Wastewater Treatment – Plant History and Overview

Wastewater Plant
1625 East Grove
Rantoul, IL 61866

Updated: October 2022

Index

Purpose

The purpose of the Village of Rantoul's Wastewater Treatment Plant (WWTP) is to treat the community's wastewater / sanitary water to protect our natural waterways, water users downstream of Rantoul, and the supply of water for future generations. This facility is specifically designed to remove organic and solid materials along with ammonia and phosphorus. This is achieved by a series of filters and clarifiers along with chemical addition.

Facility History

The original treatment plant was constructed in 1953. The facility consisted of a grit channel, two comminutors, two primary clarifiers, two conventional rock trickling filters, two final clarifiers, and a vacuum coil filter and sludge drying beds for sludge dewatering. This facility provided a secondary effluent which met the effluent standards in affect at the time.

In 1970, the capacity of the plant was expanded. Two primary clarifiers, two final clarifiers, an intermediate trickling filter using plastic media, a 24-million-gallon stormwater lagoon and pumping facilities, chlorination facilities, and sludge conditioning tanks were constructed. These improvements were made to satisfy the growing needs of the community and to meet the new effluent requirements of the State.

In 1985, the plant was expanded again to meet new effluent standards and to centralize the wastewater needs of Rantoul. The Westside Treatment Plant's capacity was increased to be able to eliminate the Eastside Treatment Plant and the Chanute Air Force Base wastewater treatment plant. This was the most cost-effective method to meet current effluent standards in affect at the time.

The 1985 upgrade included an 18 million gallon addition to the stormwater lagoon, three stormwater screw pumps, new raw sewage, secondary, and nitrification pumping facilities, three additional primary clarifiers, four secondary tower trickling filters, two new secondary clarifiers, four new nitrification tower trickling filters, two circular final clarifiers, two traveling-bridge filters, chlorination

system modifications, renovation of the anaerobic digester, additional sludge conditioning tanks, two belt filter presses for sludge dewatering, three sludge lagoons, and new sludge pumping facilities. This upgrade allowed the plant to potentially serve a population of 30,812 with average daily flows of 4.33 million gallons per day.

Since 1985, there have been minor updates including chemical addition of alum in 2014 to meet new phosphorus regulations. The latest updates in 2022 included rehabilitation of the north traveling bridge filter and new hypo tanks currently being installed.

In 2022, the plant once again needs a major overhaul as most of the equipment and basins are passed their expected life spans. New EPA regulations are also making these upgrades a necessity. There is a Capital Improvement Plan in place to address these concerns. It is currently in the design phase. It will be implemented over the next couple of years. This upgrade will change the plant from a trickling filter plant to an activated sludge plant. This will bring the plant back up to current industry standards and allow us to meet current and future regulations with ease.

Collection System Overview

The collection system feeding the WWTP is a combination of gravity mains, lift stations, and forced mains. The collection system gathers sanitary waste from both the Village of Rantoul and Thomasboro serving residential, commercial, and industrial users.

Flow of Water inside the WWTP

The water comes into the plant in the raw influent pit and flows into the stormwater diversion structure. The raw influent pit combines water from the collection system and the return from the storm lagoon. If flows max out, the water will spill over the trough into the storm pit where it will be pumped to the storm lagoon for temporary storage until it can be returned to the head of the plant.

From the stormwater diversion structure, it flows through the main influent gate which controls the amount of water that will flow into the main plant. This allows the flows to be cut back preventing the plant tanks from overflowing which could flood certain parts of the plant.

After the main influent gate, the water flows through the Parshall flume to measure flow and then through the fine screens followed by an aerated grit tank. The WWTP plant drain combines with the water at this point. Then it is pumped to the primary clarifiers via raw pumps. The raw pipes split the water between the north and south primary clarifiers.

After the primary clarifiers, the water flows into the secondary pump station which then pumps the water into the secondary trickling filter towers. The water then flows into the secondary flow splitter which splits the water between the north, middle, and south secondary clarifiers. At the secondary flow splitter box some of the water can be recirculated back to the secondary pump station to recirculate water into the secondary trickling filters during times of lower flows. This recirculation also allows the microbes another chance to consume more of the solids and nutrients in the recirculated water.

After the secondary clarifiers, the water then goes into the nitrification pump station which then pumps the water into the nitrification trickling filter towers. From the nitrification towers, the water flows into the final circular clarifiers.

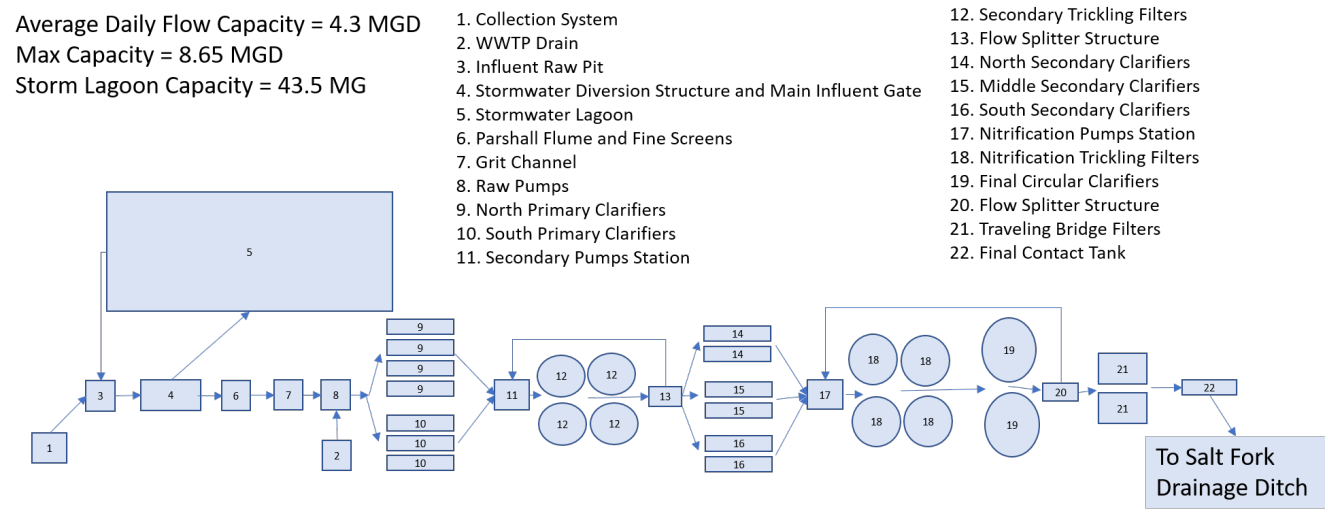
After the final clarifiers, the water flows into a flow splitter box next to the traveling bridge sand

filters. Some of the water at this point can be diverted back to the nitrification pump station. This diversion is to recirculate flow into the nitrification trickling filters during times of low flow. This recirculation also allows the microbes another chance to consume more of the solids and nutrients in the recirculated water. The remaining water flows into the traveling bridge sand filters.

After the traveling bridge sand filters, the water flows into the final contact tank. Finally, the water flows from the final contact tank into the Upper Salt Fork Drainage Ditch.

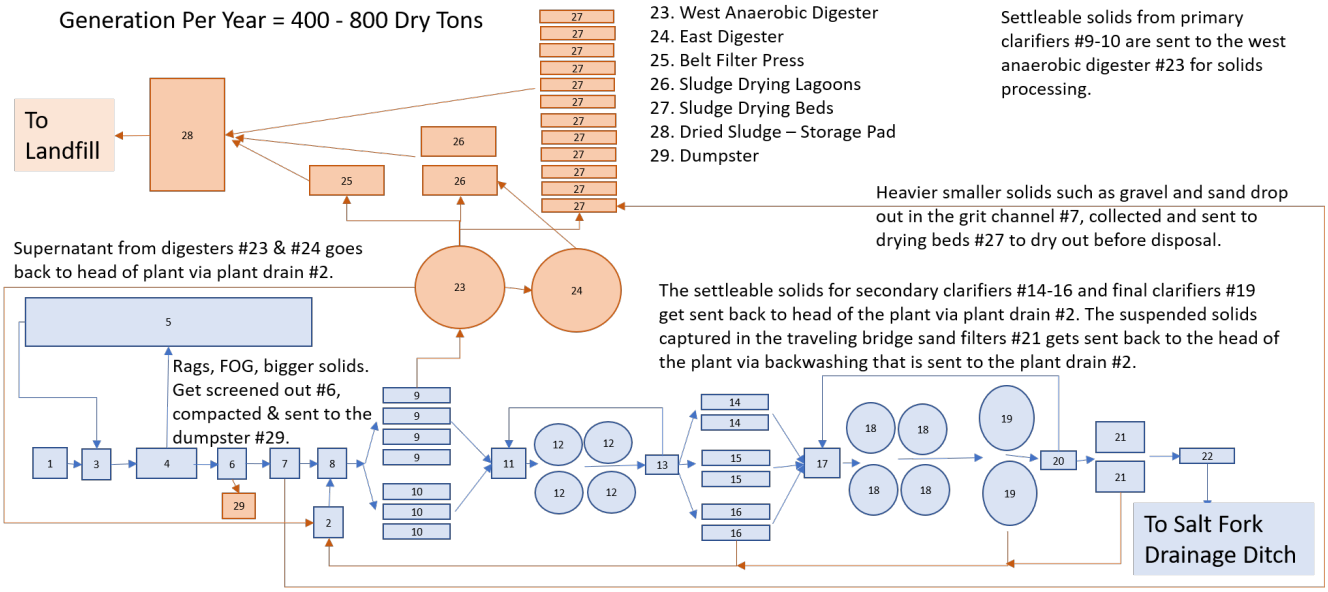
Some of the water is recycled. The water is pumped from the final contact tank via a well and stored in a pressurized tank. This water is then used for cleaning and plant processes throughout the plant via a non-potable water system feeding pumps and hoses.

Figure 1: Flow of Water



Flow of Solids inside the WWTP

Figure 2: Flow of Solids



Solids are part of the influent wastewater ranging in size from rags to rocks to microscopic particles.

The bigger solids that don't break up are screened out of the water by the fine screens just after the water passes through the main influent gate. Immediately following the fine screens, the heavier smaller solids such as rocks that make it past the screens are removed via the grit channel. The solids are collected from the screens and grit channels.

The solids from the screens are compacted and then sent to the landfill via a dumpster and trash service. Most of these solids are items that shouldn't have been flushed down the toilet such as fats, oils and grease, "flushable" wipes, toys, etc. The fats, oils and grease form balls which can be screened out.

The solids from the grit channel are stored in a drying bed and allowed to dry. Once dry, the solids are disposed of by sending them to the landfill. Most of these solids are items picked up from inflow into the collection system which has picked up sand and gravel along the way.

The remaining solids in the wastewater are treated and removed throughout the treatment plant process. The majority of these solids consist of organic material which contains nutrients and other chemicals along with bacteria. The primary clarifiers settle out a big portion of these remaining solids. Multiple times a day the solids that settle to the bottom of the clarifiers, now known as sludge, are partially pumped out and sent to the west anaerobic digester. Every day, part of the sludge in the anaerobic digester is dewatered by one of the following three processes: drying beds, drying lagoons, or ran through a belt filter press. Once dried the sludge is stored on the storage pad. Once enough accumulates, the dried sludge is then sent to the landfill for disposal.

Once the water leaves the primary clarifiers, there are still some solids in the water. The secondary trickling filters grow bacteria designed to eat some of the nutrients and solids from the water. In the secondary clarifiers, some solids settle out and are pumped back to the head of the plant.

The water continues on to the nitrification towers where more bacteria grow to eat and remove ammonia from the water. Alum is fed at the final clarifiers which captures some of the remaining phosphate and helps solids settle out as well. The solids that settle out in the final clarifiers are pumped back to the head of the plant.

Whatever solids that still happen to be in the water once it flows into the traveling bridge sand filters are then filtered out by the sand. The traveling bridge is continually backwashing the sand and sending the solids captured back to the head of the plant.

After the traveling bridge sand filters, the solids in the water should be low enough to safely be sent to the Upper Salt Fork Creek meeting IEPA requirements for both total suspended solids, phosphate levels, and ammonia levels.

Purpose of Processes

- **Stormwater Diversion and Influent Main Gate** – To prevent the treatment plant from flooding and treatment processes from being overloaded. To provide temporary storage of wastewater for plant maintenance if needed especially in emergencies.
- **Fine Screens and Grit Channel** – To remove non-organic solids and fats, oils, and grease (FOG) from the wastewater.
- **Primary and Secondary Clarifiers** – To remove settleable solids from the water.
- **Secondary Trickling Filters** – To utilize bacteria to eat / remove organic solids from the

water.

- **Nitrification Trickling Filters** – To utilize bacteria to eat / remove ammonia from the water.
- **Final Clarifiers** – To remove settleable solids from the water. This is also utilized as a place to add alum to chemically settle out some of the remaining phosphate from the water.
- **Traveling Bridge Sand Filters** – To remove suspended solids from the water.
- **Final Contact Tank** – To provide contact time for the sodium hypochlorite to kill bacteria still in the water during the warmer months (May – October) and provides a place to remove the remaining chlorine via sodium bisulfite before it enters the Upper Salt Fork Creek.

Chemical Addition Summary and Purpose

There are four bulk chemicals that are fed at different points in the treatment process to remove phosphate, kill bacteria, and help dewater sludge. The four chemicals are aluminum sulfate, sodium hypochlorite, sodium bisulfite, and clarifloc.

Aluminum sulfate (alum) is used to chemically remove the phosphate settling it out of the water with the settleable solids. This is added in the final clarifiers.

Sodium hypochlorite (hypo) is used to kill biomass / bacteria in the water. It is fed all year long at the head of the traveling bridge sand filters to prevent bacterial growth in the sand filters. It is also fed during May to October at the head of the final contact tank to kill bacteria in the water before it enters the Upper Salt Fork Creek.

Sodium bisulfite is added near the end of the final contact tank to remove any remaining chlorine residual from the water before it enters the Upper Salt Fork Creek.

Clarifloc (Polymer) is added to the sludge just before the belt filter press to floc the solids together concentrating them and improving the dewatering process.

Figure 3: Chemical Feed Points