City of St. Cloud, MN

Where Continuous Improvement is the Standard Operating Procedure

The City of St. Cloud is located in central Minnesota a little more than one hour north of the Minneapolis and St. Paul metropolitan area. The City of St. Cloud's wastewater treatment system consists of 290 miles of sewer main, 36 liftstations, and a newly rehabilitated, expanded and upgraded biological nutrient removal (BNR) facility that can treat 17.9 million gallons a day. The city provides wastewater treatment services to five neighboring communities.

The dedicated staff of wastewater treatment professionals employed by the City of St. Cloud has developed a culture of continuous improvement. This dedication is recognized immediately when you arrive at the facility. Meticulous maintained buildings and equipment, well-manicured grounds, and impressive granite buildings that remind visitors of St. Cloud's proud heritage. It is easy to be caught off guard by the facility; it is not what people normally imagine when they think about a wastewater treatment facility.

The city just recently completed a $48M wastewater treatment facility improvement project. The project included the rehabilitation of 40 year old structures and equipment, upgrading the treatment process from activated sludge to a biological nutrient removal process, upgrading disinfection by using ultraviolet technology and expansion from 13 million gallons a day capacity to 17.9 million gallons a day.

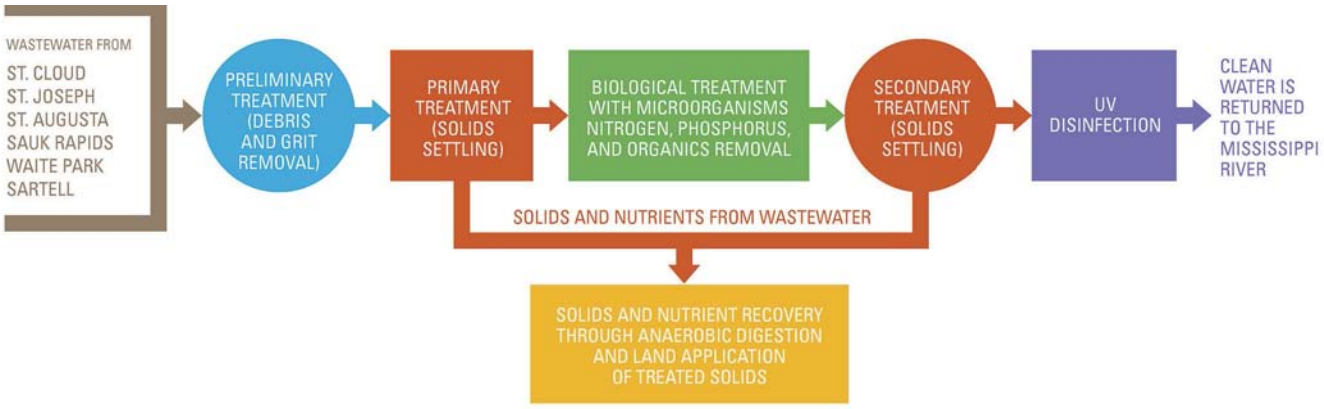
A HOLISTIC PLANNING PROCESS

The planning for the improvement project began over 13 years ago with discussions with area stakeholders regarding the need for rehabilitation to provide capacity for future growth. A key aspect of the discussions and planning was to incorporate St. Cloud's culture to not simply meet current regulatory requirements, but to exceed them in the short and long term.

To collaborate and plan for the upcoming project, a subcommittee of a joint area cities planning group was formed. The subcommittee was named the St. Cloud Area Wastewater Advisory Commission or SCAWAC. SCAWAC membership consisted of at least two members from each community. The goal of SCAWAC is to promote the equitable and efficient distribution of wastewater treatment facility cost and services. SCAWAC's presence was crucial to the success of the project. The City of St. Cloud staff met with SCAWAC often throughout the planning, design and construction phases of the improvement project to ensure success.

The city was able to overcome several challenges by working with key stakeholders including the five other communities served by the WWTF and their respective councils, regulatory agencies, environmental advocacy groups and the public.

WASTEWATER TREATMENT PROCESS - PROTECTING OUR WATERWAYS



PRELIMINARY AND PRIMARY TREATMENT

Ninety-eight percent of the wastewater flows to the Main Lift Station located three miles north of the treatment facility. The Main Lift Station has a barscreen and wash press. The remaining flow enters through two lift stations that are directly connected to the 30" forcemain and from one contract city, which enters the headworks just prior to another bar screen and wash press. Wastewater flows through a vortex grit removal system and a splitter box prior to entering the four primary clarifiers.

SECONDARY TREATMENT

The secondary treatment system was upgraded to a biological nutrient removal system using a Modified Johannesburg Recycle system. Although the facility's current NPDES permit does not have a nitrogen limit, the City incorporated nitrogen removal into the facility design to provide additional environmental protection and also to prepare for future regulatory requirements.

The facility has the flexibility to operate exclusively in Bio-P mode (Biological Phosphorus Removal) or in Full BNR mode (Nitrogen & Phosphorus Removal). With four treatment trains in service, the capacity of the trains to operate in Bio-P mode is 17.9 MGD. When operating in full BNR mode, the capacity of the four trains is 15 MGD.

Wastewater then flows through a BNR basin flow splitter box. The flow splitter box is a hexagonal cast-in-place structure. The splitter box was designed as a hexagon to distribute flow evenly for the future fifth BNR treatment train.

The three existing aeration trains and final clarifiers were rehabilitated into new BNR treatment trains and a fourth BNR treatment train was constructed. An innovative feature of the project was the conversion of the existing final clarifiers into oxic volume. The existing wastewater treatment facility had three 90-foot diameter rim-feed final clarifiers, with operating depths of 12 feet. The drive mechanisms and related equipment had well exceeded the industry standard for useful life. Instead of demolishing the final clarifiers, they were converted to oxic volume for BNR treatment trains 1-3. By converting the clarifiers, the city gained the required hydraulic capacity to incorporate nitrogen removal. This reuse of existing structures saved users of the WWTF several million dollars in capital cost.

Each BNR treatment train consists of a pre-anoxic zone, an anaerobic zone, an anoxic zone and an oxic zone prior to final clarification. The process engineers from Black & Veatch incorporated three separate anoxic zones. The second and third anoxic zones are called "swing zones." If the facility is running in Bio-P mode, the second and third anoxic zones are operated as oxic volume. In BNR mode, the air is shut off in these zones so there is additional capacity for nitrogen removal.

The facility has four new 110-foot diameter final clarifiers. Wastewater from the BNR treatment trains flows to the final clarifiers prior to disinfection.

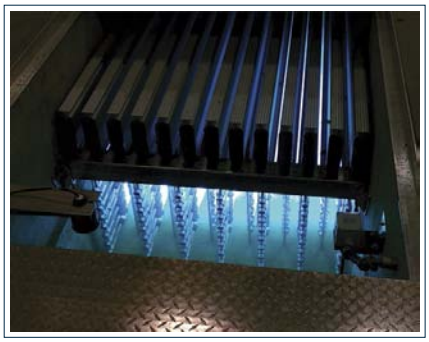
DISINFECTION AND SOLIDS PROCESSING

The chlorine and sulfur dioxide gas disinfection system was replaced with ultraviolet light disinfection using a Trojan 3000+ UV light system. There are two channels that can disinfect 17.9 MGD each.

Solids processing starts with the primary solids and waste activated solids being dewatered by a gravity belt thickener. The city has two primary anaerobic digesters, one secondary and one storage digester. The city produces over 13 million gallons of biosolids a year. This highly valuable agricultural product is recycled on approximately 2,000 acres of state approved application sites. It is a highly sought-after product.

BNR TREATMENT TRAIN

UV LIGHT SYSTEM



Click HERE to return to Table of Contents

IMPACT OF SOLIDS PROCESSING CHANGE

The Facilities Plan originally included the conversion of a secondary anaerobic digester to a primary digester because solids retention times required to meet Class B biosolids was getting close to the minimum 15 days. At that time, the city sent the primary solids to the anaerobic digester and the waste activated sludge was going to dissolved air floatation devices. During the optimization of a new gravity belt thickener that was installed in late 2003, both primary solids and waste activated solids were sent to the gravity belt thickener. This change in solids processing resulted in increasing SRT's from 16 days in 2004 to 30+ days. This helped the city avoid approximately $12 million in capital expenditures.

The solid processing change also eliminated the need for side stream treatment and the potential for slug loading from the decanted portion of the biosolids. In the past, slug loading from decant increased loading to the system several times above normal and limited pollutant removal efficiencies due to filamentous bacteria growth and foaming in the activated sludge tanks.

PERFORMANCE

After substantial completion of the construction project, the facility pollutant removal rates exceeded the design and staff expectations. A comparison of annual pollutant loading in 2008 (before construction) versus 2012 (post construction): the facility has reduced the discharge of nitrogen by over 46,000 pounds and phosphorus by over 19,000 pounds.

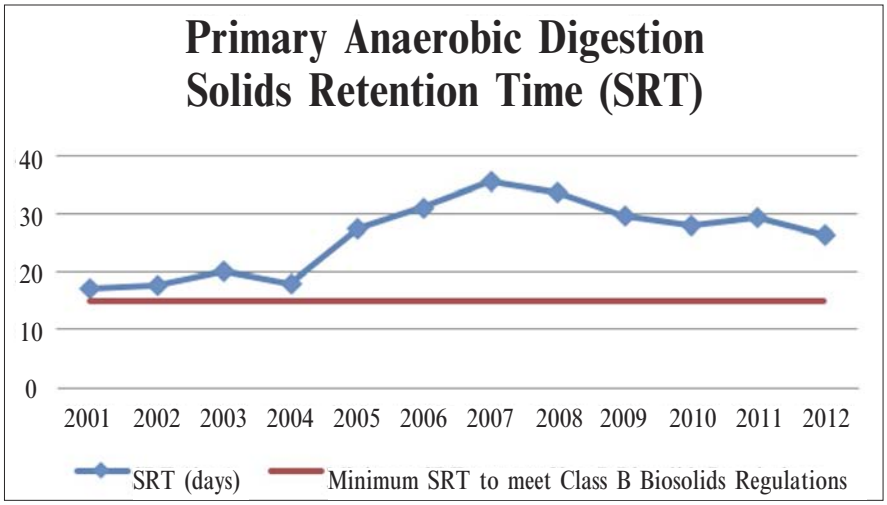
An additional benefit to the improvement project was the increased removal efficiency for total suspended solids and biochemical oxygen demand. Prior to project completion, the effluent averaged 6 mg/L for BOD and TSS; now the effluent concentration averages less than 2 mg/L. The majority of the results are below the laboratory method detection limit. In 2012, the facility discharged 118,769 fewer pounds of TSS and 135,605 fewer pounds of BOD than it did in 2008.

CONCLUSIONS

The performance results and success of the recent project is a direct reflection of the culture of continuous improvement mindset of the staff. Significant effort and ingenuity is always on the to-do list with protecting the receiving water as a primary daily objective.

FINAL CLARIFIER MECHANISM

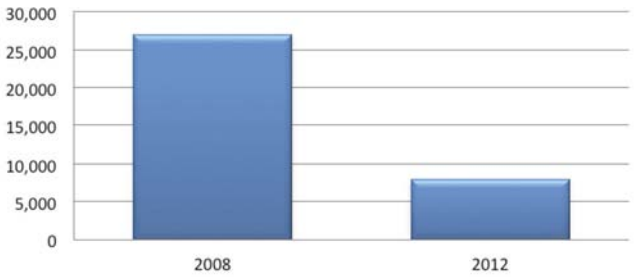
OXIC



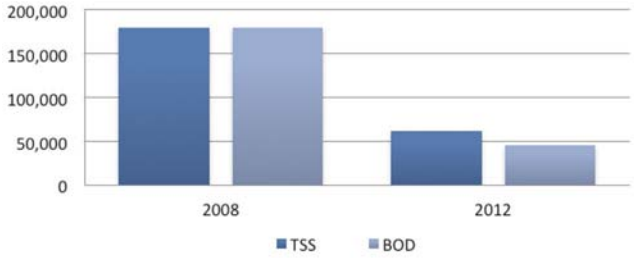
As the project reaches final completion, city staff continues to strive for improvement. The city was recently notified by the National Biosolids Partnership that the Biosolids Environmental Management System (EMS) Program has achieved Gold Level certification. Gold Level certification is a result of substantial effort by the facility's EMS Team and the ongoing commitment to continuous improvement.

Facility staff are now focusing on providing cost-effective services by researching potential energy resource and recovery options that can be employed at the facility. The goal is to always go above and beyond. CS

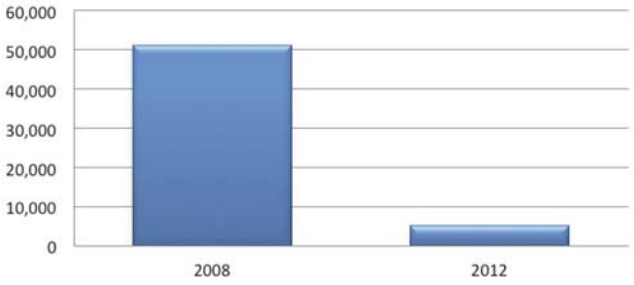
TOTAL ANNUAL POUNDS OF PHOSPHORUS IN EFFLUENT



TOTAL ANNUAL POUNDS OF TSS & BOD IN EFFLUENT



TOTAL ANNUAL POUNDS OF AMMONIA IN EFFLUENT



Click HERE to return to Table of Contents