SANCA WATER QUALITY UPGRADES
PROJECT PLAN

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1 Background and Description

1.1 BACKGROUND

The Regional District of Central Kootenay owns and operates 19 water systems in the region, including the Sanca Water System. The Sanca Water system has been under a permanent Boil Water Notice since June 06, 2000 and requires water quality upgrades. Water for Sanca is drawn from Sanca Creek and is untreated.

The water system is believed to have been originally built sometime in the 1960s. The water system became a Regional District service in 1979 and the original water intake and distribution system was replaced in 1980.

The Sanca service area has 32 parcels of land. Currently 26 properties are using water but the majority of the properties are only occupied seasonally.

The Regional District's project goals are as follows:

1. Provide safe and reliable drinking water that meets the BC Ministry of Health's and Interior Health's requirements.

2. Implement a cost effective upgrade option in terms of both initial capital costs and long term operating costs.

3. Provide a system that is simple and easy to operate.

4. Address land ownership and access requirements.

5. Ensure the long term financial sustainability of the water service.

The need for water quality upgrades has been recognized for a long time in Sanca, Several studies have been conducted and a number of options reviewed. The biggest project impediment has been cost. All water quality upgrade options are expensive and there are only a small number of customers in Sanca to share the upgrade costs.

This report provides a summary of past work and provides a plan for the recommended upgrades. Figure 1 shows the potential upgrades which include a new water intake on Sanca Creek and a new central treatment plant.

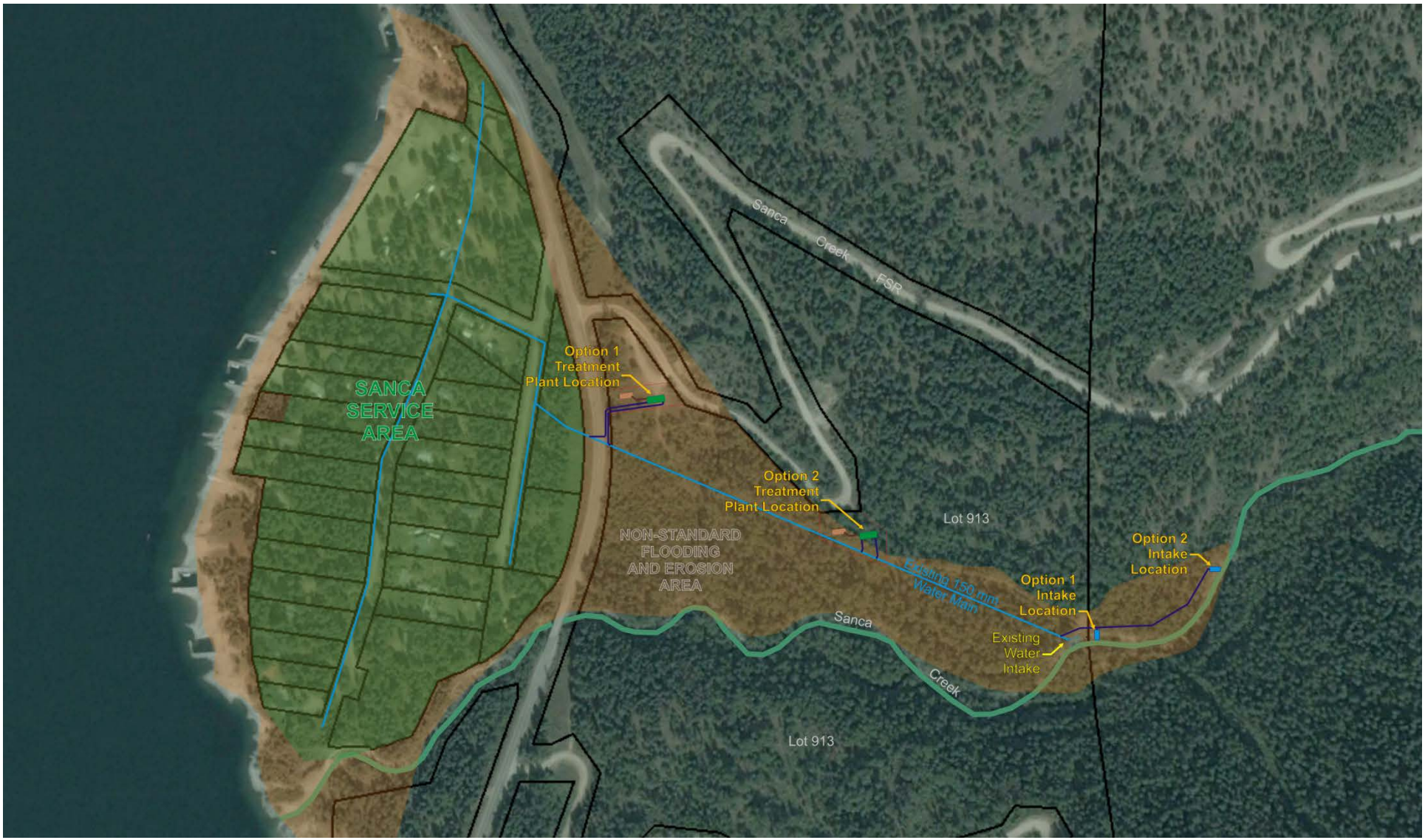

Figure 1 – Sanca Water Quality Upgrade Plan

1.2 PROJECT RATIONAL

1.2.1 Health Risk

Because of the presence of waterborne pathogens in samples, Sanca has been under a permanent Boil Water Notice since June 2000. The Sanca water system derives source water from Sanca Creek. As with all surface sources, Sanca Creek is susceptible to contamination by environmental influences. The watershed is also known to slope stability concerns, flooding concerns and seasonal fluctuations in turbidity. Logging continues to occur in the area, but the supply area is designated as a Community Watershed by the Ministry of Environment since June 1995. The intakes provide some very course screening but no other treatment is provided.

In February 2012, the Regional District received an amendment to our Interior Health Operating Permit that requires the Regional District to identify a treatment option to move out of the “High Risk requiring Boil Water Notification" category for the Sanca Water Service by March 31, 2014 and to install treatment by March 31, 2015. The installation date has since been extended to June 30, 2016 to provide more time to plan for upgrades.

Water sampling from 2012 to date has indicated Total Coliform colonies as high as 115 and E. coli colonies as high as 3 per 100ml of water sample. The following table provides a summary of Sanca Bacteriological Test Results for 2014.

Table 1 – 2014 Sanca Bacteriological Test Results

Sample Date	Total Coliforms	E. Coli
February 24	0	0
March 25	1	0
May 20	17	1
June 25	1	1
July 30	74	2
September 10	14	0
October 08	115	1
December 17	5	0

1.2.2 Development

Subdivision or system expansion is currently not possible because the system is on a permanent Boil Water Notice. Once the Boil Water Notice is lifted subdivision or system expansion is possible. If the system is sized to accommodate modest growth, growth could provide additional customers to share system costs.

1.3 REGULATORY REQUIREMENTS

1.3.1 Interior Health Operating Permit Requirements

The British Columbia *Drinking Water Protection Act* requires that all water systems hold an Interior Health issued Operating Permit and all water systems must comply with all terms and conditions identified in the Operating Permit.

In February 2012, the Regional District received an amendment to our Interior Health Operating Permit that requires the Regional District to identify a treatment option to move out of the “High Risk requiring Boil Water Notification" category for the Sanca Park Water Service by March 31, 2014 and to install treatment by March 31, 2015. The installation date has since been extended to June 30, 2016 to provide more time to plan for upgrades.

1.3.2 Interior Health Construction Permit Requirements

The British Columbia *Drinking Water Protection Act* requires that all construction, installation, alteration or extension of a water supply system must be done in accordance with terms and conditions of an Interior Health issued Construction Permit.

1.3.3 Ministry of Transportation Permit for Work on Highway Right of Ways

The British Columbia Ministry of Transportation and Infrastructure owns and operates roads in Sana and Highway 3A. All works in these right of ways require a Ministry of Transportation permit.

1.3.4 Ministry of Forests Lands and Natural Resource Operations - Water licensing

The Regional District has an existing water licences to withdraw water from Sanca Creek. Sanca Creek has the following water licences:

- Regional District #C053792 for 29,038.15 m^3/yr.
- Stanley M & Theresa E Nowek #C032477 for 2.273 m3/d.

The 1979 Mecman report states that the Water Rights Branch estimate of low flow in Sanca Creek is 140 l/s. The approximate watershed area is 9,000 hectares (90 km2), yielding a low flow runoff of approximately 1.6 L/s per km^2.

If the water intakes are moved, an amendment to the water license might be required.

1.3.5 Ministry of Environment & Fisheries and Oceans Canada – IN STREAM Works Notice

If the Sanca Creek raw water intake is replaced, a Notice under Section 9 of the British Columbia *Water Act* will be required from the Ministry of Environment for “Changes in and About a Stream”. In stream works are also subject to conditions of the Federal *Fisheries Act* which also requires a Notice from Fisheries and Oceans Canada. Typically an application to the Ministry Environment also covers the Federal application.

1.4 TREATMENT OBJECTIVES

The Ministry of Health and B.C.’s health authorities have developed the *Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia* which includes the following:

> *Water suppliers will be required to provide long term plans to reach the goals of:*
>
> *4 log inactivation of viruses*
>
> *3 log removal or inactivation of Giardia Lamblia and Cryptosporidium*
>
> *2 refers to two treatment processes for all surface drinking water systems*

1 for less than 1 NTU of turbidity with a target of 0.1 NTU

0 total and fecal coliforms and E. Coli

1.4.1 4 Log Inactivation of Viruses

Chlorination will provide 4 Log inactivation of viruses if turbidity can be controlled and if adequate chlorine contact time can be provided.

Ultraviolet provides disinfection of most viruses but not all at the common dosage of 40 mJ/cm^2.

It is possibly to get validation for 4 Log inactivation of viruses at a much higher 186 mJ/cm2 dosage but this is a much more expensive option. Ultraviolet validation is also dependent upon provision of 5 micron pre-filtration or 1 micron absolute pre-filtration depending on the standard referenced and the ultraviolet transmissibly of the source water.

1.4.2 3 Log Removal or Inactivation of Giardia Lamblia and Cryptosporidium

Chlorine is not an effective disinfectant of Giardia Lamblia and Cryptosporidium.

Ultraviolet (UV) disinfection is effective at inactivating Giardia Lamblia and Cryptosporidium at the common dosage of 40 mJ/cm^2 (National Sanitation Foundation NSF-55 standard suggests 60 mJ/cm^2).

Giardia cysts are elliptically shaped and range in size from 6 to 10 microns. Crytosporidium oocysts are usually 4 to 6 microns in diameter. 5 micron nominal media filtration should provide some protection but is not considered an effective barrier since the filter size is only considered nominal and can have bigger openings.

Cartridge filters are commonly installed in series with 5 micron nominal and 1 micron absolute filters. The 5 micron filters reduce the particulate loading on the downstream 1 micron filters. The 5 micron filters can be removed and cleaned. The 1 micron filters cannot be cleaned.

Some manufacturers recognize their 1 micron absolute filters as providing 3 Log or greater removal of Giardia Lamblia and Cryptosporidium but some standards and guidelines suggest 1 micron absolute cartridge filters only provide 2 Log removal.

1.4.3 Two Treatment Processes

Chlorination can be considered one treatment process if turbidity can be controlled and if adequate chlorine contact time can be provided.

It is not likely that media filtration would be considered a treatment process as it does not provide adequate virus, Giardia Lamblia and Cryptosporidium removal or inactivation. 5 micron nominal and 1 micron absolute cartridge filtration installed in series would be considered a treatment process.

Ultraviolet (UV) disinfection would be considered a treatment process.

1.4.4 1 NTU of Turbidity

Turbidity can impact the effectiveness of chlorine and UV disinfection.

Some UV system suppliers will validate some of their UV systems for up to 5 NTU with 5 micron pre-filtration but these systems are typically much more expensive. In addition this may not be acceptable to Interior Health. Maintenance of 1 NTU turbidity or lower is typically required by regulators for effective chlorine or UV disinfection.

In addition, some standards suggest that 1 micron pre-filtration should be used with UV systems.

1.4.5 0 Total and Fecal Coliforms and E. Coli

Chlorination is an effective disinfect of Fecal Coliforms and E. Coli, if turbidity can be controlled and if adequate chlorine contact time can be provided. UV disinfection also provides additional protection.

1.4.6 Filter Avoidance Program

Guidelines for Canadian Drinking Water recommend that filtration and one form of disinfection be used to meet treatment objectives. Alternatively, chlorination and UV disinfection may be considered if certain criteria are met.

The Ministry of Health's *Drinking Water Treatment Objectives (Microbiological) For Surface Water Supplies in British Columbia* indicates that a water supply system may be permitted to operate without filtration if the four following conditions for exclusion of filtration are met, or a timetable to implement filtration has been agreed to by the drinking water officer:

1. Overall inactivation is met using a minimum of two disinfections, providing 4-log reduction of viruses and 3-log reduction of Cryptosporidium and Giardia.

2. The number of E. coli in raw water does not exceed 20/100 mL (or if E. coli data are not available less than 100/100 mL of total coliform) in at least 90% of the weekly samples from the previous six months.

3. Average daily turbidity levels measured at equal intervals (at least every four hours) immediately prior to where the disinfectant is applied, are around 1 NTU but do not exceed 5 NTU for more than two days in a 12-month period.

4. A watershed control program is maintained that minimizes the potential for fecal contamination in the source water. (Health Canada, 2003)

1.5 PAST STUDIES AND REPORTS

A number of studies and reports have been commissioned for the Sanca Water System. They are summarized as follows:

1.5.1 Sanca Park Water Feasibility Study, Mecman Engineering, 1979

The Sanca Water System became a Regional District water service in 1979. The original water system consisted of undersized 25 mm to 62 mm distribution pipes and an intake that was too low in elevation to provide adequate water pressures. This study provided an upgrade plan for the 1980 re-construction of the water system.

1.5.2 Sanca Park Water System Assessment, Urban Systems, 2006

In 2006, the Regional District of Central Kootenay commissioned Urban Systems to conduct an assessment of the Sanca Water System. The study was mostly funded by a Province of British Columbia a grant.

The report reviewed the system water quality, reliability, integrity and capacity. The report outlined four options for disinfection along with associated capital and operating costs. The report reviewed options for filtration, relocation of the inlet structure to a higher elevation to mitigate pressure reduction through a potential filtration system, and operating and capital costs.

Given the relatively small size of the system, filtration upgrades would have required a very significant rate increase. The report recommended submission to Interior Health to gain preliminary approval of a plan for system upgrades followed by a more detailed turbidity study to optimize filtration. Essentially, no consensus was reached within the community so an initial plan was not submitted to Interior Health.

1.5.3 Point of Entry / Point of Use Water Treatment Systems, AquaVic, 2008

In 2008 a study provided by AquaVic reviewed point of entry treatment systems for potential use in Sanca, South Slocan and region wide. The Sanca part of the study made a comparison with a central treatment option. The report concluded that there would not be a significant difference in capital and operation & maintenance costs between a point of entry based system and a central treatment system. A central treatment system would require a large reservoir (200,000 L) in difficult terrain to achieve chlorine contact time. The point of entry option would require a smaller central reservoir of (45,000 L) that would only provide partial chlorine contact time. Small storage tanks would also be required with each point of entry system.

Point of entry was later determined not to be cost effective due to potential long term operating costs.

1.5.4 Sanca Park Water System Upgrade Options, Regional District of Central Kootenay, 2009

In 2009 the Regional District drafted the Sanca Park Water System Upgrade Options report. The report primarily focused on point of entry treatment. Point of entry was later determined not to be cost effective due to potential long term operating costs.

1.5.5 Sanca Water Source Assessment, Urban Systems, 2013

The Regional District commissioned Urban Systems Ltd. to conduct Water System Source Assessment that was completed in early 2013. The Source Assessment reviewed several water source and water quality upgrades options. The study identified slow sand filtration as potentially being the most cost effective option followed closely by partial filtration treatment with UV and chlorine disinfection.

The Urban Systems assessment provided a high level review of options and provided a guide for further Regional District review.

1.6 SUMMARY OF PROJECT PROGRESS TO DATE

The following provides a summary of recent project progress:

- The Regional District commissioned Urban Systems Ltd. to conduct Water System Source Assessment that was completed in early 2013.

- In 2013, Area A Director, Gary Jackman provided a $40,000 Community Works Grant to fund preliminary project work and consulting services.
- In 2013 and 2014 the Regional District expanded on upgrade options presented by Urban Systems for further review.
- In August 2013 a community open house was hosted to provide information to customers regarding servicing options and potential water quality upgrade options. The open house was followed up with a community questionnaire. Customer questionnaire responses were varied on the preferred upgrade option.
- A flow meter was installed in October 2013 to assess system demand. Having accurate flow data is critical to sizing any water upgrades.
- Media and cartridge filtration was piloted in 2013 and 2014.
- Slow sand filtration was piloted in 2014.

1.7 REGIONAL DISTRICT GENERAL WATER QUALITY UPGRADE OPTIONS REVIEW

In 2013, the Regional District expanded on the options identified in the 2013 Urban Systems study.

The Regional District reviewed options included the following:

1.7.1 Option 1 - New Intake on Crown Land, Slow Sand Filtration and Chlorine Disinfection

This was the preferred option in terms potential cost and ease of operation prior to piloting. This upgrade option included:

- Relocation of the existing intakes from District Lot 913 to upstream Crown Land.
- Provision of slow sand filtration
- Provision of chlorine disinfection

The potential advantage of this option is that it would be simple and could be operated manually without utility grid power. Slow sand filtration is capable of providing the required 3 Log removal of Giardia Lamblia and Cryptosporidium. Chlorination would be required to provide the required 4 Log inactivation of viruses but it could run on solar power.

In spring and summer 2014, a small slow sand and polishing filter pilot treatment plant was operated in Sanca, The slow sand and polishing filter pilot plant proved problematic to due algae growth. Because of the potential risk of operating issues, this option will no longer be considered.

1.7.2 Option 2 - Existing Intake, Cartridge Filtration, UV and Chlorine Disinfection

Cartridge and media filtration is a common and proven treatment technology in the region. This option might include:

- Media (sand) filter pre-filtration
- Cartridge (paper) filtration
- Chlorine disinfection
- Ultraviolet disinfection (UV)

Backwashable media filtration (approximately 5 micron nominal) is not recognized as an effective option to remove Giardia Lamblia, Cryptosporidium or viruses. Media filtration is commonly used as a pre-filter to reduce loading on downstream cartridge filters.

Cartridge filters are commonly installed in series with 5 micron nominal and 1 micron absolute filters. The 5 micron filters reduce the particulate loading on the downstream 1 micron filters. The 5 micron filters can be removed and cleaned. The 1 micron filters cannot be cleaned.

Some manufacturers recognize their 1 micron absolute filters as providing 3 Log or greater removal of Giardia Lamblia and Cryptosporidium but some standards and guidelines suggest 1 micron absolute cartridge filters only provide 2 Log removal. A disadvantage of cartridge filters is that they are consumable and the cost of filter replacement could be substantial dependent upon source water quality.

Chlorine disinfection provides an effective disinfectant for viruses (4 Log) and bacteria. Plus chlorine provides residual protection against any downstream contamination.

Ultraviolet disinfection is effective at inactivating (3 Log) Giardia Lamblia and Cryptosporidium. If 1 micron absolute filtration is provided, ultraviolet disinfection may still be required to meet the Ministry of Health's *Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies.*

Ultraviolet provides good disinfection of most viruses but not all at the common dosages of 40 mJ/cm^2 (National Sanitation Foundation NSF-55 standard suggests 60 mJ/cm^2).

It is possibly to get ultraviolet validation for 4 Log inactivation of viruses at a much higher 186 mJ/cm^2 dosage but this is a much more expensive option. Ultraviolet validation is also dependent upon the ultraviolet transmissibly of the source water and provision of 5 micron pre-filtration or 1 micron pre-filtration depending on the standard referenced.

The pilot plant that was operated in Sanca in summer 2013 had a pressurized media filter and cartridge filters. It was not expected that this type of technology would be cost effective for Sanca due to the potential high cost of consumable cartridge filters, however, the Regional District already owned the pilot plant and it was felt that any treatment data gained would be beneficial. Media and cartridge filters are typically not very good at removing small particulate turbidity, however, the pilot media filter alone appeared to reduce turbidity below the required 1 NTU level. The 2013 pilot plant was not installed early enough to capture higher source water turbidity during spring freshet as it was being used in another water system.

In spring and summer 2014, the pilot plant was again operated in Sanca. The data gained from pilot once again proved promising. Media filtration alone appeared to reduce turbidity to below 1 NTU, which might be an indication that particulate loading on downstream cartridge filters might not be significant.

This is currently a favoured option.

1.7.3 Option 3 - Point of Entry Treatment

Point of Entry Treatment consists of water treatment systems installed on individual customer water connections. The Regional District has reviewed the feasibility of installing point of entry treatment systems a number of times. Point of entry systems potentially have high operation and maintenance costs since it is anticipated that Interior Health would require regular inspection and testing of each

point of entry unit by the Regional District. Regular access to private property would also be a concern, particularly considering that most properties are only occupied seasonally.

Point of entry treatment systems typically employ ultraviolet disinfection. The Regional District has found that ultraviolet systems on point of entry systems and small treatment plants typically require a lot of maintenance and are prone to expensive electronic component failures, possibly as a result of power quality (electrical system disruptions, browns and spikes).

Points of entry systems also require regular filter changes, at least annual UV system lamp changes and possibly periodic quartz sleeve replacement. The life expectancy of a Point of Entry system is likely much less than a central water treatment plant resulting in an earlier capital replacement program.

Point of entry is not recommended for Sanca due to potential high operating and maintenance costs.

1.7.4 Option 4 - New Groundwater Source

Some Sana customers in the past have indicated that they were not in favour of implementing a ground water well but others have also indicated they would like to install their own wells.

The biggest advantage of ground water wells is the potential low operating costs as treatment would not be required if groundwater quality is good.

Development of a ground water well has considerations and risks as follows:

- Mineral and chemical content of groundwater can be a concern.
- Adequate capacity of a drilled well can be a concern. No existing drill logs in the area indicate that we are likely to get adequate capacity out of just one well and multiple wells might be required.
- Water service would be disrupted during power outage if water storage or standby power cannot be provided with the available funds.

Development of a new well with no treatment has been identified as potentially being the most cost effective option for Sanca but the risk of spending significant funds to drill wells and not have adequate supply or to have water quality issues is too high.

The Regional District also reviewed the potential of locating a new shallow well very near Sanca Creek. Considerations and risks of this option are as follows:

- Capacity would likely be good as the well would be hydraulically connected to Sanca Creek.
- Water chemical and mineral composition would potentially be similar to Sanca Creek.
- A shallow well would be more economical than a deep well.
- Because the well would be hydraulically connected to Sanca Creek it would be considered Ground Water Under Direct Influence of surface water (GUDI). A GUDI well is at risk of pathogen contamination from surface water and treatment would be required.

New GUDI and Ground Water at Risk of containing Pathogens (GARP) guidelines have been recently adopted by the Ministry of Health that clarify the requirement for treatment of GARP wells. In addition to disinfection, filtration might even be required if ground filtration is considered not adequate to remove Giardia Lamblia and Cryptosporidium or if turbidity cannot be maintained below 1 NTU.

Because of the risks attributed with well development in Sanca, a well option will no longer be considered.

1.7.5 Option 5 - Phased Treatment as Funding Becomes Available

Interior Health has indicated that we can propose a phased long-term upgrade plan that would ultimately be compliant with the Ministry of Health's *4-3-2-1-0 Treatment Objectives*.

The Regional District may apply for a Construction Permit for only partial treatment of Sanca Creek sourced water at this time with the commitment to implement additional long-term future upgrades when funds are available.

A first phase project might include media (sand) filtration, and chlorination or UV disinfection. Considerations and risks of this option area as follows:

- Piloting data indicates that media filtration (5 micron nominal) might be effective at maintain turbidly at less than 1 NTU.
- Media filtration is not considered effective at removing Giardia Lamblia and Cryptosporidium.
- Chlorination is effective at disinfecting viruses and bacteria but is not effective at disinfecting Giardia Lamblia and Cryptosporidium.
- Ultraviolet disinfection is effective at inactivating Giardia Lamblia and Cryptosporidium at common dosages of common dosages of 40 mJ/cm^2. Much more expensive 186 mJ/cm^2 dosage would be required for effective disinfection of viruses.
- Reserve contributions would have to be substantially increased to fund additional upgrades to eventually be fully compliant with the Ministry of Health's 4-3-2-1-0 Treatment Objectives.

The potential continued health risk with provision of only partial treatment now is a serious consideration, plus a commitment would have to be made to ultimately be fully compliant with the Ministry of Health's *4-3-2-1-0 Treatment Objectives*.

2 Design Considerations

2.1 SYSTEM DEMANDS

The Sanca service area has 32 parcels of land. Currently 26 properties are using water but only about 5 customers live in Sanca year round.

In 2006 and 2013 there were more active water users and the Urban Systems reports estimated the maximum daily demand (MDD) per single family residential unit at 5,200 litre per day with a 29 single-family residential connections demand of 150,800 liters per day (1.75 l/s). Urban systems estimated that peak instantaneous rates for small communities can be as high as 3 times the MDD, or approximately 5.24 l/s for Sanca.

These potential flow rates were likely based on the British Columbia *Design Guidelines for Rural Residential Community Water Systems* which were since revised in 2012.

A water meter was installed in Sanca in 2014 to gain actual water demand data. Initial data was unusable as the meter was subject to clogging due to sand and stones in the water system. The source of the sand and stones is likely the existing intakes. During pilot plant operation, it was noted that bleed

water to waste helped to keep the system free of sand and the system is now operated with water bleeding to waste, which impacts flow meter data. Accurate flow meter data will need to be acquired in 2015 for to aid in capacity design.

Full system build out and future growth should also be considered when establishing design capacity.

Since Sanca does not have reservoir storage, components of the treatment system will have to be sized to provide adequate system maintenance flushing velocities. The largest pipe in the Sanca system is 150 mm diameter. AWWA *C651 Disinfecting Water Mains*, Section 4.4.3.2 indicates that a minimum of 0.76 m/s or 12.6 l/s for 150 mm pipe is required for system flushing. Common practice though is to flush water mains at a minimum of 1.5 m/s flushing velocity or 26.5 l/s for 150 mm pipes but this is not likely economically feasible to implement for Sanca.

System design demands will need to be reviewed in further detail during detailed design.

2.2 LAND CONSIDERATIONS

The existing water intakes and supply line are located on District Lot 913 without a current Statutory Right of Way agreement. Lot 913 was historically owned by WynnWood (Wynndel Box) but has recently changed owners.

The Regional District does not own any land in Sanca and the most cost effective treatment plant location in terms of infrastructure requirements would be on District Lot 913. Preliminary discussions with the new District Lot 913 owner on the possibility of securing land was positive.

2.3 SYSTEM PRESSURES

Existing pressures in Sanca vary with service ground elevations and operating conditions. A hydraulic model was created for Sanca and modeled existing average day demand pressures range from 56 to 72 psi within the existing service area. This pressure range is considered optimum. Customers have often expressed concerns about low pressures and flows. This is believed to be the result of sand accumulation in the distribution system.

Filtration is planned as part of the water quality upgrades. A media filter can have up to a 30 psi drop in pressure across the filter and the cartridge filters can have up to 20 psi drop across the filters, resulting in a worst case scenario 50 psi pressure drop.

System pressures will need to be increased as part of the upgrade project. This might be accomplished by addition of water booster pumps or relocating the water intake to a higher elevation.

2.4 SANCA CREEK NEW WATER INTAKES AND SEDIMENT BASIN

The existing Sanca Creek intake should be replaced. The existing water intakes and supply line are located on privately owned District Lot 913.

There has been a historical problem with sand accumulation in the distribution system. The existing intake structure consists of perforated C900 PVC infiltration pipes extending out into Sanca Creek. The 1979 Mecman Engineering record drawings indicate that infiltration pipe openings are ½” (12 mm) in diameter and the drawings do not indicate if a filter sock was installed over the pipe. Recently, larger stones have been found plugging distribution system components. Likely one or more of the infiltration gallery pipes are broken.

A better alternative might be to provide an intake channel or concrete intake headwall structure on the bank of Sanca Creek that diverts water to a sediment basin or tank before entering the water supply line.

There are two options for a new intake location. Intake Location Option 1 would be located on Crown Land immediately upstream of the existing intake infiltration gallery. This option would not provide adequate pressure head to operate the water treatment plant without provision of treatment plant booster pumps. Standby power would be required for the booster pumps to operate during power outages.

Intake Location Option 2 would be located on Crown Land approximately 225 m upstream of the existing intakes. Option 2 might provide an addition 15 m (21 psi) of pressure head but this will need to be confirmed by field survey.

The Option 2 intake is about 50 m (71 psi static head) higher in elevation than the highest elevation Sanca customer. Assuming a worst case potential pressure drop of up to 50 psi across the filters, this would leave a static or low flow customer pressure of about only 21 psi, which is still below actable pressures. Water treatment booster pumps are still recommended but may only be required to operate under high demand or near fouled filter conditions. The control system can also be set up to alarm at lower pressure drop across the filters.

2.5 OPERATION AND MAINTENANCE CONSIDERATIONS

Fortunately, Sanca does not currently require much operation and maintenance in comparison to other Regional District water systems, which has keep rates historically relatively low; however, operation and maintenance costs are expected to significantly increase with treatment upgrades.

Routine operation and maintenance is currently provided by a local operator on an as needed basis and supervision is provided by the Erickson Utilities Supervisor. Travel time to Sanca is a concern. Sanca is 45 minutes from Erickson and 2 hours from Nelson, so preference should be given to a well proven, simple treatment system that would likely require minimum senior operator or supervisor attention.

3 Central Treatment Conceptual Design

The following central treatment conceptual design Options A to Option D are based on the previously reviewed Regional District Option 2. The options include variations on cartridge filtration, UV disinfection and intake relocation. Option E to Option G is based on the previously reviewed Option 5 which is a phased partial treatment option.

Table 2 – Summery of Conceptual Upgrade Options

Upgrade Option	New Intake Near Existing Intake	Intake Relocated Upstream	Media Filtration (5μ)	Cartridge Filtration (5μ)	Cartridge Filtration (1μ)	Sodium Hypochlorite Disinfection	UV Disinfection	Standby Power	Cost
Opt A	✓		✓	✓	✓	✓			$451,000
Opt B	✓		✓	✓	✓	✓		✓	$508,000
Opt C		✓	✓	✓	✓	✓			$523,000
Opt D	✓		✓	✓	✓	✓	✓	✓	$555,000
Opt E	✓		✓			✓	✓	✓	$541,000
Opt F		✓	✓			✓			$508,000
Opt G	✓		✓			✓		✓[1]	$451,000

Note: 1. Standby power under Option G only includes limited power which might only operate a booster pump, controls and chlorine system.

2. The cost estimates above include contingency at 20%, GST at 5% and Engineering at 15%.

3.1 OPTION A

Option A includes: A new intake near the existing intake, media filtration (5 micron nominal), cartridge filtration (5 micron nominal and 1 micron absolute), and sodium hypochlorite disinfection.

Considerations and risks for Option A include:

Pros

- Pilot testing indicates that media filtration and cartridge filtration is effective at maintaining turbidity at less than 1 NTU.
- This treatment option would be simple to operate but frequent cartridge filter changes might be required during freshet.

Cons

- Consumable cartridge filter costs could be a concern but pilot testing indicates that media pre-filtration is effective at removing most turbidity, potentially resulting in low filter consumption for Sanca Creek source water.
- Booster pumps will be required.
- **Without standby power, water supply will be disrupted during power failures since Sanca has no water storage**.
- If UV is not installed, the treatment system may not be fully compliant with the Ministry of Health's 4-3-2-1-0 Treatment Objectives. This will need to be confirmed with Interior Health.

3.2 OPTION B

Option B includes: A new intake near the existing intake, media filtration (5 micron nominal), cartridge filtration (5 micron nominal and 1 micron absolute), sodium hypochlorite disinfection, and standby power.

Considerations and risks for Option B include:

Pros

- Pilot testing indicates that media filtration and cartridge filtration is effective at maintaining turbidity at less than 1 NTU.
- This treatment option would be simple to operate but frequent cartridge filter changes might be required during freshet.

Cons

- Consumable cartridge filter costs could be a concern but pilot testing indicates that media pre-filtration is effective at remove most turbidity, potentially resulting in low filter consumption for Sanca Creek source water.
- Booster pumps will be required.
- Standby power is required, increasing the project cost, during power failures since Sanca has no water storage.
- If UV is not installed, the treatment system may not be fully compliant with the Ministry of Health's 4-3-2-1-0 Treatment Objectives. This will need to be confirmed with Interior Health.

3.3 OPTION C

Option C includes: A new relocated intake, media filtration (5 micron nominal), cartridge filtration (5 micron nominal and 1 micron absolute), and sodium hypochlorite disinfection.

Considerations and risks for Option C include:

Pros

- Pilot testing indicates that media filtration and cartridge filtration is effective at maintaining turbidity at less than 1 NTU.
- This treatment option would be simple to operate but frequent cartridge filter changes might be required during freshet.

Cons

- Consumable cartridge filter costs could be a concern but pilot testing indicates that media pre-filtration is effective at remove most turbidity, potentially resulting in low consumable filter consumption for Sanca Creek source water.
- If UV is not installed, the treatment system may not be fully compliant with the Ministry of Health's 4-3-2-1-0 Treatment Objectives. This will need to be confirmed with Interior Health.

- Potential system hydraulics will have to be reviewed in detail to confirm that intake relocation will provide adequate system pressures. Consideration might be made for booster pumps, and limited or portable standby power. Also, the control system can also be set up to alarm at set pressure drop across the filters that would result in low system pressures.

3.4 OPTION D

Option D includes: A new intake near the existing intake, media filtration (5 micron nominal), cartridge filtration (5 micron nominal and 1 micron absolute), sodium hypochlorite disinfection, ultraviolet disinfection and standby power.

Considerations and risks for Option D include:

Pros

- Pilot testing indicates that media filtration and cartridge filtration is effective at maintaining turbidity at less than 1 NTU.
- The combination of filtration, chlorine disinfection, and ultraviolet disinfection provides a good treatment option that would meet the Ministry of Health's *4-3-2-1-0Treatment Objective*.
- This treatment option would be simple to operate but frequent cartridge filter changes might be required during freshet.

Cons

- The Regional District has at times found ultraviolet systems to be problematic and subject to expensive electronic component replacement when power quality is a concern.
- Since Sanca has no water storage, an ultraviolet system would require the provision of standby power as the treatment system would shut down during power failures.
- Booster pumps and standby power will be required.

3.5 OPTION E

Option E includes: A new intake near the existing intake, media filtration (5 micron nominal), sodium hypochlorite disinfection, ultraviolet disinfection and standby power.

Considerations and risks for Option E include:

Pros

- Pilot testing indicates that media filtration alone is effective at maintaining turbidity at less than 1 NTU but the pilot plant was not operated year round.
- This treatment option would be simple to operate.

Cons

- The Regional District has at times found ultraviolet systems to be problematic and subject to expensive electronic component replacement when power quality is a concern.
- This option would be subject to a Filter Avoidance Program and has a continued health risk, since media filtration alone does not meet the Ministry of Health's *4-3-2-1-0 Treatment*

Objectives. We would possibly have to make a commitment to Interior Health to make upgrade to be fully compliant.

- This option includes standby power that increases the project cost.

3.6 OPTION F

Option F includes: A new relocated intake, media filtration (5 micron nominal), and sodium hypochlorite disinfection.

Considerations and risks for Option F include:

Pros

- Pilot testing indicates that media filtration alone is effective at maintaining turbidity at less than 1 NTU but the pilot plant was not operated year round.
- This treatment option would be simple to operate.

Cons

- This option would be subject to a Filter Avoidance Program and has a continued health risk, since media filtration alone does not meet the Ministry of Health's *4-3-2-1-0 Treatment Objectives*. We would possibly have to make a commitment to Interior Health to make upgrade to be fully compliant.
- Potential system hydraulics will have to be reviewed in detail to confirm that intake relocation will provide adequate system pressures. The control system can also be set up to alarm at set pressure drop across the filters that would result in low system pressures.

3.7 OPTION G

Option G includes: A new intake near the existing intake, media filtration (5 micron nominal), sodium hypochlorite disinfection, and limited or portable standby power.

Considerations and risks for Option F include:

Pros

- This provides the most cost effective option now but we would be required to commit to future upgrades.
- Pilot testing indicates that media filtration alone is effective at maintaining turbidity at less than 1 NTU but the pilot plant was not operated year round.
- This treatment option would be simple to operate but frequent cartridge filter changes might be required during freshet.

Cons

- This option would be subject to a Filter Avoidance Program and has a continued health risk, since media filtration alone does not meet the Ministry of Health's *4-3-2-1-0 Treatment Objectives*. We would possibly have to make a commitment to Interior Health to make upgrade to be fully compliant.

- This option includes portable or smaller automatic transfer generator to operate a booster pump, controls and chlorine system during power disruption. The feasibility will have to be confirmed.

3.8 RECOMMENDED OPTION

Option D provides the best option in terms of water quality and service reliability but is the most expensive and would not likely economically feasible.

Option G provides the least expensive option now but has some continued health risk and we would have to make commitments to future upgrades.

The Regional District recommends proceeding with Option C. Option C includes: A new relocated intake, media filtration (5 micron nominal), cartridge filtration (5 micron nominal and 1 micron absolute), and sodium hypochlorite disinfection. This decision was supported by the Sanca Commission by Resolution on April 28, 2015.

The recommended option includes chlorine disinfection. Chlorine disinfection might be a concern to many customers in Sanca but fortunately chlorine can be easily removed if homeowners wish to install home carbon filters. Minimum chlorine contact time might be a concern as the system has no storage to provide contact time, however, contact time can be increased by over sizing the distribution pipe downstream of the treatment plant.

3.9 NEXT STEPS

In 2013, Area A Director, Gary Jackman provided a $40,000 Community Works Grant to fund preliminary project work and consulting services. There is currently $37,337 remaining from the Community Works Grant and the Regional District has identified an additional $50,000 from Sanca Reserves for a total 2015 budget of $87,337.

If the community supports the project plan and project financing, an application will be made to Area A Director Jackman and the Board for an additional $60,000 Community Works Grant for a total potential 2015 budget of $147,337.

The next steps in the project are as follows:

1. The Regional District does not have anyone on staff licensed by the Association of Professional Engineers and Geoscientists nor the resources to do water treatment design. An Engineering Consultant will be commissioned in spring 2015 to provide treatment plant design and construction support services.

2. Continue discussions with the owner of District Lot 913 to secure a Statutory Right of Way for existing water infrastructure and to secure land for a potential water treatment plant.

3. Establish a long term rate plan for Sanca.

4. Host an Open House with the community to present the project plan.

5. Borrow money to finance the project.

6. Proceed with procurement, construction and commissioning.

4 Financial Considerations

4.1 CUSTOMER WATER RATES

Sanca has 32 parcels of land. In 2014, 26 properties were assessed a $468 Single Family Dwelling water use change. Six properties are not currently using water. All 32 properties are assessed $100 Capital Contribution Charge and a $50 water parcel tax, regardless of water usage.

The total Single Family Dwelling charge for Sanca has increased 204% from $280 in 2009 to $570 per year in 2014. A rate has not yet been approved by the Board for 2015 but it is anticipated to be a total of $674.

The following figure provides a graph of the total single family dwelling water rate for Sanca since 2009.

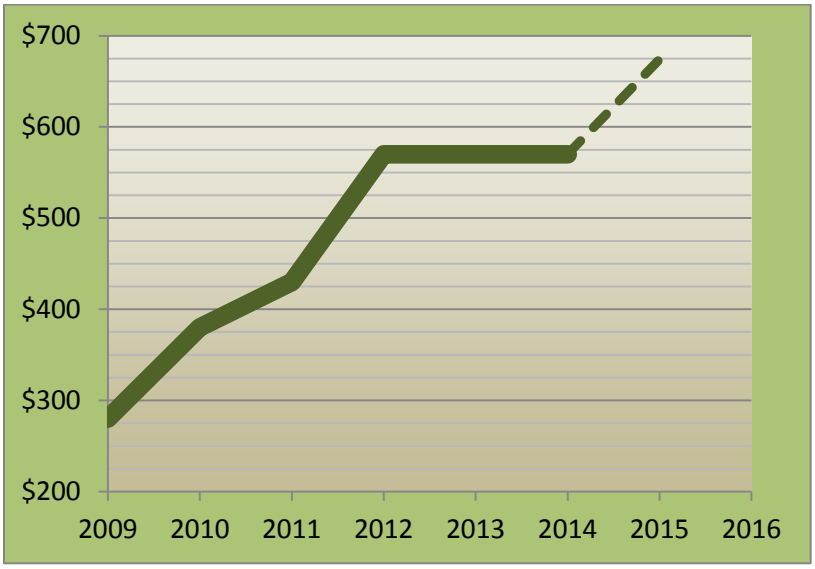

Figure 2 – Sanca Total Annual Single Family Dwelling Water Rate

The community is highly sensitive to rate increases but additional large rate increases will be required to fund water quality upgrades. Traditionally, water bills were invoiced once per year and customers were required to pay their bills in full July 1st. In order to help reduce some of the financial burden to our customers, the Regional District introduced an optional payment plan in 2014.

Because the Sanca Water Quality upgrades will result in additional significant rate increases a long term Sanca Rate Plan needs to be drafted.

Currently the Regional District establishes 5 year Financial Plans for the Sanca Water Service. The Financial Plan and proposed Sanca Rate Plan should be extended at least to the point of rate stabilization. This way the Regional District and customers will have a better understanding of how much water will cost in the long term. Inputs to a long term financial plan include:

1. Projection of linear and treatment infrastructure operating and maintenance costs

2. 100 year asset management plans

3. Required reserve contribution amounts

4. Debt financing costs

5. Potential grant contribution

The proposed Sanca Rate Plan will need to consider revenue options that might include:

1. Increase of existing single family residential rates.

2. Parcel tax and capital expenditure charge rates to fund capital improvements, borrowing costs or reserve contributions.

4.2 COST ESTIMATE

The project is anticipated to cost $523,000 for Option C. These estimates are considered conceptual only and will be refined during the design process.

Option C includes: Intake relocation, media filtration (5 micron nominal), cartridge filtration (5 micron nominal and 1 micron absolute), and chlorine disinfection.

Table 3 – Option C Conceptual Cost Estimate

No.	Item	Cost
1	New Intake Clearing and Site Prep	5,000
2	New Intake	15,000
3	Sediment Basin	15,000
4	Piping and Connection to Existing Supply Line	5,000
5	Clearing, Access and Treatment Plant Site Preparation	10,000
6	Treatment Plant Power Service	10,000
7	200 m of 150 mm PVC Piping	40,000
8	Highway Crossing	15,000
9	Treatment Plant Building	30,000
10	Building Electrical, Lighting and Heating	15,000
11	Internet Connection	5,000
12	Media Filters	15,000
23	Cartridge Filters	10,000
24	Chlorinator	10,000
25	Building Piping and Plumbing	15,000
26	Booster Pumps	10,000
27	Backwash Pumps	10,000
28	Chlorine Analyser	4,000
29	Turbidity Meters	5,000
30	Flow Meter	2,000
31	Controls	25,000
32	Intake Relocation Pipe Line	50,000

33	Backwash Pond	10,000
34	Land Costs	30,000
	Subtotal	361,000
	Contingency @ 20%	72200
	Subtotal	433,200
	GST @ 5%	21,660
	Total	455,000
	Engineering @ 15%	68250
	Project Total	**523,000**

4.3 PROJECT FUNDING AND FINANCING

There is currently $37,337 remaining from the $40,000 Community Works Grant provided by Director Jackman. The Regional District has identified an additional $50,000 from Sanca Reserves for a total 2015 budget of $87,337. This leaves a significant project shortfall that will have to be funded from borrowing. If the community supports the project plan and project financing, an application will be made to Area A Director Jackman and the Board for an additional $60,000 Community Works Grant.

In accordance the *Local Government Act*, a regional district requires participating service area approval and a loan authorization bylaw needs to be adopted by the Board of Directors in order to borrow money with some exceptions. One exception that may apply to Sanca is as follows:

> *823.1 (2) Participating area approval is not required for the following:*
>
> *(c) money borrowed for a purpose prescribed by regulation or in circumstances prescribed by regulation, subject to any conditions established by regulation.*

Interior Health has amended the Sanca Operating Permit with the requirement for water quality upgrades. Staff will present borrowing options to the Board for direction on how to proceed. If service area approval is required, this may be done by Referendum or Alternate Approval Process.

5 Implementation

5.1 SCHEDULE

The proposed project schedule is as follows:

Table 4 – Project Schedule

Item	Date
Commissioning of a Design Consultant	May 2015
Design	May 2015 to Oct 2015
Project Open House	Aug 2015
Borrowing Referendum, if required	Aug 2015
Intake Construction	Aug 2015
Treatment Plant Tender	Oct 2015
Construction	Jan 2015 to June 2016
Commissioning	Jun 2016

It is anticipated that any new intake construction would be subject to a permissible in stream works fish window which typically ranges from June 15 to August 31. If the new intakes are not constructed in 2015, the project might be completed in July or August 2016.

5.2 PROCUREMENT

Consideration will be made to procure the project by work packages rather than by one large project. This approach provides more opportunity for small local companies and typically results in lower overall project cost but would likely result increased project management requirements.

In accordance with the Regional District Purchasing Policy, project procurement will be done by quotation for work packages less than $75,000 and by tender work packages greater than $75,000.