BURNS McDONNELL

Preliminary Engineering Report

Clinton Lake WTP
Chlorine Gas Storage and Feed Building

Clinton
Hub City of Western Oklahoma

City of Clinton, Oklahoma

Chemical Feed Concept Design
Project No. 143337

Revision A
4/5/2022

1.0 GENERAL

1.1 Purpose

This Conceptual Design Report is furnished for the City of Clinton, Oklahoma (City). A gaseous chlorine leak was detected at the City's water treatment plant (WTP), which caused extensive damage and corrosion to WTP filter room equipment and electrical equipment. To optimize the City's WTP, prevent future chemical leaks, and align the City's WTP with Oklahoma Department of Environmental Quality (ODEQ) regulations, the following are evaluated and addressed in this report:

- City WTP Chemical Optimization and Leak Prevention
  - Building design to store WTP pre-oxidant and disinfection chemicals
    - Size, layout, and site location
  - Potential relocation of WTP Pre-Oxidation and Disinfection Chemicals and Chlorine Dioxide Generator
    - Sodium Hypochlorite (NaClO)
    - Hydrochloric Acid (HCl)
    - Chlorine Dioxide (ClO_2)
    - Chlorine (Cl_2)
  - Addition of Chlorine Scrubber
- ODEQ Compliance Violations (2019 Inspection)
  - Light and exhaust controls for the chlorine gas room were not located outside of the chlorine gas room
  - Chlorine gas room was not air-tight from the rest of the water treatment building
  - Absence of panic hardware in the interior doorway to the chlorine gas room

This study investigated the relocation of the WTP's chemicals and equipment relating to pre-oxidation and disinfection to a new building adjacent to the existing WTP main building. Three preliminary concept designs for a gaseous chlorine chemical feed and storage building (chlorine building) were developed and discussed with the City and Inframark on March 8th, 2022. Under the direction of the City, cost estimates for two of the chlorine building preliminary concept designs were developed and are discussed herein.

1.2 Project Background

The City's WTP uses chlorine dioxide gas as a pre-oxidant and is injected at the Clinton Lake Dam raw water intake. Chlorine gas can be injected at three locations for disinfection (filters, flash mixer, and clearwell).

Chlorine dioxide is produced onsite by a ClO_2 generator utilizing an acid-chlorite (HCl-NaClO) reaction. The ClO_2 generator and NaClO day tank are in the WTP main building, and the remaining day (HCl) and

bulk (HCl and NaClO) chemical storage is located on the southeast side of the WTP main building. Chlorine dioxide is used as pre-oxidant at the facility. Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) conducted a site visit with City and Inframark personnel (operators of the facility) on February 15th, 2022 to gather information on the existing chemical feed equipment and operations. During the site visit, the City and Inframark conveyed their preference to move the chlorine dioxide generator and associated chemicals (HCl and NaClO) closer to the injection point, Clinton Lake Dam, not to the proposed chlorine building. Therefore, for this study, the chlorine dioxide generator and associated chemicals were assumed to remain in place and were not further evaluated.

The chlorine gas utilized at the plant for disinfection is toxic in its concentrated gaseous form, although safe handling procedures and its use as a disinfectant for drinking water are common. Five one-ton gas cylinders and the chlorine gas feed system are currently located in the WTP main building. As the three disinfection injection points are within or relatively close to the WTP main building, the optimal location for the proposed chlorine building is the southeast corner of the existing WTP parking lot to minimize piping and communications routing to the WTP main building and electrical from the future Powder Activated Carbon (PAC) silo project. Additionally, this location is easily accessed by operators and vendor deliveries.

2.0 PROJECT AREA

The City of Clinton is located within Custer County, Oklahoma. The City of Clinton's city boundary is generally as shown in Figure 2-1.

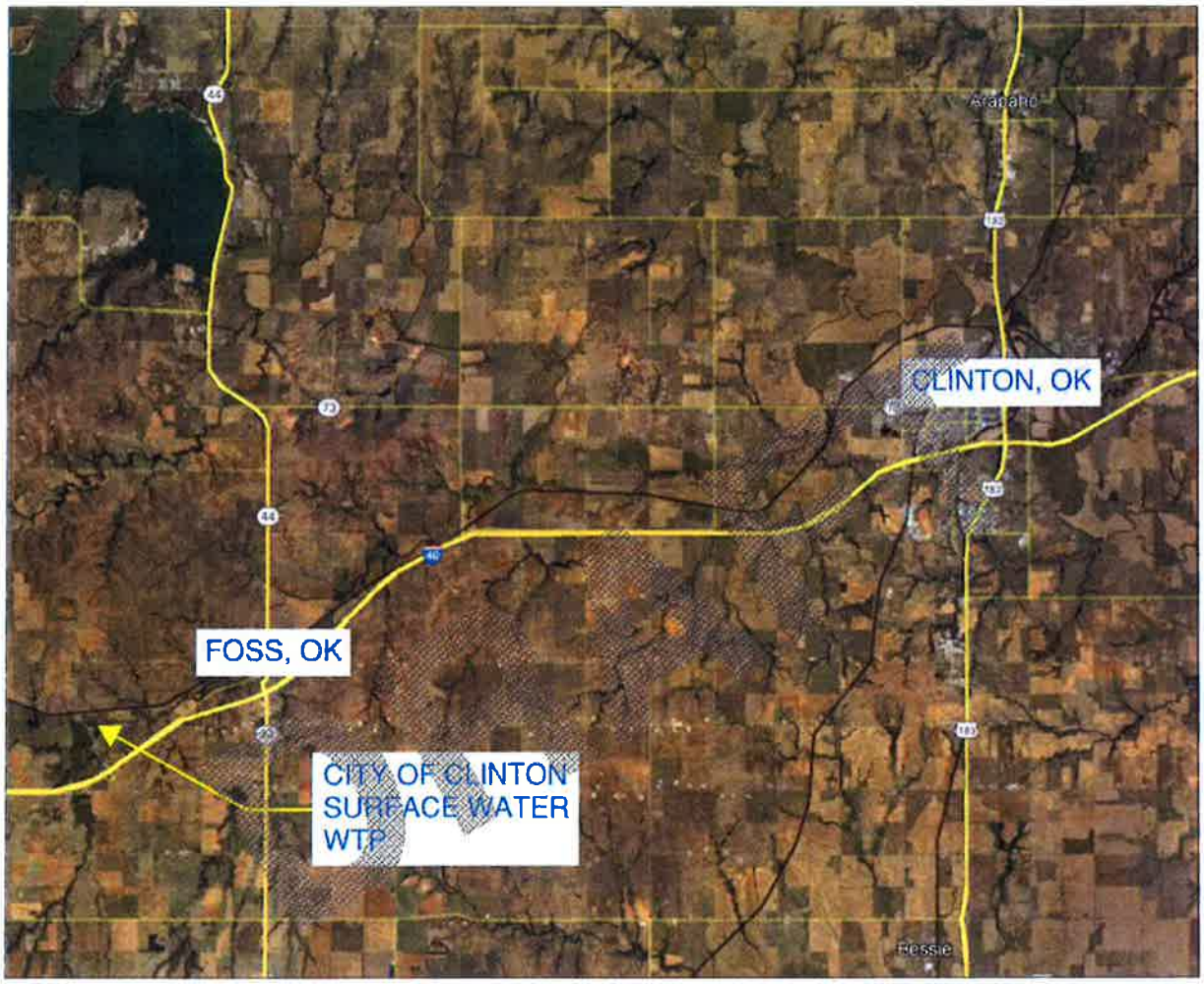

Figure 2-1: Clinton City Boundary

Clinton Lake and the City's WTP are located approximately 15 miles to the west of the City, along Interstate 40. Both the lake and the WTP are located within Washita County, Oklahoma as indicated in Figure 2-2. The WTP serves the City's population of approximately 9,200 with water. No new service areas or customers were evaluated as part of this project.

Figure 2-2: Clinton Lake and Clinton Lake WTP

3.0 EXISTING FACILITIES

The Clinton Lake WTP was originally built in 1983/1984. The water is sourced from an intake located within Clinton Lake.

The plant generally consists of the following:

- Multi-level intake within the concrete spillway on the dam
- Chlorine dioxide pre-oxidant feed within the raw water piping at the spillway
- Raw water pumps located in the WTP building
- Rapid mix
- Coagulant feed in the rapid mix
- Two (2) solids contact clarifiers
- Four (4) dual-media gravity filters
- Gaseous chlorine and liquid ammonium sulfate for disinfection
- On-site clearwell for finished water storage
- High service pumps for conveying water to the City's distribution system
- Administration and laboratory rooms in the WTP building

An aerial view of the facility is provided in Figure 3-1.

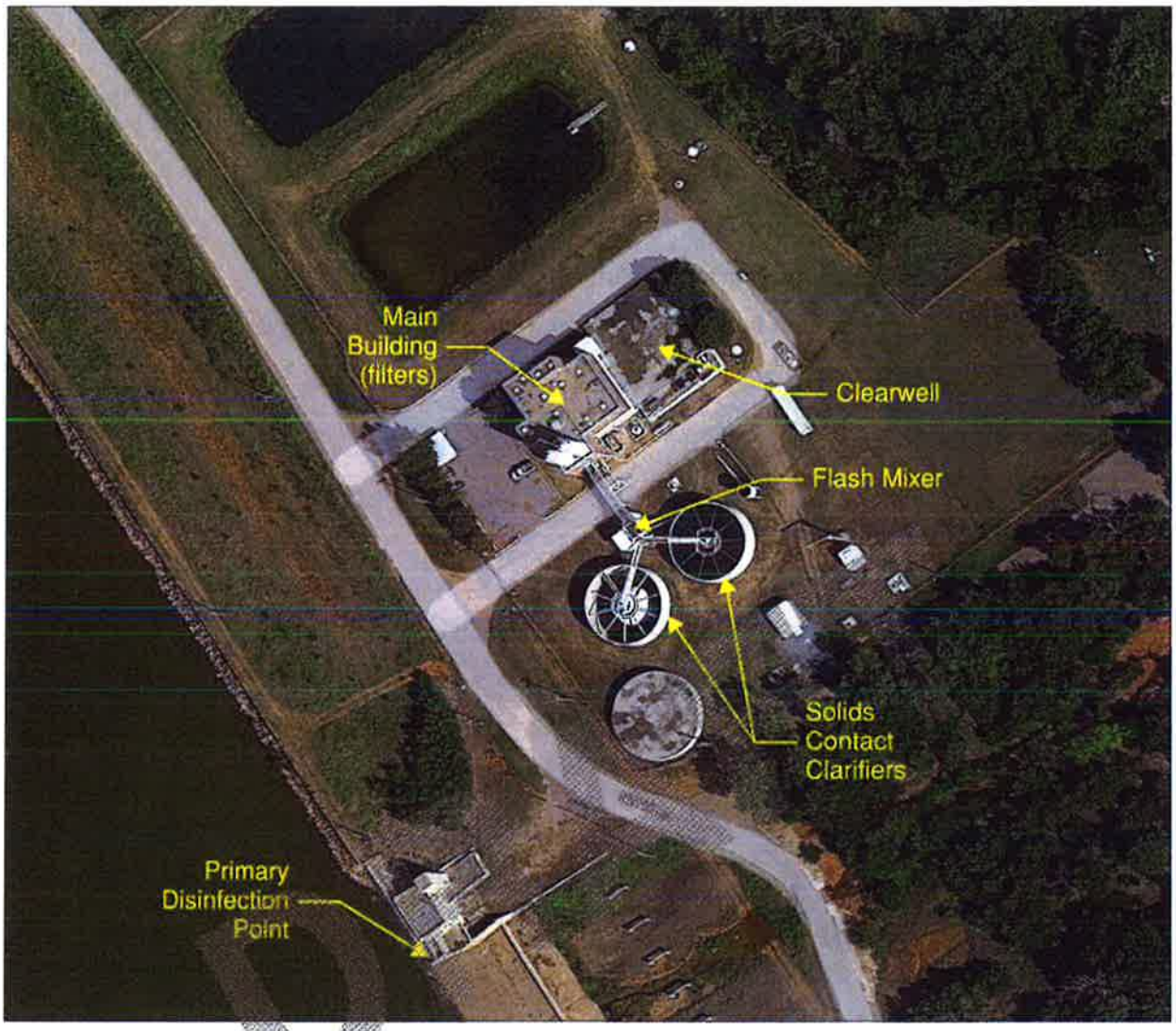

Figure 3-1: Aerial Image of Clinton Lake WTP

3.1 Impact to Existing Facility Operation

The relocation of chlorine storage and equipment will increase operator safety, while having minimal to no impact on overall daily WTP operation. The chlorine building is accessible through exterior doors only and will decrease available WTP parking.

Figure 4-6: Alternative Three Site Plan

4.4 Recommended Alternative

A meeting was held with the City on March 8th, 2022 to discuss the proposed alternatives. Based on feedback from the City, Alternative Three was removed from consideration due to the obstacles with delivery and storage of chlorine cylinders. The City requested Burns & McDonnell proceed with providing cost estimates for Alternatives One and Two. Although both alternatives meet the ODEQ requirements, Burns & McDonnell recommends Alternative 1, due to the additional safety measures with separating the chlorine feed and storage rooms. The design will include a new building complete with HVAC, eyewash and shower stations with heated tank, inside cylinder storage, air monitors, generator, and new chemical feed equipment.

5.0 PROPOSED CHLORINE BUILDING

The proposed improvements at the WTP include construction of a new chlorine building to house new chlorine gas feed and storage equipment. The chemical building will generally include site grading for water drainage, high-rate ventilation and chlorine scrubber, piping and process equipment, and structural support for moving one-ton cylinders of chlorine gas. These proposed improvements are applicable to both Alternative One and Alternative Two.

The proposed chemical feed building at the WTP is a modification to the City's water system, specifically the treatment facility. The proposed building and improvements will not affect the sources, storage, distribution system, or pumping stations of the water system. The proposed improvements will be constructed within the limits of the City's existing WTP and will occur within the limits of the City's property.

5.1 Architecture

Applicable Codes:

- 2015 International Building Code
- 2015 International Fuel Gas Code
- 2015 International Mechanical Code
- 2015 International Plumbing Code
- 2015 International Fire Code
- 2020 National Electric Code

The chlorine building will be constructed next to the WTP main building so that the two buildings' foundations do not conflict. For building roof, wall components, and walls located within 30-feet of the WTP main building, will be required to be fire rated. The building will contain rooms for chlorine cylinder storage and feed equipment and a room for electrical equipment. The exterior walls will consist of painted interior 12" concrete masonry units (CMU), 2" rigid insulation to meet the energy code required values, 2" air space, and 4" brick veneer to match the existing WTP building's aesthetic. The interior walls will consist of painted 8" CMU for walls separating rooms that are not conditioned. The interior walls may also be constructed of painted 12" insulating CMU for walls separating a conditioned room from an unconditioned room. If the chlorine feed equipment is in its own room, a window between the chlorine feed room and chlorine storage room will be provided. The chlorine storage and feed rooms are an H-occupancy and will require fire barriers in between these room(s) and the electrical room. Sprinklers are required for the H-occupancy spaces; however, a variance for omitting the sprinklers could

be pursued if the City desires. Sprinklers are excluded from the cost estimates provided in Section 6.0. The chlorine storage room includes a 50-feet long electrified 2-ton monorail and hoist to move and remove the chlorine cylinders. The monorail will extend outside the building underneath a metal canopy allowing trucks to drive through to load and unload the cylinders. The roof will be precast concrete, as described in the structural engineering section, with tapered insulation, coverboard, and a membrane roof above. Walkway pads will be furnished for walking from a roof access ladder to mechanical equipment. Scuppers and downspouts will be provided to drain the roof. The building will include a parapet for fall protection in servicing the mechanical equipment on the roof.

5.2 Civil

5.2.1 Demolition

Based on preliminary reviews of the site, the primarily demolition will include asphalt, concrete, and curb and gutter areas. Minimal demolition is anticipated on the site.

5.2.2 Groundwater

Deep excavations are not anticipated; however, due to the proximity to Clinton Lake, groundwater could be present during excavation. The Contractor will be required to develop a construction dewatering plan based on the volume and level of groundwater anticipated in the construction area.

5.2.3 Entrances

Entrances to the WTP and the parking lot will be maintained for operators and deliveries during construction.

5.2.4 Pavement

Full-depth asphalt removal and replacement around proposed chlorine building foundation and for below grade electrical routing will be completed in accordance with the City's standard specification or ODOT's asphalt pavement detail, whichever takes precedence. Concrete pavement will be provided around the proposed building for accessibility and maintenance. All pavement will maintain slopes away from the building and maintain a maximum 2% slope in any direction in accordance with 2010 ADA Standards.

5.2.5 Erosion Control

Silt fence will be placed at locations around the site to prevent silt/sedimentation from leaving the site. The specification will include maintenance of erosion control measures throughout the entire project. A Stormwater Pollution Prevention Plan (SWPPP) is not anticipated to be required for the project since

disturbance area is less than one acre; However, a Notice of Intent (NOI) is required by ODEQ and will be the responsibility of the Contractor.

5.2.6 Disturbed areas

Details and specifications will be developed and/or referenced for the restoration of all disturbed areas. Rigid and flexible pavements and any attached culverts will be restored in accordance with the City's standard specifications. Disturbed areas not indicated to receive any form of paving or other surfacing will be seeded or sodded.

5.2.7 Bollards

Bollards will be installed around the chlorine scrubber, building walls with high traffic, and at the structural supports for the monorail bisecting the driveway.

5.2.8 Floodplains

The proposed site improvements are immediately adjacent to the 100-year floodplain. The proposed work is outside of the 100-year floodplain; therefore, it is not anticipated that the site development will require a floodplain permit.

5.3 Electrical

The chlorine building will have its own power source originating from the same, new utility drop that will be installed as part of the PAC Silo project. The 480V power panel installed for the PAC power feed has spare capacity and spare space; thus, a 480V breaker will be installed at that power panel to supply the power needs for the chlorine building. This power source will include a 150kW diesel generator to supply emergency power to the chlorine building, as well as the PAC Silo, by way of an automatic transfer switch, in the event of a utility power failure. Below grade conduit will connect the chlorine building and new generator to the power panel at the PAC installation.

The 480V power source will energize any 480V loads, including a 208/120V transformer. These voltages will provide the power necessary for all the equipment installed inside the chlorine building, as well as the building lights, convenience receptacles, and heat/air equipment. Power will be provided for heat tracing of any piping. Heat tracing will only be provided as freeze protection option to assure the fluid inside exposed piping does not freeze during extreme cold conditions.

5.4 Instrumentation and Controls

The electrical room will also house a programmable logic controller (PLC), or a remote I/O cabinet (RIO), to capture and process the instrumentation signals and provide controls for the chlorine gas feed

system. The PLC/RIO will communicate to the Plant Control Room through an ethernet or fiber port into the Plant PLC. Radio communication is also an option should the plant operator prefer this option. Communication lines to the main WTP building will routed in the above grade in supported cable-tray from the chlorine building to the main WTP building, along with piping.

5.5 Mechanical Equipment

5.5.1 Codes

The following codes and standards will be utilized in addition to previously listed applicable codes and standards:

- 2015 International Mechanical Code
- 2015 International Plumbing Code
- 2015 International Fire Code
- 2015 International Building Code
- 2015 International Energy Conservation Code
- 2015 International Fuel Gas Code
- NFPA Codes, Standards, and Recommendations
- OSHA Standards Manual
- SMACNA Design and Construction Guides
- ASPE Handbooks
- ASHRAE Handbooks and Standards

5.5.2 Design Criteria

The criteria utilized for the design will be as indicated in the following tables:

Table 5-1: Ambient Design Conditions

Nearest ASHRAE Weather Station:	
Clinton-Sherman AP, OK, USA	
WMO:	723526
Elevation (feet):	1922
Site Location:	
North Latitude, degrees	35.357
West Longitude, degrees	99.204
Ambient Temperatures:	
Winter, dry bulb, °F (99.6%)	14.3
Summer, dry bulb/wet bulb, °F (0.4%)	102.2/70.4

Table 5-2: Indoor Design Conditions

Area	Design Temps, °F				Ventilation Requirements	Cont/Int	Notes
	Summer	Summer Set Point	Winter	Winter Set Point			
Chlorine Storage Room	104	104	60	50	1 CFM/SF +60AC/H when occupied	Cont	1, 4
Chlorine Feed Room	104	104	60	50	N/A	Cont	2
Electrical Room	80	75	60	50	0.06 CFM/SF	Cont	3

Notes:
1. Ventilation is per International Fire Code.
2. Ventilation-only system will be sized to remove excess heat during summer months.
3. Ventilation will provide slightly positive pressurization to the space.
4. High-rate ventilation required per ODEQ when space is occupied.

5.5.3 Electrical Room HVAC

The Electrical Room will be air conditioned by a packaged air conditioner controlled by a room thermostat. Continuous outside air will be provided to slightly pressurize the space.

5.5.4 Chlorine Storage Room HVAC

The Chlorine Storage Room will be continuously ventilated at 1 cubic feet per minute (CFM) per square foot (SF) by a makeup air unit and exhaust fan system. The makeup air unit will supply 100% fresh air to the space. The ventilation will be sufficient to provide heat removal during the summer. During the winter, the makeup air unit electric heating element will temper the air to provide freeze protection to the space. The system will be equipped with airflow and smoke detection. If no airflow is detected, the system will activate a set of horn and strobe indicators inside and outside of the space to indicate a hazardous environment may be present.

An additional system of intake air louvers, control dampers, and an exhaust fan will provide additional high-rate ventilation of 60 air changes per hour to the space when occupied. This system will be controlled by a switch on the outside of the building, next to the entrance to the space. A manual ventilation shutoff button with break-glass and label will be installed outside of the building, next to the entrance to the space. A chlorine gas scrubber will be installed to treat exhaust air in the event of a chlorine gas leak.

All equipment and ductwork will be corrosion resistant. Exhaust air will be drawn from 1 foot or less above the finished floor level to account for chlorine gas density.

5.5.5 Chlorine Feed Room HVAC

The Chlorine Feed Room will be ventilated by an exhaust fan and intake air louver system controlled by a room thermostat. This ventilation will be sufficient to provide heat removal during the summer. An electric unit heater will provide heating as needed for winter freeze protection.

5.5.6 Plumbing System

A backflow preventer will be installed at the water service entrance to the building. A tank-style electric water heater will be provided to supply hot water to fixtures. Combination emergency shower and eyewash fixtures with mixing valves will be provided in the Chlorine Feed Room and outside of the Chlorine Storage Room. All plumbing piping will be insulated.

5.6 Piping

Finished water will be conveyed from a tie-in in the existing chlorine feed room to the new building. Chlorinated water will be routed from the chlorine building to tie into:

- the flash mixer line outside as it enters the pipe rack,
- and the clearwell and filter feed lines inside the current chlorine feed room.

Interconnecting piping for the injector board and pipes carrying finished water, chlorine, and chlorinated water will be 1 ½" – 2" PVC (SCH 80), with heat trace and insultation on piping exposed to the outside environment for UV and freeze protection. Piping to and from the main WTP building will be routed in an above grade, supported cable-tray. Flexible tubing (1 ½") or hose is used to connect chlorine cylinders to scale indicator. The floor plan piping layout for Alternatives 1 and 2 are illustrated in Figure 5-1, Figure 5-2, respectfully. The general connectivity of the site plan piping layout (similar for Alternatives 1 and 2) is shown in Figure 5-3.

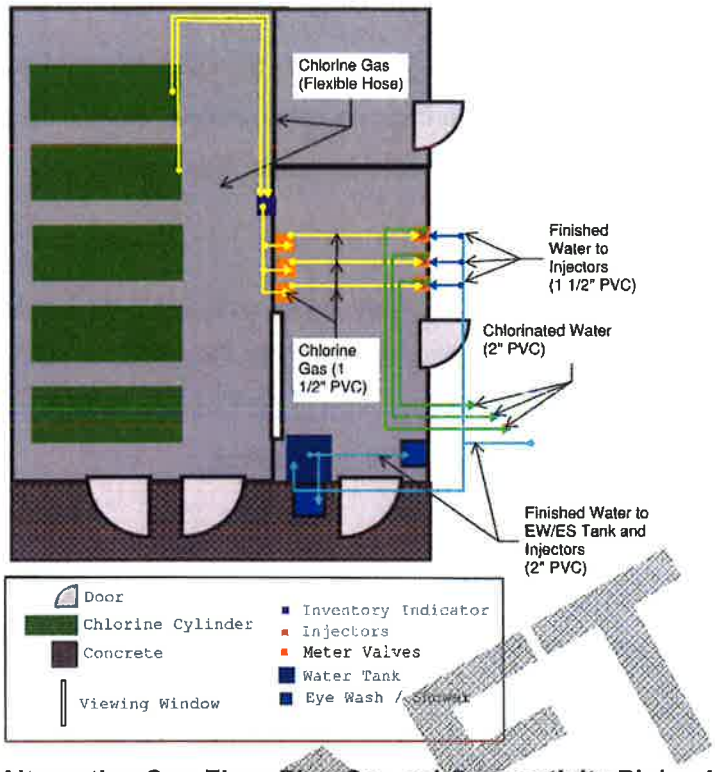

Figure 5-1: Alternative One Floor Plan General Connectivity Piping Layout

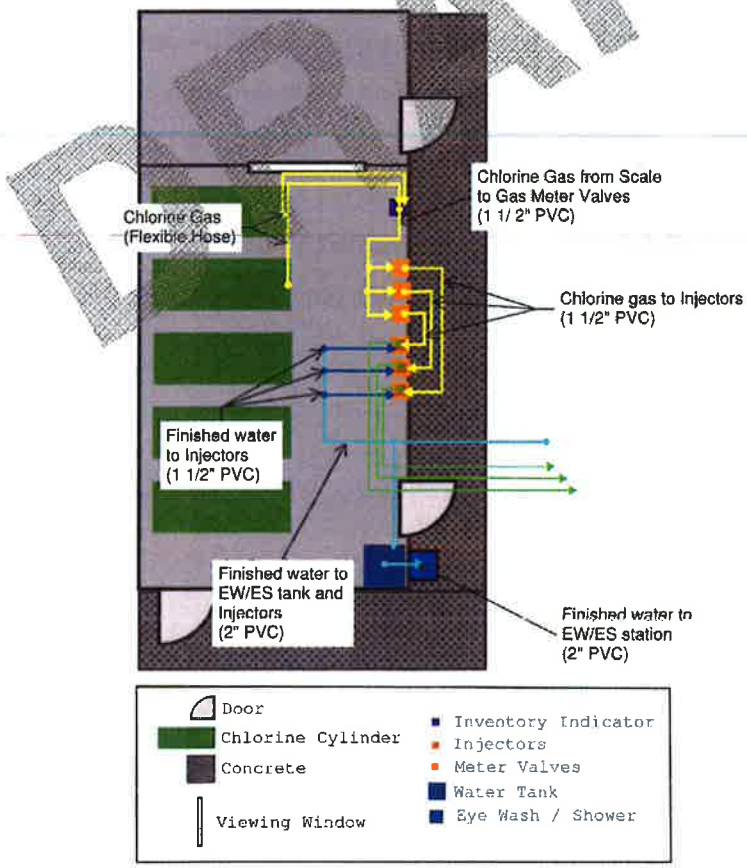

Figure 5-2: Alternative Two Floor Plan General Connectivity Piping Layout

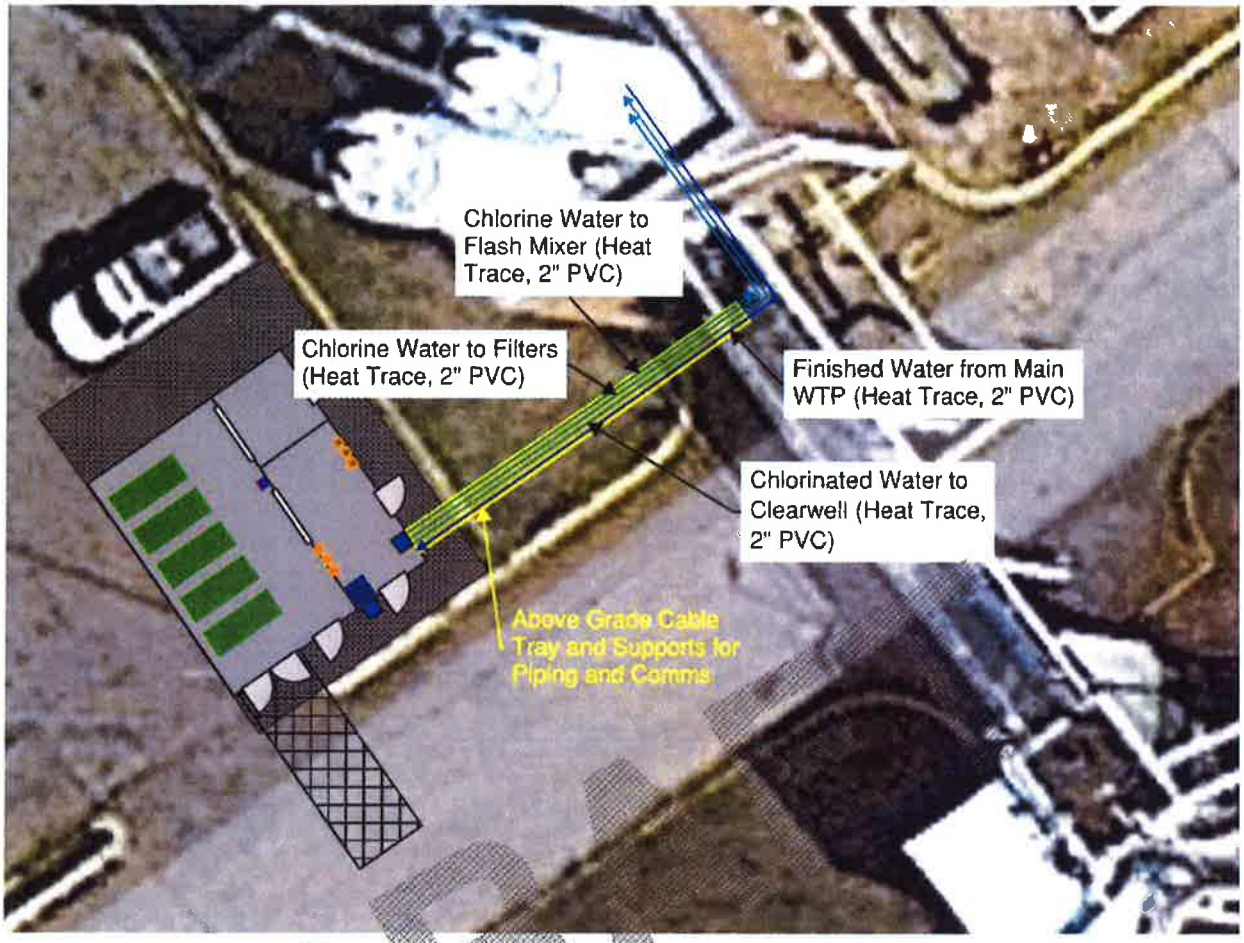

Figure 5-3: Site Plan (General Connectivity) Piping Layout

5.7 Process Equipment

The City operates with one (1) cylinder in service, and when empty, an automatic switch transfers operation over to a standby cylinder. Therefore, at any given time, two of the five chlorine cylinders will be equipped with vacuum regulators (pressure regulators), an automatic switchover valve connected to electronic scales, and a two-channel indicator to monitor gas inventory levels. Three auto-pacing valves with rotameters will measure gas flow into an injector board skid (3 injectors) that will inject the chlorine gas into the carrier water for distribution. A chlorine detector with two sensors and a battery backup will alert occupants of hazardous chlorine leaks. A chlorine scrubber with a removal capacity of 2,350 pounds of chlorine automatically engages upon detection of chlorine gas. Vacuum regulators with automatic switchover valve equipped with heater and drip legs, gas inventory monitor, auto-pacing valves, rotameters, injector board, chlorine detectors, trunnions (cylinder stands), and chlorine scrubber will be new equipment.

5.8 Structural

All options for the proposed chlorine feed building will consist of a slab-on-grade and wall foundations. The building's interior and exterior walls will be partially grouted CMU, and the roof is anticipated to consist of precast concrete hollow-core panels. These hollow-core panels will be the primary support for the monorail inside the building. Once the monorail is outside of the building, it will be supported on two steel frames to create a covered canopy area for loading/unloading. Additionally, there are anticipated to be two new steel supports to support piping/cable-tray from the existing building. All exterior supports are currently anticipated to have shallow concrete foundations. Finally, the new generator is anticipated to be placed on a slab-on-grade.