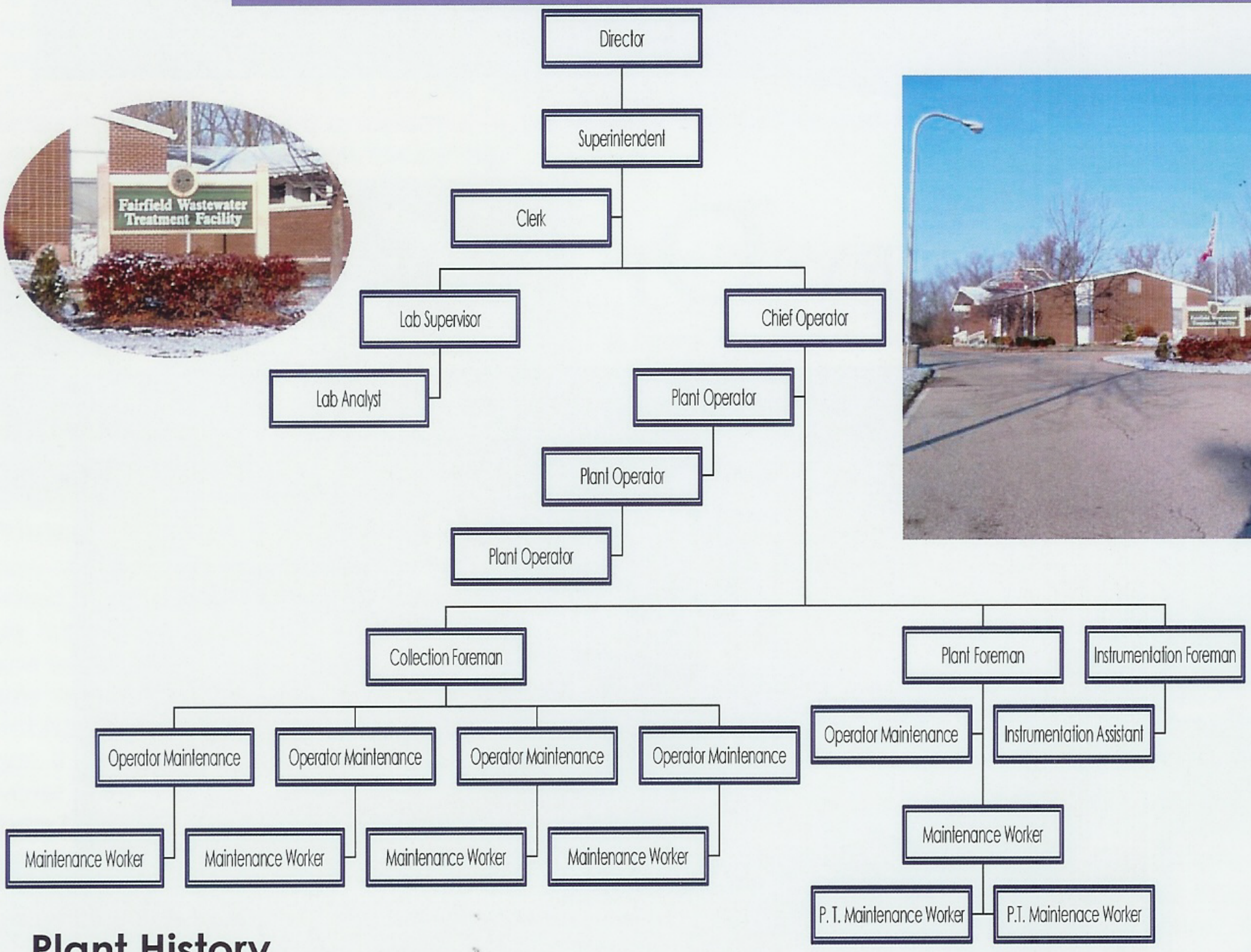
City Of Fairfield

Wastewater Treatment Plant

The Process Starts Here

City of Fairfield WWTP



Plant History

In 1965, a 2 Million Gallon per Day (MGD) treatment plant and collection system was constructed to serve the City of Fairfield, Ohio. The 1974 plant expansion provided advanced treatment facilities necessary to treat daily flows of 6 MGD. In 1988, secondary systems were upgraded to a design capacity of 10 MGD. The installation of a fine bubble aeration system enhanced treatment performance. In 1999, the facility received a hydraulic upgrade to the primary system and flow distribution chamber. This allowed the plant to be re-rated to a permitted capacity of 10 MGD in 2000.

Collection System

The City of Fairfield's wastewater is collected by a network of private laterals and main sewers. With the help of 12 lift stations, the system flows by gravity to the wastewater treatment plant (WWTP) located adjacent to the Great Miami River. In 1997, construction was completed on a 25 MGD Relief Sewer Pumping Station, 7 overflow structures, 4.6 miles of force main and a 10 million gallon equalization basin. The City's sewer collection system contains over 4,300 manholes and over 175 miles of sewer pipe. The sewer collection pipes range from 8 to 42 inches in diameter.

The Liquid Handling Process

Raw Influent Grinding/Pumping

Two (2) independently operating pump stations located at the facility's headworks handle raw wastewater. Prior to entering the wetwells, the raw wastewater passes through channel grinders reducing large coarse debris to approximately ¼ inch. This reduces pump clogging while increasing the efficiency and service life of the equipment. Raw wastewater entering the wetwells acts like an equalization basin in regards to pump sequencing. The plant's eight raw sewage pumps move the raw wastewater from 40 feet below ground level to the plant's division box.

Primary Settling

Ground, screened and degritted wastewater enters into the primary settling tanks. An aerated influent channel serves to freshen the wastewater and to promote the floatation of oil and grease. The velocity of the wastewater flow is further slowed, allowing organic solids to settle out of the wastewater flow by gravity. The organic material that settles by gravity on the tank floor is mechanically collected as sludge. This settled sludge is moved to the front of each tank by a series of plastic flights attached to plastic chain. Sludge brought to the front of the primary tank concentrates in hoppers and is hydraulically removed from the tanks as primary sludge. The same flights return the floating matter to the effluent area of the tank by traveling along the water surface, concentrating scum and other floating materials at the effluent baffle area.

Secondary Treatment

Although the primary settling tanks remove 99% of the settleable solids, the majority of the pollutants remain in the water as dissolved soluble material. Air is added in the aeration tanks to oxygenate and mix the contents. Bacteria are added as return activated sludge to mix with the primary effluent. Primary effluent mixed with the bacteria flow of concentrated (return activated sludge) creates the mixed liquor. Bacteria utilize the oxygen while removing the suspended and dissolved pollutants from the water. The bacteria purify the water while growing into colonies called floc. Floc particles are large enough to settle when introduced to the secondary clarifiers, which provide the necessary environment for secondary settling.

Secondary Settling Tanks

Mixed liquor (primary effluent mixed with bacteria) flows out of the Aeration System and into two (2) 100' diameter circular clarifiers. The quiet conditions of the settling tanks allow the floc (bacterial colonies) to settle to the tank floor. The sludge is then mechanically collected by a rake and scraper mechanism and removed to a sludge Re-Aeration basin. Air is added to the Re-Aeration basin (return activated sludge) to freshen the sludge before re-entering the aeration tank influent to continue removing primary effluent pollutants. Excess activated sludge is removed from the secondary treatment system as waste activated sludge.

Ultraviolet Disinfection

Secondary effluent enters an in-line UV disinfection system consisting of two (2) 316 stainless steel chambers. Each chamber is designed to treat 7.5 MGD and contains 16 medium pressure, high intensity (4000 watt) UV lamps installed in quartz sleeves. Ultraviolet is the band of light just beyond the short wavelength end of the visible light spectrum. UV works by affecting the DNA of microorganisms, eliminating their ability to reproduce and survive. Ultraviolet light is the natural, environmentally friendly alternative to chemical disinfection.

The Solids Handling Process

Waste Sludge Holding Tanks

The continual growth of microorganisms within the secondary treatment process requires an ongoing removal of a portion of the microorganism, known as "waste activated sludge". This ensures a proper food to microorganism ratio for a stable process. Waste sludge is sent to the waste sludge holding tanks. Air is added to mix, oxygenate, and further condition the sludge prior to sludge thickening.

Waste Sludge Thickening

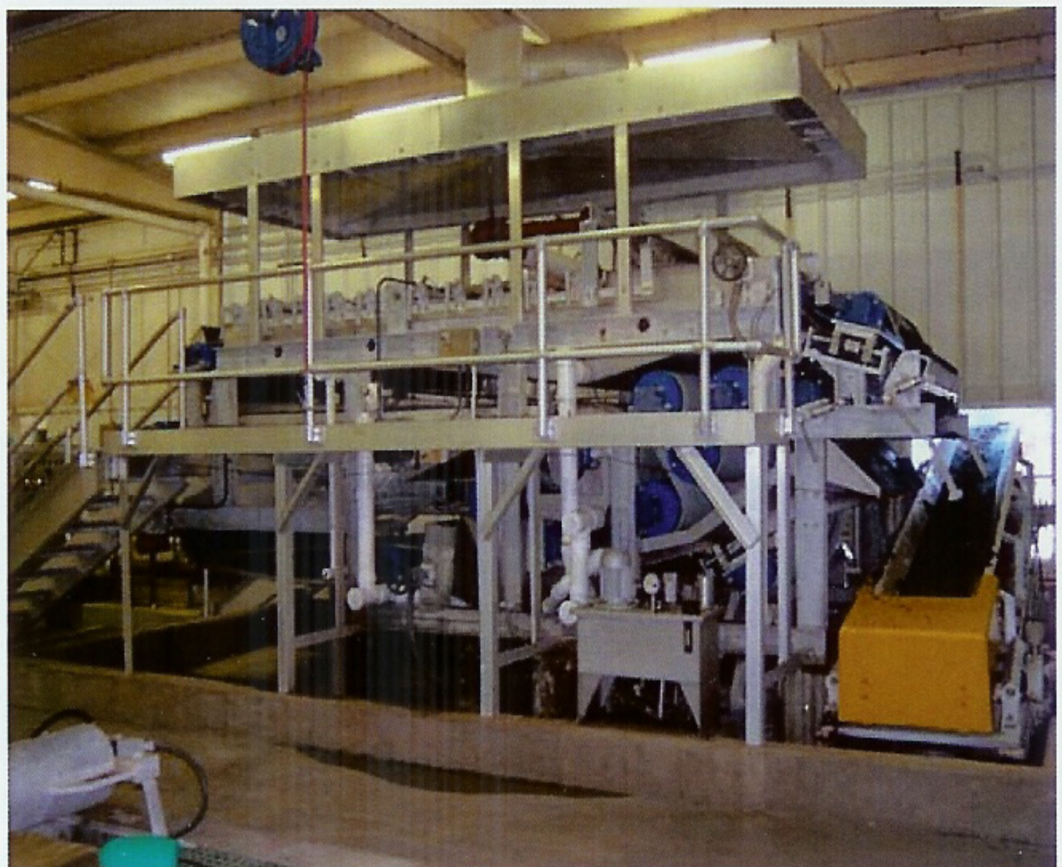
Waste Activated Sludge (WAS) is pumped from the waste sludge holding tanks to a Gravity Belt Thickener. The sludge is thickened to approximately 5% solids. It is then pumped to the primary anaerobic digesters. The gravity sludge thickener reduces the volume of sludge sent to the primary digesters, improving the anaerobic digestion process. The volume is typically reduced to a 10th of its original volume.

Primary Anaerobic Digestion

Raw sludge removed from primary settling tanks and thickened activated sludge are pumped to primary anaerobic Digester #1. The digesters are completely mixed by re-circulation pumps. The sludge temperature within the digester is maintained at a constant 95^0 F. The microorganisms conducive to this fermentation process convert the raw sludge to stabilized biosolids. A by-product of this biological process is Methane gas. It is used as an alternate fuel source by a hot water boiler. The 200^0 F water is pumped to a digester spiral heat exchanger. It is used as the primary heat source for the Administration, Digester and Tertiary Buildings.

Secondary Anaerobic Digestion

Sludge is transferred from primary Anaerobic Digester #2 to the secondary Anaerobic Digesters, #3 and #4. Although not heated, additional stabilization occurs due to the long detention time, currently in excess of 50 days. This extended digestion allows the sludge to exceed the EPA 503 Vector Attraction requirements of 38% volatile solids reduction and to meet current fecal coliform limits for a Class B Biosolid. These digesters are equipped with Dystor Domes, providing additional methane storage for enhanced utilization by auxiliary equipment.

Biosolids De-Watering

Stabilized biosolids are pumped to a Belt Filter Klam Press for dewatering. The press provides the plant with a means of continuously converting a liquid sludge into a moist dewatered cake. The biosolids are processed in three stages: Conditioning—the addition of a polymer to promote flocculation, Gravity Drainage—the portion of the equipment that allows the released liquid to pass through the weave of the belts, and Compression—the thickened biosolids are compressed between two belts at 250-300 psi for a controlled period. It is under these conditions that the material is converted to a moist cake and finally removed from the rear of the press by scraper blades. The cake is then transferred by a conveyor to a truck adjacent to the sludge thickener building. The dewatered biosolids are hauled to the onsite storage facility to be land applied, at agronomic rates, to area farmland.