Onondaga County, NY

Condition Assessment Report
Baldwinsville-Seneca Knolls Wastewater Treatment Plant

January 2015

7. Disinfection Evaluation

The Baldwinsville-Seneca Knolls WWTP was designed with gaseous chlorine feed and chlorine contact tanks for disinfection. The contact tanks were designed to treat a peak hour flow of 18 mgd with a disinfection contact time of 15 minutes. In 1999, the gaseous chlorine system was removed and replaced with liquid sodium hypochlorite. The sodium hypochlorite system consists of two chemical storage tanks and two chemical feed pumps with associated piping and valving.

The current discharge permit for the Baldwinsville-Seneca Knolls WWTP requires disinfection for the period of May 15th through October 15th. The limit for fecal coliform is 200/100 mL based on a 30-day geometric mean. The limit for Total Chlorine Residual (TCR) is 2.0 mg/L. The NYSDEC has issued a revised permit with a TCR limit lowered from 2.0 mg/L to 0.8 mg/L. Onondaga County has tasked GHD with evaluating alternatives to achieve the new TCR limit of 0.8 mg/L.

The current disinfection control strategy employed by the plant operating staff is to target a minimum chlorine residual of 0.8 mg/L. This generally provides the plant with sufficient disinfection while keeping the TCR below the current limit of 2.0 mg/L. The TCR typically varies from 0.8 to 1.4 mg/L throughout the day. The plant does not have the ability to flow pace the hypochlorite feed system. The plant is not designed or equipped to achieve dechlorination.

7.1 Preliminary Screening

The following technologies were identified and reviewed for consideration in meeting the new disinfection requirements at the Baldwinsville-Seneca Knolls WWTP:

1. Optimizing the sodium hypochlorite dose without dechlorination.
2. Chlorination/dechlorination using sodium hypochlorite.
3. Chlorination/dechlorination using calcium hypochlorite.
4. Bromine.
5. Ferrate
6. Ozone.
7. Peracetic acid.
8. Advanced oxidation processes.
9. UV disinfection.
10. High-rate disinfection.

Each of the technologies was evaluated for applicability at the Baldwinsville-Seneca Knolls WWTP. A description of each technology including advantages and disadvantages follows.

7.1.1 Optimizing the Sodium Hypochlorite Dose without Dechlorination

This alternative incorporates the use of existing chlorination equipment and facilities with new automated feedback controls. It also includes construction of an additional chlorine contact tank to accommodate a peak hourly flow of 18 mgd with one spare tank. The two existing tanks accommodate a peak hour flow of 18 mgd (9 mgd/tank). Therefore, it is recommended to construct a contact tank equal in size to the existing tanks, designed for a contact time of 15 minutes at

9 mgd. The automated controls would include a combination of flow pacing and feedback control to optimize chlorine dose and minimize residual while still meeting regulatory limits. Dechlorination would not be included for this alternative.

The benefit of this alternative is the cost savings of not having to dechlorinate. The disadvantage is that it relies solely on the use of the feedback control system to meet the maximum residual chlorine concentration requirements and fecal coliform limits.

7.1.2 Chlorination/Dechlorination Using Sodium Hypochlorite

This alternative is identical to the alternative described above, except that it includes dechlorination. A dechlorination tank would have to be added at the end of the existing chlorine contact tanks. With this alternative, adequate disinfection would be accomplished and dechlorination would allow the plant to meet the new chlorine residual permit limit.

Disadvantages of this alternative include the additional capital cost of the dechlorination tank, additional operational costs of the dechlorination system, and greater operational and maintenance issues associated with a new unit process.

7.1.3 Chlorination/Dechlorination Using Calcium Hypochlorite

This alternative includes switching from sodium hypochlorite to calcium hypochlorite, combined with a new dechlorination process. It also includes the addition of a new chlorine contact tank and new automated controls.

Calcium hypochlorite is typically supplied in pelletized form (50-lb. bags) at 65 percent chlorine. The pellets are mixed with plant effluent in a day tank to form a superchlorinated solution which is added to the main wastewater flow for disinfection.

The advantage of this alternative is that calcium hypochlorite is more stable than sodium hypochlorite and can be stored in a dry form for extended periods of time without loss of strength. This makes calcium hypochlorite well suited to small, intermittent use requirements.

The disadvantage is the higher cost of calcium hypochlorite, which is typically three times as expensive as sodium hypochlorite. Calcium hypochlorite is typically more applicable in small plants (<1 mgd) where the higher cost per pound of chlorine is outweighed by the ease of having a pelletized product.

7.1.4 Bromine

This alternative includes switching from sodium hypochlorite to bromine for disinfection. Bromine is an oxidizing agent similar in nature to chlorine. Bromine is sometimes used in swimming pools. It is traditionally used in its solid form due to the hazards of handling liquid bromine.

Advantages of bromine include a shorter contact time, and it is potentially less toxic to aquatic/human life.

The main disadvantage of bromine is that the technology is not well established; therefore, equipment reliability is unknown. Bromine also creates hazardous byproducts and has slight to moderate fish toxicity; therefore, any bromine residual would likely have to be removed.

7.1.5 Ferrate

This alternative includes switching from sodium hypochlorite to ferrate for disinfection. Ferrate is a charged iron molecule in which iron is in the +6 oxidation state. Currently, a single manufacturer, Ferrate Treatment Technologies, has patented its use. According to the manufacturer, it is a powerful disinfectant, does not create any disinfection byproducts, and is environmentally friendly.

The disadvantages of ferrate are that the technology is not well established and it is expensive. Due to the high costs of producing, storing, and transporting ferrate, it is most efficient when generated on site. New equipment, patented by Ferrate Treatment Technologies ("The Ferrator"), would be required to generate the liquid ferrate on site. Even when treating on site, the Ferrate system is very expensive. A Ferrator would cost approximately $760,000 and the O&M costs would be approximately $800 per day, or approximately $120,000 for five months of disinfection.

7.1.6 Ozone

This alternative includes switching from sodium hypochlorite to ozone for disinfection. Ozone would require new facilities for ozone generation, new ozone contact reactors, and facilities for the destruction of off-gas.

Ozone has the advantage of being an effective disinfectant. It is considered to be more effective than chlorine in inactivating most viruses, spores, cysts, and oocysts. Also, it is not influenced by pH, has a shorter contact time than chlorine, contributes dissolved oxygen, has high deodorizing ability, and does not contribute total dissolved solids.

Disadvantages of ozone include the requirement for construction of new facilities for ozone generation, contact reactors, and the destruction of the off-gas. It has a high capital cost (20 to 40 percent higher than UV of similar size facilities) and high energy requirements. It is highly corrosive and toxic, unstable, must be generated as used, and is highly operational and maintenance sensitive due to its highly corrosive nature. This makes ozone difficult to use for variable flows or disinfection demand. Also, there is no immediate measure of successful disinfection. Ozone forms disinfection byproducts and the off-gas requires treatment. There are also safety concerns associated with ozone. It is dangerous if inhaled and may cause acute respiratory distress similar to chlorine gas.

7.1.7 Peracetic Acid

This alternative includes switching from sodium hypochlorite to peracetic acid for disinfection. Peracetic acid is made up of acetic acid and hydrogen peroxide. It is traditionally a cleaning agent and disinfectant used mainly in the food, medical, and pulp industries, and is also suitable for cooling tower applications. Peracetic acid is a strong disinfectant that has no toxic or hazardous residual byproducts. Peracetic acid shows little dependence on pH, and it only requires a short contact time.

Disadvantages associated with peracetic acid include the potential for microbial regrowth due to residual acetic acid, high cost, and possible odor concerns. The use of peracetic acid is also not well established and is currently only used at one full-scale wastewater disinfection operation in the U.S.

7.1.8 Advanced Oxidation Processes

Advanced oxidation processes involve using the hydroxyl free radical (a strong oxidant) to destroy compounds that cannot be oxidized by oxidants such as oxygen, ozone, or chlorine. There are many technologies used to produce the reactive hydroxyl radical. The major processes in commercial production are divided into two categories: ozone and non-ozone based. The technologies available commercially are ozone/UV, ozone/hydrogen peroxide, ozone/UV/hydrogen peroxide, and hydrogen peroxide/UV. All of these processes would require construction of new facilities.

The main advantage of advanced oxidation processes is that they have been found to be equal to, or more effective than, individual agents (e.g., ozone, UV, hydrogen peroxide) for pathogen inactivation.

Disadvantages of advanced oxidation processes include the requirement to construct new facilities similar to ozone described above. Also, long contact times are needed for microorganism disinfection because of the short half-life of the hydroxyl free radical. Treatment can be impacted by carbonate/bicarbonate in water, suspended material, and pH. These processes are energy-intensive and highly operational and maintenance sensitive. Furthermore, these technologies are not well established in wastewater disinfection.

7.1.9 UV Disinfection

This alternative includes switching from chlorination to UV for disinfection. UV is an effective disinfectant and UV systems are a growing trend in wastewater treatment disinfection. Some of the benefits that separate UV from chemical disinfectants include:

1. No toxic residual or hazardous byproducts.
2. No chemicals (other than for cleaning).
3. Very safe.
4. Short contact time.
5. Not pH dependent.
6. Non-corrosive.
7. More effective than chlorine in inactivating most viruses, spores, cysts.
8. Does not contribute total dissolved solids.

UV systems can be equipped with various types of lamps. Various combinations of pressure and output and recommended applications according to the UV manufacturers are listed below.

1. Low Pressure, Low Output
   - Output affected by water temperature
   - 9,000 hour lamp life
   - Approximately 100 watts/lamp
2. Low Pressure, High Output – Amalgam
   - 12,000 hour lamp life
   - 250 watts/lamp

- Amalgam lamps use amalgamation of mercury and indium and/or other metals to control vapor pressure of mercury in the lamp. This allows the lamp to operate at higher temperatures, higher power, and higher specific lamp output. Amalgam lamps generally have a higher output per unit length than low pressure lamps.

3. Low Pressure, Very High Output – Amalgam
   - 15,000 hour lamp life
   - 1,000 watts/lamp
4. Medium Pressure
   - 5,000- to 10,000-hour lamp life
   - 3,000 to 0,000 watts per lamp
   - Polychromatic output, therefore less efficient at converting electrical power to UVC output
   - High power density allows for small equipment footprint

According to the UV manufacturers, low pressure/high output-type lamps would be recommended for the Baldwinsville-Seneca Knolls WWTP because this option would be the most cost effective based on the wastewater flow range for this plant.

One of the concerns with a UV system is that the wastewater needs to be relatively free of substances that absorb UV light. Typically a UV system is designed around an average transmittance of 65 percent. The Baldwinsville-Seneca Knolls WWTP effluent was sampled and tested for UV transmittance. It was found to be 70 percent, which makes UV technology still applicable.

Disadvantages of UV include high capital cost, no deodorizing ability, limited turndown, and no immediate measure of whether disinfection was successful.

7.1.10 High-Rate Disinfection

High-rate disinfection was developed for combined sewer overflows (CSOs) where long disinfection contact time was not appropriate for CSO flows. A high-rate disinfection process can be considered as any process that achieves sufficient disinfection with less contact time than the recommended 15-minute contact time stipulated in Ten-States Standards. High-rate disinfection typically includes an increased chlorine dose and increased mixing intensity using induction mixers in order to decrease contact time. The result will be an increase in peak hour flow disinfection capacity within existing tankage.

The impeller speed of the induction mixer produces intense mixing. The mixer works by rotating an impeller at a sufficient rpm to cause a vacuum behind the impeller. This vacuum pressure is then used to draw chemicals to the impeller and blast the wastewater with a fine spray of chemical disinfectant. This provides an almost instantaneous dispersion due to the high rotation of the impeller.

The mixing intensity is described by the G value (mean velocity gradient). The G value is a function of the power, mixing chamber volume, and fluid viscosity. The higher the G value, the more intense the mixing. The G value for a typical well-designed diffuser grid system is on the order of 500 to

1,000/sec. A G value of 1,000/sec will provide superior mixing; however, others have used lower G values with satisfactory results.[3]

Mixing equipment manufacturers recommend that mixers dispersing chlorine solution in a flowing stream be sized on the basis of 0.3 to 0.6 HP/mgd. Recent research by the USEPA through the Environmental Technology Verification Program found that 0.5 HP/mgd was sufficient for mixing if the wastewater was in the zone of influence of the mixer.[4]

The main advantage of high-rate disinfection is an increase in peak hour flow capacity within the existing contact tanks.

The disadvantage is an increase in chlorine and dechlorination chemical quantities due to the higher doses associated with treating in a shorter contact time.

7.2 Dechlorination

There are several chemicals which could be used for dechlorination: (1) sulfur dioxide gas; (2) sodium bisulfite ; (3) sodium metabisulfite; and (4) sodium thiosulfate .

7.2.1 Sulfur Dioxide Gas

Sulfur dioxide gas is similar to chorine gas. It is stored in gas cylinders and uses a vacuum solution feed. Although no contact chamber is required, it has the same type of safety hazards that chlorine gas has. It is classified as a toxic gas, corrosive compound, and an irritant. It is a non-explosive, non-flammable, colorless gas with a pungent odor. The use of sulfur dioxide would require specialized training for County personnel in its handling and use. Due to these safety concerns, it is not recommended for use at the Baldwinsville-Seneca Knolls WWTP.

7.2.2 Sodium Bisulfite

Sodium bisulfite is a white powder that is typically delivered in a solution, typically 39 percent strength. It can be handled wet in stainless steel, PVC, and FRP. It is a very common dechlorination chemical due to its relatively low cost.

7.2.3 Sodium Metabisulfite

Sodium metabisulfite is a cream-colored powder that is typically distributed in liquid solutions of various strengths and is similar to sodium bisulfite. It is a common dechlorination chemical.

7.2.4 Sodium Thiosulfate

Sodium thiosulfate has been used commonly in laboratory applications; however, it is not used at full-scale plant levels. Three concerns with the use of sodium thiosulfate are: (1) the reaction with chlorine is stepwise, causing it to take too long; (2) its reaction is only stoichiometric at pH of 2; and (3) its reaction with chlorine varies widely with pH. Therefore, it is not recommended for use at the Baldwinsville-Seneca Knolls WWTP.

[3] White's Handbook of Chlorination and Alternative Disinfectants.
[4] www.epa.gov/etv/pubs/09_vs_series32.pdf

7.3 Detailed Evaluations

Following a review of these technologies, three alternatives were selected for detailed evaluation. This section provides a summary of the evaluation.

1. Conventional chlorination/dechlorination using sodium hypochlorite and sodium bisulfite or sodium metabisulfite using three contact tanks.
2. Conventional chlorination/dechlorination using sodium hypochlorite and sodium bisulfite or sodium metabisulfite using existing two contact tanks.
3. UV disinfection.

7.3.1 Alternative 1 - Conventional Chlorination/Dechlorination Using Sodium Hypochlorite with Three Contact Tanks

This alternative continues the current practice of using sodium hypochlorite for disinfection. It includes a new chlorine contact tank constructed adjacent to the other tanks and identical in size and shape. The new tank will increase the capacity of the chlorine contact tanks, resulting in the ability to disinfect a peak hour flow of 18 mgd at a contact time of 15 minutes.with one tank out of service.

A new chemical induction mixer is recommended to replace the existing mixer and chemical injector/diffuser assembly. The new induction mixer acts as both the chemical injector/diffuser and mixer and is a very effective way to mix the chemical evenly in the flow.

Dechlorination, accomplished through the addition of sodium bisulfite or metabisulfite solution, will be added to reduce the chlorine residual for conformance with the new permit level. A new dechlorination tank is required, sized for a detention time of 30 seconds at a peak hour flow. The estimated dimensions of the new dechlorination tank are 14 feet wide by 38 feet long by 13 feet side wall depth with an estimated flow depth of 4 feet. A new induction mixer will also be required to inject and disperse the dechlorination chemical. Two positive displacement pumps (one duty, one standby) would be required to supply the sodium bisulfite for dechlorination. The sodium bisulfite solution would be stored in a 600-gallon FRP tank in the Chlorine Building. This tank will provide approximately 30 days of storage at an estimated flow of 20 gpd. The new chlorine and dechlorination tanks are not anticipated to be on piles because the existing tanks are not on piles.

Excess chlorine creates the need for additional bisulfite and excess bisulfite will reduce the effluent dissolved oxygen concentration. Also, the NYSDEC recently issued a revised SPDES permit for the plant (effective date July 1, 2014) containing a new Daily Minimum Dissolved Oxygen limit of 2.0 mg/l. Accordingly, accurate control of chemical dosing for both sodium hypochlorite and dechlorination is important and recommended. A combination of flow pacing and feedback control (compound loop control) is recommended to provide effective disinfection without overdosing. The dosing will generally be controlled by flow pacing, and chlorine residual analyzers would sample from the ends of both the chlorine contact tank and the dechlorination tank to aid in more accurate control of the chemical dosing. An advantage of compound loop control is that damping can be programmed into the control system to avoid oscillations caused by lag time in the process. Two free chlorine residual analyzers are required along with the necessary PLC controls. Ultrasonic measurement of flow would be accomplished over the dechlorination tank effluent weir.

The estimated time for design of this alternative is six months and the estimated time for construction is nine months.

7.3.2 Alternative 2 - Conventional Chlorination/Dechlorination Using Sodium Hypochlorite with Two Contact Tanks

This alternative continues the practice of using sodium hypochlorite for disinfection utilizing the two existing chlorine contact tanks. Similar to Alternative 1, a new chemical induction mixer is required to replace the existing mixer and chemical injector/diffuser assembly. The new induction mixer acts as both the chemical injector/diffuser and mixer. The new mixer will provide the intense mixing required to completely mix the chlorine into the wastewater flow.

Dechlorination, accomplished through the addition of sodium bisulfite or metabisulfite solution, will be added to reduce the chlorine residual for conformance with the new permit level. A new dechlorination tank is required, sized for a detention time of 30 seconds at a peak hour flow. A new induction mixer will also be required to inject and disperse the dechlorination chemical. Two positive displacement pumps (one duty, one standby) would be required to supply the sodium bisulfite for dechlorination. The sodium bisulfite solution would be stored in a 600-gallon FRP tank in the Chlorine Building. This tank will provide approximately 30 days of storage at an estimated flow of 20 gpd. As is the case with the existing tanks, the new chlorine and dechlorination tanks are not anticipated to be on piles.

7.3.3 Alternative 3 – UV Disinfection

This alternative includes a new UV disinfection system sized for a peak hour flow of 18 mgd. It could be constructed inside Chlorine Contact Tank No. 2 during the disinfection off-season, saving earthwork costs. Included in the cost of this alternative is construction of a new UV building (18 feet wide by 80 feet long) that would be constructed over Chlorine Contact Tank No. 2. The building will protect the UV system from the elements. It should be noted, however, that a UV building is not mandatory. Since the Baldwinsville-Seneca Knolls WWTP has only seasonal disinfection, the UV system could be winterized per the manufacturer’s recommended procedures. This would include storing the modules in a dry place, turning off instrumentation/alarms, and capping and plugging hydraulics and hoses.

A concern with UV is the use of iron- and/or aluminum-based coagulant for phosphorus removal (ferrous chloride is currently used at the WWTP). These coagulants can hinder the effectiveness of the UV system through accumulation of precipitants on the quartz sleeves. UV manufacturers recommend use of automatic physical and chemical quartz sleeve cleaning to minimize the problems associated with the coagulants. This has been included in the cost of the UV proposal.

Another disadvantage is the limited turndown by UV systems. Due to the large delta between peak and average flow design, the UV system will mainly be operating at the minimum power setting (one bank on at 60 percent power), which is equivalent to a 5.4 mgd flow. Therefore, at an average flow of 4 mgd, the unit will be using more energy than required. Additional banks could be provided to reduce the turndown, but the additional capital cost of more banks outweighs the energy savings.

Table 7-1 shows the basis of design for the Trojan UV 3000 Plus. The nominal water level associated with this design is 32 inches. The UV dose proposed is 30 mJ/cm^2.

Table 7-1 Basis of Design - Disinfection System

Parameter	Value
Channels	
Number of channels	1
Approximate channel length required	42 feet
Channel width based on number of UV modules	56 inches
Channel depth recommended for UV module access	62 inches
UV Modules	
Total number of banks	3 (2 duty, 1 standby)
Number of modules per bank	14
Type of lamp	Low pressure/high output
Number of lamps per module	8
Total number of UV lamps	336 (including redundant bank)
Maximum power draw	84 kW
UV Panels	
Power distribution center quantity	3
System control center quantity	1
Miscellaneous Equipment	
Level controller quantity	1
Type of level controller	Motorized weir gate, ultrasonic level sensor
Automatic chemical/mechanical cleaning	Trojan ActiClean-WW™
UV module lifting device	Davit crane + module lifting sling
Standard spare parts/safety equipment	8 lamps, 8 quartz sleeves, and 4 ballasts
Electrical Requirements	
• Each power distribution center requires an electrical supply of one 480 volt, 3 phase, 4 wire (plus ground) 31.1 kVA. • The hydraulic system center requires an electrical power supply of one 480 volt, 3 phase, 3 wire (plus ground) 2 kVA. • The system control center requires an electrical supply of one 120 volt, 1 phase, 2 wire (plus ground) 15 amps. • Electrical disconnects required per local code are not included in this proposal.	

The 20-year present worth of the each alternative is presented in Table 7-2. Detailed cost estimates are included in Appendix F.

Table 7-2 Disinfection 20-Year Present-Worth Costs

Alternative		Initial Capital Cost[(1)]	Annual O&M Cost	20-Year Present Worth
1	Conventional Chlorination/ Dechlorination - Three Tanks	$1,300,000	$27,000	$1,700,000
2	Conventional Chlorination/ Dechlorination- Two Tanks	$700,000	$28,000	$1,200,000
3	UV Disinfection[(2)]	$2,900,000	$28,000	$3,200,000

(1) Includes overhead and profit, general conditions, and 30 percent contingency. Cost in current year dollars.
(2) Includes UV building.

7.4 Conclusions

Alternative 2, Conventional chlorination/dechlorination with two tanks, has the lowest 20-year present-worth cost because it does not require a third chlorine contact tank. The use of chemical dechlorination will enable the facility to meet the new TRC limits of 0.8 mg/L that become effective in 2018.

Appendix K - Condition Assessment Photos

CHLORINE BUILDING

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
Northeast elevation, looking southwest	CHL-BLDG_001.jpg	1

Description(s):

No deterioration to note.

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
Southwest elevation, looking northeast	CHL-BLDG_002.jpg	2

Description(s):

No deterioration to note.

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
Southeast elevation, looking northwest	CHL-BLDG_007.jpg	3

Description(s):

No deterioration to note.

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
West elevation, looking east	CHL-BLDG_004.jpg	4

Description(s):

Column has some minor pattern cracking.

The concrete slab has some minor cracking.

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
North elevation, looking south	CHL-BLDG_003.jpg	5

Description(s):

Minor crack with rust staining at the top of the column.

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
Northwest corner	CHL-BLDG_002.jpg	6

Description(s):

Joint seal at base of building foundation and along the curb/sidewalk has failed. The sidewalk on grade has settled slightly.

DISINFECTION TANKS

Chlorine Contact Tank No. 1

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
West elevation, looking east	CCT1_001.jpg	1

Description(s):

All wall surfaces below black/green protective coating are worn down to exposed aggregate. There is a 1/8" difference between the wall and coating and small popouts up to 3/8" deep. When chiseled the wall is very spongy and disintegrates to a powdery consistency.

The blue colored residue on the floor is an unknown material; it appears not to be a protective coating. It disintegrates to a powdery consistency under the lightest pressure.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
North wall, looking northeast	CCT1_002.jpg	2

Description(s):

Refer to Photo # 1.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
South wall, looking southeast	CCT1_003.jpg	3

Description(s):

Refer to Photo # 1.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
East elevation, looking west	CCT1_015.jpg	4

Description(s):

Refer to Photo # 1.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
South wall, looking south	CCT1_015.jpg	5

Description(s):

Active leakage at floor/wall expansion joint.

Vertical crack with active leakage located to the west of the expansion joint.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
North wall, looking north	CCT1_031.jpg	6

Description(s):

At expansion joint.

Top slab/wall joint is deteriorated along the full length of the wall with small spalls areas.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
West elevation, looking east	CCT1_033.jpg	7

Description(s):

Concrete baffle wall is in good conditions, no structural damage.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
Looking north	CCT1_020.jpg	8

Description(s):

Concrete baffle wall and area behind is in good conditions, no structural damage.

On the north wall there is an existing vertical crack repair that starts approximately 1.0’ off the floor and continues up the wall for 4.0’ to 5.0’±.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
North fascia, looking south	CCT1_012.jpg	9

Description(s):

At the fascia of the concrete walkway, cracking as occurred at the base of each railing post.

A large chunk of concrete has fallen off the underside at the 2nd post from the west end.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
	CCT1_025.jpg	10

Description(s):

A large chunk of concrete has fallen off the underside at the 2nd post from the west end.

See photo # 9.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
	CCT1_010.jpg	11

Description(s):

At the fascia of the concrete walkway, cracking as occurred at the base of each railing post.

Location: Chlorine Contact Tank No. 1	Photo Name:	Photo #:
	CCT1_022.jpg	12

Description(s):

Top of fill chamber east wall has approximately a ¼” of wear below the top aluminum plates.

Chlorine Contact Tank No. 2

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
West elevation, looking east	CCT2_001.jpg	1

Description(s):

All wall surfaces below black/green protective coating are worn down to exposed aggregate. There is a 1/8” difference between the wall and coating and small popouts up to 3/8” deep. When chiseled the wall is very spongy and disintegrates to a powdery consistency.

The blue colored residue on the floor is an unknown material; it appears not to be a protective coating. It disintegrates to a powdery consistency under the lightest pressure.

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
East elevation, looking West	CCT2_017.jpg	2

Description(s):

Refer to Photo # 1.

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
North wall, looking north	CCT2_010.jpg	5

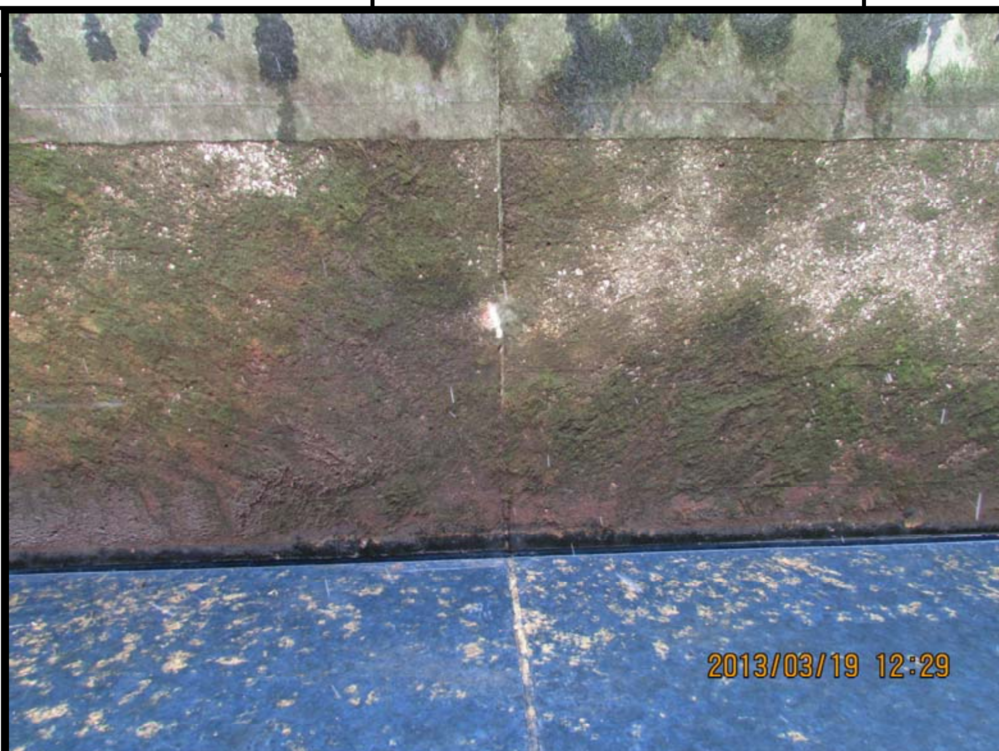
Description(s):

Vertical crack with active leakage located to the west of the expansion joint.

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
North wall, looking north	CCT2_027.jpg	6

Description(s):

At expansion joint. A small spall area with existing patch material that is failing is approximately 4.0’ above the floor.



Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
Northwest elevation, looking east	CCT2_030.jpg	7

Description(s):

Concrete baffle wall is in good conditions, no structural damage.

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
North wall, Looking north	CCT2_032.jpg	8

Description(s):

Small spall area, actively leaking at the base of the expansion joint.

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
Underside of walkway.	CCT2_022.jpg	9
Description(s): Map cracking with efflorescence is evident on the underside of the walkway.		

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
Underside of walkway.	CCT2_023.jpg	10
Description(s): A 2.0’ x 2.0’ x 1½” deep spall area has developed on the underside of the walkway.		

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
East end of tank, opening for effluent channel gate.	CCT2_019.jpg	11

Description(s):

The concrete has spalled at the location for the anchorage to the grating over the effluent channel

Location: Chlorine Contact Tank No. 2	Photo Name:	Photo #:
East end of tank, opening for effluent channel gate.	CCT2_021.jpg	12

Description(s):

The concrete has spalled at the location for the anchorage to the grating over the effluent channel

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
	CCTe_005.jpg	13

Description(s):

Deteriorated joint on the exterior tank walls.

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
	CCTe_006.jpg	14

Description(s):

Deteriorated joint on the exterior tank walls.

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
South elevation, looking northeast	CCTe_004.jpg	15

Description(s):

Random vertical cracks some with efflorescence that extend from the ground to the top of the wall.

Location: Chlorine Contact Tanks	Photo Name:	Photo #:
Looking east	CCTe_002.jpg	16

Description(s):

View of walkway between tanks.

Disinfection Building – Intake Damper

Gravity damper seized in closed position