Glenmore-Ellison Improvement District
2016 Annual Report

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INTRODUCTION

The Glenmore Ellison Improvement District continually strives to provide high quality drinking water to its rate payers through responsible operation, monitoring, evaluation and management of its water system.

As required by the British Columbia Water Protection Act, the Glenmore Ellison Improvement District (GEID) provides the following annual report in accordance with our conditions on permit that includes:

- System Description
- Source Assessment Synopsis
- Annual consumption data
- Updates to Water System Assessment and Capital Works Plan
- Updates to Water Monitoring Plan
- Updates to Emergency Response Plan
- Updates to Cross Connection Control Program
- Cross Connection Control Program Results
- System Notable Events
- Provide Environmental Operators Certification Program updates

This report also describes where your water comes from, how it is distributed, and how we ensure it is safe to drink. The information in this report will allow people, especially those with special health needs to be better informed about their drinking water. Please contact GEID (250)-763-6506 or email dwilliams@geid.org if you have any questions.

The annual report covers the period from January 1st, 2016 to December 31st, 2016.

SYSTEM DESCRIPTION

Glenmore-Ellison Improvement District (GEID) is one of five main water purveyors in Kelowna, British Columbia. The District boundaries extend across an area of approximately 3,694 hectares (36.94 km^2, or 9,127.877 acres), of which 1,750 hectares (4,330 acres) of land is serviced with water, of which 786 hectares is bonafide agricultural land. GEID supplies water to approximately 6,817 residential service connections, serving an estimated population of 17,043 people.

The distribution system consists of three distinct geographical areas, Glenmore, Ellison, and McKinley Landing. Glenmore receives water from Okanagan Lake via McKinley Reservoir. McKinley Landing receives water directly from Okanagan Lake. Ellison receives water from Kelowna Creek, which is drawn from a 1,200 m^3 intake pond, and then passed through a coarse screen (40 mesh, 400 micron) and piped to the Postill Pump Station and Reservoir, the head-works of the Ellison system. Ellison is also supplemented by the use of well water.

The Glenmore distribution system begins at the intake on Okanagan Lake where the Joe Bulach Pump Station pumps raw water into McKinley Reservoir. Water from this reservoir is disinfected by gas chlorination at the adjacent chlorinator and treated with UV light (July 2016). There are five other balancing reservoirs in

the Glenmore distribution system, namely the Union Road, Big Rock, Scenic Road, Quail Ridge, and UBCO Reservoirs.

GEID operates five wells located in various areas of the District to supplement the surface water supplies. Two wells servicing the Glenmore system include the Lochrem Road well (raw water back-up source) and Vector well (inactive).

The Ellison distribution system includes a 2,000 m^3 enclosed concrete reservoir and pump-house equipped with a chlorine gas injection system. There are three wells in the Ellison system which include Airport Wells #1 and #2 and the Ellison Well. The Ellison system is gravity supplied from Kelowna Creek for the majority of the year. However, the wells are used during spring freshet and times of major storm events to reduce the impacts of increased turbidity, and also to provide supplemental flows during periods of peak system demand.

Water for McKinley Landing Water Works system is obtained directly from an intake on Okanagan Lake at the Dewdney Pump Station and treated with chlorine gas. The water is pumped from the Dewdney pump station to the Arthur Court Reservoir and gravity feed to the Shayler pump station which fills the Shayler Road Reservoir and McKinley Beach 640 reservoir which gravity feeds the rest of the system.

Glenmore-Ellison Improvement District operates with a total of six interconnections with other adjacent water suppliers to provide an alternate supply of water in event of an emergency situation. Two of the six interconnections are with the Black Mountain Irrigation District water system and the remaining four are with the City of Kelowna water system.

SOURCE ASSESSMENT SYNOPSIS

In 2014, the District began pumping high quality Okanagan Lake water to supply the Glenmore distribution area. This includes the Glenmore Valley, the Sexsmith area, UBCO, the Kelowna Airport and Quail Ridge. GEID's new intake now provides solely Okanagan Lake water to McKinley Reservoir. The intake is currently the deepest intake on Okanagan Lake, and is situated in a desirable location, distant from local valley creeks.

The next phase of work completed in 2016 includes an ultraviolet (UV) disinfection system that will improve water quality and add an additional source protection barrier to the supply. Subject to meeting Interior Health's filtration deferral criteria, UV disinfection is expected to allow GEID to fully comply with Interior Health's Drinking Water Treatment Objectives for Surface Water Supplies in BC.

By utilizing low turbidity water from deep within Okanagan Lake, along with state-of-the-art UV disinfection, GEID hopes to provide safe, cost effective, high quality drinking water that meets Canadian Guidelines year-round and the Drinking Water Treatment Objectives for Surface Water Supplies in BC in the near future.

WATER SOURCES

GEID uses a combination of surface and groundwater sources for water supply to their system. The ground water sources are primarily used to supplement system demand and improve water quality in the Ellison distribution system. The majority of the water originates from Okanagan Lake and Kelowna/Mill Creek.

MILL CREEK

GEID has continued to actively monitor the watershed which feeds Mill Creek with regular inspections of Bulman Reservoir, Postill Reservoir and South Lake Reservoir. During the summer months, there are employees touring the watershed sampling for various parameters and speaking with the public who are using the watershed for leisure activities. GEID also meets with the individual watershed stakeholders to ensure progress towards specific action items in the Mill Creek source protection plan are being addressed. Heather Larratt from Larratt Aquatic Consulting has been contracted to monitor the biological aspects of the three mid elevation reservoirs.

OKANAGAN LAKE/MCKINLEY LANDING INTAKES

GEID has implemented their water quality monitoring program for the Okanagan Lake Intake and McKinley Reservoir. Extensive monitoring by Larratt Aquatic Consulting has provided data needed to characterize the sources. This information is used to understand biological process so that operational procedures can be suitably implemented as needed, to maintain high drinking water quality. The information was also used to design new water treatment infrastructure.

The objective of an assessment summary of GEID's Okanagan Lake intakes was used to identify current and forecast future drinking water hazards and vulnerabilities, characterize the risk posed by each hazard, and provide actionable recommendations to reduce impacts on the intake. The “Okanagan Lake Source Assessment Report”, received from Larratt Aquatic Consulting, has been completed and submitted to GEID.

GEID’S Okanagan lake deep water intake is shielded from most surface contamination throughout the summer because the lake stratifies each year from May to November. There are no major inflows into Okanagan Lake near either of GEID’s intakes.

The assessment characterizes natural and man-induced hazards to drinking water quality as physical, chemical or biological. As these risks change over time, revisions of this document may be needed. Existing research was augmented by 2012-2013 field studies of water currents, water quality profiles, and algae sampling in Okanagan Lake near the intakes. This research was used to define a proposed intake protection zone, based on a two-hour travel time of water currents to the intake under moderate winds. The largest potential impacts identified in this study include shoreline residential use, power boating, watershed influences, and the threat of invasive mussels.

Specific recommendations and action plans were developed with the dual aim of providing the best water quality and providing support to a future GEID application to Interior Health (IH) for exclusion of filtration. Key recommendations include: applying best management practices for shoreline protection, applying to Interior Land Management Bureau (ILMB) for a license of occupation for the intake protection zone, add UV disinfection, investigate the potential benefits of extending the Dewdney Intake to >20m.

WELL PROTECTION PLAN

A ground water protection initiative was under taken by the Kelowna Joint Water Committee (KJWC) in response to the Terms and Conditions placed on GEID by Interior Health's operating permit requirements. The KJWC is made up of the five major water suppliers in Kelowna who are: The City of Kelowna, South East Kelowna Irrigation District, Glenmore-Ellison Improvement District, Black Mountain Irrigation District and Rutland Waterworks. The KJWC has been following the Groundwater Protection Toolkit issued by the Ministry of Environment and working through the process with Golder Associates.

Phases I and II have identified well capture zones, completed an inventory of potential contaminant chemicals and locations of concern for the wells in consideration. Recommendations for going ahead with a more in-depth groundwater protection plan and risk management have been completed as well. The technical portion of Phase III which includes mapping, a review of risk assessments of each well, cataloguing the risks, ranking the risks and developing a risk mitigation strategy has also been completed.

A concern identified has been private wells that have not been reported to provincial agencies responsible for maintaining a well database. The potential hazard of aquifer contamination from improperly drilled and maintained wells is quite high.

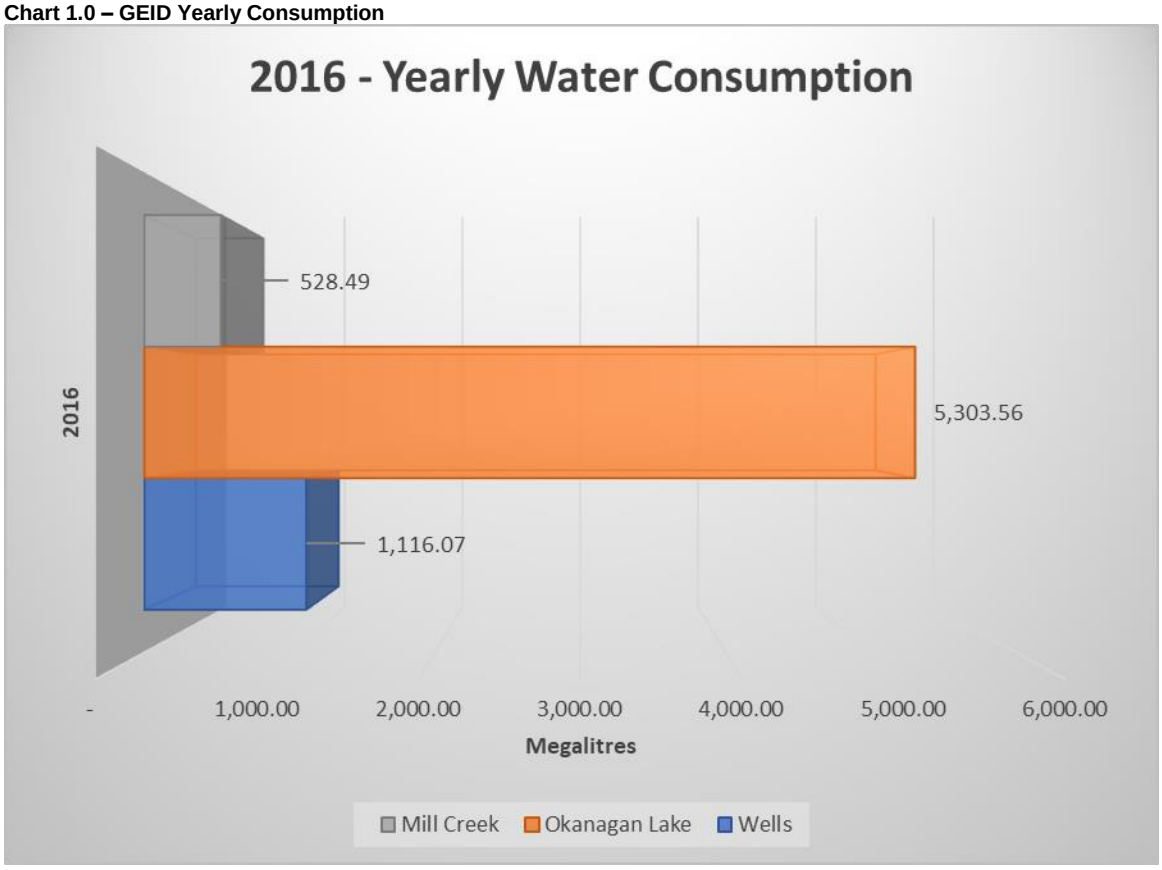
GEID has implemented a Well Head Protection Plan by upgrading facilities to flood proof and protecting well heads. All GEID wells have sanitary seals installed and are enclosed within above ground structures.

Additionally, noted was the risk of geothermal heating installations as a threat to groundwater according to the initial and second phases of the KJWC Kelowna Aquifer Assessment. There were some areas of vulnerability within city boundaries identified. Some portions of the Aquifer remain unconfined and pose a risk and possibility of contamination to the Airport Wells #1 and #2.

ANNUAL CONSUMPTION DATA – 2016

In 2016, the District obtained approximately 76% of its water from the Joe Bulach Pump Station and Dewdney Pump station on Okanagan Lake, 8% of its water from the Kelowna Creek Watershed, which includes Postill Lake, Bulman Lake, and South Lake, and pumped 16% from two of the four main wells located in the Glenmore and Ellison areas. The total consumption was 6948.12 ML, of which 1116.07 ML was supplied from groundwater sources, and 143.86 ML was supplied to McKinley Landing from Okanagan Lake. The balance of the water, 528.49 ML. was supplied from Kelowna Creek directly to the Ellison distribution system. The new Okanagan Lake Pump Station delivered 5303.56 ML to the McKinley Reservoir.

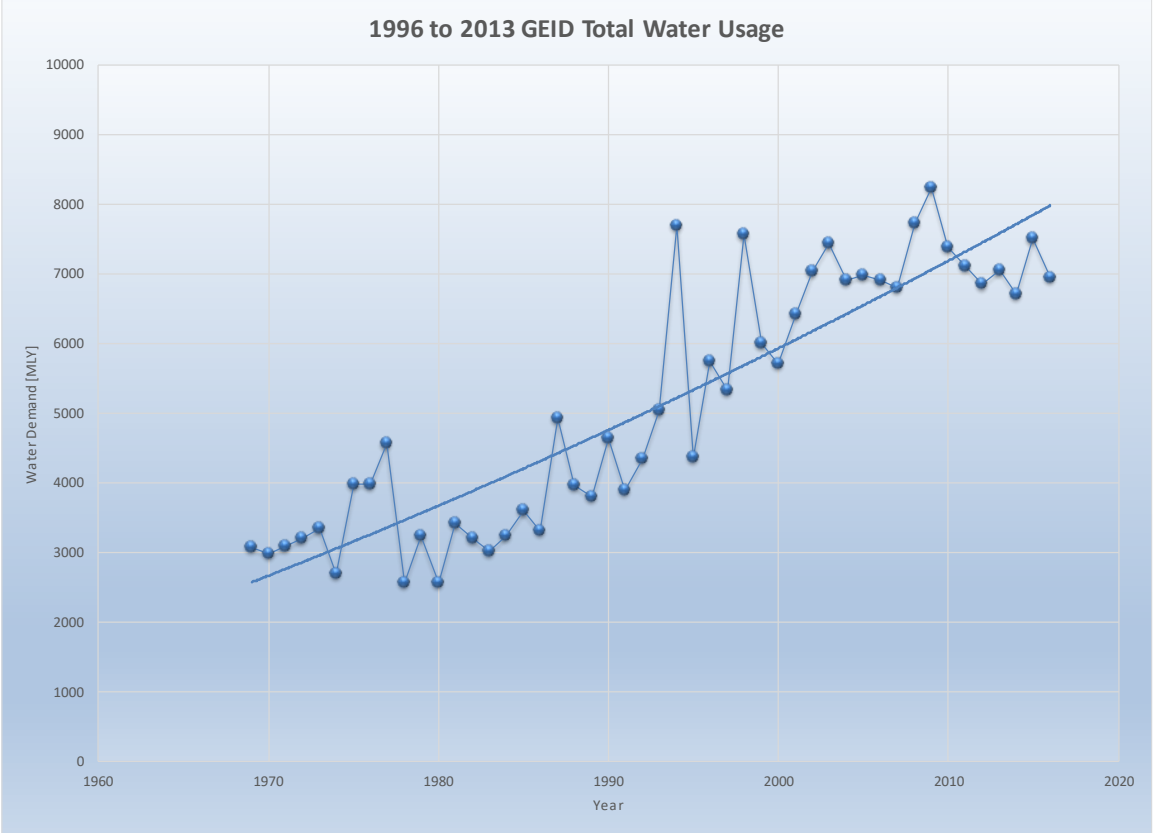
Chart 1.0 – GEID Yearly Consumption



HISTORIC GEID WATER CONSUMPTION

The historic GEID water consumption since 1996 is illustrated in Chart 2.0. The figure shows the actual recorded water consumption in Megaliters per year MLY). It should be noted that McKinley Landing was integrated into the GEID system in 2006.

Chart 2.0 – Historic Water Consumption



UPDATES TO WATER SYSTEM ASSESSMENT AND CAPITAL WORKS PLAN

Through 2016, the 2015-2019 Capital Works Plan remained in effect, with GEID completing the new McKinley reservoir by-pass crossing pipe, UV facility, Watermark subdivisions including mains and PRV stations, McKinley Beach development including mains PRV's, and the Shayler reservoir 3rd cell.

The GEID water system is complex, with the majority of the water supplied being used for both domestic and agricultural irrigation. During 2014 - 2016 there was a significant drop in consumption which could be attributed to water metering and conservation education in the district.

GEID's water system is comprised of three separate sub-systems using several water sources.

GLENMORE AREA

The largest sub-system is located in the Glenmore Valley and uses Okanagan Lake water for meeting user demands. Water from Okanagan Lake is pumped to McKinley Reservoir, located at the north-west end of the system. Water is disinfected by chlorine injection immediately downstream of the McKinley Reservoir prior to entering the distribution system. There are 2 ground water sources (Airport Wells No. 1 and No. 2) that supplement the water supply to the Ellison or Glenmore system depending on system dynamics.

The GEID has completed the installation of a UV Disinfection facility. The new facility will initially treat 79 MLD with UV light. This project will address inactivation of *Giardia* and *Cryptosporidium* requirements.

The transmission main that conveys water from McKinley Reservoir has limited spare capacity for servicing additional demands, therefore flows are closely monitored. Rather than installing additional infrastructure to increase the hydraulic capacity, the District will obtain a higher benefit if a separation plan for the agricultural irrigated lands within the Glenmore Valley is completed.

The separation of the distribution system will reduce the flows to be conveyed by the transmission main downstream of McKinley Reservoir. This project not only improves the transmission main operational conditions but will also bring savings in pumping costs. Currently, water for irrigation is pumped from Okanagan Lake to McKinley Reservoir and then pumped through Tutt Pump Station or Scenic Pump Station. The District has the option of supplying agricultural irrigation water by gravity using existing infrastructure. It should be noted that additional works will be required to fully take advantage of supplying irrigation by gravity. A third benefit of implementing this project is a reduction on the capital and operational costs of future treatment facilities at McKinley Reservoir due to reduced flows to be treated. It is estimated that the separated Maximum Day Demand will be in the range of 265L/s or 22.9 MLD (for the entire separation area proposed).

ELLISON AREA

The Ellison Area uses Kelowna/Mill Creek as its main water source. Water supply is supplemented by Ellison Well. Ellison Well has no capacity to supply both domestic and irrigation demands. It should be noted that the strata subdivisions at the north-west end of the Ellison Area are normally serviced exclusively from Airport Wells.

Water consumption in the Ellison Area is mostly for irrigation purposes, estimated at 97% (Faccini, 2015) of the MDD during the irrigation season. Drinking Water quality in the Ellison Area is compromised at times of the year when Kelowna/Mill Creek experiences high turbidity. The current situation in the Ellison system is challenging as treating all water is not economically feasible. The alternative is to carry out a system separation that would allow the installation of treatment facilities to improve drinking water quality and its delivery to users by a new

distribution system. The existing distribution system would be retained for supply of agricultural irrigation demands and fire protection.

GEID cannot afford the Ellison sytem separation as one single project unless additional funding becomes available. The proposed approach for Ellison is to complete the separation in phases and carry it out as funding from the water quality improvement reserve or other sources becomes available. The proposed timeline is to initiate the separation of the lower pressure zone (PZ 495) is scheduled to start in 2017 and will take 3 years to complete. The upper pressure zone (PZ 542) will be completed by the end of 2020.

MCKINLEY AREA

The area west of the McKinley Reservoir is expected to experience significant growth with the development of McKinley Beach lands. The current system (Dewdney Road Intake & Pump Station) uses Okanagan Lake treated by chlorination. The existing users of the McKinley Landing area will be connected to higher quality water through the interconnect with the Glenmore system in the future.

New users in the McKinley Beach Development as well as users serviced from pressure zone (PZ 553) will be supplied with water from the treatment facilities downstream of McKinley Reservoir.

The water distribution system upgrades and the water treatment upgrades required by the existing users were identified and included a review of all system components from water licensing to treatment and distribution.

UPDATES TO WATER QUALITY MONITORING PLAN

Several projects GEID plans to implement include those that are related to water quality improvements. Interior Health (IH) requires all water suppliers to implement the Drinking Water Objectives for Surface Water Supplies in BC. These are a set of goals to achieve:

- 4 log inactivation of viruses;
- 3 log removal or inactivation of *Giardia lamblia* and Cryptosporidium;
- 2 treatment processes for all surface drinking water systems;
- 1 refers to less than 1 NTU of turbidity with a target of 0.1 NTU;
- 0 Total Coliforms and E coli.

There are a number of treatment options available to meet these objectives. Selection of the appropriate treatment depends on several factors that include the raw water characteristics. Following is a discussion of GEID water quality for each of the sources used in the system. Water quality data provided by GEID is summarized and discussed below.

In 2016, GEID continued to monitor its water supply with a Water Quality Sampling Program that was previously approved by IH in 2011. The monthly reports submitted to IH contain detailed information on sampling locations, sampling frequency, bacteriological testing results, chlorine residuals, operational activities, customer complaints and response, variances of normal operation and monthly laboratory results.

During 2016 GEID plans to develop a new Water Quality Monitoring Plan to monitor the better quality of water the Okanagan Lake pump station will provide to the Glenmore distribution system.

The goals of the sampling program are to:

- meet or exceed the minimum sampling frequency for microbiological parameters as outlined in GCDWQ objectives based on water system size
- update general water quality parameters such as dissolved iron and manganese on a periodic basis
- assess source water quality. This includes an assessment of reservoir lake conditions which will be completed by a consultant. The consultant conducts ongoing sampling to identify microorganisms such as algae in the lakes, and nutrient conditions that could lead to a deterioration in water quality; and
- assess quality of water delivered to customers. This includes measurement of parameters that directly impact water quality, such as disinfection byproducts, and measurement for parameters that are indirectly related to water system maintenance.

GEID continued to work on improving the reliability of online instrumentation and real-time monitoring in 2016.

SURFACE WATER QUALITY

MCKINLEY RESERVOIR

During 2016, the Joe Bulach Pump Station supplied water from Okanagan Lake directly into McKinley Reservoir. In the past, McKinley Reservoir was supplied from Kelowna/Mill Creek. Water quality data shows that turbidity levels have dropped to in and around the 1 NTU level and color has significantly reduced as well.

There was no definite evidence showing that the water biochemistry has stabilized as of December, 2016. When water sources were switched in 2015 there was an increase in the water pH that required GEID to adjust the chlorine dosage in order to meet the 3-log Giardia removal objective during the period of peak demand. When water pH levels increase, chlorine dosage must increase in order to attain the desirable CT levels. GEID's design and construction of the UV Treatment Facility will remedy this issue by targeting the 3-log inactivation of Cryptosporidium, and Giardia. Once the UV treatment facility enters full operation, chlorine dosages are expected to decrease while complying with the requirement of 4-log removal of viruses.

KELOWNA / MILL CREEK

There are three open water reservoirs in the Kelowna/Mill Creek watershed that supply water to the Ellison distribution system. Table 5.0 shows raw water quality data for Bulman, South Lake and Postill reservoirs. Water from the upper reservoirs flows through Kelowna/Mill Creek to the Postill Rd. intake pond, then it is treated with chlorine and delivered to the Ellison Valley system. The Ellison Valley consists of a number of domestic users plus an extensive area dedicated to agriculture. Treated water in the distribution system is primarily used for agriculture as 97% of the maximum daily demand is for irrigation and only 3% is used for domestic consumption. Hence the plans to implement the separation of the Ellison distribution system. One system will serve the domestic demand in compliance with IH 4-3-2-1-0 objectives and the second system will be subject to chlorination and serve irrigation and fire protection purposes.

GEID has commissioned a study to identify options available to implement the system separation.

MCKINLEY LANDING

In 2004 McKinley Landing Waterworks was purchased by GEID. The water for this system is drawn from Okanagan Lake via the Dewdney Pump Station.

GROUND WATER QUALITY

GEID ground water sources include five wells which are Airport Well No. 1 and No. 2 (raw or chlorinated), Ellison Well, Lochrem Well (off) and Vector Well No. 1 (out of service due to fouling). All other wells are utilized depending on system requirements.

WATER QUALITY COMPLIANCE

Water sampling and testing is carried out regularly in the source and distribution piping systems to ensure the drinking water remains safe and meets legislated drinking water requirements.

The Guidelines for Canadian drinking water quality are based on current, published scientific research related to health effects, aesthetic effects, and operational considerations. Health-based guidelines are established on the basis of comprehensive review of the known health effects associated with each contaminant, on exposure levels and the availability of treatment and analytical techniques. Operational considerations are factored in when the presence of a substance may interfere with or impair a treatment process or technology (e.g. turbidity interfering with chlorination) or adversely affect drinking water infrastructure (e.g. corrosion in pipes).

In general, the highest priority guidelines are those dealing with microbiological contaminants such as bacteria, protozoa and viruses. Any measures taken to reduce concentrations of chemical contaminants should not compromise the effectiveness of disinfection.

The GEID's water quality sampling and testing program has been set up in conjunction with the Interior Health Authority. The program samples water quality at reservoirs, dead end watermains, and various pressure zones.

Collected water samples are uniquely identified and sent to a Provincially approved laboratory for testing. Test results are uploaded by the lab into a data management system.

According to the guidelines for Canadian Drinking Water Quality parameters are either health based and listed as *Maximum Acceptable Concentrations (MAC),* based on aesthetic considerations and listed as *Aesthetic Objectives (AO)* or established based on operational considerations and listed as *Operational Guidance Values (OG).*

The following table 1.0 illustrates the GEID's disinfection system met the bacteriological standards for potable water as set out in schedule A of the Drinking Water Protection Regulation.

Table 1.0 - Treated Water Microbiological (Bacteria)

Parameter	Number of Samples	Number of Exceedances	Drinking Water Regulations
Total Coliforms	715	*6	0 counts per 100 (ml)
E. coli	715	0	0 counts per 100 (ml)

*For Total Coliforms exceedances, the test station was re-sampled. In all cases the re-test results were <1

Table 2.0 - Water Quality Standards for Potable Water

Parameter	Standard
Escherichia Coli	No detectable Escherichia Coli per 100 ml
Total Coliform Bacteria	At least 90% of samples have no detectable total coliforms bacteria per 100ml and no sample has more than 10 total coliform bacteria per 100 ml

Turbidity

The GEID's water turbidity is continuously measured at several points within the water systems. The following graph 1 illustrates turbidity (raw) measured at the point right before chlorination in the Glenmore system. The Glenmore Ellison Improvement District is currently on a Water Quality Advisory.

The Guidelines for Canadian Drinking Water Quality Suggests a maximum acceptable concentration (MAC) of 1 Nephelometric Turbidity unit (NTU) and an aesthetic objective (AO) of <5 NTU.

Graph 1.0 - Raw Water Turbidity

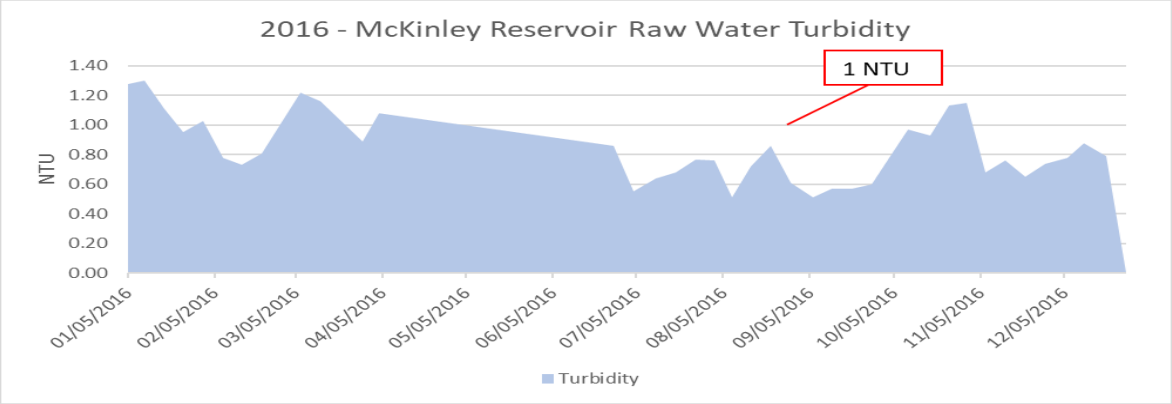


Table 3.0 - System Water Quality

Parameter	Units	25-Sep-16	10-Oct-16	25-Sep-16	Objective
		Union Rd. Post Res.	Mill Creek Raw	Arthur Ct. Res.	
Anions					
Alkalinity, Total as $CaCO_3$	mg/L	112	28	109	
Chloride	mg/L	9.07	0.73	7.32	AO≤250
Fluoride	mg/L	0.13	<0.10	0.12	MAC = 1.5
Nitrogen, Nitrate as N	mg/L	<0.010	0.026	0.017	MAC = 10
Nitrogen, Nitrite as N	mg/L	<0.010	<0.010	<0.010	MAC = 1
Sulfate	mg/L	29.7	2.1	29.9	AO≤500
General Parameters					
Colour, True		<5	63	<5	AO≤15
Conductivity	uS/cm	302	61	289	
Cyanide, total		<0.0020	<0.0020	<0.0020	MAC = 0.2
pH		7.92	7.57	7.94	AO = 6.5-8.5
Turbidity	NTU	1.1	2.71	0.58	MAC = 1.0
Hardness, Total (as $CaCO_3$)	mg/L	135	37.8	135	
Solids, Total Dissolved	mg/L	170	37	170	AO≤500
Total Recoverable Metals					
Aluminum	mg/L	< 0.05	0.12	<0.050	OG < 0.1
Antimony	mg/L	< 0.001	< 0.001	< 0.001	MAC = 0.006
Arsenic	mg/L	< 0.005	< 0.005	< 0.005	MAC = 0.01
Barium	mg/L	< 0.05	< 0.05	< 0.05	MAC = 1
Boron	mg/L	0.112	< 0.04	0.134	MAC = 5
Cadmium	mg/L	< 0.0001	< 0.0001	< 0.0001	MAC = 0.005
Calcium	mg/L	34.7	10.2	34.5	N/A
Chromium	mg/L	< 0.005	<0.0050	<0.0050	MAC = 0.05
Cobalt	mg/L	< 0.0005	< 0.0005	< 0.0005	N/A
Copper	mg/L	0.0045	<0.0020	0.0176	AO = ≤ 1
Iron	mg/L	< 0.10	0.55	< 0.10	AO = ≤ 0.3
Lead	mg/L	< 0.001	<0.0010	< 0.001	MAC = 0.01
Magnesium	mg/L	11.7	3	11.1	N/A
Manganese	mg/L	0.0138	0.019	<0.0020	AO = ≤ 0.05
Mercury	mg/L	< 0.00002	<0.00002	<0.00002	MAC = 0.001
Molybdenum	mg/L	0.0034	<0.0010	0.0038	N/A
Nickel	mg/L	< 0.002	>0.0020	< 0.002	N/A
Potassium	mg/L	2.86	0.94	2.82	N/A
Selenium	mg/L	< 0.005	< 0.005	< 0.005	MAC = 0.05
Sodium	mg/L	13.8	2.87	13.1	AO = ≤ 200
Uranium	mg/L	0.00231	< 0.0002	0.00249	MAC = 0.02
Zinc	mg/L	< 0.04	< 0.04	< 0.04	AO = ≤ 5
Microbiological Parameters					
Coliforms, Total	CFU/100ml	<1	160	<1	MAC <1
E. Coli	CFU/100ml	<1	4	<1	MAC<1

AO: Aesthetic Objective
MAC: Maximum Acceptable Concentration as per Canadian Drinking Water Guidelines.

Treated water disinfection by-products Trihalomethanes (THM's are formed as a by-product predominantly when chlorine is used to disinfect water for drinking. They represent one group of chemicals generally referred to as disinfection by-products. They result from the reaction of chlorine with organic matter present in the water being treated. The level of THM's in treated water will depend on numerous factors including: total organic carbon, temperature, pH and chlorination dose.

Table 4.0 - Total Trihalomethanes

Parameter	Units	8-Apr-16	2-Sep-16	30-Nov-16	Objective
		Rittich Rd. T/S	GEID Office Lab	Arthur Ct. Res	
Total Trihalomethanes	mg/L	0.031	0.083	0.069	MAC = 0.1
		2-Sep-16	**2-Sep-16**	**2-Sep-16**	
Total Trihalomethanes	mg/L	0.125	0.087	0.081	MAC = 0.1
		30-Nov-16	**30-Nov-16**	**30-Nov-16**	
Total Trihalomethanes	mg/L	0.023	0.069	0.069	MAC = 0.1

AO: Aesthetic Objective
MAC: Maximum Acceptable Concentration as per Canadian Drinking Water Guidelines.

According to The Guidelines for Canadian Drinking Water Quality Trihalomethane results are acceptable for two out of three distribution systems during the summer because the Rittich Rd. T/S is located in the Ellison distribution system which is supplied by surface water from Postill, Bulman and South Lakes which are high in organics. The reaction of chlorine and organics leave elevated levels of Trihalomethanes. During the winter months, the Ellison distribution system is supplied by groundwater and does not report levels above the maximum acceptable concentration (MAC).

McKinley Reservoir

According to The Guidelines for Canadian Drinking Water Quality for each parameter in the comprehensive analysis the data shows that McKinley Reservoir raw water has turbidity levels equal to the maximum acceptable value of 1.0 NTU. In general terms, the turbidity level has been decreasing although it has been above the maximum acceptable value at times. Two years has passed since the water source to McKinley Reservoir changed and it is still not clear if turbidity levels are going to remain at the current values. Variations on the Reservoir operation procedures and weather can affect the water turbidity.

McKinley Landing

All water quality parameters meet all guidelines for Canadian Drinking Water Quality. However, the McKinley Landing water system treatment does not comply with the “Drinking Water Treatment Objectives for Surface Water Supplies in BC” because of the single form of disinfection. Water users in the McKinley Landing area will be connecting to the Glenmore system and UV disinfection facilities to be completed in the future.

Watershed Reservoirs - Ellison Distribution System

All parameters within the Guideline for Canadian Drinking Water Quality are met except for turbidity levels, and Total Coliform and E. coli counts consistently higher than those acceptable by drinking water guidelines. Treatment to reduce water turbidity will be required in addition to a secondary treatment to reduce the risk of microbial or health threats.

GEID has commissioned a study to identify options available to implement the system separation. A capital project is included in this report to address the Ellison system improvements required.

Table 5.0 - Raw Water Quality of Watershed Reservoirs 0.5m

Parameter	Units	Bulman	South	Postill	Objective
Anions					
Total Alkalinity	mg/L	25	26	14	
Nitrogen, Nitrate as N	mg/L	<0.010	<0.010	<0.010	MAC = 10
Nitrogen, Nitrite as N	mg/L	<0.010	<0.010	<0.010	MAC = 1
General Parameters					
Colour, True		130	61	61	AO ≤ 15
pH		7.23	7.32	7.09	AO = 6.5 - 8.5
Turbidity	NTU	1.71	1.15	1.67	MAC = 1.0
UV Transmittance @ 254 nm	%	18.2	41.2	41	
Solids, Total Dissolved	mg/L	81	58	37	AO ≤ 500
Microbiological Parameters					
Coliforms, Total	CFU/100ml	70	11	30	MAC < 1
E.coli	CFU/100ml	<1	<1	1	MAC <1

AO: Aesthetic Objective
MAC: Maximum Acceptable Concentration as per Canadian Drinking Water Guidelines.

Table 6.0 – Water Quality of GEID Wells

Parameter	Units	4-Apr-16 Ellison Well	4-Apr-16 Airport Well #1	15-Sep-16 Airport Well #1	15-Sep-16 Airport Well #2	Objective
Anions						
Alkalinity, Total as $CaCO_3$	mg/L	284	175	189	166	
Chloride	mg/L	7.86	13.2	6.2	19.5	AO≤250
Fluoride	mg/L	0.56	0.16	0.13	<0.10	MAC = 1.5
Nitrogen, Nitrate as N	mg/L	0.025	1.7	1.62	1.71	MAC = 10
Nitrogen, Nitrite as N	mg/L	<0.010	0.017	<0.010	<0.010	MAC = 1
Sulfate	mg/L	92.3	16.9	15.8	18.6	AO≤500
General Parameters						
Colour, True		<5	<5	<5	<5	AO≤15
Conductivity	uS/cm	698	406	407	417	
Cyanide, total		<0.010	<0.010	<0.0020	<0.0020	MAC = 0.2
pH		8.15	7.94	7.98	7.86	AO = 6.5-8.5
Turbidity	NTU	2.5	0.4	0.35	0.13	MAC = 1.0
UV Transmittance @ 254 nm	%	95.7	94.9	N/A	N/A	
Hardness, Total (as $CaCO_3$)	mg/L	366	230	211	194	
Solids, Total Dissolved	mg/L	432	239	228	230	AO≤500
Total Recoverable Metals						
Aluminum	mg/L	< 0.05	< 0.05	< 0.05	<0.050	OG < 0.1
Antimony	mg/L	< 0.001	< 0.001	< 0.001	<0.0010	MAC = 0.006
Arsenic	mg/L	< 0.005	< 0.005	< 0.005	<0.0050	MAC = 0.01
Barium	mg/L	0.06	< 0.05	< 0.05	<0.050	MAC = 1
Beryllium	mg/L	< 0.001	< 0.001	N/A	N/A	N/A
Boron	mg/L	0.04	< 0.04	0.228	0.171	MAC = 5
Cadmium	mg/L	< 0.0001	< 0.0001	0.00013	0.00014	MAC = 0.005
Calcium	mg/L	75.2	62.8	55.9	49	N/A
Chromium	mg/L	< 0.005	< 0.005	< 0.005	<0.0050	MAC = 0.05
Cobalt	mg/L	< 0.0005	< 0.0005	< 0.0005	<0.00050	N/A
Copper	mg/L	0.002	0.004	0.0029	0.0063	AO = ≤ 1
Iron	mg/L	0.54	< 0.10	< 0.10	<0.10	AO = ≤ 0.3
Lead	mg/L	< 0.001	< 0.001	< 0.001	<0.0010	MAC = 0.01
Magnesium	mg/L	43.2	17.9	17.4	17.3	N/A
Manganese	mg/L	0.183	0.102	0.091	0.0149	AO = ≤ 0.05
Mercury	mg/L	< 0.00002	< 0.00002	< 0.00002	<0.00002	MAC = 0.001
Molybdenum	mg/L	0.021	0.001	0.0019	0.0015	N/A
Nickel	mg/L	<0.002	< 0.002	< 0.002	0.002	N/A
Phosphorus	mg/L	< 0.2	0.2	N/A	N/A	N/A
Potassium	mg/L	4.3	2.3	2.14	2.05	N/A
Selenium	mg/L	< 0.005	< 0.005	< 0.005	<0.0050	MAC = 0.05
Silicon	mg/L	12	13	N/A	N/A	N/A
Silver	mg/L	< 0.0005	< 0.0005	N/A	N/A	N/A
Sodium	mg/L	35.6	12.3	8.53	15.2	AO = ≤ 200
Uranium	mg/L	0.0087	0.0021	0.00274	0.00272	MAC = 0.02
Vanadium	mg/L	< 0.01	0.0024	N/A	N/A	N/A
Zinc	mg/L	< 0.04	< 0.04	< 0.04	<0.040	AO = ≤ 5
Microbiological Parameters						
Coliforms, Total	CFU/100ml	<1	<1	<1	<1	MAC <1
E. Coli	CFU/100ml	<1	<1	<1	<1	MAC<1

AO: Aesthetic Objective
MAC: Maximum Acceptable Concentration as per Canadian Drinking Water Guidelines.

WELLS

All parameters within the Guideline for Canadian Drinking Water Quality are met, except for manganese concentrations. Manganese is a naturally occurring element from rock and mineral erosion and weathering. There are no health concerns related with manganese concentrations expressed in the Guideline. The Guideline provides an aesthetic objective since manganese will impart some taste to the water and creates issues with laundry staining. A NTU value of 2.5 was reported but may possibly be a bad sample as results are constantly below 1 NTU during grab samples.

MCKINLEY WATER TREATMENT UPGRADES

GEID has previously adopted a plan for upgrading the water quality at McKinley Reservoir. The plan included several phases to use water from Okanagan Lake and improve the treatment processes with the final objective of meeting the Interior Health requirements.

Phase 1 of the McKinley Water Treatment Upgrades has been completed, allowing water from Okanagan Lake to be delivered to McKinley Reservoir. The works included the installation of a new intake, pump station at Okanagan Lake and all the transmission main components to McKinley reservoir.

Although water quality has significantly improved, there are still upgrades required to address existing system deficiencies. The McKinley Water Treatment Upgrades – Phase 2 has two main components:

• Installation of a UV Disinfection Facility-COMPLETE.

• Installation of a raw water main by-passing McKinley Reservoir-COMPLETE.

• Phase 3 includes the construction start for a 9 ML two cell concrete treated water reservoir to be completed in 2017.

In the scope of the McKinley Water Treatment Upgrades – Phase 2, GEID has completed the design and installation of a main by-passing McKinley Reservoir. The objective is to have the opportunity of using water directly from Okanagan Lake when the water quality at McKinley Reservoir is compromised.

Although this is a project that is required for the current users of the system, its implementation will also benefit future users. The cost of the project has been apportioned based on the maximum day demands and the anticipated currently installed capacity of the UV Facility, as confirmed by GEID at 79 MLD.

The UV Disinfection facility will provide the required second treatment for water delivered to the Glenmore area, and will provide 3-log inactivation of Cryptosporidium and Giardia. Improvements required for the Ellison Area are identified later in this section.

ELLISON SEPARATION – PHASE 2

Water for the Ellison System originates at Kelowna/Mill Creek with supplemental water from Airport Well #1 & #2 and Ellison Well. The area has a significant agricultural irrigation demand component estimated at 359.6 L/s (31.1 MLD) for

the Max Daily Demand (MDD). The domestic MDD is estimated at 13.4 L/s (1.2 MLD).

The Ellison System Separation has been previously identified as a required project to address the water quality issues in the Ellison area. The separation was planned in three phases with Phase 1 already completed.

The separation will allow implementing water treatment for the domestic water while maintaining the current level of treatment for the agricultural irrigation demands. GEID commissioned AF consulting Ltd. In 2016 to complete a study on the options for the Ellison System Separation. GEID staff indicated that the remaining Ellison System Separation could be completed in two phases. GEID anticipates that Phase 2 will include the installation of small diameter mains for domestic water use supply to areas within the lower 495 pressure zone.

ELLISON SEPARATION – PHASE 3

Phase 3 of the Ellison separation involves the installation of small diameter mains for domestic water supply within PZ 542 and one booster pump station and small capacity storage reservoir.

SCADA HMI UPGRADES

All sites with SCADA computers, except the main office, are running unsupported operational system (Windows XP) and old versions of the Lookout Development software. The sites that have a computer running Lookout are Airport Well, Arthur Court, Ellison Well, McKinley Chlorinator, Postill Booster Station, Quail Booster Station, Quail Reservoir, Tutt Pump Station, Union Road, Vector Well and Joe Bulach Pump Station.

GEID continues to upgrade the SCADA system to an Ethernet based system, in phases throughout 2016 – 2020. The initial 'backbone' of the new Ethernet system will be installed with the new UV Facility, with other locations being upgraded as part of the annual budget on an ongoing basis.

MCKINLEY RESERVOIR TO SHAYLER RESERVOIR MAIN

The installation of a watermain for treated water supply to McKinley Beach and Shayler Reservoir is identified as Project 5 in GEID's Capital Plan. -Complete

The existing users currently serviced by Shayler Reservoir will also benefit from this project, as Shayler Reservoir will be fed from water originating at McKinley Reservoir instead of the current temporary feed from Dewdney Pump Station.

VECTOR WELL NO. 1 REHABILITATION

As indicated in the description of GEID water sources, Vector Well No. 1 was contaminated by bacteria growing as a result of increased aquifer temperature. The temperature increase was the result of using the aquifer as part of a geo-thermal system.

The use of the geo-thermal system has been discontinued and GEID wants to make use of the infrastructure installed at Vector Well No. 1. The equipment will have to be disinfected and the well rehabilitated for safe use as drinking water source.

AIRPORT WELL NO. 1 MAINTENANCE

A maintenance process consisting of removal of existing components in contact with water source for cleaning is required at Airport Well No. 1. In addition, the existing well casing requires swabbing and cleaning. The project will improve the water quality and will extend the life span of the existing assets. This project has no effect on CEC rates as it will be paid for by existing users.

AIRPORT WELL NO. 2 MAINTENANCE

Airport Well No. 2 maintenance process is required. The scope of the work is the same as described under Airport Well no. 1 maintenance. The project will improve the water quality and will extend the life span of the existing assets. This project has no effect on CEC rates as it will be paid for by existing users.

SYSTEM NOTABLE EVENTS

On 10-March-16 the Dry Valley area was switched from being supplied from the Glenmore distribution system to being serviced by Airport Well #1 due to works being completed on the Dry Valley PRV (waiting for parts).

On 21-March-16 divers were brought in to clean the Postill Rd. reservoir.

On 18-April-16 the Airport Well #2 was started to supplement flows in the Ellison distribution system. Due to mechanical issues with the Well #2 chlorine injection system the Airport Well #1 was used as the main chlorination source for Well #2 (23-April-16) by double dosing from Well #1.

On 11-April-16 the Ellison Well was started to supply additional water to the Ellison distribution system.

Service/source supply for the McKinley beach pump station required the chlorine injection point to be moved upstream on the supply main to ensure chlorinated water supply to this new area. - Complete

On May 2nd, 2016 at 4:00pm a Precautionary Boil Water was issued for18 specific residents in the Ellison distribution system which could be affected by turbid water (>5 NTU) entering the distribution system.

On May 3rd, 2016 the Glenmore Ellison Improvement District re-issued a reminder to customers of the Ellison distribution system that they are on a WQA. The residents of Country Rhodes and Country View Estates are not affected by the WQA due to location and being supplied by groundwater.

Due to a brief turbidity spike (>5) NTU in Mill Creek on 19-June-2016 additional turbidity and Cl2 monitoring was completed in the distribution system. Additional bacteriological samples were sent to CARO Analytical for analysis and all returned >1 Total Coliforms and >1 E. coli within our distribution system. Letter to Interior Health attached.

On the 10-June-16 the Ellison Well which supplements flows in the Ellison distribution system shut down due to a faulty pump. GEID is currently waiting for parts to repair the well.

Due to elevated turbidity levels (>5) NTU in Mill Creek on 6-July-16 and 17-July-2016 additional turbidity and Cl2 monitoring was completed in the Ellison distribution system. Additional bacteriological samples were sent to CARO Analytical for analysis and all returned >1 Total Coliforms and >1 E. coli within our distribution system.

Ellison Well which supplements flow to the Ellison distribution system is currently O-O-S due to mechanical issues.

On August 21st, 2016 at approximately 10:00 PM there was a power outage which effected the McKinley chlorinator. The backup generator to the McKinley chlorinator failed to transfer power during the power outage causing a slug of only UV treated water to enter the distribution system. The on-call operator was paged and dispatched to site. The Generator power transfer was back on at 11:09 PM and the Glenmore distribution system was back-feeding from Union Rd. P/S at 11:13 PM and flushing commenced to restore chlorine residuals to acceptable concentrations. Based on the flows at the time of 5059 usgpm and duration the chlorinator was down (70 minutes) the total amount of water was calculated to approximately 1340 m^3. Calculations based on pipe size and flow it was determined that the water travelled 2.94 km from the chlorinator which is approximately at the corner of John Hindle Drive and Glenmore Rd. North (Yaletown apartments). Chlorine concentrations were restored to acceptable levels within the affected area by 4:20 am on August 22nd, 2016 and the system was treating with UV light and chlorine gas.
During spot checks within the affected area Tutt P/S which had been turned off reported a chlorine residual of 0.03 ppm Cl_2 and 0.60 ppm CL_2 from the nearest downstream irrigation service which indicated how far the slug of water reached. Spot checks outside the affected area within the Scenic zone had a chlorine residual of 3.0+ ppm and the inflow at Union rd. reservoir was 2.68 ppm CL_2. A hydrant at 1250 Glenmore Rd. North reported a chlorine residual of 1.8 ppm.
Bacterial samples were collected from several locations within the Glenmore distribution system and sent to Caro Analytical Laboratory for analysis. All results reported <1 Total Coliforms and <1 E. coli. The incident was reported to Interior Health.

Due to elevated turbidity levels (>5) NTU in Mill Creek on 2-Aug-16 additional turbidity and Cl2 monitoring was completed in the Ellison distribution system. Additional bacteriological samples were sent to CARO Analytical for analysis and all returned >1 Total Coliforms and >1 E. coli within our distribution system.

During August, there has been three sites within the Glenmore Distribution System which reported Total Coliforms. The Union Rd. Res pre and post T/S as

well as the Acaterra North T/S. The Union Rd. Reservoir sites reported free chlorine residual >2.00 mg/L. The Acaterra T/S North reported a free chlorine residual of 0.27 mg/L (end of line in distribution system with almost zero usage). An operator was dispatched to flush close to the T/S to increase flow and bring the free chlorine residual up. Re-samples were taken at these sites which eventually reported <1 Total Coliforms and <1 E. coli. The samples for the Union Rd. pre-reservoir T/S and Acaterra T/S North were sent for identification and the total Coliform results are attached.

The Dewdney P/S which is located in the McKinley Landing Distribution System reported 4 total Coliforms with a free chlorine residual of 3.20 mg/l. The Dewdney P/S was re-sampled which reported <1 Total Coliforms and <1 E. coli. In the future, the Dewdney T/S will become a raw sample and not a distribution sample with no contact time.

On September 22nd, 2016 at 7:20 PM the on-call operator received a call for the McKinley Chlorinator for low chlorine residual. The operator immediately called the works foreman and headed to site. The operator arrived on site at 7:45 PM and confirmed no chlorine residual with HACH pocket colorimeter. Operator then consulted with works foreman looking for any obvious issues. At 8:05 PM the works foreman arrived on site and began manually dosing. At 8:12 the online chlorine analyzers began to register a residual. Continual chlorine monitoring was done during the time operators were looking for the issue. The maximum flows during this time frame did not go over 2500 GPM.

During the time the chlorination system was down the UV plant was running at full power with 4.56 log removal and a turbidity level of 0.90 NTU. The next morning additional bacterial sampling was completed within the Glenmore Distribution system and returned results <1 Total Coliforms and <1 E. coli. Chlorine residuals were also tested on September 23rd, 2016 and reported 3.68 ppm at Tutt P/S, 2.35 ppm at Union Rd Post Reservoir, and 3.01 ppm at Mail Rd. B/O.

On October 5th, 2016, the works foreman intercepted an alarm that was received by the SCADA system for low chlorine residual approximately between 8:12 am and 8:14 am. The SCADA system is set to alarm out when residuals drop below 2.00 ppm Cl_2 for 120 seconds. The foreman and lead hand immediately headed out to McKinley Chlorinator to investigate. It was determined that the ultrasonic flow meter had failed which controls the chlorine dosing system. Once this was discovered the chlorine dosing system was immediately put into manual mode and the system was dosing by 8:44 am between 2.5 ppm and 10.0 ppm CL_2 depending on flow (1200 GPM average) which could be monitored at the UV plant. During this event the GEID UV plant was treating the entire time and the disinfection effectiveness was 3-log inactivation of Giardia or better.

After further investigation, it appeared the cable to the flow meter transducer had been chewed which caused it to fail. These cables are located in a chamber which has a vent pipe. New vent pipe screens were installed and reinforced to prevent reoccurrence. The electrician from Interior Instruments installed new

cables and restored function to the flow meter at 5:30 pm which enabled the chlorine system to revert back to flow-based dosing.

EMERGENCY RESPONSE PLAN

The emergency response plan is updated bi-annually, and copies of the updated plan were provided to IH in January 2015. Updates include changes to contact numbers (including GEID staff, consultants, contractors and regulatory agencies), as well as changes to the plans that may be required including the addition of new facilities. The ERP will be updated in 2017 to include the new Okanagan Lake Pump Station.

UPDATES TO CROSS-CONNECTION CONTROL PROGRAM

The cross-connection control program for GEID and the Kelowna Joint Water Committee is administered by the City of Kelowna and results are reported annually to IH. The testing and registration devices for backflow prevention is tracked by the City of Kelowna using a dedicated software package, and utilities are provided a list of customers by the KJWC which confirms that the annual testing has been completed for all customers. Customers with backflow prevention assemblies are required to maintain and test their devices annually for proper operation.

CROSS CONNECTION CONTROL PROGRAM RESULTS

Central Data Registry Budget 2016

4th Quarter (January 1, 2016 to December 31, 2016)

Chart 7.0 – Cross Connection Control Program Results

Revenue	YTD Actual	Budget 2016	Balance (-) +
City of Kelowna	$35,346.26	$41,265.90	$5,919.64
RWW	$4,252.21	$5,145.70	$893.49
BMID	$9,376.32	$10,815.41	$1,439.09
SEKID	$895.74	$1,093.69	$197.95
GEID	$6,562.52	$8,699.77	$2,137.25
Contingency @ 5%	$2,821.63	$3,351.01	$529.38
TOTAL	$59,254.68	$70,371.48	$11,116.80

Expenses			
Postage	$1,853.25	$1,974.00	$120.75
Stationary	$685.69	$730.39	$44.70
Labour	$38,232.34	$45,625.64	$7,393.30
overhead	$15,661.77	$18,690.44	$3,028.67
Contingency @5%	$2,821.63	$3,351.01	$529.38
TOTAL	$59,254.68	$70,371.48	$11,116.80

Notes:

- This report represents the cost of managing the "Central Data Registry" only. It does not include expenses incurred on such things as public relations that may benefit KJWC members.
- This YTD calculation is up to the end of Q3 only.
- Multiplication factors were calculated using historical averages. 2.3 installs / facility 1.8 facilities / customer and number of actual installs = projected activity as provided by each district.
- **Line items were calculated as follows:**

  Postage $1.00 x# customers x 1.75

  Stationary $0.37 x # customers x 1.75

  Labour $25.74 x 0.37 x # of tests

  Overhead $10.55 x 0.37 x # of tests

EOCP UPDATES

GEID's water distribution system is classified as a Level IV by the Environmental Operators Certification Program (EOCP).

Water system operators are the first line of defense for water quality issues, as they identify, manage, and remedy risks to the water supply. The tasks

completed by GEID's operators are essential in ensuring safe, reliable, water supply, including:

- Daily system checks of critical infrastructure such as pump stations and chlorinators
- Daily monitoring of SCADA system to assess system performance
- Response to system alarms 24 hours a day, seven days a week
- Water main flushing twice a year to enhance water quality
- Completion of water system maintenance, repair and renewal works
- Instrument testing and calibration
- Watershed monitoring and protection

In addition to the operation of the water system, water quality sampling was also completed in 2016 by qualified operators. Five of the 8 operators are graduates of Okanagan College's Water Quality and Environmental Engineering Technology program. The two-year Water Quality diploma program is designed for the water and wastewater industry and provides instruction in areas such as water system design, maintenance, water treatment, and water quality testing and analysis.

As of year-end 2016, GEID had the following certified water distribution operators:

Table 8.0 - Current Operators

Name	Certification Level	Position
Drew Allingham	Operator Level 4	Operations Foreman
Brandon Fletcher	Operator Level 4	Lead Hand
Mike Rojem	Operator Level 3	Special Projects Coordinator
Konrad Moskal	Operator Level 3	System Operator
Kelvin Giesbrecht	Operator Level 2	System Operator
Ernie Schmidt	Operator Level 2	System Operator (Part Time)
Daniel King	Operator Level 2	System Operator
Shawn McGaw	Operator Level 2	System Operator
Chris Mackay	Operator Level 1	System Operator
Andrew Cammell	Operator Level 1	Water Quality Technician

At this time, Mr. Mike Rojem continues to earn CEU's and the direct supervision time necessary to obtain Level 4 certification.

AVAILABILITY OF THE REPORT

This report may be found on the districts website at www.glenmoreellison.com under the water quality tab.

References

Faccini, A. F. (2015). *Glenmore Ellison Improvement District 2015-2019 Capital Plan.* Kelowna: AF Consulting Ltd.