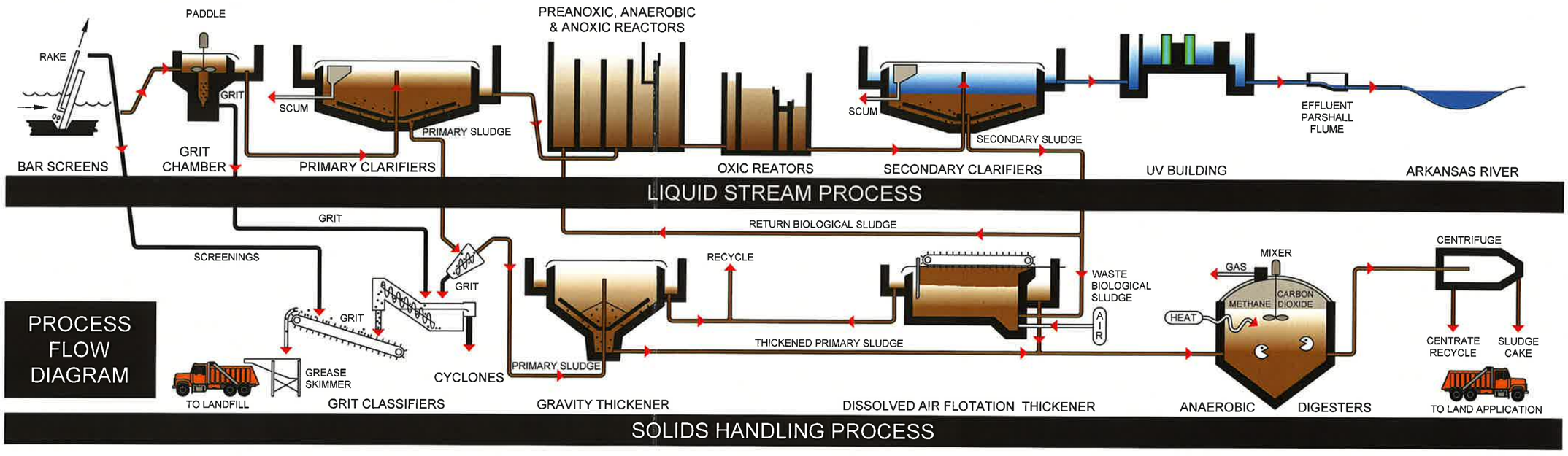
CITY OF PUEBLO
Wastewater Reclamation Facility

CHANGING WASTEWATER INTO CLEAN WATER



Introduction

Dedicated in October 1989, Pueblo's Wastewater Reclamation Facility is the culmination of a planning process that began in 1977 to replace the City's deteriorating 50 year old treatment facility. The Colorado Water Quality Commission adopted standards for the Arkansas River. Pueblo worked with the 208 management plan to design a new facility that could meet the standards. The Colorado Department of Public Health and Environment approved the final version of Pueblo's 201 Facilities Plan in 1983 and design was completed a year later. Construction began in 1985 and the plant was fully on line by May 1989. Pueblo has wholeheartedly committed itself to fulfilling the Clean Water Act goal, meeting or exceeding all permit requirements.

Preliminary Treatment

Raw wastewater from Pueblo's sewer system enters the plant 12 feet below ground level and first flows through two **BAR SCREENS** in the headworks building. The bars are spaced 1-inch apart to remove large objects such as rocks, logs, and rags. Rakes automatically clean deposited debris off the bars and dump it on a conveyor belt, where they are carried to a waiting dump truck to be hauled to a disposal facility.

Following the **BAR SCREENS**, four 6-foot diameter enclosed screw pumps lift the incoming flow 29 feet to start its gravity flow path through the front portion of the plant.

A motor-driven paddle gently swirls raw wastewater inside the 18-foot diameter **GRIT CHAMBER**. The resulting vortex separates heavy grit particles such as sand to the lower center chamber where they are pumped off. Degritted wastewater overflows the side and continues to the next process.

Primary Treatment - Gravity Settling

In the **PRIMARY CLARIFIERS** wastewater is quietly detained for 3 to 5 hours in two tanks. Heavier sludge particles separate by gravity to the bottom and are scraped into a hopper for pumping. Floating grease and scum are also skimmed into hoppers for pumping. The remaining wastewater flows over V-notch weirs to the next process.

Sludge is pumped from the bottom of the Primary Clarifiers to **CYCLONES** in the headworks building. Swirling flow inside the **CYCLONES** separates grit out of the sludge. Grit then dumps into **GRIT CLASSIFIERS** where lighter weight organic matter that was captured with the grit is washed away and returned to the front end of the plant via the Recycle line. Washed grit is then dumped onto the conveyor belt where it is carried to a waiting dump truck.

Secondary Treatment - Biological

The Biological Nutrient Removal (BNR) Facilities consist of two **PRE-ANOXIC**, two **ANAEROBIC**, two **ANOXIC**, and eight **OXIC REACTORS**.

Return activated sludge (RAS) is delivered to the **PRE-ANOXIC REACTORS** which serve as the first step in the BNR process, and remove dissolved oxygen (DO) and nitrate in the RAS before it enters the **ANAEROBIC REACTORS**.

In the **ANAEROBIC REACTORS**, phosphorus accumulating organisms (PAOs) take up volatile fatty acids (VFAs) and release internal phosphorus, which promotes the further uptake of phosphorus in the **OXIC REACTORS**.

A baffle wall separates the **ANAEROBIC** and **ANOXIC REACTORS**. On the downstream side of this baffle wall, nitrified mixed liquor is returned to the anoxic zones through the mixed liquor return (MLR) pump station and piping. One function the MLR provides is a biologically mediated reaction where soluble carbon is oxidized and nitrate is reduced to nitrogen gas, which vents to the atmosphere. Another function of the MLR is the dilution of the influent ammonia, which becomes the resulting nitrate concentration in the final effluent. Depending upon the MLR pumping rate, up to 70 percent of the nitrate produced through oxic zone nitrification can be removed using this method.


Anoxic Reactor

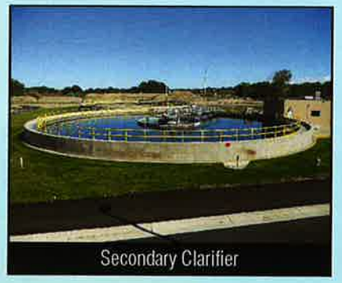
The **OXIC REACTORS** are the last BNR process step. The oxic reactors provide an aerobic environment for final biological oxygen demand removal, nitrification, and the luxury uptake of the phosphorous which is the mechanism by which PAOs reabsorb all of the phosphorous they release in the **ANAEROBIC REACTORS**, in addition to most of that in the primary effluent. The oxic basins also remove, through biological nitrification, primary effluent ammonia concentration.

Water and microorganisms leave the **OXIC REACTORS** and settle in the calm water of three **SECONDARY CLARIFIERS**. Here, the microorganisms clump together and fall by gravity, leaving clear, clean water on top. Pumps suck the microorganism sludge off the bottom of the tanks and pump almost all of it back into the **PREANOXIC REACTOR** to seed the activated sludge. The remaining clear water on the top of the tanks flows over V-notch weirs and continues to the disinfection process.

Solids Handling

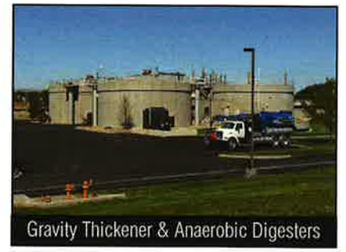
After flowing through the **CYCLONES**, degritted primary sludge enters the **GRAVITY THICKENER** to remove excess water. Thicker sludge material falls to the bottom of the 40-foot diameter tank where it is scraped into a center hopper and pumped to the Digesters. Excess water rises to the top, overflows the tank weirs and returns to the front end of the plant via the recycle line.

Two **DISSOLVED AIR FLOATATION THICKENERS** located in the sludge processing building also remove excess water from the sludge prior to entering the Digesters. In this case, the secondary sludge they receive from the **SECONDARY CLARIFIERS** is mostly waste organisms from the **OXIC REACTORS**. The microorganisms are about the same density as water and therefore do not readily separate from water by gravity. These thickeners separate from sludge from water by injecting tiny air bubbles into the tank, which attach to the sludge particles and float them to top. Skimmer arms across the top of the tanks push the floating sludge blanket into a hopper where it is pumped into the Digesters. Excess water below the sludge blanket returns to the front end of the plant via the recycle line.


Secondary Clarifier

Four **ANAEROBIC DIGESTERS** biologically reduce the organic content of raw sludge to the point where it can be applied on the land without causing odor and health problems. Thickened primary sludge from the **GRAVITY THICKENER** and thickened biological sludge from the **DISSOLVED AIR FLOATATION THICKENERS** is slowly fed into the digesters while draft tube mixers keep the contents stirred and boilers keep the contents heated to 95 degrees F. The biological digestion is an anaerobic process, that is, the microorganisms live without oxygen. Steel dome covers on the Digesters keep air out of the process and collect methane and carbon dioxide gas produced from the digestion. Digester gas is burned in boilers to heat the Digesters and the plant buildings.

Two **CENTRIFUGES** on the second floor of the sludge processing building dewater digested liquid sludge from the Digesters to the consistency of pudding. This dewatering operation represents five-fold reduction in volume, which is necessary when the City has to haul the sludge to land application sites, The **CENTRIFUGES** separate excess water from heavier sludge particles by spinning sludge at 1995 RPM to create a centrifugal force 1350 times the force of gravity. Dewatered sludge cake drops into


Gravity Thickener & Anaerobic Digesters

waiting **TRAILER TRUCKS** for hauling to the on-site sludge storage area or directly to land application sites. Excess water drains back to the plant via the Recycle line.

Disinfection

The objective of the **UV DISINFECTION SYSTEM** is to disinfect the water to the level required to meet or exceed the National Pollutant Discharge Elimination System (NPDES) permit effluent limits for *Escherichia Coli*, commonly referred to as *E. Coli*. Microorganisms in the water are exposed to UV light when they pass by UV lamps submerged in the wastewater. The UV light instantly destroys the genetic material within bacteria, viruses, and protozoa, eliminating their ability to reproduce and cause infection. Unable to multiply, the microorganisms die and no longer pose a health risk.