each member utility – enabling the consensus necessary for the preparation of this Master Water Plan.

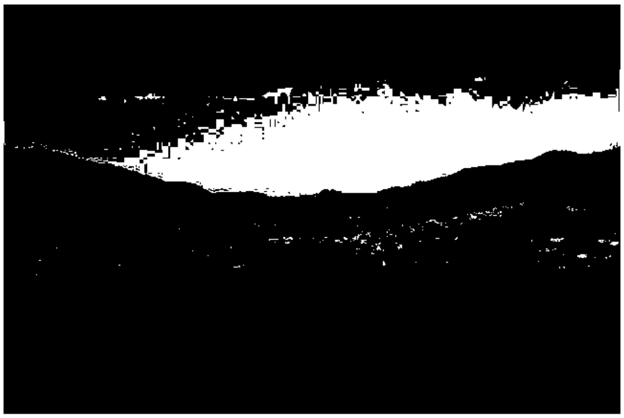
THE EXISTING SITUATION

SECTION 2

Three independent water supply utilities have operated in the Greater Vernon area for nearly a century. The City of Vernon and the District of Coldstream have both operated piped municipal water systems, serving primarily domestic customers within their respective boundaries. The Vernon Irrigation District originally operated an open flume agricultural irrigation system. This was converted to a piped system, supplying both agricultural and domestic customers, in the 1960s.

2.1 REGIONAL WATER – WHY CONSIDER IT?

In the 1970s and 1980s, the Greater Vernon area experienced significant development. The capacity and the availability of piped water to both the valley and upper hillsides allowed water to be supplied at a relatively low cost. In particular, the domestic customer base on the VID system continued to expand through the servicing of new suburban development.


Kalamalka Lake

In the late 1980s, concerns regarding long-term water quality and the ability of the supplies to meet the future needs of the region were identified. A series of engineering studies concluded that approaching water management on a regional basis would offer a number of synergies and would allow the region to tackle the domestic water quality issue on a more cost effective basis.

2.2 THE IMPLEMENTATION PLAN

Discussions on a regional water strategy continued on and off throughout the early 1990s. Following municipal elections in November 1999, there was renewed interest in the formation of a regional water supply at the political level. Discussions recommenced and tentative agreement was reached on a revised governance structure for a regional water concept. A revised Statement of Principles was adopted and the Implementation Plan was finalized in August 2000.

The Implementation Plan provided further detail of the proposed governance structure for the regional concept. The next step was the preparation of a master water plan that would set the "road-map" to upgrade and expand the water systems over the next 40 years. Work on this Master Water Plan (MWP) commenced in November 2000.

2.3 THE EXISTING UTILITIES

The Greater Vernon area, covered by the MWP, includes six political jurisdictions within the North Okanagan Regional District. These include:

- City of Vernon
- District of Coldstream
- Electoral Area B
- Electoral Area C
- Electoral Area D
- Portions of the Township of Spallumcheen.

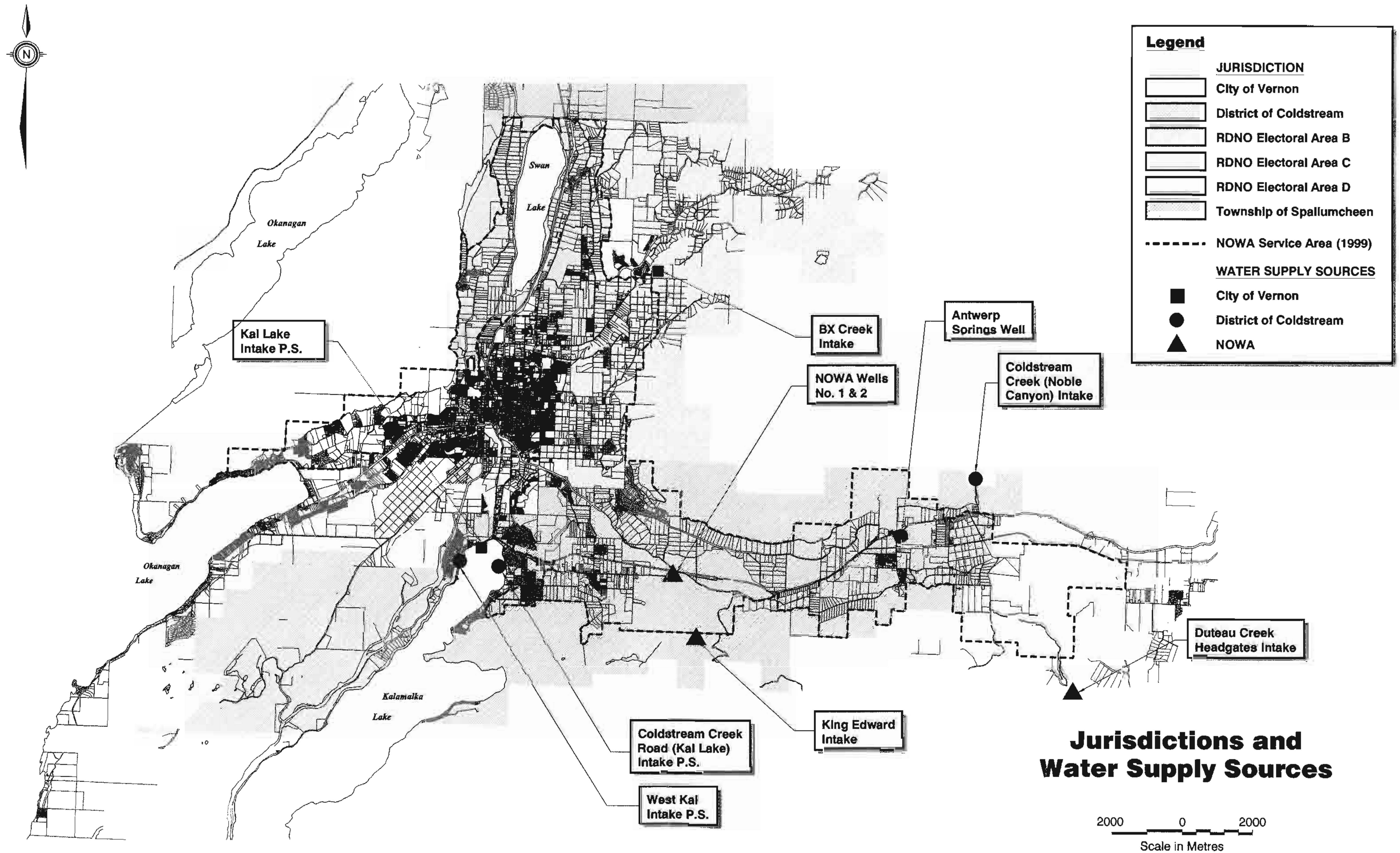
The majority of the area is served by three water utilities: the City of Vernon, the District of Coldstream and the North Okanagan Water Authority. Some residents are supplied by smaller, private water systems or by individual wells or lake intakes. Figure 2-1 shows the boundaries of the political jurisdictions.

The three utilities are described briefly below. The existing domestic and irrigation water customer base, for each utility, are shown in Tables 2-1 and 2-2. Additional details on the existing systems are contained in Technical Working Paper No. 1.

Table 2-1
Regional Water Service Area – Domestic Water Connections

Utility	Number of Accounts[1]		
	Residential	ICI	Total
City of Vernon	11,980	720	12,700
District of Coldstream	1905	20	1925
NOWA	5163	112	5275
Total	19,048	852	19,900

Note 1: Estimated 2001 data.



Jurisdictions and Water Supply Sources

Figure 2-1

Time: 14:51 Date: 2002/2/19 Plot Scale: 1=1 (Paper Space) AutoCAD File: 002121\REPORT\FEB2002\FIG2-1.DWG (ST)
Xrefs: AL-VERNON

Table 2-2
Regional Water Service Area – Irrigated Area

Utility	Irrigated Area [1](ha)
City of Vernon	20
District of Coldstream	2
NOWA	3455
Total	3477

Note 1: Estimated 2001 data. Does not include residential lawn irrigation areas. Note that the City of Vernon also irrigates 970 ha using reclaimed water.

2.3.1 City of Vernon Water Utility

The majority of the City of Vernon is serviced by the City's water utility. This is primarily a domestic water system with a limited number of irrigation connections. There are currently about 12,700 residential and industrial, commercial and institutional (ICI) accounts. The irrigated area supplied by this system is only about 20 ha.

Water supply was historically from Kalamalka Lake, supplemented by BX Creek. The use of the BX Creek supply was terminated in 2000 due to concerns regarding the high levels of the parasite, Cryptosporidium, in the raw water. Water treatment on the Kalamalka Lake supply is limited to chlorination. This supply is also considered to be at risk of parasitic disease transmission due to urban and agricultural drainage entering the lake. Chlorination alone provides little or no barrier to water borne parasitic disease.

The Kalamalka water supply is also currently at its limit. During extended high water use periods in the summer, the pumping station capacity cannot meet the demands. In addition, the annual license capacity is fully committed. The City thus has limited capability to supply water to property owners within the City boundary that are currently supplied from other sources.

2.3.2 District of Coldstream Water Utility

The District of Coldstream water utility is also primarily a domestic water system, supplying about one-half of the District's residential customers (about 1925 residential and ICl connections). The agricultural irrigated area served by this system is only 2 ha. NOWA supplies the majority of the remainder of the District's residential properties, as well as the majority of the agricultural and industrial customers. Some properties also utilize individual wells, surface water intakes or are served by small private water systems.

Historically the Coldstream system has been operated as three independent systems: the Lavington, Coldstream and Kalview systems. The Lavington system, serving about 744 connections in the eastern portion of the valley, is supplied by the Antwerp Springs groundwater well system. The Coldstream and Kalview systems, serving about 1181 connections in the core urban area of the District, both utilize Kalamalka Lake water. The only water treatment provided on the three systems is chlorination. Water quality issues on the water systems that use Kalamalka Lake water are similar to the City of Vernon's water system. The Antwerp Springs groundwater is very hard and the use of home water softeners is required.

Components of the District's water system are fairly old and in some cases do not meet current performance standards. Although the District has additional license capacity on Kalamalka Lake, it is difficult to cost-effectively utilize this capacity due to the fragmented nature of the intake pumping stations.

2.3.3 North Okanagan Water Authority

The present NOWA system is a large, combined irrigation and domestic system that supplies lands within the District of Coldstream, City of Vernon, Electoral Areas B, C and D, and the Township of Spallumcheen. There are currently about 5275 residential and ICI connections. There are about 960 irrigation connections, serving about 3455 hectares.

The NOWA system was originally designed as a gravity irrigation system with seasonal booster pumping to the agricultural land on the valley sides. While it is the "newest" of the three water systems, the nature of the system design presents some limitations in terms of domestic water supply. In a number of upper areas, fire protection may be unavailable during times of power failure.

The system currently operates near capacity during the periods of peak irrigation demand. While NOWA holds unused license capacity on Kalamalka Lake, there are currently no water supply works in place. Utilization of this source would thus require the construction of a new water supply system.

In addition to the above three water utilities, the City of Vernon also operates a reclaimed water system that is solely used for irrigation. The system currently uses secondary quality effluent, coupled with long-term storage to meet a variety of irrigation needs including range land, hay production, silviculture and golf courses. At the present time, approximately 970 hectares are under irrigation. The City is currently upgrading its wastewater treatment system to provide a quality of effluent that will be suitable for direct irrigation without storage.

2.4 EXISTING WATER DEMANDS

Assessment of the adequacy of existing water supplies for long-term use requires an understanding of present water use patterns. Table 2-3 provides a summary of existing domestic and irrigation water demands. Additional water use data is contained in Technical Working Papers Nos. 1 and 4.

Table 2-3
Existing Water Demands - 2001

Parameter (Note 1)	Vernon Water Utility	Coldstream Water Utility	NOWA Water Utility	Total / Average
Average Annual Domestic Water Use (ML)				
Residential	3,850	670	2,642	7,162
ICI	454	11	248	713
UFW	516	82	347	945
TOTAL	**4,820**	**763**	**3,237**	**8,820**
Residential Population (Note 2)	26,350	4200	11,200	41,750
Per Capita Water Use (L/d cap) (Note 3)	400	437	646	470
Average Annual Irrigation Water Use (ML)				
Irrigation Use	73	8	12,575	12,656
UFW	9	1	1,509	1,519
TOTAL	**82**	**9**	**14,084**	**14,175**
Irrigated Area (ha)	20	2	3,455	3,477
Average Irrigation Rate (m/yr) (Note 4)	0.365	0.400	0.364	0.364
Total Annual Water Demand (ML)	4,902	772	17,321	22,995

Notes:

1. Estimated based on 1999 data.
2. Populations shown are estimated serviced populations only. Approximately 10,000 persons in the electoral jurisdictions are served by individual or private community water systems. The average persons per dwelling unit for the region is 2.2.
3. Per capita use is based on residential population and excludes industrial, commercial, and institutional (ICI) and unaccounted for water (UFW) use.
4. Average irrigation rate is based on applied irrigation quantity only and excludes UFW.

The reader should appreciate that while overall water use is measured fairly accurately, the actual split of water use into categories is based on a number of assumptions and calculation methodologies. In particular for the NOWA combined system, there is significant uncertainty in the amount of water used for irrigation versus the water used for domestic purposes due to the lack of metering.

The existing water use data indicates that about 60 % of the overall water demand in going to irrigation use. This figure can fluctuate significantly from year to year, depending upon the amount of rainfall during the irrigation season

2.5 THE WATER QUALITY QUESTION

The most significant issue facing the water utilities in the Greater Vernon area is the question of domestic water quality. For decades, the water from the main valley lakes and the creeks was considered to be excellent quality – low in colour and turbidity – that only required chlorination to be considered potable. The construction of the piped VID system in the 1960s offered the potential to serve additional domestic customers at low cost. While the water suffered from moderately high colour and occasional high turbidity, it was accepted by the customers and only chlorination was required to meet the regulatory standards of the time for drinking water use.

Unfortunately, this is no longer the case. With increasing development and activity in the watersheds, the levels of pathogenic cysts such as *Cryptosporidium* and *Giardia* in the raw water will likely increase. This is not simply a problem in the Vernon area, but a North American wide problem. While more vigilant watershed management can reduce the problem, the ultimate solution is a higher level of drinking water treatment.

The problem is complicated in the Vernon area by the variety and number of water sources. The fact that the NOWA system provides both irrigation and domestic water adds to difficulty of cost effective water treatment. What appeared to be a low cost supply of domestic water is turning out to be a costly problem.

NOWA, however, is not alone. Both the City of Vernon and the District of Coldstream are served by intakes and pumping stations on the shore of Kalamalka Lake. Insufficient space is available for additional water treatment at the existing facilities. Sites for water treatment plants need to obtained and water supply systems reconstructed to allow raw water to be pumped to the water treatment plant sites and treated water to be returned to the distribution systems.

The question to be addressed in the MWP was thus – how can additional water treatment be provided on a cost-effective basis?

2.6 THE DO-NOTHING ALTERNATIVE

Does a "do-nothing" alternative exist? The answer is no – for several reasons.
The first is the issue of domestic water quality. While the risk may be acceptable at the present time, the water quality of the sources will likely continue to decline. If additional water treatment is not implemented, there is a real risk of a water-borne public health problem, such as a *Crypotosporadiasis* outbreak in the coming years.

The second is increasing water demand. The need to increase the capacity of the Kalamalka Lake supply source that serves both the City and the District of Coldstream was identified in the late 1980s. This work has not been carried out due to slower than anticipated growth in the region, the off-setting gains made due to water conservation and the uncertainty due to discussions on regional water. As a result, with water demands now increasing due to growth, the supply capability in the summer months is severely stretched – to the point where a breakdown of pumping equipment during peak summer demand periods could lead to a severe water shortage from the Kalamalka Lake source.

The third reason is the aging of the water system components, particularly in the City of Vernon and the District of Coldstream systems. System replacement or upgrading has been put on hold in a number of instances due to the lack of a long-term plan. Dollars now need to be spent on upgrading water pumping stations and reservoirs and increasing distribution capacity to ensure that the systems meet expected municipal performance and reliability standards.

The goal of the Master Water Plan is thus to develop a long-term strategy to upgrade and expand the existing water systems to meet the needs of both the domestic water user and the irrigation water user in a cost-effective and sustainable manner.

CHAPTER SYNOPSIS

All three water utilities are facing problems with either domestic water quality and system capacity or both. The City of Vernon and the District of Coldstream also have a number of water system components that need replacement due to age or condition. A "do-nothing" alternative does not exist – each utility needs to invest considerable dollars in addressing the water quality and long- term water demand issues.

SECTION 3

EXPECTED COMMUNITY DEVELOPMENT AND LAND USE

Community development and land use changes in the study area have been forecast over the 40-year planning horizon. The reader is referred to Technical Working Paper No. 3 for additional information.

Figure 3-1 indicates projected community development in Greater Vernon, as described in the following sections.

3.1 COMMUNITY GROWTH

The Greater Vernon Settlement Strategy projects that a population of about 140,000 could be accommodated in the Greater Vernon area. The report, completed in 1996, concluded that this population could be reached in about five decades.

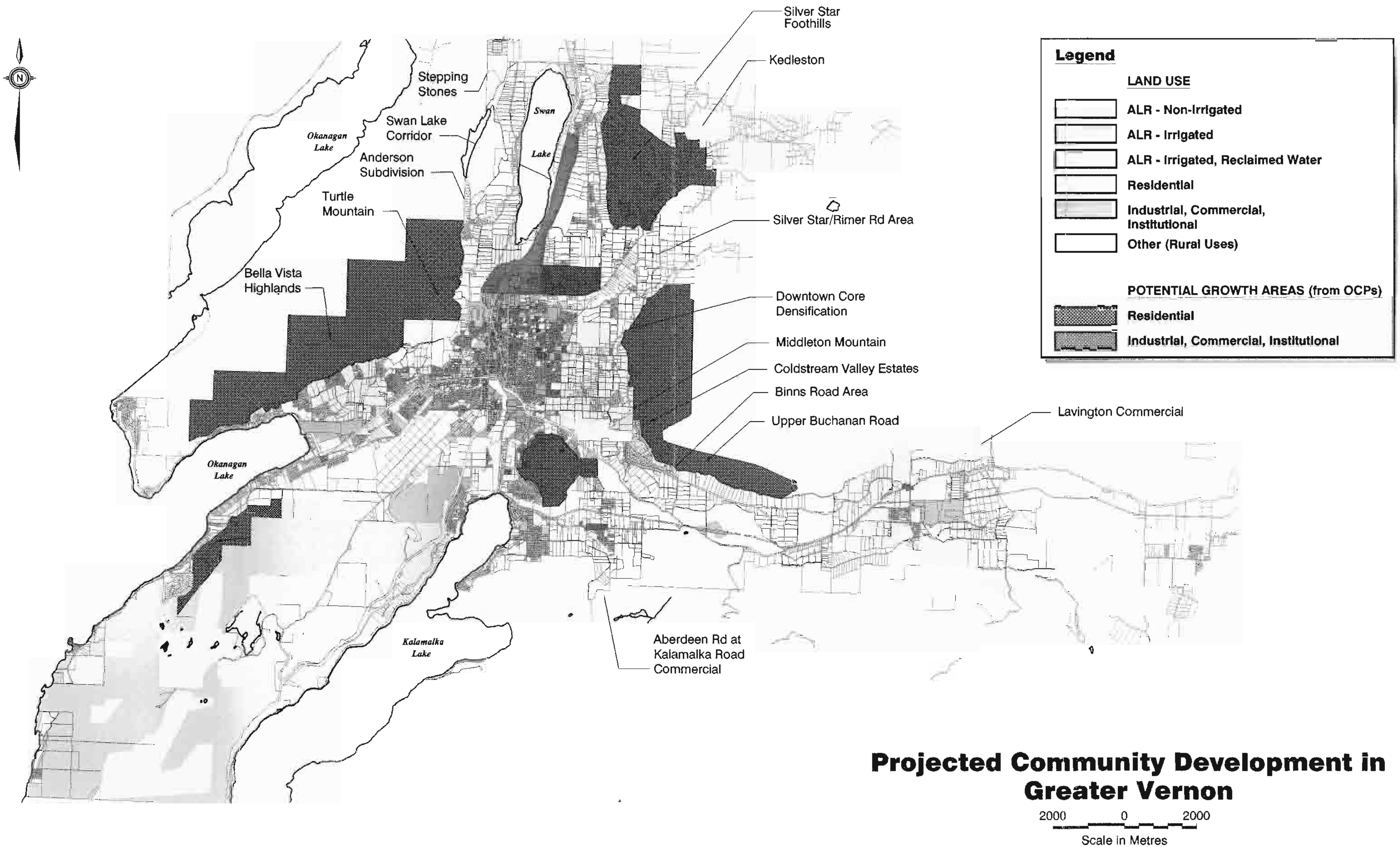
In addition to the Strategy, the City of Vernon, the District of Coldstream and NORD have completed Official Community Plans (OCPs). These plans focus on development and growth over the shorter term. A brief discussion of anticipated growth and development in each jurisdiction is provided below.

3.1.1 City of Vernon

City of Vernon

As indicated by the City's OCP, Vernon is emphasizing an increased densification of the downtown core, infill of existing developed areas and an increase in the proportion of multi-family housing. Long-term residential development will be accommodated by the gradual annexation of lands within Electoral Areas B and C adjacent to present City boundaries.

For the purposes of the Master Water Plan, population growth rates of between 2.0% and 3.0% are considered reasonable for long-term projections. Commercial development is expected to grow at about 0.4% per year, resulting in about 15 ha of additional commercial land development between 2001 and 2011. In addition to continued growth, the City water utility will experience occasional block



Projected Community Development in Greater Vernon

Figure 3-1

Time: 14:52 Date: 2002/4/17 Plot Scale: 1=1 (Paper Space) AutoCAD File: 00212\REPORT\SUMMARY\FIG3-1.DWG (ST)
Xrefs: AL-VERNON

increases in its customer base, as existing private systems are integrated in the Okanagan Landing area.

3.1.2 District of Coldstream

The District of Coldstream is predominantly rural/agricultural in character. Residential development is concentrated in the Kalamalka Lake, Middleton Mountain and Coldstream Valley Estates areas, with limited development in the Lavington area. The District's OCP is keyed toward preserving the rural and agricultural character and lifestyle and stresses maintaining large lot sizes. Only limited exclusions from the ALR are anticipated. Limited growth in commercial activities is anticipated. Given the direction in the District's OCP and historic growth rates, low and high growth rates of 1.5% and 3.5% are used for the present Master Water Plan.

The Coldstream Valley

3.1.3 Electoral Areas B & C

The OCPs for these electoral areas anticipate that the main changes will occur as a result of annexations by the City of Vernon. Most of the future annex areas are currently served by NOWA. For the present Master Water Plan high and low population growth rates of 2.0% and 2.75% were used based on historical growth patterns. Block additions may occur, if the Keddleston community in Area C is integrated with the water system.

3.1.4 Township of Spallumcheen

Based on the Township's current planning direction, and existing ALR predominance, it is unlikely that substantial residential growth will occur in the south Spallumcheen area. The exception to this is about 50 one-hectare lots in the area north of Stepping Stones. For the present Master Water Plan, it is assumed that the Spallumcheen service area will increase by 50 to 100 lots, and 100 ha of irrigation over the study period, representing an overall growth rate of 1.0% to 2.0% over 40 years.

3.1.5 Area D

It is anticipated that there will be some residential infill on the lands serviced within Area D. Growth rates of 3.0% to 5.0% per year were assumed given the few residential dwellings presently existing in this area.

3.2 SERVICED POPULATION GROWTH

Table 3-1 indicates the projected residential water service populations within the study jurisdictions to 2041. Overall, the average expected annual growth rate is approximately 2.7% over the 40-year period. This reflects servicing both existing development on individual or private water supplies, as well as new development. This percentage growth represents about the 75-th percentile relative to the low and high projections. This is believed reasonable for water system planning as it provides a slightly conservative bias – in other words, there is a greater chance that actual growth will be slightly less than projected. In most cases, this means that expansion of water system components could be delayed a few years relative to the projected year in the plan. As it is difficult to predict the actual growth cycles that may occur over the four decades, a linear growth pattern has thus been assumed over the 40-years. Detailed supplementary tables are provided in Technical Working Paper No. 3.

Table 3-1
Projected Average Growth in Water Service Areas, 2001 to 2041

Jurisdiction	Population				
	2001	2011	2021	2031	2041
City of Vernon	30,200	39,700	52,200	67,900	88,200
District of Coldstream	6600	8600	11,200	14,800	19,700
Electoral Area B	2500	3200	4000	5100	6500
Electoral Area C	2100	2600	3700	4700	6000
Spallumcheen	200	250	300	350	400
Electoral Area D	50	50	50	100	200
Total	41,750	54,800	71,850	93,250	121,000

Of key significance to the Master Water Plan, is the fact that the residential population in the Greater Vernon area will essentially triple over the next 40-years, based on the average expected growth rate. In reality, actual long-term growth rates will be higher or lower than projected. The strategy under the plan thus needs to be flexible to accommodate the actual increase in population in the future.

3.3 IRRIGATED LAND AREA

Irrigated land areas, as defined in the MWP, refer to irrigated land used for commercial or institutional purposes. The vast majority of this land base is agricultural – grain or hay crops, rangeland, orchards, or vineyards. The remainder of the irrigated land base is typically golf courses, playgrounds, recreation fields, cemeteries or other municipal applications. Residential land is not included in the definition. This water is accounted for under the residential water use.

The agricultural area is likely to remain quite stable over the long term, but land uses may change to reflect economic and climatic trends. The most marked influence on water supply required for irrigated land may result from expansion of reclaimed wastewater irrigation onto presently irrigated lands. This item is discussed in Technical Working Papers Nos. 3 and 11.

Projected irrigated land areas are shown in Table 3-2.

Table 3-2
Projected Irrigation Land, 2001 to 2041

Jurisdiction	Irrigation Land Area (ha)				
	2001	**2011**	**2021**	**2031**	**2041**
City of Vernon	340	390	400	400	400
District of Coldstream	1700	1710	1780	1800	1820
Electoral Area B	660	670	680	680	690
Electoral Area C	510	510	520	520	530
Spallumcheen	100	100	100	150	150
Electoral Area D	170	170	180	180	230
Total	3480	3560	3650	3740	3820

CHAPTER SYNOPSIS

The residential population of the Greater Vernon area is expected to increase from the current figure of about 42,000 to about 121,000 over the next 40 years. This tripling of the population will have a significant impact on water management planning. The irrigation land base, on the other hand, will likely see only a slight increase over the 40-year planning horizon.

PROJECTED WATER DEMANDS

SECTION 4

The present Master Water Plan utilizes a 40-year horizon for planning purposes. Projected water demands for that period were developed in Technical Working Paper No. 5, based on the existing usage patterns summarized in Technical Working Paper No. 1, the population and land use projections in Technical Working Paper No. 3, and the expected trends in demand patterns set out in Technical Working Paper No. 4. The reader is referred to these working papers for additional information.

4.1 CURRENT WATER DEMANDS

The three utilities supply an average of 23 billion litres per year. Irrigation water use accounts for about 55 % of the total use. Residential and industrial, commercial and institutional (ICI) are 31% and 3%, respectively, of total use. The remaining 11 % is unmeasured water use and leakage. This is termed unaccounted for water (UFW).

4.2 WATER CONSERVATION – IMPACT ON LONG TERM PLANNING

The District of Coldstream has had universal metering of customers for many years. NOWA has implemented metering of new residential (about 350 customers) and ICI connections but does not yet universally meter domestic water customers. Agricultural water customers are not metered. The City of Vernon has made significant strides in the last decade in water conservation, with the implementation of universal metering, as well as a number of other water use reduction programs.

Technical Working Paper No. 4 - Water Conservation and Reuse looked at both existing programs and future trends in the area of water use efficiency. While the region has come a long way, there are still opportunities for further reductions over the planning horizon. The question is the degree of aggressiveness and the acceptance of the public in further conservation measures.

In Technical Working Paper No. 5 - Projection of Water Demands, three scenarios for future water use were developed. The scenarios were termed the low, average and high estimates. They consider both a range in residential population and irrigation land growth, as well as varying degrees of water conservation.

The low estimates assume minimal customer participation or acceptance of measures, as well as conservative estimates of potential demand reductions. The high estimates represent high levels of implementation by customers, and maximum water savings. The average of the low (cautious) and high (optimistic) estimates may be the best approximation of what could be achieved, given the present state of knowledge. The savings projected for the average estimates are consistent with results that have been achieved by other utilities.

4.3 WATER DEMAND PROJECTIONS

Based on the range of future projections, an "average" water demand scenario was selected for detailed planning. These values are shown in Table 4-1. In reality, actual future water demands will be higher or lower than the values selected. It is important that the on-going water use data be collected and the plan re-visited at five-year intervals to reassess the timing of future water system components.

Table 4-1
Water Demand Projections
Irrigation

Year	Irrigation Area[1] (ha)	Irrigation Rates[2] (ML/ha/yr)	Annual Irrigation Demand			Maximum Day Demand[4] (ML/d)
			Agricultural (ML)	UFW Allowance[3] (ML)	Total (ML)	
2001	3477	3.64	12,656	1519	14,175	209
2011	3562	3.30	11,755	1411	13,166	178
2021	3648	3.30	12,039	1445	13,484	182
2031	3735	3.30	12,326	1479	13,805	187
2041	3823	3.30	12,615	1514	14,129	191

Note 1: Irrigation area based on 2001 estimate, additions at 0.1%/yr and 50 ha block additions every 10 years.
Note 2: Initial irrigation rate based on 2001 data, assumed to decline to 3.30 ML/ha/yr in 10 years.
Note 3: Overall assumed UFW rate of 12% applied to Agricultural Demands. Assumed constant overtime.
Note 4: Assumed to be 0.06 ML/d per hectare for the period 2001 to 2010, decreasing to 0.05 ML/d per hectare after 2010.

Table 4-2
Water Demand Projections
Domestic

Year	Residential Population[1]	Per Capita Demand[2] (L/cap/day)	Annual Domestic Demand					Maximum Day Demand (ML/d)[5]
			Residential (ML)	ICI[4] (ML)	Total Before UFW (ML)	UFW Allowance[4] (ML)	Total (ML)	
2001	41,750	470	7162	713	7876	945	8821	56
2011	54,800	445	8901	723	9624	962	10,586	58
2021	71,851	420	11,015	784	11,798	1062	12,860	71
2031	93,250	415	14,125	873	14,998	1200	16,198	88
2041	121,000	410	18,108	1014	19,122	1530	20,651	113

Note 1: Population based on an average of high and low growth rate scenarios.

Note 2: Per Capita Demands assuming average effectiveness of water conservation measures.

Note 3: Initial UFW rate of 12% applied to Domestic Demands in 2001, decreasing to 8% by 2031 and constant thereafter.

Note 4: ICI is 3.6% of combined Residential and Agricultural Demands before UFW, decreasing to 3.3% by 2041.

Note 5: Assumed to 2.3 times the average annual demand in 2001, decreasing to 2.0 by 2011 and constant thereafter.

CHAPTER SYNOPSIS

The annual domestic water use is expected to increase from 8,821 ML to 20,651 ML, over the 40-year period. Maximum day domestic demands will increase from the current amount of about 60 ML/d, to in the order of 113 ML/d in 2041.

While irrigated land area is expected to increase slightly over the planning horizon, more efficient irrigation practice will keep overall annual irrigation water use at about 14,000 ML. The portion of overall water used for irrigation in the region will decrease from the current level of 55% to 36% by 2041. Maximum day irrigation demands are expected to drop from the current figure of 209 ML/d to about 180 ML/d by 2011. They are then expected to rise slightly over the remainder of the planning period. This change reflects the impact of metering and changing land use.

WATER QUALITY GOALS

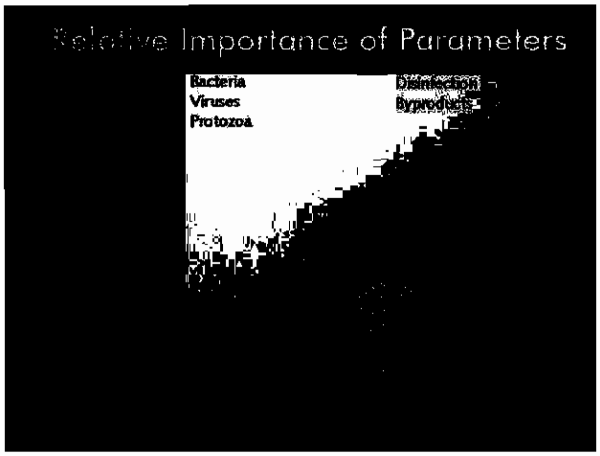
SECTION 5

A key element of the Master Water Plan is the development of water quality goals. While this would initially appear to be fairly straight forward, it is in fact a complex subject. The regulatory environment in North America has changed dramatically over the last decade, as new threats to water quality are better understood. Recent water borne public health problems, such as in Walkerton and North Battleford, has caused provincial regulators to reassess their approach.

In British Columbia, the regulatory situation is even less clear than in other provinces. New legislation was introduced in April 2001 and then shortly thereafter rescinded by the new government. At the time of completion of this MWP, the regulatory direction is still not clear. Technical Working Paper No. 6 provides an in-depth discussion on setting water quality goals. Key elements of this discussion and the selected criteria are discussed below.

5.1 DOMESTIC WATER QUALITY GOALS

The overall objective for potable water quality is to provide water that is safe and aesthetically pleasing. While there is considerable overlap of these two goals, there are differences. Water that is technically quite safe to drink may appear unpleasant to the consumer. Conversely, water that appears good to the human senses may, in fact, threaten the health of the consumer. Where these differences are apparent, it is reasonable to say that water providers have generally leaned towards providing safe water while the customer will generally judge water by its aesthetics. Thus, addressing both goals is important.



Water Quality Standards are a provincial responsibility. In British Columbia, the standards are defined in the Safe Drinking Water Regulation, B.C., Reg. 230/92 adopted under the Health Act. Under Section 5 of the Safe Drinking Water Regulation (SWDR), the water purveyor has the responsibility to provide potable water to all users served by the water works system.

"Potable Water" is defined in the SDWR as "water, which meets the requirements of the schedule (attached to the SDWR) and is safe to drink and fit for domestic purposes without further treatment".

Giardia Cysts

The schedule attached to the SDWR defines bacterial standards that must be met. The Province, under the former NDP government, introduced the Drinking Water Protection Act in April 2001. This new Act was essentially enabling legislation to allow the establishment of regulations and revisions to the Safe Drinking Water Regulation. In the September 2001, the new Liberal government repealed this legislation and established a Drinking Water Review Panel to review drinking water legislation. In February 2002, the Panel submitted its final report to the Government. The report recommends fairly sweeping changes to drinking water regulation, including more stringent tap water standards. It is not known if the Government will accept all or any of the Panel's recommendations.

Cryptosporidium Oocysts

In the absence of a definitive Provincial direction, it is necessary to look elsewhere. Most, if not all, provinces have at least adopted the Guidelines for Canadian Drinking Water Quality (GCDWQ) as their standards. However, application and enforcement vary. Provincial water quality regulations in Ontario and Alberta draw heavily from the U.S. EPA regulations. Thus, if these regulations are not immediately used for guidance by the GVWU, the Master Water Plan must account for the possibility that future regulations in British Columbia may be based on them.

Given the current situation in British Columbia, three broad goals have been identified:

- Achieve a quality standard that is within the parameters established by the GCDWQ.
- Reduce the risk of disease caused by ingestion of pathogenic micro-organisms.
- Ensure that disinfection byproducts are maintained within established limits.

Achieving these goals will require a further investment in water treatment. The water treatment requirements and specific treated water criteria will vary depending upon the water supply source, the quality of the raw water and expected impacts on the watershed in the future. In general, the water treatment strategy will have to deal with the following immediate water quality issues: pathogenic organisms, triholomethanes (THMs), colour, turbidity, taste and odour.

Specific water quality criteria targets are provided in Chapter 8.

5.2 IRRIGATION WATER QUALITY GOALS

The requirements for the quality of irrigation water are less stringent than for drinking water. The major considerations are the potential for gross levels of contamination or high dissolved chemical concentrations. Provincial guidelines exist for irrigation water. These have been adopted as the water quality goal in the Master Water Plan.

As noted earlier, the City of Vernon operates a reclaimed water irrigation system. This system is regulated under an Operational Certificate, issued under the City's Liquid Waste Management Plan. The establishment of water quality goals for this system is outside the scope of this plan.

CHAPTER SYNOPSIS

The Province of British Columbia lacks definite drinking water quality goals at this time. Domestic water quality goals have thus been developed, based on experience elsewhere and the expected regulatory direction of the Province. The four key domestic water quality criteria are pathogenic organisms, triholomethanes (THMs), colour, turbidity, taste and odour. Specific numerical criteria are contained in Chapter 8.

Irrigation water quality should meet the Provincial guidelines for irrigation water use.

THE REGIONAL WATER CONCEPT

SECTION 6

Technical Working Paper No. 9 evaluated the long-term economics of either staying with a combined water system, that serves both domestic and irrigation customers, or separating the existing combined system into two independent systems. The economics strongly favoured separation.

Technical Working Papers Nos. 10 and 11 then examined how the separated domestic and irrigation systems could be developed. Technical Working Paper No. 12 evaluated five possible options for a regional water strategy, considering various water sources and the timing of combined system separation.

A brief overview of the technical aspects covered in the working papers is presented below.

6.1 COMBINED WATER SYSTEM OR SEPARATION?

On an average annual basis, about 80% of the water use in the existing NOWA combined system goes to irrigation. The remainder is for domestic use. The quality of water used for potable purposes must be improved to meet the water quality goals. The question is therefore - is it better to treat all of the water or is it better to separate the irrigation and domestic functions and treat only the domestic supply?

The major factor in this decision is cost. This was investigated using an economic analysis technique known as "life cycle costing". This analysis essentially determines how much money in year 2001 dollars would be required to meet all cash flow obligations for each option over the analysis period. A 50-year period was selected. The results clearly show that water system separation, to create a domestic water system and an irrigation water system, has a clear economic advantage over the long-term. Based on a 50-year lifecycle cost analysis, the cost to implement and operate a separated water system is about $149 million. The cost for a combined water system, over the same period and providing the same domestic water quality, is about $198 million.

The analysis does not consider the economics of future integration of the City of Vernon's reclaimed water system. When this is subjectively factored in, the move to a separated system becomes more attractive. The reason for this is that, once a non-potable irrigation system has been established, a number of options for blending of irrigation sources are available. This in turn frees up additional upland lake water, that is currently used for irrigation, for domestic water use.

6.2 THE PROPOSED REGIONAL WATER STRATEGY

The regional water strategy, that has been adopted, is to separate the existing combined water system over the next five years and construct a new water treatment plant in the Middleton Mountain area in the same time frame.

This water treatment plant would be supplied by both Kalamalka Lake water and Duteau Creek water. Once in-place, this plant would supply all of the domestic water demands in the Vernon region.

Kalamalka Lake Intake

The main components of the strategy are:

1. Separate the combined water system by constructing new domestic water distribution water mains. This would be accomplished in a five-year program, commencing in 2003 and being completed by the end of 2007.

2. Construct the first stage of a new water treatment plant (clarification, UV primary disinfection and chlorine secondary disinfection) in the Coldstream Valley near Middleton Mountain by the end of 2005. Raw water supply to the plant would come from Kalamalka Lake via a new water supply line and from Duteau Creek via the existing NOWA transmission main.

   The subsequent stage of treatment (additional chemical pre-treatment for taste/odour reduction and filtration) and an expansion of plant capacity would occur in about 2021. The actual timing will depend upon the performance of the first stage of treatment, future water quality regulations and the rate of increase of water demands. A third stage of expansion would occur in about 2029.

3. Construct a new, raw water transmission main from the Kalamalka Lake pumping station to the new water treatment plant in 2003. Prior to commissioning of the plant, this main would deliver chlorinated water to the PZ479 zone.

4. Construct a new, covered PZ 479 reservoir on the existing McMechan reservoir site in 2003.

5. Upgrade the Kalamalka Lake pumping station with higher capacity pumps in 2003.

6. Construct miscellaneous improvements in the existing domestic water distribution systems in the City of Vernon and the District of Coldstream over the period from 2003 to 2007 in order to increase hydraulic capacity.

7. Expand the domestic water system to meet the needs of development over the next four decades. This will include both replacing and adding water mains in the core areas to move water across the pressures zones as well as constructing new water mains in the new, outlying development areas.

8. Following creation of a separated irrigation system, operate and maintain this system to provide irrigation water to meet the demands. Irrigation demands are expected to stay relatively constant over the coming decades. Opportunities to integrate the use of reclaimed water need to be explored, once the City of Vernon completes the upgrade of its wastewater treatment plant to provide an effluent quality that will allow direct irrigation.

This strategy is very aggressive in dealing with the separation and domestic water quality issues. It requires a significant capital expenditure in the first five years of the plan to implement both separation and a high level of water treatment. Correspondingly, it reduces the potential risk of water-borne public health problems and reduces aesthetic domestic water quality concerns with colour, taste or odour. Capital expenditures after 2008 will be less onerous.

The regional water strategy strongly emphasizes a multi-barrier approach to drinking water quality. In addition to water treatment, key elements of the long-term strategy will be watershed protection and protection of the water quality within the distribution system. Watershed protection will mean taking an active stakeholder role in ensuring that there is a strong voice for drinking water protection in the overall land use of the upland and valley watersheds, as well as in the protection of the groundwater resource. Protection of the water quality within the distribution system will require implementation of a cross-connection control program, as well as a diligent quality assurance program during the changeover of the combined system customers to the domestic water system.

CHAPTER SYNOPSIS

The regional water strategy, that has been adopted, is to separate the existing combined water system over the next five years and construct a new water treatment plant in the Middleton Mountain area in the same time frame. This water treatment plant would be supplied by both raw Kalamalka Lake water and raw Duteau Creek water. Following the completion of separation and commissioning of the new water treatment plant, the domestic water system would be expanded over the next three decades to meet the development needs of the region.

groundwater supply and, possibly, reclaimed water. As an example, if the Deer Creek supply was used to its license capacity (3699 ML) and no groundwater or reclaimed water was used, then the quantity required from Duteau Creek would be 10,430 ML. Combining the domestic and irrigation demands for the Duteau Creek source (22,300 ML) indicates that 89% of the water license capacity would be used.

The license capacity (24,922 ML) can be easily provided in an average run-off year (38,800 ML). During drought years, water stored in the upland lakes will be required to supplement available runoff. In a 1 in 50 year drought, it is likely that less than 5000 ML of runoff may be available once downstream releases are considered. This would mean that upland storage volumes (19,000 ML) would be virtually completely depleted to meet the combined domestic and irrigation demand. At this time, there is considerable uncertainty in any long-term projections due the changing irrigation demands, the use of reclaimed water and global climate change. While under most scenarios there should be adequate water from the proposed sources to meet the 40-year demands, the GVWU should develop a statistical forecast model for watershed management to allow determination of the "what if" scenarios, based on expected runoff and future water demands. This model should be used in the future to track demands versus supply volumes and to determine when new supplies, such as Okanagan Lake, are required.

The Duteau Creek transmission system was originally designed to meet the peak irrigation needs of the service area. The maximum day delivery is thus far greater than the average annual license capacity. The peak capacity to deliver flow is dependent upon the supply from other upland sources, from Goose Lake, and the HGL created by the irrigation demands. Detailed hydraulic modeling is required at the preliminary engineering stage to determine delivery capacities under future scenarios. Based on current operating data, the transmission system should be capable of delivering raw water to the water treatment plant at a rate of about 2400 L/s. This is about 1.8 times the plant maximum day capacity in the year 2041. In the winter months, when the plant is supplied entirely on Duteau Creek water, the transmission system would only be operating at about 20 to 25% capacity.

The worst-case scenario would be if the Kalamalka Lake water raw water supply was not available during the peak summer demand period. In this event (assuming the year 2041), about 55% of the capacity of the Duteau Creek transmission system would be dedicated to supplying the plant demands. The remaining capacity (1100 L/s) would be available for irrigation demands. As the peak irrigation demand is about double this amount, some restrictions in irrigation would be required during the emergency. This will depend upon the availability of supply from other surface water sources, groundwater and reclaimed water.

7.3 OTHER UPLAND SOURCES

Other potential upland sources include Deer Creek, Coldstream Creek and BX Creek. The regional strategy proposes to keep the Deer Creek source as an active irrigation source and as a raw water source to the Middleton Mountain water treatment plant, as it is an integral part to the irrigation system. The annual license capacity of this source is 3699 ML, or about 11% of the total regional water demand in 2041.

The Coldstream Creek and BX Creek sources should be decommissioned but the works retained. These sources could be utilized for local irrigation water at some point in the future. In the case of Coldstream Creek, it may be possible to transfer this license capacity to Kalamalka Lake, as the creek drains to the lake.

BX Creek

7.4 GROUNDWATER

In the upper portion of the valley, the Antwerp Springs groundwater wells have supplied the Lavington water system for a number of years. This water, however, is very hard (325 mg/L) and has necessitated the use of home water softeners. While the continued use of this water source was contemplated in the early stages of the plan, the feedback from water users was that the hardness made the long-term use of the water unacceptable, particularly if a high-quality water was available from a regional treatment plant. Evaluations carried out comparing hardness removal from the Antwerp Springs supply versus supply from the Middleton Mountain water treatment plant concluded that the latter was more cost effective. The decision was thus made to discontinue the Antwerp Springs supply as a domestic water source, after the regional water treatment plant was on-line.

Groundwater in the Coldstream Valley will continue to play a role in irrigation water supply. The existing Wells Nos. 1 and 2 in the western part of the valley will continue to feed into the existing irrigation water system. The current Antwerp Springs wells could be used for either local irrigation or will be tied into the regional irrigation grid. This should be evaluated further in the preliminary engineering stage.

As the Antwerp Springs supply will continue to be used as a domestic source until 2008, a well-head survey, conducted in 2002 or 2003, is recommended to confirm that the wells are not influenced by surface runoff and the current method of disinfection provides an adequate level of public health protection.

7.5 RECLAIMED WATER

Irrigation, using reclaimed water, will be a significant component of overall irrigation use in the region. The question is - to what degree will reclaimed water be integrated into the separated irrigation system?

Currently the City utilizes about 4900 ML/yr in its own irrigation system. Over the next 40 years, the additional volume available is estimated to be about 9300 ML/yr. This represents about 65% of the expected irrigation demand in the GVWU irrigation system. There is thus ample reclaimed water available to be considered as a possible source water for the GVWU irrigation system.

This is discussed further in Chapter 10.

7.6 OKANAGAN LAKE

The development of Okanagan Lake, as a regional water source, is not required from a capacity viewpoint over the next 40 years, based on the selected regional water strategy.

At this point, it is difficult to look beyond 40 years with any confidence. If the expected population growth did not happen and a significant use of reclaimed water occurs, the development of Okanagan Lake, as a domestic water source, may not be needed for well beyond the 40 years. On the other hand, if the population exceeds the 120,000 figure and technology and economics dictate only a limited expansion of the City's water reuse system, then development of the Okanagan Lake source may be required near the end of the 40-year planning period.

If this is the case, a local treatment plant will be required. It would be prudent to secure a site at an early stage prior to in-fill of the area around the head of the lake. It may also be prudent for the GVWU to secure license capacity on Okanagan Lake, well in advance of development of this source.

CHAPTER SYNOPSIS

Kalamalka Lake and Duteau Creek will be the major water sources over the next 40-years. Kalamalka Lake will serve as a domestic water source only. Duteau Creek will provide both irrigation water and raw water to the treatment plant, primarily during the non-irrigation season. Groundwater in the Coldstream Valley will continue to be utilized as a irrigation water source. Deer Creek, other local creeks, and groundwater are potential local irrigation sources. Reclaimed water from the City of Vernon's wastewater system offers a significant potential irrigation water source to offset other irrigation supplies. This would free up additional raw water supply to the water treatment plant. The development of Okanagan Lake, as a supply source, may be required by the end of the 40-year planning horizon.

WATER TREATMENT

SECTION 8

Domestic water for the Greater Vernon area will be provided by a single source – the Middleton Mountain water treatment plant. The proposed Middleton Mountain water treatment plant will be located northeast of Middleton Mountain. This plant will utilize both Kalamalka Lake and Duteau Creek as raw water sources.

A brief description of the facilities is provided below. Additional information is contained in Technical Working Paper No. 13.

8.1 SITING

The Middleton Mountain water treatment plant would be a new facility on a, yet to be determined, site in the Coldstream Valley, northeast of Middleton Mountain near Hwy 6. This location is reasonably near the two raw water sources, near the core water demands in the PZ 479 pressure zone, and allows access to the City's sanitary sewer system.

The plant site should be at least 4 ha in area. The average site elevation should be between about 430 and 475 m. As the water treatment plant is a very heavy structure, the bearing capacity of the underlying soils is critical in site selection. A number of potential sites exist in the general vicinity. Evaluation of specific sites would occur at the preliminary engineering stage. For the purpose of planning and costing out the water transmission mains, the plant site was assumed to be located near the NORD office. Figure 8-1 presents the general layout of the plant on a generic site.

8.2 PLANT CAPACITY

The ultimate plant capacity is set by the amount of raw water that can be delivered to the plant site by the two raw water sources, Kalamalka Lake and Duteau Creek. This is governed by license capacity and the amount of irrigation water supplied by the Duteau Creek source in the future.

The actual plant would be constructed in stages. Based on the projected populations over a 40–year period, a Stage 1 capacity has been selected at 71 ML/d. This would provide capacity to meet domestic demands until about 2021. The plant would then be expanded in two additional stages to provide the following capacities, 85 ML/d in 2021 and 113 ML/d in 2029. The site would be laid out for a further 50% expansion, after 2041.

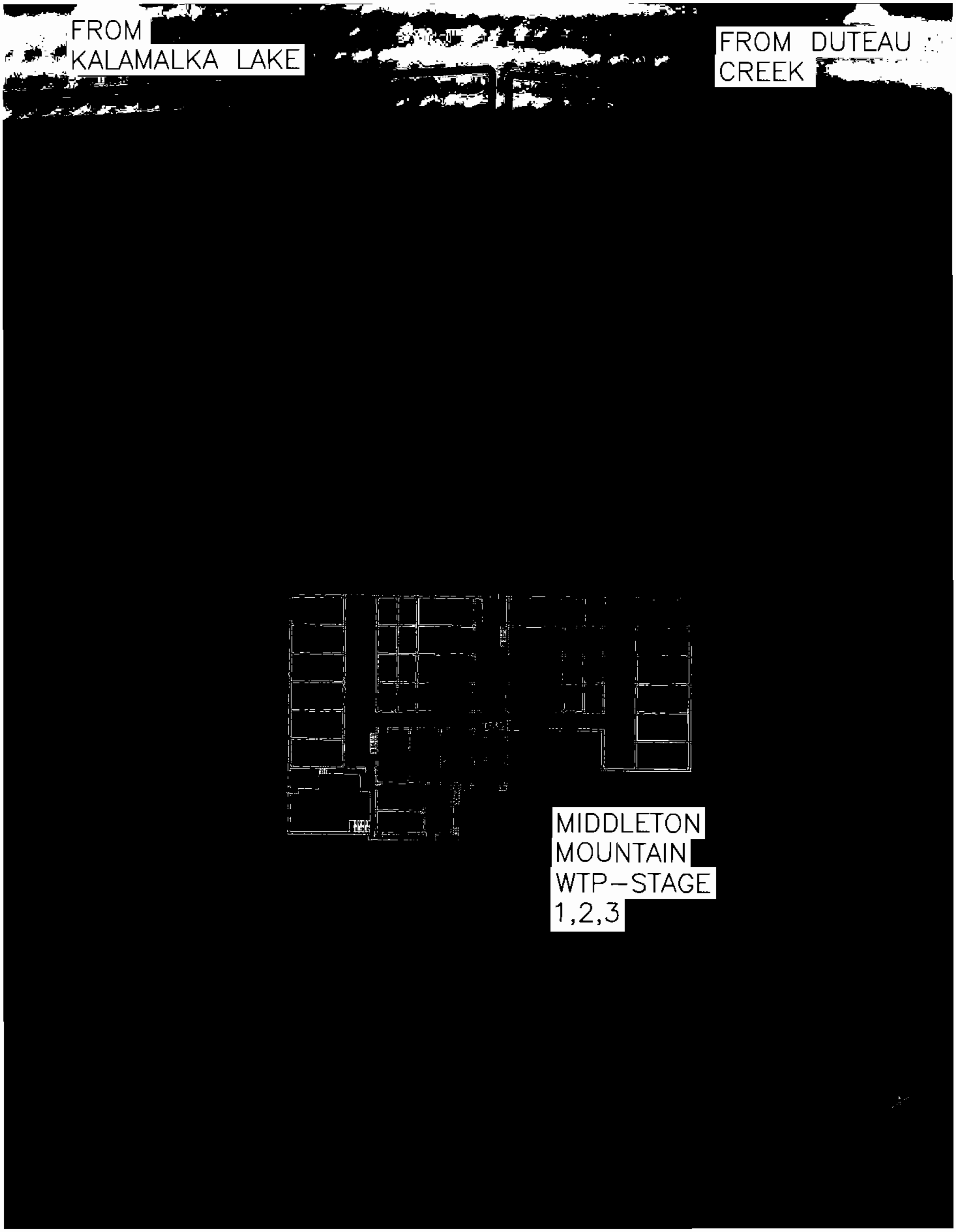


FIGURE 8-1
PROPOSED MIDDLETON MOUNTAIN
WATER TREATMENT PLANT-TYPICAL LAYOUT
SCALE: 1:2000±

Time: 17:10 Date: 2002/3/28 Plot Scale: 1=1 (Paper Space) AutoCAD File: 002121\REPORT\FEB2002\FIG8-1.DWG (ST)

The timing of expansions will depend upon the growth in water demand in the region. As multiple process trains are proposed, it would also be possible to increase the number of expansion stages and to expand the capacity in smaller increments. This will be evaluated further at the preliminary engineering stage.

8.3 DESIGN PARAMETERS

Goals for long term treated water quality were set out in Chapter 5. The immediate goals for Duteau Creek and Kalamalka Lake water include addressing colour, turbidity, taste and odour, and reduction of pathogenic organisms and chlorinated disinfection by-products (e.g., trihalomethanes). Based on the raw water quality characteristics of Duteau Creek and Kalamalka Lake, the expected treated water quality is summarized in Table 8-1.

Table 8-1
Summary of Raw Water Quality and Treated Water Goals

Parameter	Duteau Creek Range	Kalamalka Lake Range	GCDWQ Guideline Description	Treated Water Target Level
Alkalinity (mg/L)	20 to 40	140 to 150	No standard	min 25 mg/L (as $CaCO_3$)
Aluminum (mg/L)	0.100 to 0.150		0.1 mg/L[1]	≤ 0.1 mg/L
Coliform Bacteria	n/a[7]	N/a[7]	<1 org./100mL[2]	<1 org./100mL
Cryptosporidium	n/a[7]	N/a[7]	No standard[3]	>2 log reduction
Enteric Viruses	n/a[7]	N/a[7]	No standard[4]	4-log reduction
Giardia (cysts/1000 L)	3 to 200	n/a[7]	No standard[3]	>3 log reduction (> 2.5 log by clarification/filtration/UV, 0.5 log by Cl_2)
Iron (mg/L)	0.050 to 0.800		≤ 0.3mg/L AO	≤ 0.3 mg/L
Sulphate	6.50 to 6.80		≤ 200 mg/L	≤ 200 mg/L
PH	5.85 to 8.50	6.7 to 9	6.5 – 8.5	Stable, non-aggressive
Temperature (°C)			≤ 15 AO	≤ 15
THM (total)			< 100 µg/L MAC	< 80 µg/L
TOC	8.0 to 10.2	0.3 to 7	No standard	Sufficient to meet THM & aesthetic targets

Parameter	Duteau Creek Range	Kalamalka Leke Range	GCDWQ Guideline Description	Treated Water Target Level
True Colour (TCU)	20 to 130	< 5	≤ 15 TCU AO	≤ 15 TCU 100 % of time
Turbidity	0.0 to 14.15	0.50 to 0.54	1.0 NTU MAC[5] (≤ 5 NTU AO)[6]	≤ 0.3 NTU 95 % of time ≤ 1 NTU 100 % of time

Notes

1. A health-based guideline for aluminum in drinking water has not been established. However, water treatment plants using aluminum-based coagulants should optimize their operations to reduce residual aluminum levels in treated water to the lowest extent possible as a precautionary measure. *Operational guidance values* of less than 100µg/L total aluminum for conventional treatment plants and less than 200 µg/L total aluminum for other types of treatment systems are recommended.
2. Under review. No sample should contain more that 10 total coliform organisms per 100 mL, none of which should be *E.Coli* or thermotolerant coliforms; or No consecutive sample from the same site should show the presence of coliform organisms; and not more than one sample from a set of samples taken from a community on a given day should show the presence of coliform organisms; and not more than 10% of the samples based on a minimum of 10 samples should show the presence of coliform organisms.
3. Health Canada guidelines state that protozoa should not be present. US EPA has set 3 log reduction as a minimum where there is less than one cyst per 100 L.
4. Health Canada is currently preparing a guideline for human enteric viruses. It is anticipated that an approach similar to that used for protozoa will be taken, rather than stipulating a numerical value.
5. Under review. For rapid sand filtration proposed is a 95 percentile of <0.3 NTU when monthly average raw water turbidity >1.5 NTU, a 95 percentile of <0.2 NTU when monthly average raw water turbidity <1.5 NTU, and maintaining the MAC at 1.0 NTU. For membrane filtration a combined filtered water 95%ile of <0.1 NTU is proposed and a MAC of 0.3 NTU.
6. At the point of consumption.
7. No reported data reviewed but given the watershed characteristics, these organisms are to be expected.

AO = Aesthetic Objective
IMAC = Interim Maximum Allowable Concentration
MAC = Maximum Allowable Concentration

8.4 TREATMENT PROCESSES

Two water treatment process technologies could be considered for this plant. One process would combine high-rate clarification, filtration and UV disinfection. The second process choice would be membrane separation and chlorine disinfection. The final process selection should be made at the preliminary engineering stage, following pilot testing of the water treatment processes.

Clarification Process

For the purposes of developing a plant layout and costing, the former process technology has been selected. A process schematic, floor plans and sections are provided in Technical Working Paper No.13.

The proposed unit processes include:

- Chemical pre-treatment (coagulant, activated carbon) for turbidity, taste, colour and odour reduction
- High-rate clarification (i.e. DAF or ballasted flocculation)
- Granular filtration
- UV and chlorine primary disinfection
- Clearwell storage
- Chlorine or chloramine post-disinfection

Dissolved air flotation (DAF) is a non-proprietary process that would occupy a larger footprint than ballasted flocculation. Otherwise, the two processes have many of their components in common (e.g., rapid mix, flocculation and coagulant). Given the characteristics of the raw water, it is anticipated that DAF will perform well but is the more conservative and established of the two alternatives. Therefore, the layout has been developed using the dissolved air flotation process.

Under the proposed concept, the initial treatment steps that would be built include chemical pre-treatment (coagulant addition only), high-rate clarification, UV and chlorine primary disinfection and chlorine (or chloramines) post-disinfection. These processes, termed Stage 1, will greatly improve the quality of the raw water, addressing colour, some taste and odour and reduction of pathogens.

At Stage 2, additional pre-treatment (powder activated carbon) and granular filtration would be added. These additional treatment processes will further reduce any taste and odour concerns and will provide an additional barrier to protozoan pathogens. This process change is shown to occur in conjunction with the capacity increase in 2021. In actual fact, it could be either implemented at an earlier or later time depending upon the performance of the first stage of treatment and the regulatory criteria. This needs to be evaluated further at the preliminary engineering stage, following pilot plant testing.

8.5 RAW WATER SUPPLY AND TRANSMISSION MAINS

A 750 mm diameter raw water feed to the plant would be constructed from the existing NOWA transmission system to the plant. A similar 750 mm diameter raw water main would provide Kalamalka Lake water to the plant.

Both raw water mains would enter into a central raw water pipe gallery in the plant building. The Duteau Creek main would be gravity fed while the Kalamalka Lake main would be pumped. The hydraulic head on the Duteau Creek main needs to be reduced upon entering the plant. This is normally accomplished through a pressure reducing valve. During the non-irrigation season, a significant reduction in hydraulic head may be necessary. This may make the installation of a micro-turbine to utilize the available head to generate power for the water treatment plant attractive. The pay-back period for installation of a turbine should be reviewed at the preliminary engineering stage.

Three treated water transmission mains would exit the site. The major water main would be the feed to the PZ 479 zone. A second transmission main would supply treated water to the two PZ 535 zones; one on Middleton Mountain and the second in East Vernon. The third transmission main would provide water to the PZ500 zone in the urban area of Coldstream.

8.6 CLEARWELL STORAGE

The plant's clearwell storage would provide multiple functions, namely contact time (CT) to meet minimum chlorine disimfection requirements, and storage for operational and distribution system demands. The operational storage requirements would significantly increase at Stage 2 when filtration would introduce demands and loss of production through backwashing and filtering-to-waste. It is proposed that the plant's clearwell be constructed in stages, based on the overall plant staging.

A treated water pump station would be constructed as part of the Stage 1 main plant building. The pump well would be sized to accommodate the Stage 3 plant pumping equipment, however, initial pumping capacity provided at Stage 1 would be sized to satisfy the Stage 2 design flows, with a pumping capacity upgrade required at Stage 3. It is proposed that initially seven low-lift finished water pumps would be required to supply the three pressure zones (PZ 479, PZ 500 and PZ 535). Space would also be provided in the finished water pump well for two backwash supply pumps required at Stage 2.

8.7 PROCESS WASTEWATER MANAGEMENT

The process wastewater from the DAF system would be disposed to the sanitary sewer system, thereby negating the requirement for on-site sludge storage and dewatering facilities. Periodic cleaning of the flocculation and DAF process tanks would also produce a short-term waste sludge stream, which would also be disposed to the sanitary sewer system. The estimated volume of wastewater from this source is about 0.5 to 1% of the water treatment plant throughput.

With the addition of filtration in Stage 2, the wastewater volume from the plant could potentially increase to the range of 4 or 5% of the plant throughput, without internal backwash recycling. The alternative is to provide a concentration step for the backwash water and recycle the supernatant back through the plant. This will create a lower volume, higher concentration wastewater to the sanitary sewer system.

The optimum solution depends on the costs to implement and operate the internal recycle system, the impact of the discharge on the City's sewerage system and the disposal fee charged by the City. This needs to be looked in greater detail at the preliminary engineering stage.

8.8 PLANT BUILDING

The main plant building would be designed to fully enclose all process units, providing protection against winter operating conditions. The plant building also serves to house ancillary equipment and functions.

The proposed building is of masonry construction, approximately 78 m by 47 m at Stage 3. For the purposes of the conceptual design the construction method has been assumed to be a raft foundation. This would be confirmed following geotechnical evaluation at the preliminary design stage.

The proposed building would have a gently pitched roof to accommodate the headspace requirements of the DAF's packed tower air saturation tanks and to aid in developing an aesthetic architecture. The architectural design of the building would be suited to be compatible with the surround landscape. A construction material with an aesthetically attractive appearance, such as split-face concrete block, would be selected.

The clearwell level would be positioned below the existing site grade level, with earth berms being employed to reduce the visual impact of the two story operations building. It is proposed that the main operations floor would be slightly above the finished grade level, allowing for easy unloading of bulk chemicals into the plant's storage facilities.

Main access to the building would be provided on the main operating floor level, where the control room, offices and laboratory would be located. Various stairwells would be provided for access between the main floor and lower floor, along with external access to the lower floor to satisfy emergency exit requirements.

CHAPTER SYNOPSIS

The region's domestic water supply facility will be the new Middleton Mountain water treatment plant, located near the Regional District office, on a site yet to be determined. The treatment processes will be housed entirely in a building with clearwell storage provided beneath the process units. The plant will be constructed in a staged approach to meet water quality targets and increasing demand.

DOMESTIC WATER SYSTEM

SECTION 9

The Master Water Plan sets out the basis for the development of the domestic water system over the next 40 years. The chapter briefly describes the strategy and timing of system development. Technical Working Papers Nos. 10 and 13 provide more detailed information.

The work in the plan has essentially been carried out to a "planning" level. The next step is to move to a preliminary engineering level that would see the development of hydraulic distribution models to confirm piping sizes. This would then be followed by analysis of the specific water main routing requirements and determination of sites for pumping stations and reservoirs. Detailed designs would then be prepared for the various areas to allow tendering of construction contracts.

9.1 DESIGN CRITERIA

The design criteria suggested for initial sizing of domestic water system components is shown in Table 9-1.

Table 9-1
Water System Design Criteria

Criteria	Value	
	Short-Term Year 2011	Long-Term Year 2041
Annual Average Per Capita Demand[1] (L/d/cap)	580	470
Ratio of Maximum Day to Average Annual Demand	2.0	2.0
Ratio of Peak Hour Demand to Maximum Day Demand	1.5	1.5

Note 1: Based on residential population. Includes ICI and UFW.

On a domestic system wide basis, annual average per capita demands (based on residential population) are currently in the order of 470 L/d/cap. This excludes institutional, commercial and industrial (ICI) demands, as well as unaccounted for water (UFW) from leakage, flushing, fire fighting or non-recorded connections. If these components are added in, the current annual average per capita demand is about 580 L/d/cap (based on residential population).

The average annual water demand is expected to decrease over the 40-year planning period, due to improvements in technology and in changing public attitude to water use efficiency. By 2041, the average annual per capita water demand is forecast to be about 470 L/d/cap.

The current average ratio of maximum day to annual average demands is about 2.3. This is also expected to decrease over the planning horizon. By 2011, this ratio should drop to about 2.0. This ratio is then expected to stay constant over the duration of the planning horizon. Data on the ratio of peak hour to maximum day demands is not available for the utilities. The implementation of additional metering in the future should provide a reasonable database to estimate this ratio. For the purpose of initial planning, a ratio of peak hour to maximum day of 1.5 is assumed.

In the preliminary sizing of domestic water system components, the following design criteria is suggested:

- Domestic transmission mains should be sized to provide maximum day demands in areas where balancing storage is available.
- Domestic distribution water main size should be adequate to supply the greater of the peak hour demands or the maximum day demands plus fire flow.
- Distribution system piping should be sized so that there is no more than 10 m of headloss across a zone under peak hour demand conditions.
- Pump stations should be sized to provide maximum day demand, where there is balancing storage in the zone above. Where balancing storage is unavailable, pumps must convey peak hour demand and have emergency gen-set power.
- Reservoirs are sized to provide balancing storage; plus fire protection to FUS standard; plus 25% of the first two volumes for emergency conditions.
- In pressure zones without gravity storage for fire protection, pumping stations should be provided with either an engine-drive fire pump or an electric-drive fire pump equipped with emergency gen-set power.

In some rural areas, currently supplied by the NOWA combined water system, fire protection is to less than a current municipal standard in terms of hydrant spacing and reliability of service. In developing a new domestic water system in these areas, the following approach is suggested.

.1 Where the area is proposed for further development within a 10-year time frame, the domestic water system should be designed to provide a municipal standard of fire protection. Opportunities to decrease the initial water main size and supplement future capacity with "looping" should be investigated.

.2 If the area will not realistically be developed and will remain with the current land use, the rural standard of fire protection should be maintained.

.3 If the area may see redevelopment after the 10-year horizon, consideration should be given to oversizing water mains to provide a future level of municipal fire protection, only if the opportunity to increase capacity in the future through "looping" or alternative supply points does not reasonably exist.

9.2 PRESSURE ZONE DEVELOPMENT

Historic pressure zone development in the Greater Vernon area has been influenced by the varied topography, the large number of municipal and private water systems and the differing nature of the water systems. At the present time, there are over 50 different pressure zones.

The development of pressure zones over the planning horizon will be governed by a number of factors. A key driver will be to consolidate the pressure zones, where possible, to allow the efficient distribution of water with a minimum of booster pumping stations and reservoirs. The major obstacle in zone consolidation is the presence of development on either side of the north-south Okanagan Valley and the east-west Coldstream Valley. This means, that while lower zones can be consolidated, the upper zones on each side of the valleys will have independent pumping and reservoir systems.

Another major factor in zone development is the presence of existing reservoirs and pumping stations. While this is not an overriding criterion in long-term planning, many of the structures have years of service remaining. This needs to be considered in the short-term planning of pressure zones.

For the purpose of pressure zone planning, the terms primary and secondary zones are introduced. Primary zones are intended to be the long-term pressure zone development goal. Secondary zones, on the other hand, exist due to a local topographic constraint or existing water system components. It is intended that these zones be consolidated with the primary zones over time. Some of these zones may remain for some time, however, if consolidation with a primary zone is not feasible.

Pressure zones are identified by their normal hydraulic grade line in metres. In the case of a pressure zone with a reservoir, this would be the top water level (TWL) of the reservoir. For a zone without a reservoir, the zone grade line would be the normal operating head created by the pumps. The zone "spread" or difference between adjacent zone hydraulic grade lines is typically 45 to 60-m. In general, the zone should be set to provide a minimum static pressure at the upper zone boundary of 40 m or 390 kPa. The pressure at the lower zone boundary should be a maximum of 100 m or 980 kPa. This would provide a zone normal operating pressure ranging from about 340 kPa at the top of the zone (under peak demands) to 1030 kPa at the bottom (under reservoir re-filling at night).

9.3 PRESSURE ZONES

The proposed primary domestic water service zones are as follows:

- PZ 425 Okanagan Landing
- PZ 479 Vernon – Main Zone
- PZ 535 Vernon – East, West and Middleton Mountain
- PZ 585 Vernon – Upper East, West and Lavington

In addition to the major pressure zones, there are numerous secondary zones that provide water service to local areas. Given the large number of secondary pressure zones, the Greater Vernon area has been divided up into six geographical regions. Table 9-2 shows the primary and secondary pressure zones for each region. These zones are shown in Figure 9-1. Detail drawings of the various zones and proposed water main locations are contained in Technical Working Paper No. 13.

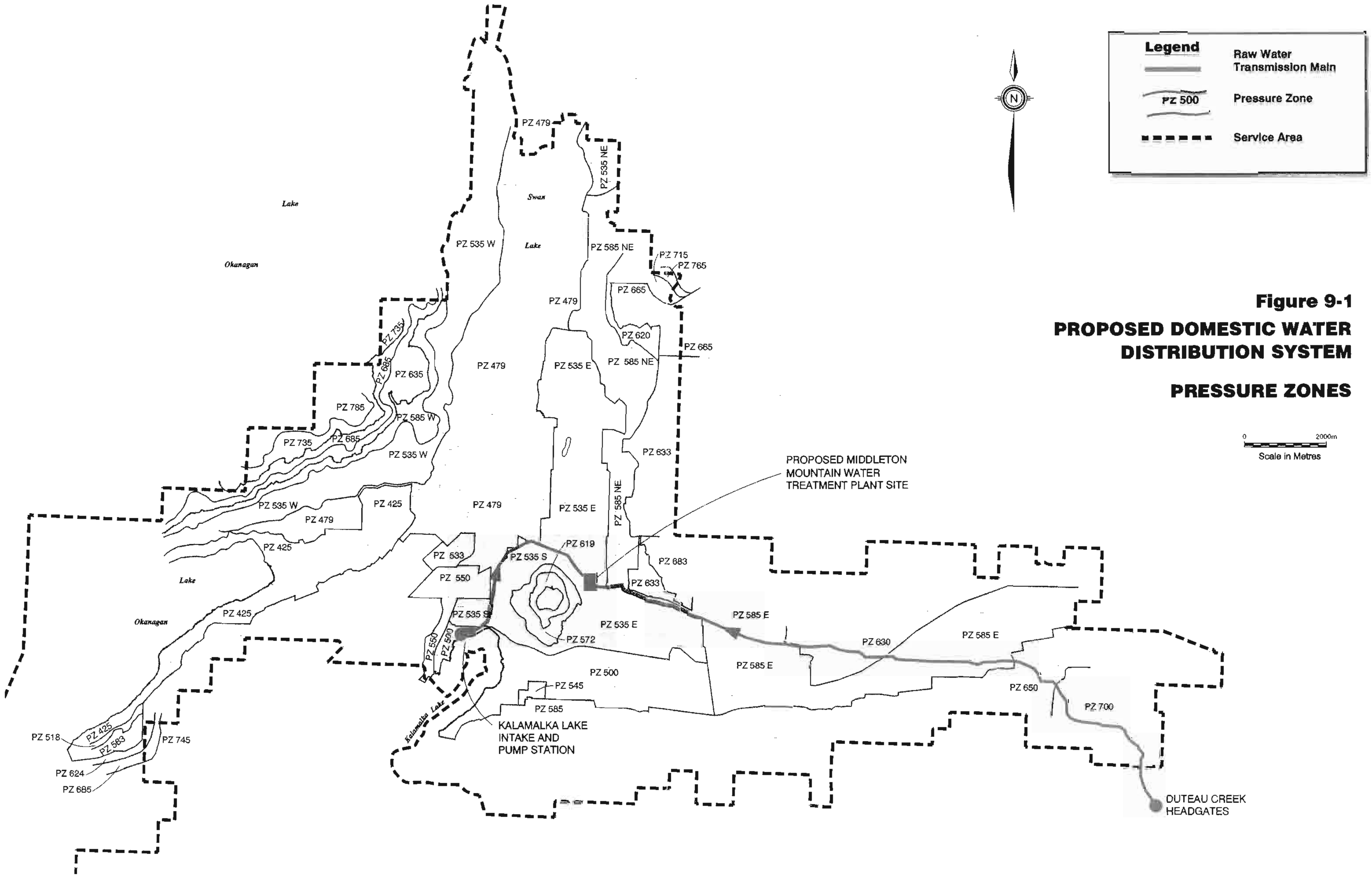


Figure 9-1

PROPOSED DOMESTIC WATER DISTRIBUTION SYSTEM

PRESSURE ZONES

0 2000m
Scale in Metres

Time: 13:13 Date 2002/4/2 Plot Scale: 1=1 (Paper Space) AutoCAD File: 00212\REPORT\FEB2002\FIG9-1.DWG (ST)
Xrefs: WP13BASE

Table 9-2
Pressure Zone Criteria
Vernon-West

Pressure Zone	Upper Boundary		Lower Boundary		Zone Type
	Elev (m)	Pressure (m)	Elev (m)	Pressure (m)	
425	385	40	343	82	Primary - existing
479	439	40	385	94	Primary - existing
535 W	495	40	439	96	Primary - future
585 W	545	40	495	90	Primary - future
635	595	40	545	90	Secondary - future
685	645	40	595	90	Secondary - future
735	695	40	645	90	Secondary - future
785	745	40	695	90	Secondary – future

Pressure Zone Criteria
Vernon – East

Pressure Zone	Upper Boundary		Lower Boundary		Zone Type
	Elev (m)	Pressure (m)	Elev (m)	Pressure (m)	
479	439	40	385	94	Primary - existing
535 E & NE	495	40	439	96	Primary - future
585 NE	545	40	495	90	Primary - future
620	580	40	545	75	Secondary - existing
633	593	40	548	85	Secondary - future
665	625	40	593	72	Secondary - existing
683	643	40	593]	90	Secondary - existing
715	675	40	625	90	Secondary - existing
765	725	40	675	90	Secondary – existing

Pressure Zone Criteria
Middleton Mountain

Pressure Zone	Upper Boundary		Lower Boundary		Zone Type
	Elev (m)	Pressure (m)	Elev (m)	Pressure (m)	
479	439	40	390	89	Primary - existing
535 S	495	40	439	96	Primary - existing
572	532	40	495	77	Secondary - future
619	579	40	532	87	Secondary - future

Pressure Zone Criteria
Coldstream West

Pressure Zone	Upper Boundary		Lower Boundary		Zone Type
	Elev (m)	Pressure (m)	Elev (m)	Pressure (m)	
500	460	40	394	106	Secondary - existing
533	493	40	439	94	Secondary - existing
545	505	40	460	85	Secondary - existing
550	510	40	460	90	Secondary - existing

Pressure Zone Criteria
Coldstream East

Pressure Zone	Upper Boundary		Lower Boundary		Zone Type
	Elev (m)	Pressure (m)	Elev (m)	Pressure (m)	
500	460	40	395	106	Secondary - existing
535 E	495	40	460	75	Primary - future
585 E	545	40	495	90	Primary - future
630	590	40	545	85	Secondary - future
650	610	40	545	105	Secondary - existing
700	660	40	610	90	Secondary – existing
728	688	40	623	105	Secondary - existing

Pressure Zone Criteria
Okanagan Lake - South

Pressure Zone	Upper Boundary		Lower Boundary		Zone Type
	Elev (m)	Pressure (m)	Elev (m)	Pressure (m)	
425	385	40	343	82	Primary – existing
479	439	40	385	94	Primary - existing
518	478	40	439	79	Secondary - existing
563	523	40	478	85	Secondary - existing
624	584	40	523	101	Secondary - future
685	645	40	584	101	Secondary - future
745	705	40	645	100	Secondary – existing

A breakdown of population for each zone for the years 2001, 2011 and 2041, as well as a reservoir storage strategy, are contained in Technical Working Paper No. 13. Descriptions of primary and significant secondary pressure zones are also provided in Technical Working Paper No.13.

CHAPTER SYNOPSIS

There are currently over 50 pressure zones in the Greater Vernon area. The Master Water Plan identifies primary and secondary zones. Primary zones are intended to be the long-term pressure zone development goal. Secondary zones exist due to a local topographic constraint or existing water system component. It is intended that these zones be consolidated with the primary zones over time, based on the zone development strategy contained in the plan.

IRRIGATION SYSTEM

SECTION 10

Following the "separation" of the NOWA combined water system and removal of the domestic customers, the irrigation system reverts back to its original function – provision of non-potable irrigation water. This is scheduled to occur by the end of 2007. This chapter provides a brief discussion of irrigation system development and operation. Water source development is discussed in Chapter 7.

Additional information on the irrigation system can be found in Technical Working Papers Nos. 11 and 13.

10.1 IRRIGATION SYSTEM DEVELOPMENT

As compared to the domestic water system, there is essentially no development beyond removal of the domestic water customers from the irrigation system mainline and laterals. In essence, the irrigation system returns to its original intent – a piped irrigation system.

The system, however, will have a second function – the supply of raw water from the Duteau Creek Headgates intake to the new Middleton Mountain water treatment plant. The delivery of water to the plant will be on a year-round basis. This section of the transmission main must thus be kept in continuous operation. In other sections of the system, purely used for irrigation, the pipes could be isolated and drained during the non-irrigation months.

The irrigation system, as it will function after 2007, is shown in Figure 10-1. The major change in the system is that chlorination at the Duteau Creek Headgates intake is no longer required, as the water is not intended for potable use. In reality, the system should be simply shutdown in the initial years after the system separation and retained as an emergency backup. After a few years of operational experience, a decision of whether or not to fully decommission the chlorination equipment can be made.

10.2 SEASONAL OPERATION

During the irrigation season, the system will be fully operational. Flow will be by gravity from the Duteau Creek intake to the Goose Lake reservoir, with line pressure controlled by the two mainline PRV stations. Pressure on the upper valley sides will be provided by the existing booster pumping stations.

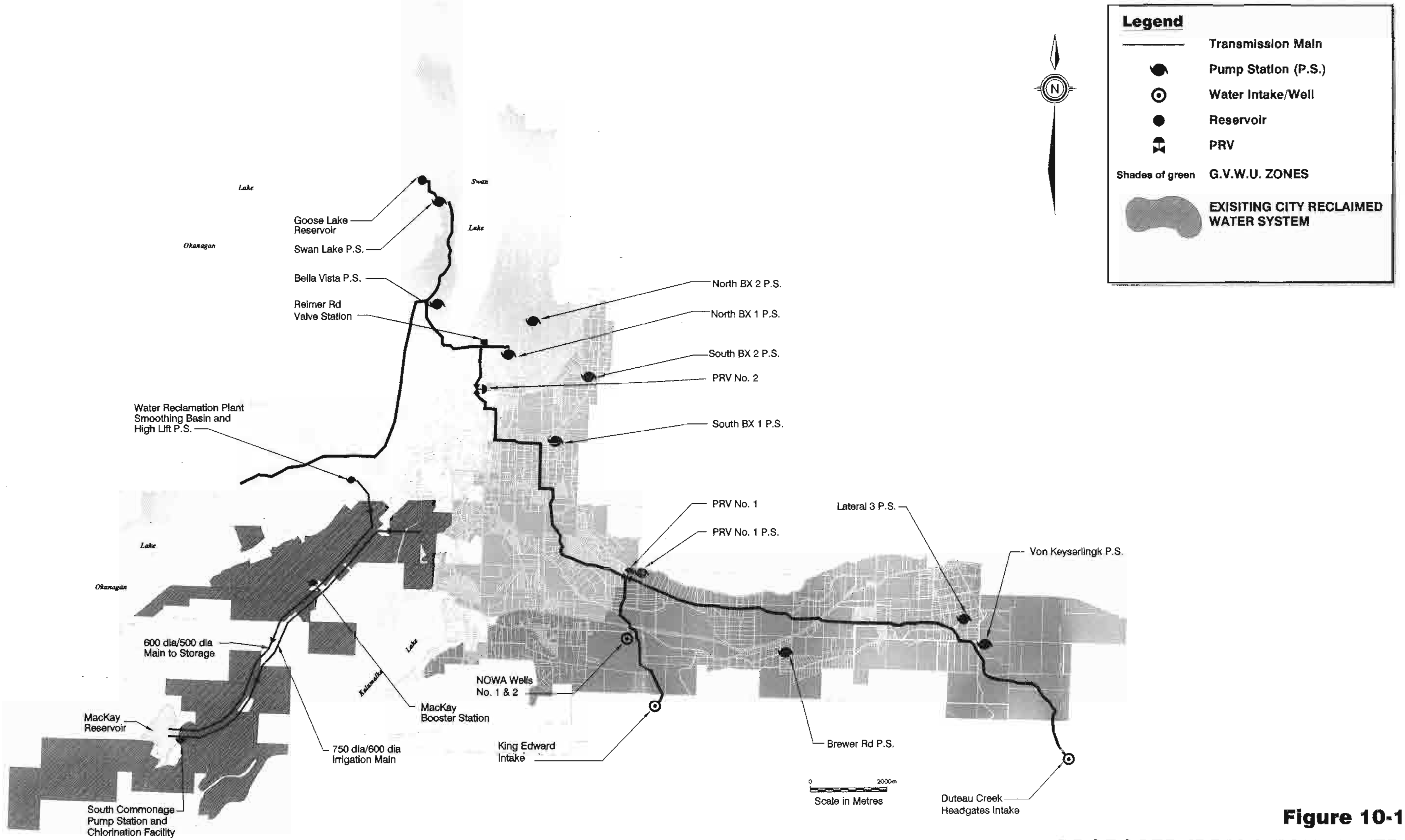


Figure 10-1

PROPOSED IRRIGATION WATER DISTRIBUTION SYSTEM

PRESSURE ZONES

Time: 16:1 Date: 2002/3/28 Plot Scale: 1=1 (Paper Space) AutoCAD File: 002121\REPORT\FEB2002\FIG10-1.DWG (ST)
Xrefs: WP13BASE

GVS water lines

Summer 2005

WATER DEPARTMENT

Get to know your water source

Greater Vernon Services has two intakes on Kal Lake.

Greater Vernon Services' (GVS) Water Department manages a complex system, which depends on the Kalamalka, Antwerp/Kal, and Upland Distribution Systems. There are nine water sources that feed these three systems, which provide water for about 50,000 customers. Water works or operations are contracted to the City of Vernon and the District of Coldstream.

At this time, all sources are chlorinated to provide a barrier against bacteria. Chlorine levels are adjusted to also inhibit bacterial re-growth within the distribution systems and to inactivate *Giardia* cysts. GVS water quality staff has coordinated a water quality program in conjunction with Interior Health to ensure the potable water supply addresses the standards outlined in the federal *Guidelines for Canadian Drinking Water Quality* and the provincial *Drinking Water Protection Act* A monthly water quality summary report is available, plus a detailed annual analysis of sources and distribution water quality.

Through the Master Water Supply Plan and related projects, the utility is moving forward in providing a higher quality product at your tap. To help you through the transition, it is important you "Know Your Water Source" in the event of a Water Quality Advisory (the risk to drinking water user is low), or a Boil Water Advisory (an identified risk in drinking the water). If you are not sure where your water comes from, read on. The water quality or characteristics may also help you to determine your source. If you're still not sure, check out our web page **www.greatervernon.ca** or contact us at 550-3702 and ask for the water quality department.

Kalamalka Lake

This surface water source is a large valley-bottom lake with two intake pump stations, one on West Kal Road (for the Kalamalka Distribution System) and the other at the west end of Coldstream Creek Road (for the Antwerp/Kal Distribution System). These intakes supply water to the majority of the City of Vernon (except upper Bella Vista, Blue Jay, and parts of East Hill) and west Coldstream to McClounie (excluded south of Coldstream Creek Road east of Cunliffe).

The McMechan Reservoir is a year-round balancing reservoir that's filled via the Kal Lake water distribution system. Water is distributed to the Foothills area, East Hill, and the north section of the city. This source is part of the Kalamalka Distribution System.

Water quality is generally good, but the

See 'Water source' page 6

GREATER VERNON SERVICES
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Interior Health introduces new and upcoming initiatives

Treatment goals will provide high-quality drinking water

Interior Health is proposing new water treatment goals for the water suppliers within its region. These will be included in existing water systems' long-term plans, and be applied as standards for all new water systems. Risk to human health will be substantially reduced when water suppliers meet these goals.

Water suppliers will be asked to provide long-term plans to reach Interior Health goals of 4-3-2-1-0-Dual Treatment:

- 4 log (99.99%) protection against viruses, which are easily inactivated with chlorine.
- 3 log (99.9%) protection against *Giardia*, which can be inactivated with large doses of free chlorine or by using filtration, ultraviolet light, ozone, and/or chlorine dioxide.
- 2 log (99%) protection against *Cryptosporidia*, which can be removed using conventional rapid sand filtration or ultraviolet disinfection.
- 1 NTU turbidity. More than 1 NTU turbidity (suspended particles in water) can compromise the water treatment process. Turbidity is removed through sedimentation and/or filtration.
- 0 total or fecal coliform (bacteria) present in the water. The *Drinking Water Protection Act* calls for water suppliers to provide water with 0 fecal coliform readings. Coliforms are easily controlled with chlorine and UV light, and can be reduced by filtration.
- Dual treatment (e.g. water filtration and disinfection) will become the norm for surface water supplies to meet the proposed treatment goals.

Notification system will inform public of water quality deviations

Interior Health has developed more ways for water suppliers to notify the public when there may be a threat to water quality. The model meets Interior Health objectives to work closely with the water suppliers and to ensure the public is well informed in the event of an incident where water quality has been compromised.

In the past, informing users of a problem with a water system was limited to issuing a boil water advisory. Interior Health's new model provides other means of notification to ensure meaningful communication of the risk to the users of the drinking water. The type of notification used will depend on a health risk assessment of the threat to the water quality. Three levels have been developed:

A **Water Quality Advisory** will be issued as a precautionary measure when the risk to drinking water users is determined to be minimal or low.

A **Boil Water Notice** will be issued when an identified threat is determined to be a risk to the users of the drinking water.

A **Do Not Use the Water Notice** will be used if there is an immediate threat or possible unknown threat to water quality (such as chemical spills, vandalism, acts of nature) and where boiling the water will not remove or reduce the risk to water quality.

In all cases, the immune compromised should take special precautions. ■

Interior Health

Interior Health's 55 drinking water officers support more than 1600 water suppliers in the region in meeting their obligations under the Drinking Water Protection Act *and corresponding regulations. Their job is to audit the water suppliers for operational accountability. This includes using a multibarrier approach consisting of: 1) protecting the water source; 2) ensuring adequate water treatment; 3) protecting water quality once it enters the distribution system; and 4) monitoring the maintenance and operation of a water system. By reviewing water quality results, carrying out an inspection and compliance program, and assessing risks associated with drinking water, the officers work to ensure potable water is provided for all. From left to right are the Senior Drinking Water Officers and the Drinking Water Manager: Dan Byron, Mike Adams, Robert Rippin, Serge Zibin, and Elizabeth Sigalet.*

WLAP implementing Ground Water Protection Regulation

Since last fall, the Ministry of Water, Land and Air Protection (WLAP) has been implementing its new Ground Water Protection Regulation (GWPR). In particular, the ministry has focussed on: 1) registration of well drillers and pump installers; 2) staffing of groundwater hydrologists in specific regional offices; and 3) identification of community wells.

Registration of well drillers and pump installers

The GWPR required qualified well drillers and well pump installers to register with WLAP starting November 1, 2004. As of March 24, 2005, 34 qualified well drillers and 33 qualified well pump installers were registered, with more expected to apply. The registry of qualified well drillers and well pump installers, and application forms can be found at **http://wlapwww.gov.bc.ca/wat/gws/gwis.html.**

Staffing of ground water hydrologists in WLAP offices

WLAP is also in the process of staffing its regional offices with ground water hydrologists to support compliance with the GWPR. To date, there are four such hydrologists:

- Des Anderson in Penticton covers the Okanagan and Kootenays (250-490-8221);
- Kevin Bennett in Kamloops covers the Thompson and Cariboo (250-371-6319);
- Gwyn Graham in Surrey covers the Lower Mainland and Sea-to-Sky (604-582-5369); and
- Mike Feduk in Nanaimo covers Vancouver Island (250-751-3149).

Identifying community wells supplying drinking water

A GWPR provision of direct interest to drinking water supply system owners is the requirement to identify existing and new drinking water supply wells by attaching a well identification plate to the well (see photo). Beginning November 1, 2005, all newly constructed water supply wells must have a well identification plate supplied by WLAP. All existing drinking water supply system wells must have well identification plates by November 1, 2006.

The ministry has plates available and is currently developing procedures for distributing them. Further information on well identification will be available in the near future on the ministry's Ground Water homepage: **http://wlapwww.gov.bc.ca/wat/gws/gwis.html.** ■

Well identification plate attached to a well.

Regional Groundwater Assessments in the Okanagan Basin

In 2004, the Groundwater Assessment in the Okanagan Basin (GAOB) project was initiated. The objectives of this multi-agency partnership project are to gain a greater understanding of the ground water resources in this important region of the province.

One of the sub-projects of GAOB is a pilot project to collect accurate inventory information including locations of sources for public drinking water supplies (both ground water and surface water) in the Okanagan Basin. The Interior Health Authority, the Ministry of Health Services, the Ministry of Water, Land and Air Protection, and more than 300 public water supply systems in the Okanagan are involved in the pilot project. It is directly linked to the Drinking Water Information Management Project (DWIMP), an initiative that enables the sharing of data on public drinking water systems between multiple government and stakeholder databases. DWIMP is designed to support effective and efficient decision-making by directly engaging ministries, health authorities, and drinking water supply systems.

In addition to collecting accurate inventory information on water supply systems and their water sources, the pilot project will cross-reference information on public drinking water sources (the well, the aquifer) in various government databases (e.g., WLAP's WELL and aquifer databases to the health authority's water system database). Cross-referencing allows public drinking water sources to be identified and referred to without ambiguity by various agencies and water supply systems. ■

Okanagan Water Supply and Demand Study underway

Record lows were reached in many Okanagan streams and groundwater wells over the past two years; at the same time, the population increased by more than 4,000. With water in many streams fully allocated, water suppliers are looking to groundwater and Okanagan Lake as alternative supplies. Therefore, we must clearly define how much water is available in the Okanagan Basin now, and for the future, considering the influence of growth, climate change, and other relevant factors. To that end, Land and Water British Columbia, Inc., in collaboration with other provincial ministries, Environment Canada, and the Okanagan Basin Water Board, has initiated a two-phase water supply and demand analysis of the basin.

With the numerous water-related studies previously conducted in the basin, much of the data needed for a supply and demand analysis already exists. Phase 1 of the current study, completed in March 2005, included a review of this information. The results of the information evaluation and the approach for the analysis, to be conducted in Phase 2, were discussed at a workshop in early March with key water managers from federal, provincial, local, and First Nation governments, along with representatives from academic and industry groups. Workshop recommendations will be reflected in the Phase 1 report from the consultants. A key message from the group was that the second phase of the study should include a comprehensive consultation process to foster information sharing on the goals, limitations, progress, and results of the study, helping to ensure the study results are useful for current and future decision makers. Phase 2 is estimated to be complete by the fall of 2006.

In addition to this study, 21 grants totalling about $294,000 have been provided to Okanagan water suppliers to create drought and water conservation plans, and to educate the public on the need for water conservation. In total, LWBC has committed nearly $1.3 million in grants to more than 100 communities across the province.

As part of the larger "2004 Dealing with Drought" effort launched by the province in July 2004, the grant program was intended to help communities across the province plan for and respond to the pressures of dry weather, growing populations, and increased competition amongst users. Water conservation is key this summer, and for the future.

"Think water... every drop counts"

Courtesy of Kelowna Joint Water Committee

Wally says...

Properly-installed, well-maintained and wisely-managed automatic sprinkler systems conserve water admirably. Remember to —

- *schedule properly, watering only when needed.*
- *clean filters routinely, and*
- *adjust sprinkler head pressure to avoid overlap and the unnecessary watering of roadways and sidewalks.*

Master Water Plan Update

Mission Hill Disinfection Facility & Kalamalka Lake Pump Station

Greater Vernon Services (GVS) recently awarded supply contracts for the ultraviolet disinfection system, the on-site sodium hypochlorite generator, and the two 400-hp pumps. Construction of the new disinfection facility and upgrades to the pump station will commence this fall with a target completion date of May 2006. The work will result in improved capacity and water quality for areas receiving Kalamalka Lake water.

Bella Vista Separation Project

Domestic connections in the Bella Vista corridor, which are currently receiving water from the Duteau Creek/Goose Lake system, will be converted to the Kalamalka Lake source. The project includes a new pump station on Bella Vista Road near Allenby Way, and about six kilometers of new water main. Work is scheduled for July through October this year. Irrigation customers will continue to receive Duteau Creek water for agricultural use.

West Swan Lake Separation Project

The Duteau Creek/Goose Lake system supplies water to the Old Kamloops Road area. Domestic customers in this area will be converted to the Kal Lake supply. This work is currently in predesign stage. Irrigation customers will continue to receive Duteau Creek water for agricultural use.

Duteau Creek Water Treatment Plant

Pilot water treatment studies at the Headgates site on Duteau Creek are completed. Three clarification technologies were tested in the most challenging water quality conditions during spring runoff. All three technologies performed well, and the pilot testing report will be completed in June. The Duteau Creek Water Treatment Plant is scheduled for construction through 2006, with commissioning in spring 2007. Residents currently receiving Duteau Creek water (e.g. East Coldstream, BX, and Swan Lake) will see a substantial reduction in colour and turbidity when the plant is brought into service.

McMechan Reservoir

The new 13,000-cubic-metre concrete reservoir is now on stream. The reservoir improves water quality and lowers the health risk to customers on the Kal Lake system, including those being converted on Bella Vista and Old Kamloops Road. ■

Planting smart to reduce water use

Gardening is thirsty work. In fact, as we exercise our green thumbs during warm spring and summer months, domestic water consumption skyrockets.

The solution to our overindulgence is to adopt a two-pronged approach to the critical issue of long-term water conservation. Simply put, outdoor water consumption depends on what you plant and how you water.

What is Xeriscaping?

The concept of xeriscaping was introduced during Denver, Colorado's drought of the late '70s. It's now the big thing in water-conscious California, and is quickly making its way up here.

What's all the fuss about? As well as being beautiful and less costly and labour intensive, xeriscaping can reduce domestic irrigation by as much as 50 percent. Drought-tolerant (often indigenous) plants are watered for the first year after planting until healthy root systems are established into the groundwater table. After that, they're watered very little, if at all. ■

Wally says...

get to the root of water management by xeriscaping!

Courtesy Kelowna Joint Water Committee

Water source... continued from page 1

water is slightly hard. Algae sometimes causes taste and odour concerns.

Duteau Creek

Duteau Creek — a surface water source originating on the Aberdeen Plateau, south of Lavington — is the main supply for the Upland Distribution System (former NOWA/VID customers). Water is distributed to Areas B and C, Stepping Stones, Blue Jay, upper Bella Vista, parts of East Hill, Middleton Mountain (Coldstream), Coldstream Estates, south of Coldstream Creek Road east of Cunliffe, some areas east of McClounie Rd in Coldstream and Lavington.

Supplied by three reservoirs on Aberdeen, Haddo, and Grizzly Lakes, the Duteau Creek source relies heavily on snow accumulation in winter to fill the reservoirs.

The water is very soft, with high organic content that creates a tea-like colour. The organics are derived from peat, soils and vegetation. Spring runoff can cause seasonal (spring) turbidity or clarity problems.

Antwerp Springs

Two groundwater wells located near the intersection of Hwy. 6 and School Road supply water to most of Lavington and Coldstream east of McClounie Rd. These wells are part of the Antwerp/Kal Distribution System.

Antwerp Well #1 water is very hard, which can cause spotting and calcium buildup in hot water tanks and appliances. Although it has excellent clarity and very low turbidity, it does have slightly elevated nitrate levels. It has a mineral taste.

Antwerp Well #2 water is very hard with manganese levels high enough to cause aesthetic problems such as temporary black water and may cause black spotting on laundry. While the water is clear with low turbidity, it has a mineral taste.

Duteau Creek is fed by three reservoirs — Aberdeen, Haddo, and Grizzly Lakes.

Seasonal Sources

Goose Lake: May to September

Goose Lake is a surface source that services Area "C" on the westside of Swan Lake, Stepping Stone, Blue Jay Subdivision, and most of the upper Bella Vista area during peak water use months. This source is filled from the Upland Distribution System and is a balancing reservoir for it.

The water has low hardness, and low turbidity. Since this source is located near the valley bottom and is only five meters deep, it becomes very warm. This can cause algae problems that compromise taste and odour.

Deer Creek (King Edward): May to late August

Part of the Upland Distribution System, Deer Creek is an upland surface source originating at King Edward Lake. Usage is directed to Coldstream Ranch, but can be distributed to Coldstream west of the ranch.

The water is very soft with moderate clarity or turbidity and has a tea-like colour. Late summer and fall algae blooms determine the use of this source.

Coldstream Ranch Wells

Two groundwater sources located on Coldstream Ranch supplement the Upland Water Distribution during spring runoff and peak water use months. Usage is directed to Coldstream Ranch, but can be distributed in Coldstream west of the ranch.

Well #1's water is very hard and it may cause spotting on glassware and cutlery. Elevated manganese may cause black spotting on laundry. The water is very clear but has a mineral taste.

Well #2 water is very hard with slightly elevated nitrate levels. Its water, too, is very clear but has a mineral taste. ■

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