Black Mountain Irrigation District

UV Disinfection Facility Construction Timeline

BLACK MOUNTAIN IRRIGATION DISTRICT
285 Gray Road
Kelowna, B.C.
V1X 1W8

Piping is fabricated and coated

Building footings are poured

Large diameter pipe is installed

UV reactors are installed

Installing interior process piping

Disinfection and testing of process piping

2015 / 11

2016 / 01

2016 / 03

2016 / 06

2016 / 06

2017 / 06

2015

2016

2017

2015 / 10

2015 / 10

2016 / 06

2016 / 08

2017 / 01

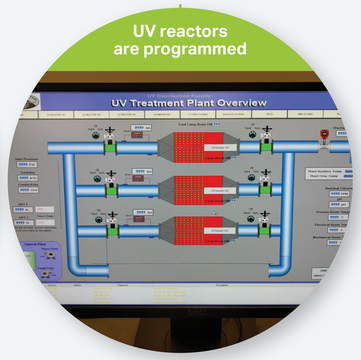
Site is cleared and graded

Installing site piping

Constructing the building foundation

Building superstructure is built

System is ready for commissioning



UV reactors are programmed

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UV Disinfection

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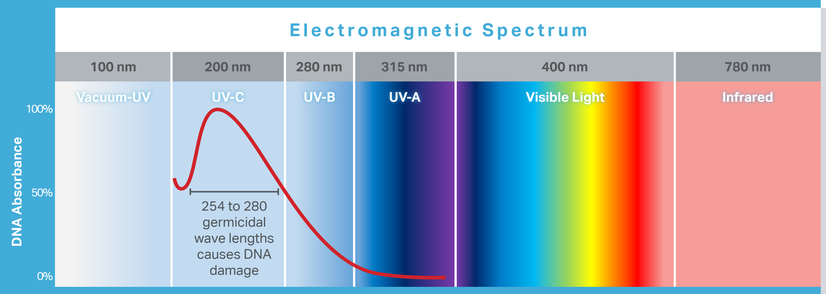
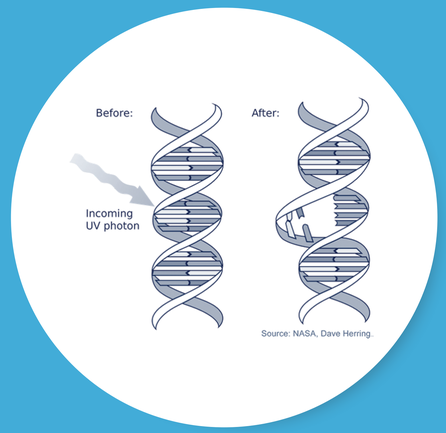
Ultraviolet Light and Microorganisms

Ultraviolet (UV) light energy is part of the electromagnetic spectrum. In water treatment, UV light is used to inactive harmful pathogens. The UV light penetrates organisms cell membrane and destructs the cell's DNA preventing reproduction. Each organism requires a different UV dose to be inactivated.



The UV reactors at BMID are designed to inactivate Cryptosporidium, a harmful protozoa. Cryptosporidium is highly resistant to chlorine, yet easily inactivated by UV light energy. Cryptosporidium is a common source of gastro-intestinal illness.



BMID UV Reactors

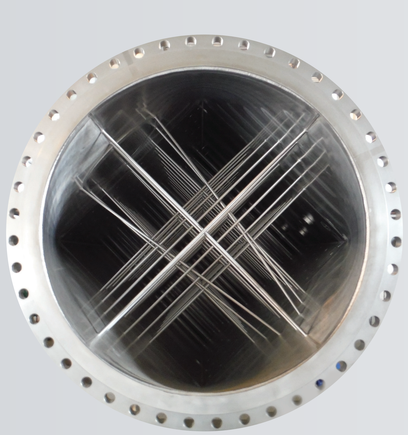
BMID has three Wedeco K-series low pressure high output reactors. The facility has space allocated to add a fourth reactor and the ability in install additional lamps inside each reactor. This provides built-in resiliency to meet growing demands for water and changes in water quality due to factors such as climate change or development activities within the watershed.

The current system is capable of treating up to 150 million litres of water per day. This is Equivalent to 60 Olympic sized swimming pools.

During normal operating conditions, only a single reactor is required.

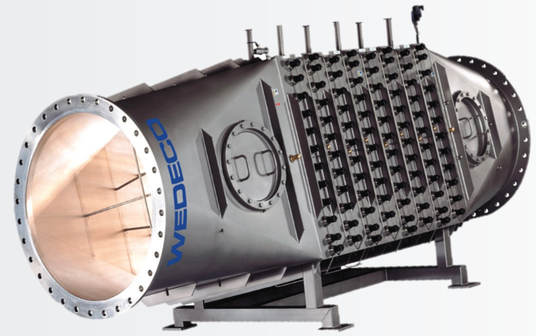
The BMID facility continuously monitors UV transmittance, flow rate, pH, turbidity, and conductivity of the water entering the UV reactors.

To save energy and extend equipment replacement frequency, such as the lamps, an electronic ballast is used to continuously modulate the output power of each row of lamps. The power is modulated based on changes in water quality and flow rate through each reactor.



Intensity Sensor

UV Bulb



Reactor

How the UV Reactors Work

Each reactor has 8 rows of 12 lamps (bulbs) for a total of 96 UV lamps. Each lamps uses 360 Watts of energy at full power - Six times as powerful as a regular light bulb.

The lamps are individual protected by a quartz sleeve housing. Over time the quartz sleeves become dirty, reducing the effectiveness of the UV lamps. The sleeves are cleaned regularly using a chemical cleaning system to restore the UV lamp effectiveness.

UV intensity sensors are located inside the UV reactor to measure the amount of UV light being emitted by the lamps. Each row of lamps contains one sensor (total of 8 sensors per UV reactor). The UV intensity sensors are used to calculate the UV dose being delivered in real-time.

To ensure the required level of treatment is being achieved, the UV reactors continuously monitor and adjusted the output of the lamps. The UV effectiveness is measured by calculating the "dose" of UV light in millijoules per square centimetre (mJ/cm2) applied to the water. The UV dose is a function of:

- The amount of light emitted by each row of lamps as measured by the UV intensity sensors.
- How long the water is exposed to the UV light, which is a function of the rate the water travels through the reactor.
- The percentage of emitted light that can shine through the water as measured by an UV transmittance analyzer that continuously samples the incoming water.

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Water Treatment System

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1

Automated Headgates and Grit Pond

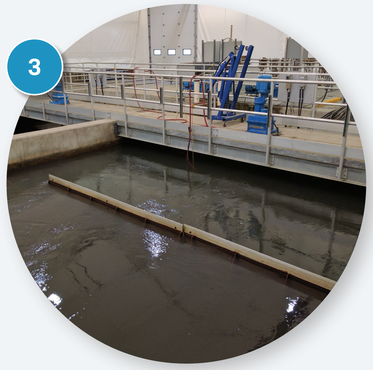
Water diverted from Mission Creek passes through trash racks and automated head gates that can automatically close if raw water quality in Mission Creek deteriorates. Once water is in the grit pond the water slows down allowing heavier particles such as sand and silt to settle out.

2

Fish Screen

Water leaving the grit pond passes through a 1.50mm clear opening Coanda fish screen before entering the water treatment process. Fish, debris, and excess water pass over the screen and are returned to Mission Creek.

3



Rapid Mix and Floc Tanks

Two rapid mix tanks provide high energy mixing to completely disperse coagulant for upwards of one minute. The water then enters three consecutive flocculation tanks where a cationic polymer is added and the coagulated water is gently mixed to allow flocs to form.

4

Sedimentation Clarifiers

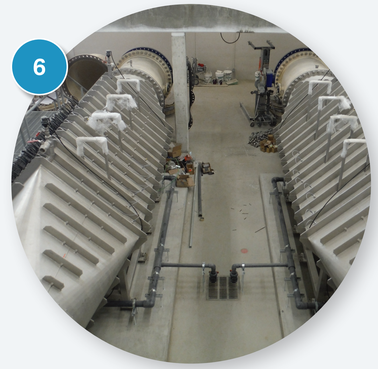
Leaving the flocculation tanks, water enters one of two clarifiers. Each clarifier is divided into two consecutive bays by a perforated baffle curtain. The curtain slows the water allowing heavier particulates to settle out. Water then travels into the second bay where further separation occurs before the clear water overtops the outlet weir.

5

Stevens and Hadden Reservoirs

From the clarifiers, water enters the balancing reservoirs for storage. Chlorine is added to the water leaving the lower balancing reservoir. The chlorine kills potentially harmful viruses and bacteria that may be present in the water.

6



UV Disinfection Facility

Before entering the distribution system, the treated water flows through the UV Disinfection Facility where it receives UV light energy to inactivate chlorine resistant pathogens such as Cryptosporidium. Finally, chlorine is added, as required, to maintain a residual concentration of chlorine throughout the distribution system.

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Drinking Water Treatment Objectives

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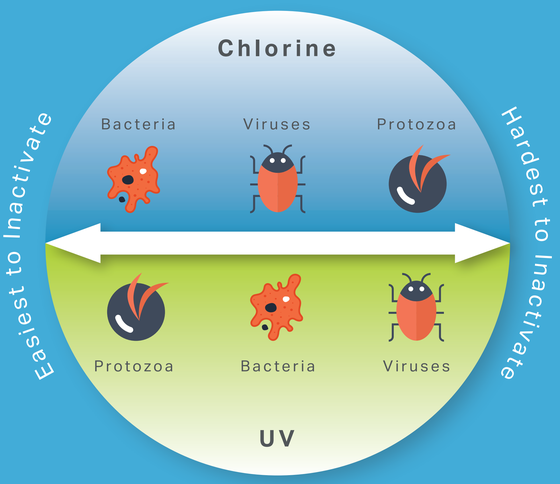
There are three types of microorganisms in water that pose a risk to human health; viruses, bacteria and protozoa. These risks are best managed through a multi-barrier approach to ensure safe drinking water.

The BMID drinking water treatment system must meet the provincial drinking water quality objectives. BMID has developed a treatment approach to address the unique conditions of the source water.

Expanding on the Guidelines for Canadian Drinking Water Quality, the Province of BC has set the minimum treatment objectives that drinking water systems must achieve to be considered "potable". The Drinking Water Treatment Objectives for Surface Water's in BC are designated by "4,3,2,1,0".

BMID uses two types of disinfection; UV and chlorination as they target different microorganisms.



BC Drinking Water Treatment Objectives

	Objectives	What does this mean to me?	Possible source	How does it affect me?	BMID treatment methods
4	**Log virus inactivation**	99.99% of viruses are to be inactivated.	Intestine of humans and animals.	Could cause severe gastrointestinal illnesses.	Chlorination.
3	**Log protozoa (Giardia and Cryptosporidium) removal or inactivation**	99.9% of protozoa (Giardia and Cryptospordium) are to be inactivated.	Intestine of humans and animals.	Could cause severe gastrointestinal illnesses.	Chlorination and UV inactivation.
2	**Treatment barriers**	At least two types of treatment barriers are required to provide redundancy and treat for a wide range of potentially harmful organisms.		Risks are reduced with multiple barriers.	Clarification, chlorination and UV disinfection.
1	**Less than 1 NTU turbidity**	Measure of the cloudiness of water. Cloudy water can contain microorganisms and potentially reduce treatment effectiveness.	Spring run off sediment and organics in the water	High turbidity can make water appear dirty and potentially shield organisms from proper disinfection.	Source control and clarification.
0	**Detectable E. Coli, Faecal Coliforms and Total Coliforms**	Organisms that indicate the possible presence of disease causing microbes.	Intestine of humans and animals bacterial growth in the distribution system.	Could cause severe gastrointestinal illnesses.	UV inactivation, with residual chlorination in the distribution system.

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