Regional District of Central Kootenay

Point of Entry / Point of Use Water Treatment Systems

Feasibility Studies

Prepared for:

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31st July 2008

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DRAFT
1st June 2008

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Dear Ms. Horan,

Regional District of Central Kootenay
Point of Entry / Point of Use Feasibility Studies

We are pleased to enclose our report on the Point of Entry / Point of Use (POE / POU) Feasibility Studies. We are pleased to acknowledge the assistance received from staff of RDCK during the preparation of this report.

One of the recommendations arising from this work is that a pilot project to further explore POE / POU should be undertaken. We will be pleased to assist with this next stage as appropriate.

If you have any questions about the work covered in this document please contact the undersigned. Thank you very much for the opportunity to work on this important project.

Yours truly,

Vernon Rogers M.Sc. P. Eng.
President

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Please Note

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1. INTRODUCTION

1.1 Purpose

The purpose of the work covered by this report is to undertake three studies for the Regional District of Central Kootenay to determine the feasibility of various water treatment technologies. It is also to compare POE/POU water treatment against the alternative option of constructing a centralized treatment facility.

The purpose of the work is also to examine the opportunity for a full-scale pilot project to examine the use of POE / POU technology, and also to look at the use of options for using Gas Tax Agreement (GTA) funding to contribute to the cost of the pilot project. The work includes preparation of terms of reference for a pilot project. This work will serve as the basis for the Ministry of Community Services (MCS) to determine if GTA funding should be recommended to assist in installation of POE/POU water treatment and to perform other necessary upgrades.

The deliverables from the three studies should relate directly to the provincial POE / POU water treatment Guidebook prepared in draft by the Sustainable Infrastructure Society (SIS) with sponsorship from the BC Ministry of Health.

1.2 Project Team & Approach

This work was carried by AquaVic Water Solutions Inc. AquaVic was assisted by Blue Mountain Engineering Ltd. which undertook site investigations and aspects of the technical analyses and costing of the water systems included in this work.

The project team reviewed existing information concerning the RDCK water systems, together with literature covering the use of POE / POU water treatment technology in other jurisdictions. Existing documents prepared to assist in the application of POE / POU in British Columbia were also reviewed.

Several staff members of the RDCK were consulted at various stages in the project. Visits to the water system covered by this work were made by members of the project team under the guidance of RDCK staff.

1.3 Regional Context

The Regional District of Central Kootenay is located in south east British Columbia. The headquarters of the regional district is in Nelson, on the shores of Kootenay Lake.

The RDCK operates several small water systems, certain of which are on a Boil Water Advisory. The status of RDCK water systems is shown in Table C1: *Small Water Systems in the Regional District of Central Kootenay.* As purveyors, the RDCK is ultimately responsible for the safety of the drinking water being provided by these drinking water systems. The Interior Health Authority (IHA) is encouraging the RDCK to bring these small water systems into compliance with provincial legislation and standards. It is a goal of RDCK to improve the state of the infrastructure of these

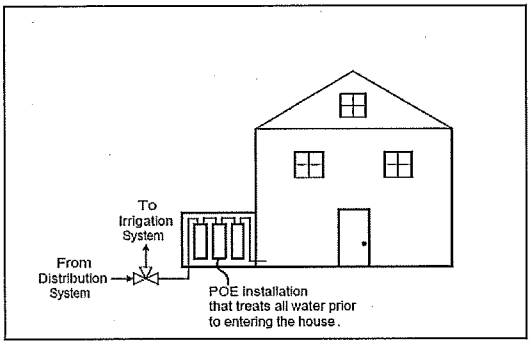
fourteen small water systems as well as introduce the necessary technology to enable the water provided to be considered potable.

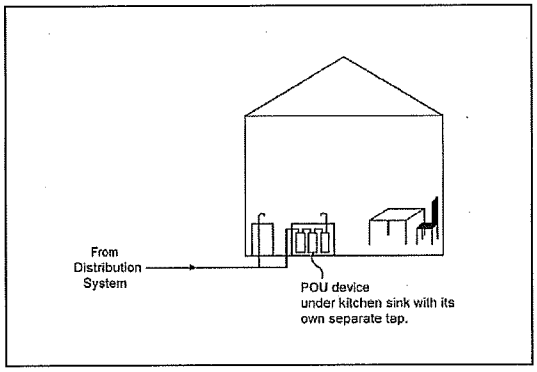
The Ministry of Community Services (MCS), through the Infrastructure Planning Grant Program, has provided the RDCK with funding to carry out these three feasibility studies related to Point of Entry/Point of Use (POE/POU) water treatment. POE/POU has the potential to provide a solution to a prevalent and persistent challenge in the Regional District – bringing small water systems into compliance with the BC *Drinking Water Protection Act* in a manner that is economically, socially, and environmentally viable. However, more information about POE/POU is required before any clear direction can be identified. These feasibility studies are intended to lay the groundwork for a future pilot project in which POE/POU will be tested in an actual community setting. Funding for such a project has not yet been identified.

1.4 POE / POU Water Treatment

The following provides a brief description of POE and POU technology.

Point of Entry (POE): A Point of Entry water treatment device is one which is located at the point where the water supply enters the premises and treats all water entering the premises to a potable standard.





Point of Use (POU): A Point of Use water treatment device is one that is typically, but not necessarily, installed within the premises and located immediately before the point at which water is drawn for consumption, such as a kitchen tap, and which treats only water drawn at that point to a potable standard.

Potential Benefit to Water System

POE / POU systems may offer benefits to certain kinds of small water systems. If a water system manager answers "Yes" to any of the following questions, then further exploration of POE / POU is warranted.

- Is a high percentage of the total water you supply used for irrigation or other non domestic use?
- Do many of your customers provide their own potable water supply, and use your system only for irrigation, fire fighting or other non-domestic purpose?
- Are you are in a remote location where electricity is only produced on individual properties for personal use?
- Do you think that POE / POU may be more affordable for your small system to own or to operate than a centralized treatment system?
- Do you have a chronic chemical contaminant in your source water, for example arsenic, that must be removed to make the water safe to drink?
- Is contamination occurring from parts of your distribution system which are difficult to remediate?
- Do you customers want chlorine or chlorine by products removed from the water supply before it enters their homes?

POE / POU Outline Planning Considerations

The managers of small water systems who decide to investigate the use of POE / POU should be aware of certain considerations, some of which derive from best practices or legislated requirements. When planning a POE / POU system, managers of small water systems should:

- Make decisions about the kind of water treatment to be used with reference to the long-term plan for the water system, and identify in writing the water treatment needs of the system at an early stage in the process
- Contact the local drinking water officer (DWO) at an early stage and describe the plans for POE / POU, and review the applicable legislation.
- Be aware that all POU / POE equipment should be owned and maintained by the water system.
- Prepare a written plan covering purchase, installation, monitoring and operation of the POE / POU devices which is acceptable to the DWO.
- Ensure that the owners of all homes and other premises connected to the water system agree to the installation of POE / POU equipment.
- Plan for full communication with the customers about the use of POE / POU.
- Be aware that Point of Use (POU) devices should not be used to treat for microbial contaminants or for an indicator of a microbial contaminant.

- Be prepared to demonstrate to the DWO that the technology selected is effective in removing the contaminants of concern and is appropriately certified; that the microbiological safety of the water will be maintained at all times, and that the equipment will provide a level of health protection equivalent to that provided by centralized water treatment.

- Ensure that the POU and POE units have a warning device which will automatically notify customers of operational problems, and that POE units will have an automatic shut-off mechanism which activates if there is a malfunction.

The full version of these POE / POU planning considerations is given in the appendices and is available on the web site of the Sustainable Infrastructure Society at: www.SustainIS.Org

POE Permit Applications

It is a requirement of BC legislation that all water systems have an operating permit. In addition any water system contemplating installation of a POE system may require a construction permit. These permits are obtained form the regional health authority having jurisdiction. The information that will be required by the health officials when considering a permit application in connection with POE / POU has yet to be fully determined.

To provide initial guidance to small water systems considering POE / POU a preliminary permit application check list has been prepared. A copy of this draft POE Permit Application Checklists is given for reference in Appendix 3.

1.5 References

References were made during this project to documents including the following:

1. An Introduction to POE / POU Water treatment Systems in BC.

2. Point of Entry and Point Of use Water treatment Systems: planning considerations for British Columbia.

3. Guidebook: Planning and Implementation of Point of Entry and Point of use Water Treatment Systems in BC, and appendices.

PART A: SANCA PARK WATER SYSTEM

Deliverables: Sanca Park Water System

In order to provide the required deliverables of this project the project team was required to examined the feasibility of using POE/POU for bringing the Sanca Park Water System into compliance with the appropriate legislation, and to meet the 4-3-2-1-0 objectives of the Interior health Authority. This includes providing ballpark estimates for implementing POE/POU in the community if it is deemed superior to a centralized treatment facility. As well, the project team was required to developed recommendations on available POE/POU technologies that may be applicable.

A1. Existing Sanca Park Water System

The following sections are based on the State of the System Report prepared by staff of RDCK, Engineering and Environmental Services Department in January 2007.

A1.1 System Overview

The Sanca Park water system is located along the eastern shore of Kootenay Lake, approximately half way between the communities of Creston and Crawford Bay. It came under Regional District Central Kootenay governance in 1979. It has 29 individual residential connections and one strata development with 6 connections. There are only 6 year round residents. The Elks Club dormitory is now closed and the property was sold to Sanca Creek Beach Resort. The location is now proposed to be developed into a 14 lot subdivision but with only 6 connections. There are also plans for a retreat or campground and further growth seems likely.

With 29 single-family residential units and 6 additional connections, each using 5,200 L/d, the consumption is 182,000 L/day. Maximum day demand (MDD) is assessed at 207,500 L/day. Fire protection is considered inadequate. A shed in the middle of Road C contains 150 m of fire hose. Fire protection is provided by volunteers. No fire truck is available. No formal fire protection is provided.

A1.2 Water Source & Usage

There is only one water source: Sanca Creek. The estimated low flow is 140 L/s. Watershed runoff is approximately 1.6 L/s per km^2 which is a comparable yield with other Kootenay watersheds. The Sanca Creek Community Watershed (CWS 340.115) was established in June 1995 and encompasses approximately 10,879 ha. Logging is permitted in the watershed (by Wynndel Box and Lumber Co. Ltd); the watershed is also accessible to recreation. There is no record of mining taking place in the watershed.

Sanca Creek is considered to be fish-bearing, mainly with Kokanee salmon. The water license allows for a maximum extraction of 29,000 m^3/annum or 66,325 L/day.

The intake on Sanca Creek was reconstructed in 1980 and utilizes an infiltration gallery to draw in water. Sand and gravel provide basic filtration; there is no other treatment. Visual analysis suggests that siltation and root infiltration is taking place. The water supply and distribution network was completely rebuilt in 1980 following a design by Mecman Engineering.

The current usage for the average dwelling in the Sanca Park water system is documented at 5,200L/day. This is about 5 times more than the national average and may be due to high irrigation use or line breaks.

A1.3 Existing Water Quality & Treatment

Apart from filtration provided by sand and gravel at the intake there is no other treatment. Most residents are reported to use in-house filters with the majority being POU (point of use) located under the kitchen sink. Some residents use POE (point of entry) devices. The shut-down protocol used by seasonal residents is unknown

A2. Water Treatment Options

The terms of reference for this project require the project team to compare POE / POU against the alternative option of constructing a centralized treatment facility within the community. In order to meet this requirement the following sections outline both a POE / POU configuration and a centralized treatment configuration. Both the POE option and the centralized treatment options include for treatment to 4,3,2,1,0 standards of the water entering the homes of customers. The application of Point of Use (POU) equipment (which is installed typically only at the kitchen tap) to treat water subject to microbiological contaminants is excluded by the POE / POU Guidelines. This is because of the possibility of occupants ingesting water from outlets other than the kitchen tap, such as those in a bathroom. POU has not been explored further for application in this case.

Generalized Comparison of Options

Before considering the specific characteristics of the Sanca Park water system it is helpful to compare the generalized advantages and disadvantages of POE and Central water treatment systems. A generalized comparison of the two options, which will typically apply to installations in most small systems in British Columbia is provided in Table A3 below. This information is derived from operating experience elsewhere. This table is not intended to substitute for the detailed comparisons of costs and benefits that should be made for a specific water system. Estimates of the costs of water treatment options for Sanca Park and South Slocan are given elsewhere in this report. .

Table A3: Generalized Comparison of POE & Centralized Treatment

Element	Point of Entry		Centralized Treatment	
	Advantages	Disadvantages	Advantages	Disadvantages
Capital Cost	May be less expensive below 100 connections?		May be less expensive above 100 connections?	Components may be sized for future populations
Operating cost		Limited economies of scale	Opportunities for economies of scale	
Scalability	Easily scaled			Less easily scaled
Maintenance		Visits to each household required	Straightforward	
Chlorine removal	Can provide			Cannot provide & protect
Distribution system deficiencies	Can remove contaminants originating in distribution system			Cannot remove contaminants originating in distribution system
Administration		More complicated	Straightforward	
Public involvement		More complicated	Less complicated	
Non domestic water use (e.g irrigation)	Avoids treatment costs			Costs incurred to treat
Monitoring		Monitoring at each household	Straightforward	
Regulatory Issues		Not well understood	Well understood	

Centralized Treatment Components Common to Both Options

The State of the System report for Sanca Park, together with on-site inspections, both suggest that the water intake should be upgraded and a method of primary filtration should be introduced. Primary filtration in a centralized treatment facility will have the effect of reducing sediment in the distribution system and provide limited reduction of certain pathogens.

There are currently 35 connections, but only 6 of these are for year round residents. It is expected therefore that at certain times of the year the distribution system will contain significant amounts of stagnant water which may lead to water quality deterioration.

There is very limited experience with the regulation of POE in BC when used in small water systems (A report is now available on a RDCK pilot project for installation of a POE system in a Sanca Park residence: see references). There is therefore some uncertainty about the regulatory requirements that may apply to disinfection of water using POE. Some BC health authorities may propose two stages of disinfection in circumstances similar to Sanca Park, for example chlorination at a central location followed by u.v. treatment by the POE system at each household. (Conversations with a representative of IHA indicated that IHA may want to review the content of this report before entering into detailed discussions on this topic).

For the reasons noted above there may be a requirement for providing chlorine injection and other preliminary treatment at a centralized location, even if the POE option is pursued.

Centralized Treatment Components Common to Both Options

In discussion below concerning the Sanca Park system it is therefore assumed that both the POE option and the centralized treatment option would include the following components placed in a centralized location within the water system:

- Upgraded intake works
- Cartridge filter bank (If the upgraded intake works includes effective filtration through sand the resulting water may be suitable for 20 micron filtration through cartridge filter banks). As an alternative, use of a self-cleaning sediment filter to 30 microns could be investigated. This has higher capital cost but reduces maintenance costs and the cleaning cycle is automatic
- Chlorine injection.

The capital cost estimates for these items are shown in the Tables A1 and A2. Cost estimates given in this report are generally Class C (See Appendices). The capital and operating cost estimates do not include the upgrade to the intake works since this must be based on site investigations and site-specific engineering design.
The estimates include for the installation of centralized primary filtration and centralized chlorine injection: these are common to both options.

Two Options for Treatment of Water

Two options for treatment of water to potable standards are outlined in the following. Due to various considerations a third option, providing treatment by POE alone, has not been examined further. These consideration include the amount of sand and silt that enters the system at the intake, the recommendation by RDCK staff in a report of April 2008 that POE does not appear to be feasible, and the expectation by the health authority that a form of centralized treatment will be installed.

The two options for Sanca Park examined further are:

Option 1: Centralized treatment components followed by POE installations

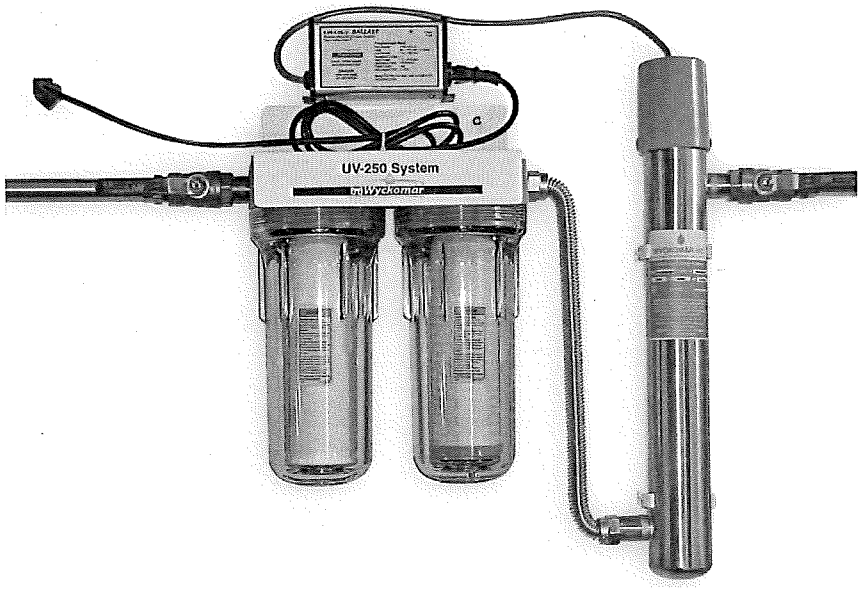
Option 2: Centralized treatment alone

Each option is outlined in the following sections. The configurations outlined below have been developed based on readily available data and not on detailed site-specific investigations. The actual configurations of either POE / POU or centralized treatment installed in this water system must be determined after further engineering investigations and detailed design. The configurations outlined below may not therefore reflect the actual designs found after further investigation to be appropriate for this system.

Option 1: Sanca Park Centralized treatment components followed by POE installations

This option is for the use of POE water treatment in Sanca Park, together with the centralized components described above. The capacity of the POE configuration use in this analysis is sufficient to treat water being used within the household for domestic purposes. It is based on the assumption that water for irrigation and other outdoor uses is not treated by the POE system.

The POE configuration that has been used for this work is described further in Appendix A1. The POE system consists of consecutively finer filtration until a turbidity of <1 NTU is achieved. The water will then undergo UV disinfection before flowing to the house. The cost estimates for installation of the POE system are shown in Table A1. The operating costs for installation of the POE system are shown in Table A1 also. An example of a POE configuration is shown in the following illustration.



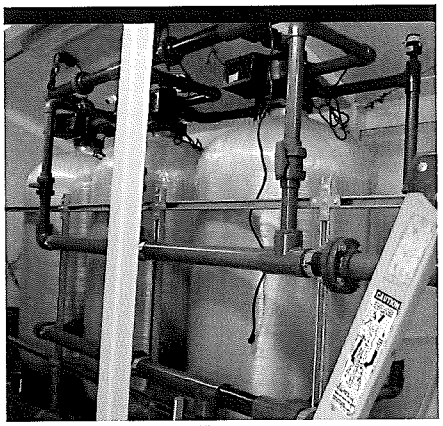
5/1 Micron Filtration followed by UV Treatment

Option 2: Sanca Park Centralized Treatment Alone

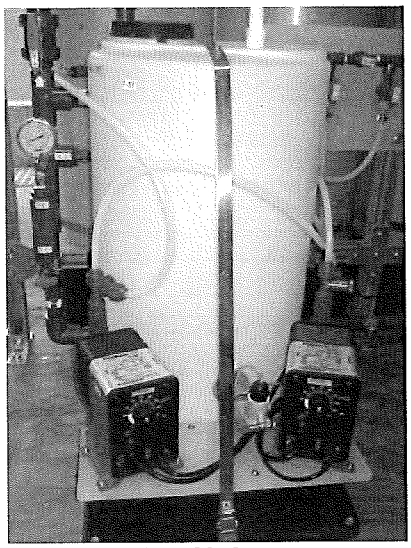
This option is for the use of centralized treatment alone in Sanca Park. Centralized treatment is assumed for these purposes to include primary filtration, secondary filtration and disinfection using chlorine.

The capacity of the centralized treatment installation used in the analysis is sufficient to treat water being used both within the household for domestic purposes, and water that is used for irrigation.

The centralized configuration that has been used for this work is described further in Appendix A2. The cost estimates for installation of the centralized system are shown in Table A2.



Rapid Sand Filter



Chlorination Unit

A3. Comparison of Options

Most of the generalized advantages and disadvantages of centralized systems and POE treatment systems, as given in Table A3, apply to the Sanca Park water system.

For the reasons noted above, certain centralized treatment components have been included in the POE option. The cost estimates provided for Sanca Park in Table A1 include for the cost of these centralized treatment components.

Central Treatment Option: For the central treatment option a large contact reservoir (200,000L) has been assumed in order to provide an appropriate chlorine contact time for the large flows including irrigation demand. This volume of reservoir will require custom construction in a remote location in difficult terrain; all of which will be more costly than the use of much smaller off-the shelf tankage.

POE Option: For the POE option, a much smaller centralized reservoir is assumed (45,000L), which will provide only limited chlorine contact time for the large flows which include water for irrigation. However the presence of chlorine, even with reduced contact time, will weaken certain pathogens. The POE installations in each household will provide filtration (to 1 micron for cyst removal), which together with the UV treatment will remove pathogens.

Small off-the-shelf storage tanks may be required in each household (and which are included for in the cost estimates) to balance peak demand with the capacity of the POE units.

Given the approach noted above there is little difference in the capital costs and operating costs of the two options. For POE treatment for Sanca Park to provide significant cost savings, the central treatment components would have to be eliminated or further reduced in scope. For this to occur, certain issues must be addressed as follows:

- Ingress of sand and silt at the intake must be controlled
- Any water quality problems that may result from seasonal use of large parts of the distribution system, and that will not be rectified by use of the POE installations, should be solved.
- Final disinfection of the water only by each household POE installation must be acceptable to regulators.

A4. Conclusions & Recommendations

Conclusions

The analysis above in part compares the option of using centralized treatment with use of POE treatment in individual households. The following conclusions are drawn from the comparison of the options, from on site inspections at Sanca Park, and from other sources.

1. If a POE system is employed the water used by each household for irrigation may be withdrawn from the service line to the house prior to treatment in the POE unit. In this case the capacity of the POE unit would then need only to be sufficient to treat the flow used within the house for domestic purposes.
2. If centralized water treatment is employed the capacity of the treatment components must be sufficient to treat the peak flows, which include a significant irrigation demand.
3. For reasons noted certain centralized treatment components have been included in the option utilizing POE treatment at individual households. The cost estimates provided include for the cost of these centralized treatment components. With the costs of these centralized treatment elements included there is no great difference in the capital costs and operating costs of the two options.

4. There is very limited cost data available concerning the design, installation and operational costs of POE systems. (However pilot project costs data provided by RDCK for Sanca Park is now available) The estimates are provided in this report should be refined following operating experience. There are also challenges in making comparisons of the costs of centralized treatment and POE treatment; these will eventually be resolved through pilot projects and subsequent documentation of actual operating experience.

5. As POE systems are considered further, pilot testing should be conducted to determine the effectiveness of the POE systems to meet 4,3,2,1,0 guidelines, and before POE units are installed in individual households.

6. Use of the POE systems will require clear communication with residents and enhanced resources for water sampling, administration and maintenance.

7. There is a reported accumulation of sand and gravel occurring in the fire stand pipes. This may result from poor performance of the infiltration gallery or from one or more significant breaks in the distribution lines. These issues should be investigated further.

8. The current usage for the average dwelling in the Sanca Park water system is documented at up to 5,200L/day. This is up to 5 times the national average water consumption. This high consumption is likely to be due to high irrigation usage in the summer, and possibly due to breaks in the distribution system.

9. If following further investigations the high water usage is shown to result from irrigation use, consideration should be given to the installation of water meters to measure both irrigation use and domestic use by individual properties: the costs of meter reading and maintenance should be analysed beforehand.

Recommendations

1. The initial stages of the pilot project recommended for South Slocan (See Section B) and covering installation of POE should be monitored and the experience gained should be applied to Sanca Park.

2. Drawing on the results of the pilot project for South Slocan, the comparisons of the use of POE compared to centralized treatment for Sanca Park should be refined.

3. These detailed comparisons should be informed by further discussion with regional health staff to determine their requirements for chlorination in addition to the treatment provided by POE installations at each household.

4. The installation of water meters should be considered in the future, with the meters measuring water used for both domestic and irrigation and other outside purposes.

PART B: SOUTH SLOCAN WATER SYSTEM

Deliverable: South Slocan Water System

In order to provide the required deliverables for this project the project team was required to examine the option of combining centralized treatment with POE/POU treatment to remove chlorine at the household level. The community of South Slocan has repeatedly expressed its opposition towards the use of chlorine as a disinfectant but has agreed to allow it provided that residents can be assured that the chlorine is removed from drinking water before its use or consumption. A centralized water treatment facility is already planned for this community. As a result, the team is required to examine a scenario where POE/POU technologies that remove chlorine only are employed.

B1. Existing South Slocan Water System

The following is taken from the State of the System Report prepared by staff of RDCK, Engineering and Environmental Services Department in January 2007.

B1.1 Existing System

The community of South Slocan is located approximately 23 km from Nelson on Highway 3A. The original water system was constructed prior to 1950. It became an RDCK owned system in the 1980's in order to fund capital works needed at the time (e.g. storage tank). The system is currently operated by the RDCK in cooperation with the South Slocan Commission of Management. The growth rate of the community has been relatively static for the last 30 years. There is currently no ability to expand the capacity of the system.

In 1954, a dam was constructed on Smokey Creek to store water. Distribution from this storage structure is via a 4" cast iron water line. A PRV is in place. In 1992, a section of the distribution line in the lower part of the community was replaced. Some valve boxes were also replaced at this time. Four inlets consisting of perforated vertical culvert sections connected to a PVC manifold are located at Watts Brook and another at Rivulet Spring. These pipes are 3" diameter and deliver water downhill to a 272 m^3 (60,000 Imperial gallon) steel storage tank constructed in the early 1980's. There is 2,500 feet of 3" dia. cast iron supply main from Watts storage tank. In 2003, 122 m of 40 year old galvanized pipe was replaced by ¾" clad PVC along the north shoulder of Blewett Road. 1100 feet of the supply line from Smokey Creek is 3" cast iron, the rest is 4" diameter.

The system does not meet current standards for fire protection; therefore there is inadequate fire protection. There are five fire hydrants (6" hydrants on 3" line), and two stand pipes in place. No maintenance is currently taking place. No engineering standards have been applied to the system in the past. The system classification from the Environmental Operator's Certificate Program (EOCP) is pending completion of capital upgrades. The operator is not EOCP/BCWWA trained or certified.

The system is regarded as poorly maintained and subject to malfunction. Distribution is comprised of 3" steel and cast iron piping, with white PVC. Supply line from storage tank to PRV is exposed to the surface and, therefore, exposed to the elements.

B1.2 Water Sources & Usage

The following water sources contribute to the system:

Watts Brook – Groundwater outflow accumulates in a natural depression measuring approximately 3 m x 6m. There is approximately 0.5 m of organic material at the bottom of the pond, which overlays glacial substrate. Water is collected downstream in a concrete basin measuring

Rivulet Spring – Water from Rivulet is intercepted by a small ditch and directed into a collection box.

In 1979, flow from Rivulet Spring and Watts Brook was estimated using a v-notch weir. It was determined that flow was approximately 8,000 Imperial gallons per day. This is well below licensed capacity. Flow estimates made 30-40 years earlier were approximately 30,000 Imperial gallons per day.

Smoky Creek – It is reported that the flow levels drop significantly in the fall/winter. In late 1979, a streamflow analysis was taken using a v-notch weir. Only 8,000 Imperial gallons per day (36,368 L/day) was recorded. This is well below the licensed allowable draw of 60,000 Imperial gallons per day for this source.

In 1987, the RDCK purchased the property located above the Smokey Creek dam for the purpose of controlling land activities (e.g. logging, and mining). The area is accessible by logging road from a number of surrounding properties. In 1990 a court order resulted in a 20 year moratorium on logging activities in the watershed.

There is no information on Smokey Creek therefore, by default, it is considered to be fish-bearing despite the fact that it is impassable at the location of the dam. The upper watershed has been subject to logging activities as recent as 1970. These activities have impacted water quality downstream in the form of increased sedimentation and turbidity.

Smokey Creek watershed is relatively small and vulnerable to land use activities which may alter the hydrologic regime. Logging activity has resulted in a reduction in base flows during periods of low flow as well as increased activity. There is no protection at the source. The water is subject to high turbidity and sedimentation. There is no security at intake, and no physical barriers are in place. Smokey Creek levels fluctuate depending on the time of year. It is also known that the springs are barely sufficient for meeting demand year round. No flow records are available to confirm this. A new source supply will be required in order to meet existing and future demands.

The system currently has 59 connections and there are 60 lots in the service area. The connections include 53 residential units (49 detached dwellings, 4 apartments), 2 commercial, and the community hall. The area is mainly rural residential with some irrigation demands. Maximum daily demand (MDD) is calculated as 5,200 l/day/dwelling.

There are no flow records for the system. However, it is suspected that daily usage is high and that the system is drawing at capacity. As a result, the community could benefit from conservation efforts.

Existing sources are, at best, marginally adequate to meet the water demands of the community. It has been reported that during the summer months, flow is frequently low. The 3" supply main from Smokey Creek is inadequate to meet peak summer water demands. Watts Brook supply main is inadequate to meet minimum fire flow requirements (400 Gpm). Currently, only 100 Gpm is provided and via a 3" line. System is subject to seasonally low water levels. Current sources are marginally adequate for existing demands. Sources are inadequate for future demands.

B1.3 Existing Water Quality & Treatment

There is currently no water treatment provided. The system does not meet BC Drinking Water Protection Regulations or Canadian Drinking Water Guidelines. Results from full parameter tests conducted in 2006 indicate levels of lead (Pb), arsenic (As), aluminum (Al), and iron (Fe) in selected parts of the system that exceed acceptable concentrations according to the Canadian Guidelines for Drinking Water Quality (CGDWQ).

The State of the System report for South Slocan notes that the water at source is subject to high turbidity and sedimentation. There is no security at the intake, and no physical barriers are in place. Further on-site inspections suggest that the water intake should be upgraded, and primary filtration should be considered in part to protect the distribution system. These considerations all confirm the intention on the part of the RDCK to proceed with a form of improved treatment.

B2. Water Treatment Options

A centralized water treatment facility is already planned by RDCK for this community, and which will include chlorination. As noted, the terms of reference for this project require the project team to examine the option of combining centralized treatment with POE/POU treatment to remove chlorine at the household level. The community of South Slocan has repeatedly expressed its opposition towards the use of chlorine as a disinfectant but has agreed to allow it provided that residents can be assured that the chlorine is removed from drinking water before its use or consumption. The following table shows water quality parameters from the Canadian Drinking Water Guidelines related to chlorination

Possible result of Chlorination	**MAC** (maximum acceptable concentration)
Trihalomethanes-total	0.100 mg/L
Taste	Inoffensive
Odour	Inoffensive

For the purposes of this project we have made assumptions about the form of centralized treatment that may eventually be provided by RDCK to meet 4,3,2,1, 0 standards. The form assumed in this project for the South Slocan source water consists of filtration (50 micron, 5 micron), followed by chlorine injection and a contact tank to meet contact time requirements. It has the following elements:

- Central intake
- Screening, to remove debris.
- Rapid sand filters to control turbidity.
- 50 micron filtration.
- 5 micron filtration to prepare the water for chlorination.
- Chlorination equipment.
- Tank to provide chlorine contact time.
- 1 micron filtration to remove cysts.

The RDCK may however choose to cover and protect the springs from contamination at source, and to eliminate supplies from Smokey Creek. Once source protection of this sort is provided the turbidity of the source water will be reduced and the only treatment required may be disinfection, possibly by ultra violet treatment and chlorination. An alternative approach after protecting the source may be to provide limited filtration if this still proves necessary, followed by chlorination. Any threat from the presence of cysts may be effectively mitigated by 1 micron filtration, perhaps at POE.

Point of Entry Water Treatment

The use of POE water treatment in South Slocan is outlined in the following sections. As discussed above, the application of Point of Use (POU) equipment to treat water subject to microbiological contaminants is excluded by the Guidelines and has not been explored further for application in this case.

The capacity of the POE configurations outlined below is sufficient to treat water being used within the household for domestic purposes. It is based on the assumption that water for irrigation and other outdoor uses is not treated by the POE systems. The system currently has about 53 residential units, 2 commercial connections and 1 community hall. The configuration described may be suitable for use in the typical residential unit. A larger capacity POE unit may be required for the commercial connections and the community hall.

This POE configuration has been developed based on readily available data and not on any detailed site-specific investigations, since these were not within the scope of the work. The actual configuration of POE treatment equipment installed in this water system must be determined after further water quality sampling and analysis and engineering investigations and detailed design. The configuration outlined below may not therefore reflect actual designs appropriate for this system.

Removal of Chlorine and Chlorine Byproducts

Activated carbon is typically used for chlorine removal. The most common forms are KDF filtration, Carbon Block filtration, and Granulated Activated Carbon (GAC) filtration. Of these, Carbon Block filtration is commonly used as a combination carbon filter/fine filter and is not optimized for straight chlorine removal. Further discussion of options for removing chlorine and chlorine byproducts in the POE units is given below.

Removal of Metals

There is evidence of failures in the distribution system in South Slocan, and complications with the location of distribution pipes in some areas. There are elevated levels of lead, arsenic, aluminum and iron reported in the system. These elevated levels may be due to leaching or ingress of contaminated water in the distribution system or could be in part attributable to the source water. Further investigations are required to fully determine the nature of the sources, and the extent to which it is feasible to control or remediate the sources of these contaminants.

In order to provide assurance that levels of metals can be reduced to acceptable standards and the microbiological quality of the water can be maintained it may be the case that the distribution system should be completely reconstructed to meet approved specifications. If this is not an option in the medium term, then water for domestic purposes may be rendered potable by a combination of central treatment as proposed, together with POE units that include for removal of metals and other contaminants.

As a result of the need to remove chlorine and byproducts of chlorination and the presence of other contaminants possibly resulting from the condition of the distribution system, the following POE options have been considered in this analysis. It is important to note that the following options have been identified for the purposes of this project only. The actual POE option installed should be selected following the pilot project.

- Option A: Carbon Filter
- Option B: KDF/Carbon filter
- Option C: KDF/Carbon/UV

These options are outlined in the following:

Option A: To remove chlorine only

This option would meet the expectation of residents that chlorine and chlorine by products should not enter individual homes. This option consists of a 1 micron Absolute filter followed by a carbon filter to remove chlorine and chlorine residuals. A cartridge filter will be the most cost effective for this purpose.

Option A: To remove chlorine only

This option would meet the expectation of residents that chlorine and chlorine by products should not enter individual homes. This option consists of a 1 micron Absolute filter followed by a carbon filter to remove chlorine and chlorine residuals. A cartridge

filter will be the most cost effective for this purpose. (The 1-micron filter will remove cysts that are difficult to kill with chlorine. The carbon filter will remove byproducts of chlorination. This is an appropriate approach for South Slocan because of deficiencies in the existing distribution system.

Option B: To remove chlorine and metals

This option would meet the expectation of residents that chlorine and chlorine by products should not enter individual homes. It would also remove contamination by metals arising from the poor condition of the distribution system. (However field testing should be carried out to determine the effectiveness of metal removal and the frequency between filter changes). It consists of a 1 micron absolute filter followed by a KDF filter to remove metals then a carbon block cartridge filter to remove chlorine and chlorine residuals.

Option C: To remove chlorine, metals and biological contaminants

This option would meet the expectation of residents that chlorine and chlorine by products should not enter individual homes. It would also remove contamination by metals and biological contamination arising from the poor condition of the distribution system. This option will consist of a 1 micron absolute filter followed by a KDF and carbon filter to remove chlorine and chlorine by-products, then UV treatment to remove any residual biological contaminants which may have entered the system through pipe breaks or infiltration from contaminated areas of the distribution system.

Further technical descriptions of the POE configurations that have been considered in this work are given in outlined in Appendix A3.The cost estimates for installation and maintenance of the POE options are shown in Table B.1.

B3. Comparison of Options

The following section summarizes a comparison of the POE options noted above.

Option A: Carbon Filter

Granulated activated carbon or activated carbon block filters are effective at removing chlorine and chlorine residuals. These filters also remove components that cause bad taste and odor. Granulated carbon media filters benefit from a longer life and ease of maintenance. If the entire community plans to remove chlorine, media for the filter can be purchased in bulk and then shared, to provide an additional savings. A further option is to make residents responsible for maintenance of the filters, although this contradicts the POE / POU guidelines which call for the water system to carry out all maintenance to ensure it is competently undertaken at appropriate intervals..

Option B: KDF/Carbon filter

KDF/Carbon filters would meet the expectation of residents that chlorine and chlorine by products should not enter individual homes. In addition, the KDF filter will reduce metal contaminants (including iron, lead, and arsenic) and will significantly increase the life of the carbon filter, resulting in fewer operating costs. For chlorine removal KDF filtration alone is not effective.

Option C: KDF/Carbon/UV

KDF/Carbon filters would meet the expectation of residents that chlorine and chlorine by products should not enter individual homes. In addition, the KDF filter will remove metal contamination from the deteriorating distribution system or form other sources. In addition, Option C includes a UV treatment system that will inactivate biological contamination that may enter the system through pipe breaks and other means.

B4. Conclusions & Recommendations

Conclusions

1. Treatment to potable standards of water supplied by the South Slocan system should be considered a priority. This may occur through a combination of centralized treatment and POE treatment (The centralized treatment enabling a reduction in the functional requirements and hence the cost of the POE installation).

2. A centralized treatment facility for South Slocan will include disinfection. However if downstream contamination of the water supply may result from failures in the distribution system then use of a POE treatment train including KDF and Carbon filtration followed by UV disinfection should be considered.

3. Activated carbon in cartridge form within POE installations may prove the most cost efficient way to remove chlorine and chlorine byproducts for the South Slocan water system. Central treatment to remove chlorine and chlorine by-products would eliminate a chlorine residual in the distribution system. This would threaten the potability of supplies; therefore central treatment to remove chlorine has not been considered in this report.

4. Carbon / KDF filtration is an alternative POE approach to consider for water that has persistent high metals content. It will also remove the chlorine residual and byproducts. KDF filtration is expensive. It should be used if its cost is clearly justified by the treatment results produced.

5. The current POE / POU Guidelines (see appendices) require that when a water system is planning the installation of POE / POU that all customers should agree to the installation of the treatment units. Given the state of the distribution system in South Slocan, it may be that an option involving POE is the only way to assure

water that meets guidelines. In this event a clear statement of the possible consequences of not installing POE should be communicated to all homeowners, Installation shortly thereafter may then be provided for homeowners who are agreeable.

Recommendations

1. Further investigation of the causes of the water quality problems should be undertaken with some urgency. This should include a determination of the cause of the metals and biological contaminants in the distribution system. Unless it can be shown that these contaminants will be removed by centralized treatment a form of POE should be considered to remove both these contaminants and the results of centralized chlorination.

2. The South Slocan water system should be the subject of a POE pilot project, possibly funded from the Gas Tax Agreement accessible through the provincial government. The pilot project may follow the Terms of Reference given in the appendices.

3. The pilot project should be designed in part to provide detailed information that can be used in comparisons of the costs and benefits of POE treatment and centralized treatment in BC. This information resulting from the pilot project should then be incorporated in the POE / POU Guidebook under preparation by the Sustainable Infrastructure Society.

4. The installation of water meters should be considered in the future, with the meters measuring water used for both domestic and irrigation and other outside purposes.

PART C: REGION-WIDE USE OF POE / POU

Deliverable: Region-wide POE/POU

In order to provide the required deliverables for this project the project team was required to evaluate which communities in the RDCK are suited for POE/POU technology as a means of removing their water system off boil water advisory. It is acknowledged ahead of time that, after evaluation, it may be identified that few or no communities may be suitable for POE/POU technology. One community that should be examined is the small residential jurisdiction, Denver Siding.

C1. Regional Goals for Water Systems

As noted in the Introduction, the majority of the fourteen small water systems in RDCK are on permanent Boil Water Advisory. As purveyors, the RDCK is ultimately responsible for the safety of the drinking water being provided by these drinking water systems. The Interior Health Authority (IHA) is encouraging the RDCK to bring these small water systems into compliance with provincial legislation and standards. It is a goal of RDCK to improve the state of the infrastructure of these fourteen small water systems as well as introduce the necessary technology to enable the water provided to be considered potable.

C2. Criteria for POE / POU Application

The Guidelines which have been developed for the application of POE / POU technology in British Columbia are summarized in Section 1 of this report. These Guidelines are an important reference source when establishing the criteria which may apply to the application of POE / POU in small water systems within RDCK.

Small water systems are typically placed on a permanent Boil Water Advisory because of concerns about the possibility of microbiological contamination. The Guidelines state that Point of Use (POU) treatment should not be employed for systems in which microbiological contaminants may be present. This is in part because when POU devices are used they are often installed only at the kitchen tap. However the possibility exists that the occupants may drink water from other sources within the house such as the bathroom sink, and would then not be protected from contaminants in the water. Microbiological contaminants may be present in the majority of RDCK small systems; therefore POU systems are not considered as suitable in these cases and were not examined for application in the RDCK small water systems as part of this work.

Preliminary Evaluation Criteria

The small water systems within the RDCK are listed in Table C1 together with information about each system. Certain initial screening criteria were applied to identify those water systems which may be suitable for POE application. These criteria are:

- Currently on boil water advisory?
- Number of connections less than 150?
- Surface water source?

These preliminary criteria are established for the following reasons: A central purpose of this project is to remove boil water advisories. Experience in other jurisdictions indicates that POE / POU may be an economically viable alternative to central treatment for systems with up to 150 connections. In general surface water sources are much more susceptible to microbiological contaminants than are well sources.

Systems to Investigate further for POE

Application of the criteria noted above suggests that the following systems, as identified in Table C1, should be further evaluated to determine if POE is suitable: Denver Siding, Sanca Park, South Slocan. Installation of POE in Ymir is unlikely to be economically justifiable.

Detailed Evaluation Considerations

The following more detailed considerations have been developed for use when further considering the application of Point of Entry water treatment systems within small water systems in the RDCK. Following the pilot project recommended in this document, the systems identified as POE candidates using the preliminary criteria above should be evaluated against these more detailed considerations before decisions are taken to implement POE. The detailed criteria are as follows:

- Treatment effectiveness
- Customer Acceptance
- Cost effectiveness
- Operational feasibility
- Regulatory acceptance
- High irrigation use
- Physical characteristics of site
- Deteriorating distribution system
- Requirement to remove disinfection by products
- Mix of water sources.

Each of these criteria is discussed in the following sections.

Treatment Effectiveness

The POE system must treat the water effectively. This means in practice that the water must be treated to consistently meet the 4,3,2,1,0 Standards of Interior Health Authority and to meet the Canadian Drinking Water Guidelines. Therefore the development and enforcement of POE maintenance and replacement schedules are essential to ensure the consistent delivery of safe drinking water. The design and installation of the

treatment systems are critical elements in ensuring treatment effectiveness. Is the water system amenable to systematic monitoring and maintenance of POE installations?

Customer Acceptance

POE devices, which according to the Guidelines should be owned by the water supply system, are installed on the premises of the customers of the water system. They may be mounted within an enclosure located on the outside of the house. Customers must be informed of the purpose of the treatment units and of the need for regular maintenance by qualified staff. They must be prepared to allow access for maintenance and to enter into a formal agreement with the water supplier concerning access and ownership. In most cases, all customers of the water supply system must agree to have the POE devices installed.

Cost Effectiveness

The POE devices must be cost effective when compared against the cost of alternatives. Typically a central reason for interest in POE among small water systems is the view that they may be more affordable than centralized water treatment. Experience in jurisdictions outside BC suggests that the capital cost of POE may be less than that for centralized treatment for water systems having a limited number of connections. The cross over point, at which centralized treatment becomes less expensive than POE, may vary from systems with 50 connections to systems with 150 connections, depending on circumstances. A true comparison of costs between centralized treatment and POE should be based on a life cycle cost comparison. However the literature notes that this is a difficult thing to do, in part because of the lack of operating cost information for POE systems. There is almost no history of operating cost information for community POE systems in British Columbia. The pilot project should in part be designed to provide operating cost data.

For the purposes of this work we have identified RDCK small water systems with less than 150 connections. For these communities the cost effectiveness of POE / POU installations should be examined further in a later stage of work.

Operational Feasibility

The operation of POE water treatment system by small water suppliers involves a number of considerations, many of which are covered by the Guidelines referred to previously. One of the first steps in determining operational feasibility is to examine the characteristics of the water supply system involved. Operational feasibility of POE systems is determined very much by the resources available to manage and operate the system and by the relationship between the customers and the system owners and managers. The operational feasibility of POE for a specific water supply system can only be accurately confirmed after a detailed review of the system has been undertaken.

Regulatory Acceptance

The BC Drinking Water protection Act and Regulation require that an operating permit be in place for all water systems. It is likely that in most cases a construction permit will be required before a POE system is installed. For the RDCK these permits are provided by officials of the Interior Health Authority. The POE / POU guidelines referenced in this document have no regulatory authority. There is currently no document prepared by regulators which reflects a consistent province-wide approach to POE / POU and which outlines best practices. An early stage in the planning of a POE installation for any water supply system should involve discussion with local drinking water officials to determine the approach which is likely to secure acceptance by regulators.

High Irrigation Use

Many small communities in BC have residents who use high volumes of water in the summer for irrigation. This means that a high percentage of the water supplied by the water system is used for irrigation: in some cases the irrigation use may be 5, 10 or even 15 times the water use for domestic purposes. Treating water to potable standard that is to be used for irrigation is a cost that many small systems seek to avoid. In these circumstances use of POE / POU systems may be the most cost effective approach.

Physical characteristics of site

In certain limited cases the physical characteristics of the site may be such as to suggest POE / POU is a preferred approach. For example certain systems may not have a location at which a centralized treatment and storage facility can be located in an economic manner.

Deteriorating distribution system

In some cases small water systems may have deteriorating water distribution systems. Material, including certain metals, may be leaching into the water from the pipes themselves. There may also be the possibility of undetected cross connections, or the ingress of contaminated groundwater. Renewal of the distribution system may be prohibitively expensive in the short term for the small community. In this event POE/ POU installed at the individual homes may offer a solution.

Requirement to remove disinfection by products

Certain communities resist the use of chlorination for disinfection of their drinking water. This typically arises because of concerns about the health effects of chlorine or chlorine by products in the water. The local health authority will however wish to enforce regulations designed to ensure safety of supplies, which typically involves chlorine disinfection. Use of POE may offer a solution to these situations. The community water supply can be provided with central disinfection using chlorine. POE units can be installed at individual homes to remove the chlorine and chlorine by products.

Mix of water sources.

Certain communities have a mix of water sources providing water to residents. An example is a community in which a significant number of residents have wells within their lots which provide the household with drinking water. The remainder of the homes

in the community may take all water from the community water system. The community water system may require improved treatment to render the water potable. However those drawing drinking water from individual wells may be reluctant to pay for the upgrade. In this event, those without wells may consider the installtion of POE / POU units to treat the community water supplied to their individual homes. This is one circumstance in which the Guidelines requirements, that all homes within community agree to have POE / POU installed, may be waived if the certain conditions apply.

C3. Evaluation of Communities

The small water supply systems within the RDCK were evaluated against the criteria outlined above, and the results are shown in Table C1. It is important to note that the evaluation provides an indication of those communities in which POE / POU may be applicable. Further more detailed investigations of those communities should be undertaken before clear recommendations can be developed concerning the installation of POE / POU. These investigations may include further source water monitoring, review of the conditions of the distribution system, examination of water usage patterns, and review of site and ground conditions. It will also be necessary to talk with community members to determine the likelihood that all customers will agree to the installation POE / POU and that they are prepared to meet the costs of installation.

C4. Conclusions & Recommendations

Conclusions

1. The preliminary review of RDCK small water systems indicates that there are three communities in which the installation of POE may help in the removal of boil water advisories. These are: Sanca Park, South Slocan and Denver Siding. A fourth community, Ymir, may have too many connections to make POE an economic alternative to centralized treatment.

2. As recommended above, a pilot project should be undertaken in South Slocan and the results used to refine the criteria used in identifying water systems as suitable for POE installation.

Recommendations

1. The preliminary set of criteria and considerations outlined in Section C2 should be reviewed with regional health officials and other interested parties.

2. The modified set of criteria and considerations outlined in Section C2 should be used in further review of the suitability of POE in the communities noted. This will include review of details such as water quality, the extent of irrigation demand,

and the condition of the distribution network, as well as the views of customers in these water systems.

3. When the pilot project outlined in the appendices has been completed, the list of POE criteria and considerations should be modified and the RDCK small water systems compared against the revised version.

Appendix 1: POE / POU Planning Considerations

Point of Entry / Point of Use Water Treatment: Summary of Planning Considerations for British Columbia

Prepared by Sustainable Infrastructure Society, September 2007

Please Note

This summary of POE / POU planning considerations for British Columbia has been prepared by the Sustainable Infrastructure Society. It is intended for reference by water supply systems who may be considering the application of Point of Entry / Point of Use (POE / POU) water treatment systems. It should be used only for initial reference when considering use of POE / POU equipment and does not replace the need for site-specific examination or the advice of experienced specialists.

This document outlines planning considerations, certain of which may evolve in the future into "best practices" as experience is gained with POE / POU installations in BC. It is important to note that best practices are not the same as regulatory requirements. This document does not set out regulatory requirements and is not intended to replace or supersede any directives or similar documents produced by the regional health authorities or any other authorities having jurisdiction. It has not been endorsed by any branch of government or by any health authority or any other organization.

This document may be replaced at some point by other materials such as a formal Best Management Practice guide covering the use of POE / POU systems, and prepared following consultation with a number of organizations.. The planning considerations in this document have been prepared from study of experience and guidelines from other jurisdictions, together with an initial review of regulations and procedures in British Columbia. They are themselves subject to change based on experience with POE / POU pilot projects in various areas of BC.

The document: *"Guide Book: Planning and Implementation of "Point of Entry" and "Point of Use" Water Treatment Systems in British Columbia"* provides a more comprehensive guide to the application of POE / POU equipment and will be available early in 2008.

Preface to the Planning Considerations

The following notes provide background to the POE / POU planning considerations for BC:

Amendment to the Regulation: The amended British Columbia Drinking Water Protection Regulation states that a small system is exempt from section 6 of the Drinking Water Protection Act if each recipient of the water from the system has a Point of Entry or Point of Use (POE/ POU) treatment system that makes the water potable. By being exempt from section 6 of the Act in this way, the water purveyor is no longer required to provide water that is potable before it reaches the consumer's home.

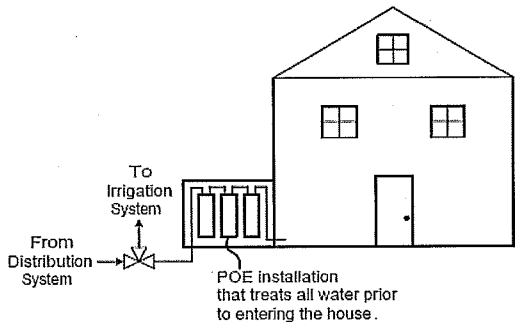
Small System: Section 1 of the Regulation defines "small system" to mean all water supply systems that serve up to 500 individuals during any 24-hour period.

POE / POU Installations: A POE / POU installation consists of various items of equipment, for example filters and disinfection units, which when assembled together treat the water to a desired standard. These devices are typically installed at the home or facility of the consumer.

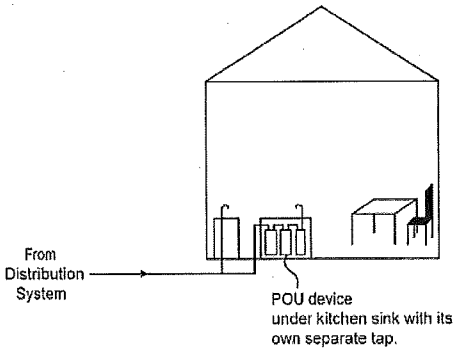
Operating Permits: Water suppliers must not operate a water supply system without an operating permit and must comply with the terms and conditions of the permit.

Drinking Water Officer (DWO): A DWO is a member of the regional health authority having jurisdiction, and who is responsible for enforcement of drinking water protection legislation including the issuance of operating permits.

Point of Entry (POE): A Point of Entry device is one which is located at the point where the water supply enters the premises and treats all water entering the premises to a potable standard.



Point of Use (POU): A Point of Use device is one that is typically (but not necessarily) installed within the premises and located immediately before the point at which water is drawn for consumption, such as a kitchen tap, and which treats only water drawn at that point to potable standard.



Summary of Planning Considerations for British Columbia: Edition 1

A. General

1. Decisions about the kind of water treatment to be used should be made with reference to a long-term or strategic plan for the water system.

It is good practice for every water system to have a long term plan in place which covers such items as the renewal of infrastructure including estimated costs and schedules, the long term financial viability of the system including the adequacy of rates and charges, and the protection of water quality. Within this context decisions about water treatment can be made more effectively.

2. The water treatment needs of the system should be clearly identified at an early stage in the examination of POE / POU systems, and the expected advantages of POE / POU should be fully analyzed.

In certain circumstances POE / POU may offer clear advantages. For example some systems supply water in the summer, a very high percentage of which is required for irrigation and does not need treatment to potable standards. Other systems may have a large group of customers each with an individual well providing drinking water. This group of customers may require system water only for irrigation and fire-fighting purposes and may be reluctant to pay for centralized treatment. In all cases a systematic analysis, including examination of life cycle costs for each option, should be undertaken before making decisions about the use of centralized or POE / POU water treatment.

3. All POU / POE equipment should be owned and installed by the water supplier. All POE / POU equipment should be monitored and maintained by the water supplier or by a contractor hired for the purpose.

This will help to ensure proper operation, monitoring and maintenance of the devices. The water supplier retains the ultimate responsibility for the quality and quantity of the water provided to the customers and must closely monitor all contractors. Further, the water supplier should not delegate its responsibility for the operation and maintenance of installed POU or POE devices to homeowners. The Drinking Water Officer may require a trained or certified operator for the operation and maintenance of POE/POU units.

4. At an early stage in considering the use of POE / POU the water supplier should contact the local drinking water officer (DWO). The water supplier should follow the process clearly defined by the DWO when providing information in connection with the installation of a POE / POU system.

The DWO may require submission of a range of information concerned with the design, installation, operation, monitoring and maintenance of the POE / POU system. This may include the legal agreement between the water supplier and the customer.

5. POE / POU devices should be procured, installed, operated, monitored and maintained under a written plan acceptable to the DWO, and which considers local context and circumstances.

The DWO may require adequate certification of performance and field-testing of the POE /POU devices. The water supplier should consider the context in which POE /POU devices are to be installed. For example, will the treatment devices require protection against freezing and/or will they be readily accessible for inspection and maintenance? Plans and specifications may require approval by the DWO or other official.

6. The owners of all homes and other premises connected to the water system and in which the water supplied by the system may be used for drinking or other domestic purposes must agree to the installation of POE / POU equipment.

The water supplier should have a governance structure which enables effective planning, implementation and operation of the POE / POU system. Procedures may be required that enable the water supplier to disconnect buildings without a POE / POU device if the owner has not agreed to the installation within a stated period of time.

B. Applications & Effectiveness

7. POU devices should not be used as a treatment technique for microbial contaminants or for an indicator of a microbial contaminant.

POU devices only treat water at an individual tap (usually the kitchen faucet) and therefore raise the possibility of potential exposure to contaminants at other faucets. Also, they do not treat contaminants introduced by the shower (breathing) and skin contact (bathing).

8. In certain circumstances specialized guidelines may be required to cover the use of POE / POU devices.

Specialized guidelines may be required for example when there is an indication of the need for corrosion control treatment requirements for lead and copper, or where there are contaminants present such as radium, beta particle activity and regulated radionuclides.

9. The water supplier should be prepared to demonstrate that the technology selected is effective in removing the contaminants of concern.

The water supplier may choose to work with suppliers and other specialists to demonstrate effectiveness. In some cases this may mean field testing,

demonstration of compliance with applicable standards, or certification by an experienced professional.

10. POE devices should provide a level of health protection equivalent to that provided by centralized water treatment. Where appropriate the equipment should be certified for potable water use.

"Equivalent" means that the water would be of quality comparable to water taken from the same source and treated by a central treatment plant to meet quality objectives established by the health authority having jurisdiction.

11. The microbiological safety of the water should be maintained at all times, and POE / POU installations should be designed and operated accordingly.

There may be a tendency for certain POE devices to increase bacterial concentrations in treated water. This is a problem sometimes associated with activated carbon technologies. Therefore, it may be necessary to require frequent back-washing, post-filter disinfection, and monitoring to ensure the microbiological safety of the treated water.

C. Involvement with Customers

12. Prior to installation, an information notice about the POE /POU units and a contact number for servicing should be given to (and verbally explained to) all occupants, homeowners and property owners.

The water supplier should ensure that all customers are delivered the information notice and are verbally contacted to ensure they are aware of and understand the information provided. The purpose of the notice is to inform people of basic information about the POE / POU system including that:

- POE units are for the purpose of drinking water safety.
- The drinking water system is the owner of the POE / POU installation and is responsible for the maintenance and operation of POE/ POU units.
- The drinking water system owner and/or contractor will periodically require access to the premises for the purpose of maintenance of POE / POU units and water sampling.
- POE units are installed with automatic shut-off in the event that there is insufficient water flow to ensure to proper functioning of the unit. If the water supply is interrupted the resident should contact the water supplier to obtain further assistance.
- A legal agreement will be required between the water supplier and the end user.

13. The water supplier should develop procedures to ensure every building connected to the system continues to have a POE/ POU device installed, maintained, and adequately monitored.

The water supplier should seek 100 percent participation of all property and/or building owners except those exempt from the requirement to provide potable water under Section 3.1 (a) of the Regulation. Procedures should be developed that enable the water supplier to formally notify all owners and occupiers of the risks of non compliance, and which enable the supplier to disconnect buildings without a POE / POU device if the owner has not agreed to the installation within a stated period of time. Lack of cooperation by a small number of customers may disrupt plans for installation of POE / POU equipment throughout the system. Without 100% participation the water supplier will lose the exemption from the requirement to provide potable water, and may be exposed to legal liability.

14. The water supplier should ensure that the rights and responsibilities of each customer in connection with the POE/ POU installation are clearly conveyed in a written agreement with customer, and that these rights and responsibilities convey with title upon sale of property.

The written agreement should include items covering access and maintenance. For example the water supplier should be allowed access to the property or residence for the purpose of maintenance of POE units and water sampling. The property owner's responsibilities for the POE /POU device must be included in the title to the property. The rights and responsibilities of the customer in connection with the POE /POU installation must be transferred to the new owner with the title when the building is sold. The agreement may include arrangements for enforcement, and for the recovery of costs of the POE / POU installation and maintenance.

15. The water supplier should have a written plan in place for continuing public communication and education concerning the use of POE /POU devices, and should provide a clear mechanism to receive and respond to customer concerns, and communicate this to the public and to the DWO.

Complete participation of the public is an important component of a successful POE / POU strategy. The water supplier should provide a customer contact line and ensure that there is always a prompt reply to queries. Even with regular maintenance and replacement of certified, reliable POE units, there may be unanticipated problems, particularly when the units are first installed. Maintenance resources should be on call at all times.

D. Operation and Monitoring

16. POU and POE units should have a warning device which will automatically notify customers of operational problems. POE units should have an automatic shut-off mechanism which activates if there is a malfunction of the unit and a device to notify customers of the problem.

Each POU /POE treatment device should be equipped with a warning device (e.g., alarm, light, etc.) that will alert users when the unit is no longer adequately treating the water. If loss of power may lead to ineffective operation of the unit then an automatic shut-off mechanism should be installed which would be activated upon loss of power. Procedures that cover by-pass or interference by the customer with the POE/POU treatment device should be in place.

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17. The water supplier should develop a monitoring plan that is acceptable to the drinking water officer prior to the installation of POE / POU devices.

The monitoring plan should help ensure that the POE / POU device continues to treat contaminants of concern. The monitoring plan should include frequency of monitoring for the contaminant of concern and number of units to be monitored. Monitoring may include physical measurements and observations such as total flow treated and mechanical condition of the treatment equipment. Monitoring results should be linked to administration of maintenance, repairs and replacement parts inventory.

18. The water supplier should develop a written operating plan, including record-keeping, that is acceptable to the drinking water officer, prior to the installation of POE / POU devices

The drinking water supplier should ensure that accurate records are kept of installations, servicing and maintenance visits, work performed, sample test results and property access problems.

19. In cases where the POE / POU devices are used to augment central treatment, these planning considerations may also be useful.

In some cases POE / POU devices maybe used to supplement central treatment. For example central disinfection may be provided, with POU devices used in individual premises to reduce the level of a certain inorganic contaminant.

These POE / POU planning considerations are available on the web site of the Sustainable Infrastructure Society at:

www.SustainIS.Org

Appendix 2: Classes of Capital Cost Estimates

Class A Estimate
This is a detailed estimate based on quantity take-offs from final drawings and specifications. It is used to evaluate tenders. A contingency allowance of 5% plus engineering and other allowances is appropriate for this class of estimate.

Class B Estimate
This estimate is prepared after site investigations and studies have been completed and the major systems defined. It is based on a project brief and preliminary design. It is used for obtaining firm financial commitments, budgetary control and design cost control. A contingency allowance of 15% plus engineering and other allowances is appropriate for
this class of estimate.

Class C Estimate
This estimate, which is prepared with limited site information, is based on probable conditions affecting the project. It represents the summation of all identifiable project component costs. It is used for program planning; to establish a more specific definition of client needs and to obtain approval in principle. A contingency allowance of 25% plus engineering and other allowances is appropriate for this class of estimate.

Class D Estimate
This is a preliminary estimate which, due to little or no site information indicates the approximate magnitude of cost of the proposed project, based on the client's broad requirements. This overall cost estimate may be derived from lump sum or unit costs associated with other recent similar projects. It may be used to obtain approval in principle and for discussion purposes. A contingency allowance of 35% plus engineering and other allowances is appropriate for this class of estimate.

Appendix 3: POE Permit Application Checklists

These checklists are for use by Water Suppliers (WS) when considering the installation of a POE / POU water treatment system. These checklists do not replace the need for direct communication with the Drinking Water Officer (DWO) having jurisdiction. The DWO may require information in addition to that indicated below. Further information about POE / POU is available on the web site of the Sustainable Infrastructure Society at www.SustanIS.Org

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Construction Permit

Section 7 of the DWPA requires a person to obtain a construction permit for the construction, installation, alteration or extension of a water supply system. In preparing an application for a construction permit in connection with a POE / POU system, a water supply system is advised to assemble the following:

1. An analysis of key parameters (*1) for the source water.	☐
2. Brief written description of the water source, including type and location	☐
3. Plans showing location and layout plan of the water system.	☐
4. A written outline of the proposed POE / POU installation.	☐
5. Proposals for field testing and /or engineering review (if applicable).	☐
6. Preliminary implementation timetable.	☐
7. A covering letter which summarizes your preliminary plans.	☐
8. Brief written summary of the related experience of key individuals responsible	☐

*1 See SIS web site at www.SustainIS.Org

Operating permit

Section 8 of the DWPA prohibits a person from operating a water supply system unless the water supplier holds a valid operating permit. In preparing an application for an operating permit in connection with a POE / POU system, a water supply system is advised to assemble the following:

1. An analysis of the source water, and description of the water source (*1).	☐
3. Plans showing location and layout of the system & brief history of system.	☐
3. Description of the proposed POE / POU installation	☐
4. Results of field testing, if applicable.	☐
5. An emergency response plan	☐
6. The construction permit if applicable & an installation plan and timetable	☐
7. An operating plan including: i. Monitoring, and alarm response considerations ii. Operator qualifications & training iii. Planned maintenance schedules iv. Record keeping procedures v. Public information documents vi. Summary of the responsibilities of the Water supplier & the customers vii. Ownership and access agreements viii. How any tendency for bacterial growth will be managed ix. Approach to non-compliance from individual customers.	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
8. Covering letter signed by your duly authorized representative.	☐

Appendix 4: Sample Access and Maintenance Agreement

DRAFT FOR REFERENCE ONLY

Following is an example access and maintenance agreement (taken from US jurisdiction) that may be needed between the SWS (small water system) and each homeowner. Water systems should amend this agreement to meet their particular needs.

Water systems should seek legal assistance prior to preparing an agreement based on this model.

INSERT NAME OF PUBLIC WATER SYSTEM has decided to install *INSERT TYPE OF POU OR POE TREATMENT DEVICE* to treat for *INSERT CONTAMINANT(S) BEING REMOVED.*
We have chosen to use this treatment technology as an effective means of removing this type of contamination from our drinking water in a cost-efficient manner. Installation of this technology will help to ensure the delivery of safe water to your home or business. Failure to properly operate and maintain these units may produce water with new or higher levels of contamination.

The undersigned are the current legal owners of, and can provide access to, the following property:

(Insert a description of the property here. This description should include the full address and, if known, the legal description provided in land records . Ensure that the undersigned owns the structure (e.g., house, business, office, other building) and not just the land that the structure is on).

The undersigned agree:

1. To allow the *INSERT NAME OF PUBLIC WATER SYSTEM*, its employees, authorized representatives, and others under agreement with the *INSERT NAME OF PUBLIC WATER SYSTEM* , to enter the aforementioned property to:

    a. Install, replace, maintain, or remove the treatment unit and any ancillary equipment.
    b. Maintain the treatment unit and any ancillary equipment. Maintenance may include periodic testing of the unit as well as the collection of samples. Any maintenance, testing, or sample collection will occur during normal business hours or as arranged between the *INSERT NAME OF PUBLIC WATER SYSTEM* and property owner:
    (Insert a description of the frequency of sampling and maintenance activities (e.g., the first of each month, once per calendar quarter, twice a year, etc.)

2. To not adjust, modify, tamper with, bypass, or remove the treatment unit or any ancillary equipment.

3. To, within a reasonable period of time, notify the *INSERT NAME OF PUBLIC WATER*

SYSTEM of:

a. Any problems, concerns, or questions concerning the treatment unit or any ancillary equipment.
b. The rental, lease, sale, or other transfer of the aforementioned property.

4. To indemnify and hold harmless the *INSERT NAME OF PUBLIC WATER SYSTEM* for any injury or damage which may occur as a result of the installation, maintenance, operation, monitoring, or removal of the treatment unit or any ancillary equipment.

All equipment shall remain the property of the *INSERT NAME OF PUBLIC WATER SYSTEM* . The undersigned agree to reimburse the *INSERT NAME OF PUBLIC WATER SYSTEM* for any costs incurred because the undersigned adjusted, modified, bypassed, tampered with, or removed the treatment unit or any ancillary equipment.

This agreement remains in effect: _ *(Insert the length of time that the agreement is to remain in effect. For example, "for a period of one year from the date of installation; until the Public Water System determines that the treatment system is no longer necessary, or until the treatment unit is removed from the property)."*

While in effect, this agreement shall run with the land and shall be binding on all parties having or acquiring any right, title, or interest in the property described herein. This written permission is given by the undersigned voluntarily with knowledge of legal rights and without threat or promise of any kind.

Owners: Witnesses:

Name Date	Name Date

Appendix 5: Preliminary Terms of Reference for Pilot Project

As recommended in the main body of the report, we suggest that an initial POE Pilot Project be carried out in the South Slocan water supply system. This document provides preliminary Terms of Reference. These Terms of Reference should be revised following discussions with interested parties.

Terms of Reference: POE Pilot Project in South Slocan Water Supply System

1. Introduction

Purpose

The community of South Slocan is located approximately 23 km from Nelson on Highway 3A. This pilot project will examine the use of Point of Entry (POE) water treatment systems to remove chlorine and chlorine by-products from the water supplied to individuals homes within the South Slocan system. It will also include investigations to determine the source and characteristics of contaminants in the water supply including metals. The pilot project will include for removal of these contaminants by the POE systems also if warranted.

Background

The original South Slocan water system was constructed prior to 1950. The growth rate of the community has been relatively static for the last 30 years. There is currently no ability to expand the capacity of the system. Existing sources are, at best, marginally adequate to meet the water demands of the community. It has been reported that during the summer months, flow is frequently low.

The system does not meet current standards for fire protection. No maintenance is currently taking place, and no engineering standards have been applied to the system in the past. The system is regarded as poorly maintained and subject to malfunction. Distribution is comprised of 3" steel and cast iron piping, with white PVC piping. The supply line from storage tank to PRV is exposed to the surface and, therefore, exposed to the elements. The system currently has 59 connections and there are 60 lots in the service area. The connections include 53 residential units (49 detached dwellings, 4 apartments), 2 commercial, and the community hall. The area is mainly rural residential with some irrigation demands.

Maximum daily demand (MDD) is calculated as 5,200 l/day/dwelling. There are no flow records for the system. However, it is suspected that daily usage is high and that the system is drawing at capacity. As a result, the community could benefit from conservation efforts.

There is currently no water treatment provided. The system does not meet BC Drinking Water Protection Regulations or Canadian Drinking Water Guidelines. Results from full parameter tests conducted in 2006 indicate levels of lead (Pb), arsenic (As), aluminum (Al), and iron (Fe) in selected parts of the system that exceed acceptable concentrations according to the Canadian Guidelines for Drinking Water Quality (CGDWQ). Regulators consider improvements in water quality to be a higher priority than fire protection: the system is on a Boil Water Notice and they believe water quality should be the primary driving force for upgrades.

The State of the System report for South Slocan notes that the water at source is subject to high turbidity and sedimentation. There is no security at the intake, and no physical barriers are in place. Further on-site inspections suggest that the water intake should be upgraded, and primary filtration should be considered in part to protect the distribution system. These considerations all confirm the intention on the part of the RDCK to proceed with a form of improved treatment.

2. Pilot Project Activities

The following activities should be carried out in connection with the pilot project. Certain of the activities below should be carried out in parallel, one with another. The activities below are not necessarily in chronological order.

A. Funding Related Activities

- Review current status of Gas tax Agreement funding. Discuss the program with staff of the Ministry of Community Services and others. Confirm eligibility of the POE pilot project for funding, and the scope of work to be included in the funding application. Identify existing grants that have already been made for this water system.

- With assistance from specialists prepare an application for Gas Tax Agreement funding. Use elements from these Terms of Reference as appropriate. Include project scope, schedule and budget and proposed allocation of project costs.

- Prior to start of the pilot project ensure that mechanisms are in place to capture all costs and benefits of the project, including the costs of the POE installations and of the central treatment components. Ensure costs and other details are recorded in a way that makes the information useful for other similar projects. Costs recorded should include those for planning, administration, engineering, public involvement, legal and operational issues.

B. Initial Activities

- Institute a water sampling and testing program. This should include sampling at all water sources used by the system, sampling at designated points within the

distribution system and sampling at the homes of designated consumers. The parameters to be sampled should be determined after further review. Sampling should be carried out over a twelve month period, and continued beyond this period after adjustments based on the results of the first twelve months. Ensure the sampling program is approved by the DWO. (Note: It is not the intention that water treatment, particularly disinfection, be delayed until after completion of 12 months of testing)

- Carry out a source to tap assessment of the system following guidelines developed by the BC provincial government where appropriate. Include as an early step a systematic inspection of the distribution system to characterize the system and to help locate points at which contamination may be occurring or at which there is danger of future contamination or failure.

- Based on the results of 1) and 2) above, develop a strategy for upgrading the distribution system. Include a budget and schedule showing phasing of the work if required.

- Prepare a project plan, including objectives, scope, schedule, budget, task and resources to be used. Follow the seven step process outlined in the publication: *Guide Book: Planning and Implementation of "Point of Entry" and "Point of Use" Water Treatment Systems in BC.* Use resources on the web site of the Sustainable Infrastructure Society at: www.SustainIS.Org Review the project plan with health officials, with residents and other stakeholders.

- Prepare a preliminary engineering report which describes proposals for installation of centralized water treatment components and the POE installations in individual homes. Include a description of the treatment processes to be used and characterize the expected quality of the water leaving the treatment plant. Include preparation of a capital and operating budget and construction schedule. Review together the proposed functioning of the central treatment plan and the POE installations to ensure they function together with maximum effectiveness.

- Prepare a schedule of project activities which reflects the high degree of urgency which should be attached to improving water quality by the installation of treatment.

C. Activities Directly Related to POE

- Plan and implement a public information program. This will inform residents of proposals to install centralized treatment components together with POE equipment at each home to remove chlorine and chlorine by-products and possibly other substances. Make a preliminary determination of the extent to which residents are likely to support this course of action. Inform residents that the POE / POU Guidelines require all residents within a water supply system to agree to the installation of POE or POU equipment.

- Undertake consultations with the DWO. If the POE installation is to provide potable water, then 100% participation of residents is required. (Note: There may

be a question by the DWO as to whether removal of residual chlorine makes the water potable). If the POE/POU is only for chlorine residual removal there may not be a requirement for 100% participation.

- Review results of the initial sampling and testing results together with results of the systematic engineering assessment. Confirm water treatment objectives for the POE units to be installed. Include for removal of chlorine and by-products, together with removal of metals and microbiological contaminants. Examine results to assess effectiveness of POE in removing chlorine residual and by-products. (There is no intention to imply that disinfection be delayed a year to complete monitoring).

- Prepare initial drawings and specifications for the POE system required. Contact suppliers of POE equipment to obtain firm proposals including detailed specifications, operating and maintenance requirements, warranty information costs and schedules. Also request suggested monitoring and testing protocols.

- Develop inspection, monitoring and testing protocols to cover field testing of a limited number of units. Agree these protocols with local health officials and residents. Install several POE systems for field testing, each at a selected location within the water system. This phase may include units from several suppliers.

- Review results of field testing. Based on results modify drawings and specifications to cover the full water supply system. Finalize the application for a construction permit from the regional health authority. Obtain firm proposals from suppliers. Following approvals, install POE treatment in each home with the water system. Carry out sampling, testing and monitoring, and share results with health officials, residents, and the equipment suppliers. Adjust the POE equipment as required based on results.

- Include field testing of at least one POE unit which treats water directly from source rather than water receiving central treatment. Draw conclusions concerning the relative effectiveness of the central treatment and the POE treatment in producing water to potable standards, and compare costs and operational aspects.

- Establish continuing monitoring and testing regime. Set up maintenance schedules, review effectiveness of public involvement program and of administrative and maintenance issues including access agreements and record keeping.

- Carry out a project review. Develop practical recommendations covering the application of POE / POU in other water systems in RDCK and elsewhere.

Appendix A1: POE Configuration for Sanca Park

The treatment configuration including POE which is used for comparison purposes in Sanca Park is shown in Fig. A1 and is as follows:

Centralized Components

The peak flows used to size the equipment below are:

- Peak day demand: 207,000 L/day
- Peak hour demand: 18,000 L/hr. (4,800 gal per hour).

1. Intake works: work consisting of an intake gallery with filtration through sand and gravel.
2. Sand filters: to meet system demand 4 sand filters are utilized; each of approximate dimension 1 m. dia. and 1.8 m. high and rated at 100 Lpm (21 GPM) each.
3. Storage Reservoir: 1- 200,000 L. (55,000 gal) storage reservoir to provide chlorine contact time for maximum flow.

POE Components

- The peak flows used to size the POE equipment below are: 45 Lpm (10 Gpm).

1. POE systems at individual households each consisting of 5 micron filter followed by a 1 micron absolute filtration, then UV treatment.

This configuration means that all water supplied by the Sanca Park water system will be filtered and chlorinated. Water used for household consumption will be treated to potable standards by the individual POE units. Water used by the home owner for non potable purposes should be withdrawn upstream of the POE treatment module.

Ultra Violet (UV) Disinfection

Disinfection using UV is part of the POE configuration. UV treatment units that meet NSF requirements are available to remove bacteria and most viruses. UV units may also include built in monitoring and warning devices which operate in the event of failure. To comply with the POE / POU Guidelines, units with built in monitoring and warning devices should be used.

The effectiveness of UV treatment may deteriorate if the treated water has low UV transmittance (<76%). Pilot testing will be required to ensure that full 4, 3, 2, 1, 0 treatment guidelines are met.

The UV system on which this configuration is based is the Trojan UVMax Pro. This system has NSF approval, and includes monitoring and alarm systems. When the monitoring system detects a failure it will shut down any water flow to the house by actuating a solenoid valve.

Ultrafiltration

Two POE systems configurations were considered for this exercise: one using UV treatment and one using ultrafiltration. Ultra filtration units are available that have NSF certification for bacterial removal. Certain units will also remove chlorine and trihalomethanes (THM) using built in carbon filters. Since these systems do not have NSF ratings for virus removal they were not considered further in this project.

At some future point pilot testing may show that ultrafiltration is effective for applications such as Sanca Park. Test data on use of ultrafiltration is available from organizations in California and elsewhere. UV is generally cost effective in comparison to ultrafiltration over periods of 10 years or less, and is part of the POE configuration used in this project for comparison purposes with central treatment.

Appendix A2: Central Treatment Plant Configuration for Sanca Park

The centralized treatment configuration which is used for comparison purposes in Sanca Park is shown in Fig. A1 and is as follows:

The peak flows used to size the equipment below are:

- Peak day demand: 207,000 L/day
- Peak hour demand: 22,000 L per hour.

1. **Intake works:** sand filtration through the intake gallery
2. **Filtration:** Rapid sand filtration using 4 units to meet daily demand, followed by 5 micron filtration. (Further filtration to 1 micron absolute would help to minimize generation of chlorine by-products but may lead to plugging).
3. **Disinfection**: Chlorine injection and storage/contact tankage will complete the central system to meet current 4, 3, 2, 1, 0 guidelines.

The estimated costs for this central treatment configuration are shown in Table A2.

Pilot testing may be required to ensure the ability of the sand filters to effectively reduce turbidity to less than 1 NTU during freshet flows. A series of 1 micron absolute filters would reduce turbidity to less than 1 NTU and may be considered at the design stage if this option is pursued.

Location of the Centralized Treatment Facility

There are two possible locations for a centralized chlorination facility in the Sanca park area.

Location 1*:* Near the intake gallery on the source creek. Such a facility would be ideally located to ensure security and adequate space. This location suffers from a lack of accessibility, and power would have to be brought to the station raising costs substantially.

Location 2*:* Directly beneath the power lines alongside the western side of the highway. There is a broad tract of flat land in this location. This is a convenient location to provide for accessibility and power. Because of elevation differences between source and this location additional pumping capacity may be required. This consideration however applies to both the centralized and the POE treatment options, and is not considered further in the comparison of options.

Chlorination will involve a storage tank capable of providing the 20-minute contact time required to ensure effective disinfection. For the flow rates documented by Sanca Park, the facility will require a contact tank approximately 45,400 L (10,000 IGal.) in size to meet the 20 minute contact time required for chlorination at peak flow of (2,000 Lpm) for the current 35 residents if potable water treatment only is considered. However, a storage tank with capacity 200,000 L (55,000 IGal.) may be required to meet irrigation and fire demands. In the cost comparisons 200,000 L (55,000 gal) was assumed for central treatment and 45,400 L (10,000 gal) tank was assumed for the POE option.

Appendix B1: POE Configurations for South Slocan

See Figure B1 for schematic.

Forms of Activated Carbon

Granular activated carbon is commonly available in two formats: cartridge filter and granulated carbon tanks.

Cartridge Filter: Cartridge GAC filters, prepackaged in a cartridge format, benefit from lower initial costs and ease of maintenance and have a shorter lifecycle (say 6 to 12 months).

Granulated activated carbon tank: This type of filter consists of a tank with loose bulk granulated carbon inside. If the entire community plans to remove chlorine, granulated carbon could be purchased in bulk, an added cost benefit. It has a longer life and requires limited servicing. Media tanks can suffer from channeling, resulting in poor chlorine removal. Regular backwashing may be in order.

The ability of granulated activated carbon (GAC) to remove chlorine is dependant on the net volume of water that has flowed through the filter and the chlorine content of the water. The capacity and costs for POE systems considered in this work are based on POE treatment of water used for domestic purposes only, assumed to be 1,600 L /day. Water for irrigation use is assumed not to be treated by the POE units. The following table provides a cost comparison:

	Initial Cost	Maintenance Cost Max flow (10 GPM)
Installation only	$200	$20
Supply: granulated carbon with container	$1,400	$150 / 4-6 years
Supply: cartridge type	$220	$92 / year

Supplementary Information about Ultrafiltration

Certain models of ultrafiltration use activated carbon to remove chlorine. These models could be used to meet the expectation of residents that chlorine and chlorine by products should not enter individual homes. In the event that the distribution system is not upgraded in the near future ultrafiltration may be employed to treat contaminants in the water supplied to homes that results from the poor condition of the distribution system.

The General Electric Homespring ultrafilter is an example of an ultrafiltration unit. It is NSF approved and includes a carbon filter. The typical listed cost for a POE ultrafilter is $4,000. This exceeds the capital cost for chlorine removal alone. Ultrafiltration is not included in the work in the body of the report. For information, the specifications for the Homespring filter are given below:

Source:http://www.homespring.com/technical_specifications.shtml

Maximum peak flow rate (LPM/USgal)	Up to 11 GPM
Maximum continous flow rate (LPM/USgal)	17/4.5
Minimum temperature (°C/°F)	>0/32
Maximum temperature (°C/°F)	<38/100
Approximate flush volume (litres/USgal)	45/12
Typical system efficiency*	95%
Controller Voltage (VAC)	120 / 230
Bacteria Removal	>99.99999%
Virus removal	>99.999%
Cyst removal	>99.95%

*Depends upon model, water quality and flow rate.