Integration of Decentralized Wastewater Management Concepts Into an Urban “Centralized” Infrastructure in Mobile, Alabama

USEPA National Decentralized Wastewater Demonstration Project
Three Mile Creek Watershed
Mobile, Alabama

Final Report

Mobile Area Water and Sewer System
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Introduction

Traditionally, wastewater (including solids) has been collected in relatively large diameter sewers and transported long distances to a “centralized” mechanical treatment plant. Solids handling (clarification, dewatering, digestion, disposal, etc.) defines much of the design, layout, and cost of this collection and treatment system. The treated wastewater, collected from throughout a large service area (or watershed) and transported great distances to a treatment facility, is typically discharged to a surface stream at one location. This concentrated discharge must be thoroughly treated (and regulated) to minimize water quality impacts to the receiving stream. To keep this large, complex collection and treatment system operating properly, a large capital investment in infrastructure (large mechanical treatment plants, large diameter sewer lines, pump stations, etc.) and significant yearly operation and maintenance requirements (trained full-time operators, power costs, equipment/infrastructure repair, solids handling, etc.) are needed.

Decentralized wastewater management (DWM), by contrast, is defined as “the collection, treatment, and disposal/reuse of wastewater at or near the point of wastewater generation” (Tchobanoglous, 1995). Treatment facilities that serve portions of a community (sometimes called satellite treatment plants) can also be classified as decentralized facilities (Crites and Tchobanoglous, 1998). Key concepts employed by decentralized systems that offer advantages in both operational simplicity and cost effectiveness include:

1. Minimization of collection system (total length and diameter, where appropriate),

2. Use of simple, low O&M treatment technologies,
3. Minimization of solids handling, and
4. Use of localized disposal and/or reuse of the treated wastewater

These decentralized concepts have been touted as a way to minimize infrastructure costs (both capital costs and O&M), while efficiently protecting public health and the environment. This nationally recognized demonstration project is being operated to "integrate decentralized wastewater management concepts into a traditional urban centralized wastewater system" by extracting wastewater directly from a large interceptor sewer, treating locally using innovative, low O&M technologies, and then reusing the treated effluent locally to drip irrigate (sub-surface) a newly created urban park.

Primarily, the project is attempting to demonstrate to regulatory authorities, small communities, utilities, and other wastewater professionals the feasibility and cost-effectiveness of:

1. Integration of decentralized concepts into an urban centralized system, and
2. Urban reuse of treated wastewater, thus conserving drinking water supplies.

In addition, the project is attempting to show that these decentralized concepts can help minimize stream loadings (thus affecting TMDLs and watershed management) and show that decentralized (or satellite) wastewater treatment concepts can be a part of an overall strategy to address capacity issues. Watershed loadings and TMDL restrictions are currently EPA's focus for regulating water quality. Decentralized wastewater concepts and reuse may offer a cost-effective way of reducing stream loadings, while providing added value benefits such as irrigation water.

Successful demonstrations of decentralized concepts and technologies and urban reuse applications, and educational outreach may offer viable alternatives to many urban water/wastewater utilities facing similar wastewater management issues related to costs, infrastructure, watershed protection, and conservation of drinking water supplies.

Background

The Mobile Area Water and Sewer System (MAWSS) is the wastewater utility serving much of the metropolitan area of Mobile, Alabama (population ~200,000). Like utilities in many other urban areas in the U.S., MAWSS is constantly evaluating and upgrading the capabilities of its traditional centralized wastewater management system focusing on cost effectiveness, infrastructure needs, and watershed protection.

Since 1999, MAWSS has undertaken the implementation and management of several decentralized (cluster) wastewater treatment facilities (DWWTF) in the developing west-Mobile area, outside the existing sewer system boundary (watershed). Each DWWTF services between 50 and 300 homes (equivalent). STEP or STEG collection (small diameter) systems have been followed by recirculating media filters (sand or textile) for treatment in these operating cluster systems. MAWSS's experience with these decentralized cluster systems has led to an increased understanding of the key advantages and disadvantages of the decentralized infrastructure concept.

The involvement of MAWSS in both centralized and decentralized wastewater infrastructure and management, and its significant involvement in Three Mile Creek watershed protection measures (Clean Water Action Plan, a major water quality study, I&I and SSO corrective actions, and capacity issues) offered a unique opportunity to evaluate the integration of decentralized wastewater infrastructure and management concepts into an urban sewered environment. Information about the implementation of decentralized wastewater infrastructure, costs, performance, viability, and management, were needed in order to make educated decisions about infrastructure and policy.

Conservation of drinking water resources is another issue that all water management entities are now providing emphasis. In 2007 and 2008, surface water supplies in the Southeastern U.S. have been severely depleted due to drought conditions and water use restrictions were implemented in many areas. MAWSS, as the managing utility for Mobile's drinking water and wastewater systems, is keenly aware that significant quantities of its potable water production is used for urban landscape irrigation–estimated at approximately 10 percent of total production. This demand becomes critical during dry-weather periods and is applicable nationwide. Ways to conserve drinking water resources should be a key part of the nation's and a community's "sustainability" plan.

A strategy for reusing treated wastewater, via underground irrigation, near the source of generation may help alleviate some of the demands on drinking water supplies and help disperse wastewater disposal throughout a watershed and not at a single, in-stream location. In-ground disposal of carbon, nitrogen, and phosphorus compounds (contained in wastewater) at several locations throughout a watershed may help minimize loadings to surface waters, thus helping to improve stream water quality. Subsurface drip irrigation is a disposal method that can provide for irrigation water demand (and some natural vegetation nutrient demand), yet limits public accessibility. Designed so that treated wastewater is input into the shallow subsurface (6- to 10-inches below grade) where plant uptake and biological action are greatest, the drip disposal system is sized based on established plant uptake rates and/or soil hydraulic acceptability. Subsurface drip disposal thus offers applications in urban environments for landscaping of commercial facilities, transportation corridors, parks, recreational fields, etc. Long-term viability of drip disposal systems require at least secondary treatment and in some cases, disinfection.

Another issue experienced by many aging municipal wastewater systems is insufficient infrastructure capacity (sewers and treatment facilities) and the inability to adequately accommodate peak flows. A comprehensive examination of the multiplicity of causes of this condition, and sewer system overflows (SSOs) that are all too often the result, is convincing evidence that the operation of centralized wastewater transportation and treatment facilities can benefit from permanent and/or intermittent incremental reduction of interceptor flows. A recent *Water Environment Research Foundation* report (Wet Weather Flow Management: A Research Needs Survey for Urban Areas, 1998) listed the following priorities (that this demonstration project significantly addresses):

- *Source reduction or elimination, where possible, accompanied by treatment, provides a long-term, sustainable solution to wet weather flow (WWF) problems.*
- *Innovative management strategies that are more compatible with bottom-up integrated watershed management must be developed.*
- *Methods are needed to integrate management of urban WWFs and watershed management.*
- *Documented cases are needed of "success stories" of how a high level of environmental quality would enable communities to make their waterways focal points of redevelopment.*
- *On-site and local wet weather flow re-use systems should be evaluated with particular attention to re-use for irrigation and cooling water.*
- *Unconventional sewer systems and flushing systems should be evaluated*.
- *More rigorous methods are needed to evaluate the efficacy of storage and treatment and other BMPs (including monitoring).*

Finally, the City of Mobile has recently developed urban property adjacent to Three Mile Creek as a recreational park. The City has improved the park with walking trails, landscaping, playground construction, and picnicking structures that encourage access to the park for neighborhood residents. Subsurface irrigation for landscaping and grassing are integrated into the park.

Study Area

The proposed project site is adjacent to the Three Mile Creek in midtown Mobile, a city of about 200,000 people. The Three Mile Creek Interceptor Sewer collects wastewater from a large portion of north and west Mobile and transports it to the Wright Smith Wastewater Treatment Facility (~10 MGD capacity) just north of downtown near the confluence of Three Mile Creek and the Mobile River. The demo project was designed to divert approximately 40,000 gallons per day of raw sewage from the Three Mile Interceptor Sewer to the Lake Drive Park Demonstration Facility for treatment and subsurface drip disposal. Irrigation for landscaping and grassing will be key components in this urban re-development project.

The area designated for the treatment systems, pumping units, and UV disinfection is near MAWSS' stormwater attenuation tank (SWAT) and is enclosed within a locked and fenced area. The subsurface drip dispersal areas are located in a grassy area just to the west of the treatment facility along Three Mile Creek and generally to the north of a small lake. The proposed drip irrigation zone will be limited to the areas East of the Park access drive ensuring a buffer of approximately 300 feet from the nearest residence. The project area is shown below in figure 1.

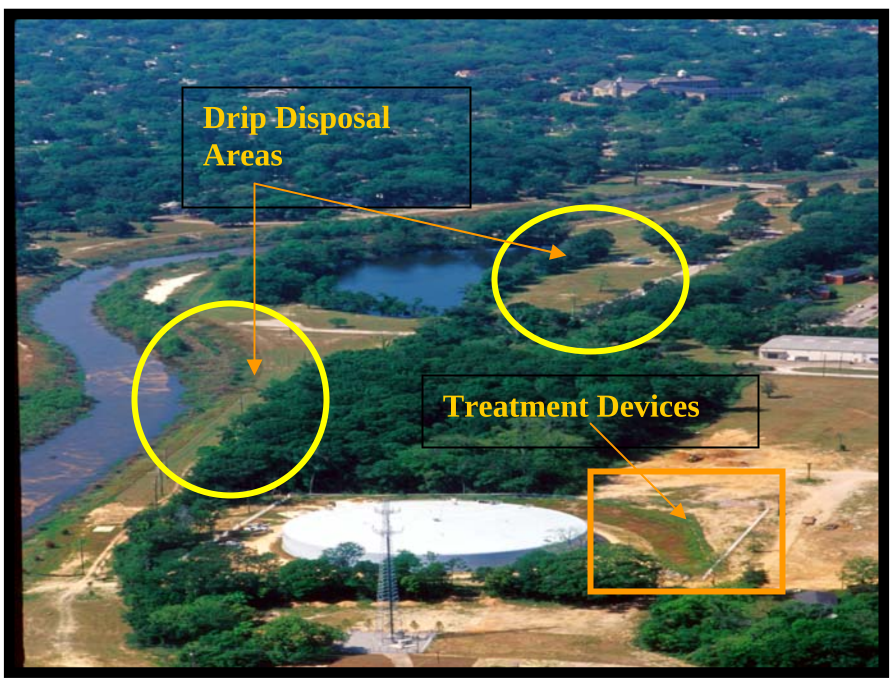

Figure 1. Project Demonstration Site along Three Mile Creek.

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Soils exploration work in the drip disposal area indicated firm sandy soils from the surface to about elevation –15 to –20 feet with the sands being underlain by stiff clays to about elevation –40 feet. The ground in the area of the walking trails (figure 2 below) is relatively flat at elevation +9 ft. Soil borings in this area indicate loose to firm sands from the surface to about elevation –10 ft. A thin layer of wood was encountered, which, was underlain by medium consistency clays to the boring termination elevation of – 21 feet. Ground water was found to be present at elevation +3 feet (about 6 feet below the surface).

The average rainfall in the Mobile, Alabama area is approximately 64 inches of rain. The peak months of July through September typically average 6 or more inches of rainfall. The average temperatures for Mobile range from 77.4 F to 57.4 F.

Figure 2. Subsurface drip irrigation area near walking trails.

PROJECT OBJECTIVES

In an effort to address a number of wastewater and urban watershed management issues, MAWSS, Volkert and Associates, Inc., and the University of South Alabama (USA) are cooperating to implement and operate a project that has as its primary objectives to:

1. Demonstrate a concept of integrating decentralized wastewater elements into a centralized wastewater system that may offer advantages to large, urban utilities. Decentralized treatment systems to be implemented are characterized by minimal collection and solids handling, low O&M technologies, and employing reuse—thus are relatively cost efficient to build and operate when compared to conventional treatment systems. Operational effects on the existing centralized treatment facility should be minimal, however, reuse benefits, capacity enhancement benefits, and some watershed load reductions should be recognized. Costs and performance information are being identified. Decentralized treatment systems (typically low O&M) will be evaluated in terms of cost, performance, capacity, and flexibility under conditions of:

    a. diurnal flow variation
    b. dry weather flows
    c. wet weather flows

2. Demonstrate to (and educate) our local environmental regulatory agency (ADEM) and other water/wastewater utilities that urban wastewater reuse is viable in Alabama and has many applications that offer benefits to drinking water source conservation and watershed management.

5.0 PROJECT APPROACH

Project Participants

Key to the success of the project will be the involvement of a variety of technical, management, and community support personnel.

1. Mobile Area Water and Sewer System. MAWSS is the urban utility providing water and wastewater services to the City of Mobile, Alabama (city population 198,915) and surrounding areas. Traditionally providing wastewater services via a centralized collection system and three (3) centralized treatment facilities, MAWSS is currently implementing several decentralized cluster systems in areas outside the watershed boundaries of the existing centralized sewer system. Project oversight and operation were coordinated by MAWSS.

2. Volkert & Associates, Inc., is a full service, professional engineering consulting firm headquartered in Mobile, that has taken the lead role in engineering a number of wastewater projects for MAWSS, including the decentralized cluster systems, now in operation. Design and construction of the wastewater and reuse elements of the project were coordinated by Volkert.

3. The University of South Alabama, Department of Civil Engineering. Dr. Kevin White, a professor at USA, has researched small community wastewater issues and technologies for over fifteen (15) years at USA. Dr. White will coordinate monitoring the performance of the installed systems.

4. The City of Mobile (Parks and Recreation Department, and Engineering). Elements of the project (siting, infrastructure needs, etc.) obviously needed coordination with the City's plan for the park.

Technical Approach

The demonstration project was implemented to:

1. Target an urban sewer interceptor line in an urban area that is sometimes subject to over-capacity conditions, during extreme storm events,

2. Extract a constant daily wastewater flow from the targeted interceptor,

3. Treat the extracted wastewater locally, using several, small, low O&M treatment technologies that can be evaluated, and

4. Re-use the treated effluent to irrigate (by subsurface drip) a community stream-side park (created in association with the City of Mobile) in an older urban area of the City in need of redevelopment.

Three small treatment systems (designed to treat approximately 40,000 gpd of wastewater) were installed to treat wastewater extracted directly from the Three Mile Creek interceptor sewer in urban Mobile. Following pretreatment (using a rotary mechanical screen) to remove solids (which will be reintroduced back into the interceptor), wastewater was treated to secondary levels, disinfected via UV, and then dosed to a subsurface drip irrigation system within the urban community park. Figure 3, below, shows a schematic of the process.

A major component to this project was the evaluation of several treatment technologies for this type of application. An attached-growth process (Aquapoint Bioclear™), and two fixed-film-activated-sludge systems (Delta BioPod™ and

Biomicrobics FAST™) were operated to treat fine-screened effluent. Figures 4, 5, and 6 show the treatment units selected. Cost (both capital and O&M) and performance data were evaluated. Pollutant concentrations (BOD, TSS, nutrients, and pathogenic indicators) were monitored in effluents, in groundwater, and in runoff to validate performance.

This innovative concept is attempting to demonstrate a cost-effective methodology for reusing treated wastewater as irrigation water in an urban setting, minimizing collection system capacity concerns, potential sewer system overflows, and treatment plant capacity issues. By minimizing

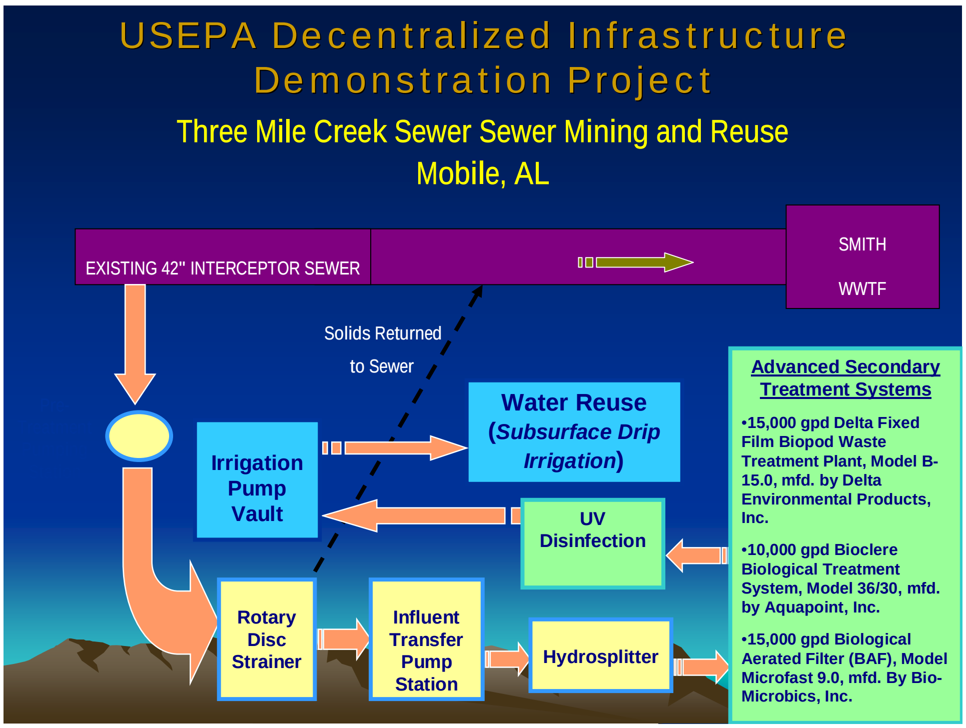


Figure 3. Schematic of the treatment process.

these capacity issues, urban watershed protection may be facilitated. Currently, a major regulatory focus is developing Total Maximum Daily Loads (TMDLs) for watersheds, as a way of reducing overall pollutant loading. This demonstration project, by extracting wastewater from an urban sewer, treating and then reusing the treated effluent for subsurface irrigation may have a significant impact in reducing pollutant loads (Carbon, Nitrogen, Phosphorus, and other constituents) to the stream (normally disposed of by direct stream discharges) and thus will reduce TMDLs.

As a major municipal water/wastewater utility, MAWSS is in a unique position to evaluate the use of decentralized wastewater management concepts within an

Figure 4. Biomicrobics FAST installation.

Figure 5. Aquapoint's BioClere installation.

Figure 6. Delta's BioPod installation.

existing urban/centralized wastewater collection/treatment system. This demonstration is thought to be transferable to other urban areas around the U.S. The use of simple, effective treatment and disposal technologies in a localized urban area to facilitate the redevelopment of an attractive community park was a key component of the project.

Project Implementation

As the park site and treatment locations have been chosen previously, most of the project approach will deal with the selection, implementation, and monitoring of this concept to determine effectiveness (cost and performance).

1. Technology Selection

   The philosophy was to select simple, low O&M technologies. Appropriate pretreatment to remove solids and oil & grease is important and a rotary screen was chosen to remove solids from the raw wastewater stream. The rotary screen was chosen to be a Hycor Rotostrainer and is shown in figure 7.

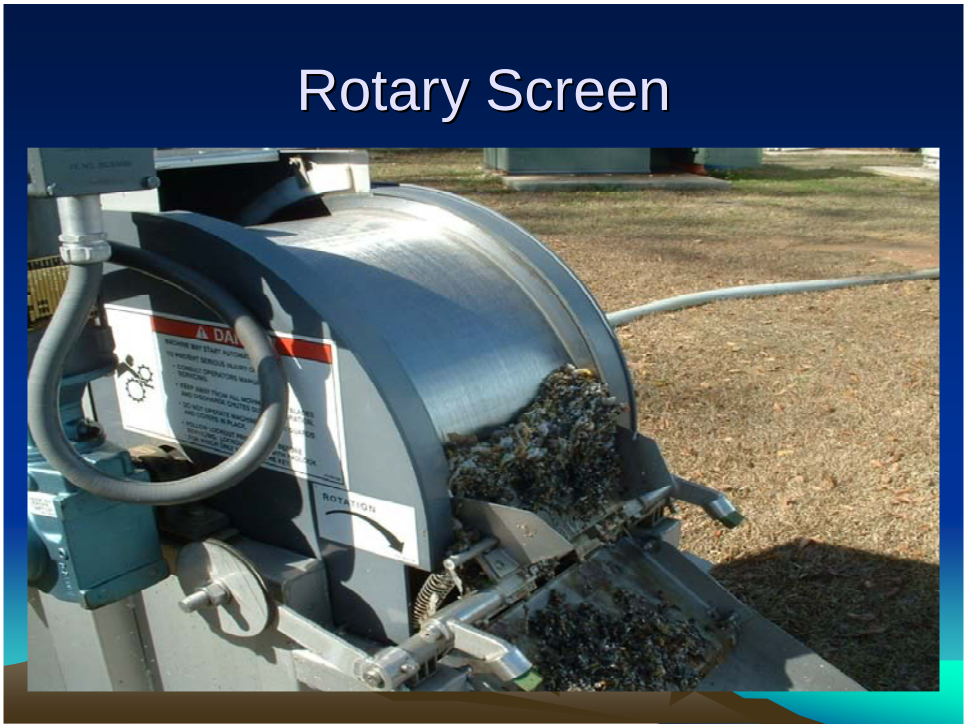


Figure 7. Hycor Rotostrainer rotary screen.

Subsurface drip-irrigation technology is being used to apply the treated effluent into the shallow subsurface soil. Based on soil conditions and manufacturers recommendations, an effluent loading rate to the soil of 0.3 gpd/ft^2 was chosen as the design hydraulic loading rate. For the 40,000 gpd design flow, this equates to about 3.1 acres of area for subsurface drip irrigation dispersal. Drip-irrigation areas easily fit into the confines of the Park and walking trail areas. Automatic flushing of zones will ensure long-term operational effectiveness. UV disinfection of the effluent was designed into the system to protect the park users. Drip irrigation installation is shown in figure 8.

Figure 8. Subsurface drip irrigation installation.

2. Water Quality Monitoring and Evaluation of Treatment and Reuse

   To adequately determine the performance and impact of our urban reuse program, a water quality monitoring program was implemented. Prior to start-up in June of 2005, baseline data on water quality (in-stream, runoff, and in-ground) was collected.

   Preliminary studies on Three Mile Creek stream flow and stream water quality have recently been previously performed by the USGS (Alabama District) in cooperation with MAWSS, in a separate, but useful, project.

   Monitoring includes treatment system performance, shallow groundwater wells (10-20 feet), and storm water runoff in the effluent disposal areas of the park to evaluate water quality conditions and water table elevations, and in-stream monitoring to evaluate baseline conditions. Shallow groundwater wells were placed within and outside of the drip dispersal areas, two (2) surface water runoff points were located to collect runoff from the reuse areas, and an upstream and downstream location on Three Mile Creek were sampled. Fecal coliform, nitrogen (including nitrate), and phosphorus were determined in all water quality evaluations of the site. The treatment systems were monitored for BOD, TSS, ammonia, nitrate, phosphorus, and fecal coliform in both the influent and effluent.

It should be noted that significant flow interruptions occurred during the project period. Just 2 months after startup, and at the very beginning of routine sampling, Hurricane Katrina disrupted power to the City of Mobile for up 10 days in places. The project was offline for about 10 days, while the MAWSS and the city recovered from the Hurricane disaster. Additional flow treatment and flow interruptions occurred in April and November of 2006 as a result of pump failure and rotary screen failure. The pump failure was due to fine solids accumulation in the pump intake, and in hind site was caused by a) the inappropriate selection of an effluent pump (just past the rotary screen in the flow scheme) instead of a sewage (solids handling) pump and b) the rotary screen not adequately removing fine solids. Figure 4 below shows the flow pattern over the entire project period.

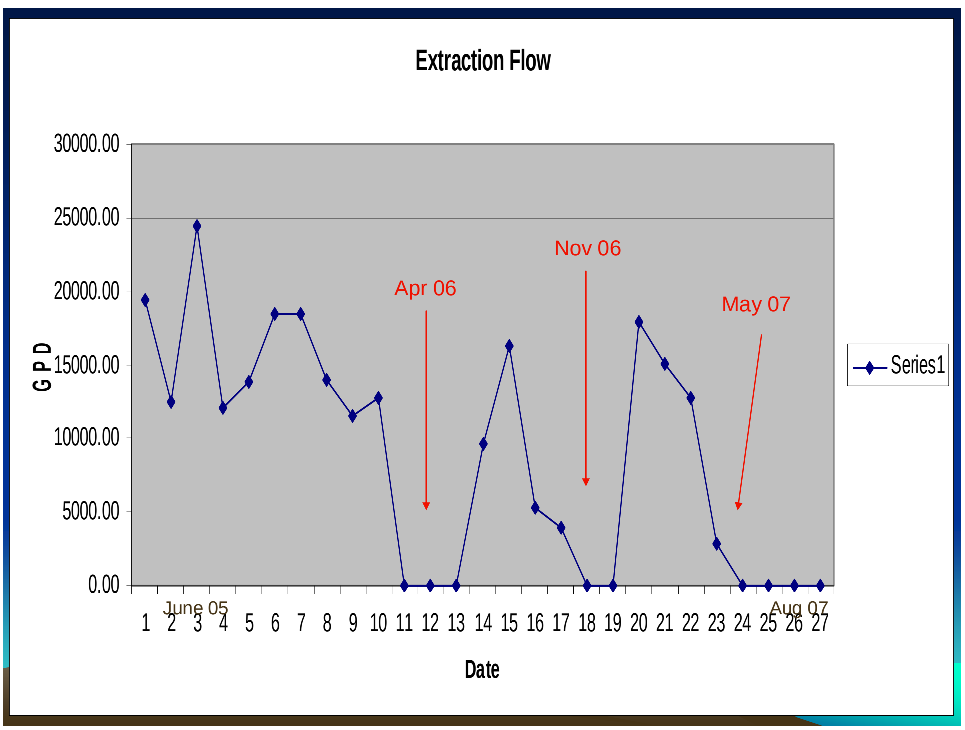


Figure 7. Extraction flow during the project period.

3. Capital Cost and O&M Monitoring

   Costs associated with the construction, operation, and maintenance of the systems (and on each separate treatment system) were documented. Management/maintenance requirements on each component will also be documented.

   A. Capital cost of primary treatment, each treatment system, and the reuse system (drip)

   B. Operational costs
      1. Treatment #1 power
      2. Treatment #2 power
      3. Treatment #3 power
      4. Reuse system power
      5. Operational visits required and costs

   C. Maintenance records and costs
      1. Maintenance needs/visits per treatment unit and reuse system
         a. Manpower / mhrs
         b. Parts / Supplies
         c. Nature of maintenance

Technology Performance and Water Quality Monitoring

Ground water, surface water runoff, and treatment system performance monitoring was begun in the Summer of 2004. Prior to the installation of the treatment system and the subsurface drip irrigation, ground water and surface water runoff in the area of the subsurface disposal of effluent was sampled and analyzed to get representative background water quality.

Initially, 5 ground water monitoring wells were installed in various locations, one of which (labeled MW-C) was located 100 feet or more from the proposed subsurface drip disposal area. MW-C will remain a background well, even after the installation of the drip disposal system. The four remaining ground water monitoring wells were located within the drip irrigation disposal area. Due to the final layout of the drip disposal area, only monitoring wells E and F were sampled long term. The wells are sampled initially about every other month and later, about once per quarter using standard methods (Standard Methods for the Examination of Water and Wastewater, AWWA 2003). Bailers are used to evacuate the well prior to sampling.

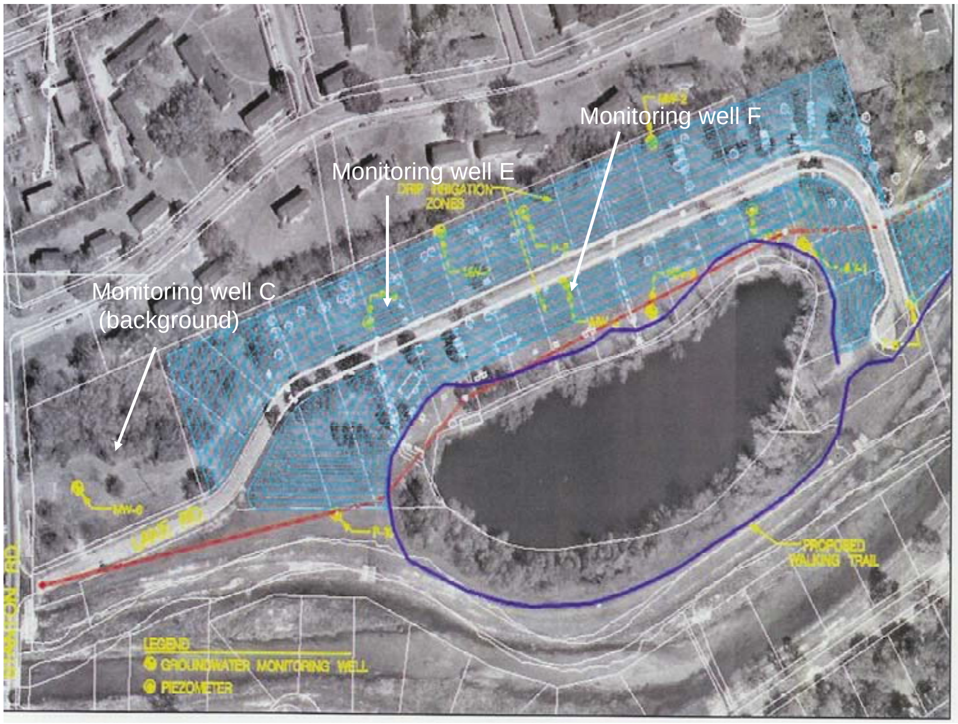


Figure 8. Ground water monitoring well locations.

Depth to water level, temperature, and specific conductance are measured in the field. Lab analysis for nitrate, phosphorus, and fecal coliform was performed in the lab. Figure 6 below shows a typical monitoring well installation. No fecal colifom was detected in any ground water sample collected at any location. And figure 7 shows that nitrate concentrations in groundwater were less than 1.5 mg/L for all samples taken, and did not significantly differ from background samples outside the drip irrigation dispersal area and prior to project startup. These results indicate that the subsurface drip dispersal system did not impact groundwater quality significantly.

Figure 9. Typical monitoring well installation.

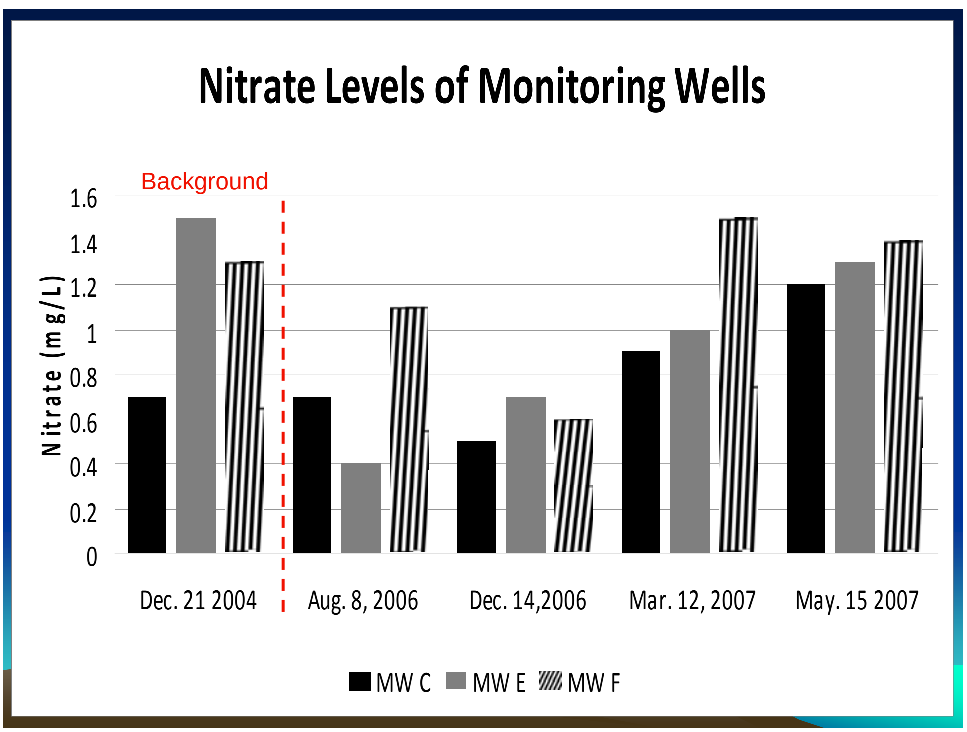
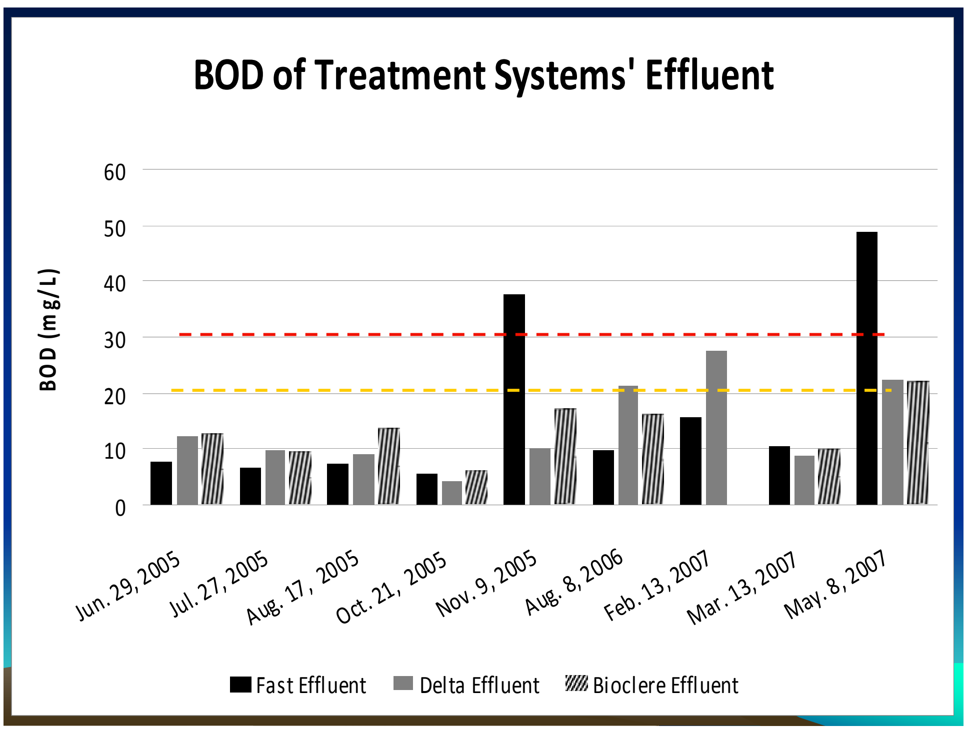


Figure 10. Nitrate concentrations in groundwater monitoring wells.

Influent and effluent samples were collected monthly (as the units were operated) from each system after startup. Treatment system samples were analyzed for BOD, TSS, ammonia, nitrate, phosphorus, pH, detergents, and fecal coliform. Data summaries are listed below and in the appendix.

BOD removal seems to be very good for all three treatment systems, with few exceptions. All but just a few effluent samples exceeded 20 mg/L and when samples did exceed traditional secondary limits (30 mg/L), it usually followed some startup period. Figure 11 shows BOD effluent concentrations.



Nitrate concentrations in treated effluents were also quite reasonable. It was noted that the fixed film/activated sludge processes typically exhibited higher effluent nitrate concentrations (about 14 mg/L) than did the packed bed system (about 4 mg/L). This result may help target treatment system selection based on effluent requirements. Figure 12 shows the effluent nitrate concentration.

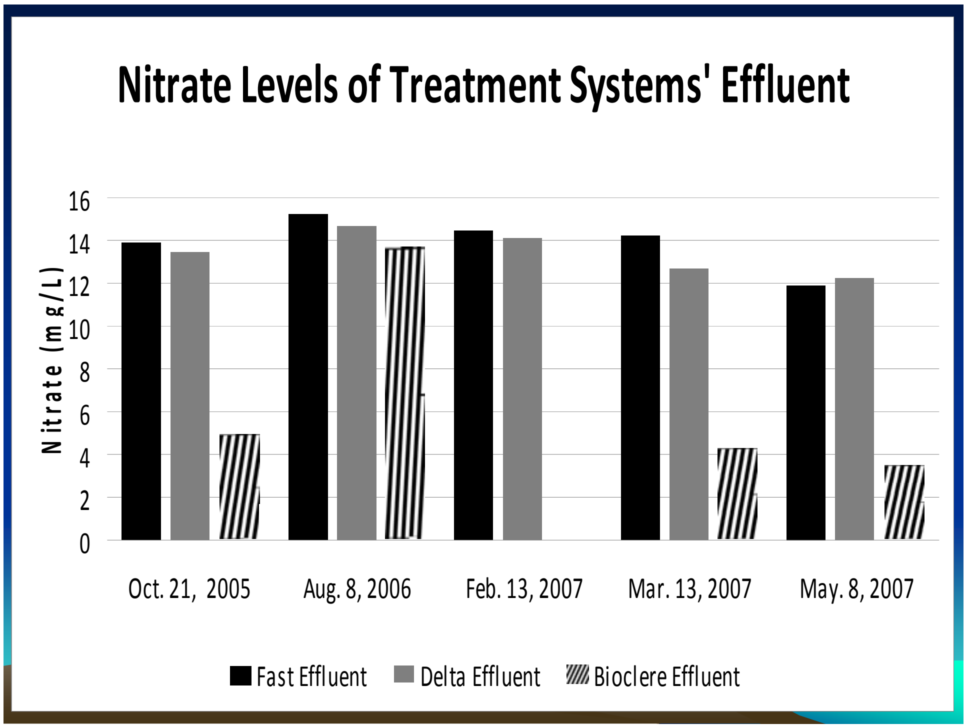
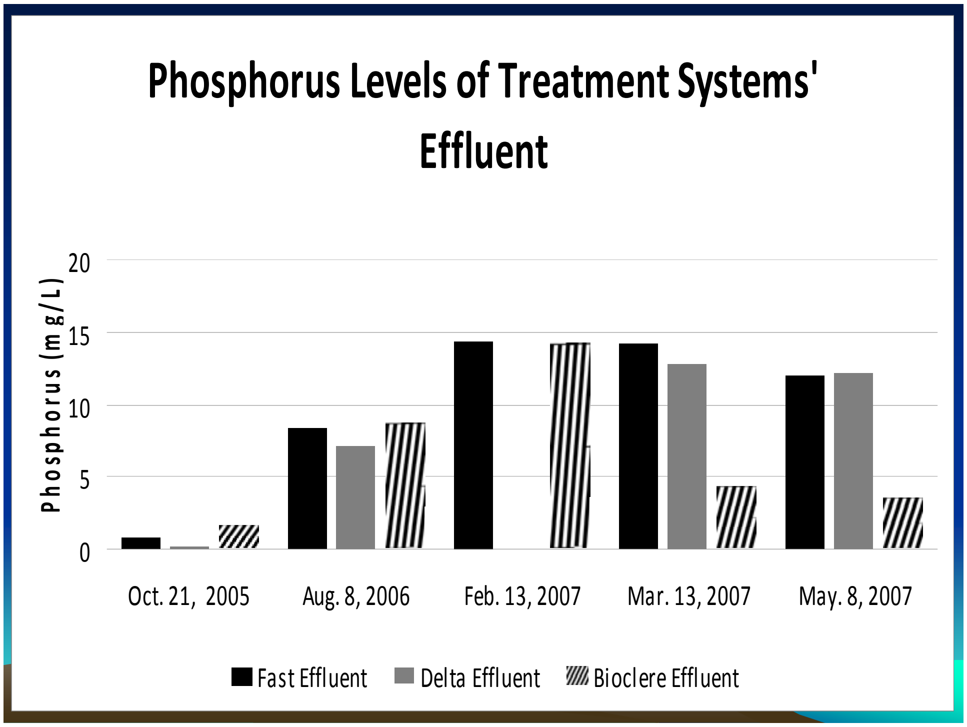


Figure 12. Effluent Nitrate concentrations.

Phosphorus concentrations in the effluents typically ranged from 5 to 15 mg/L and were relatively consistent between treatment systems. Figure 13 shows effluent phosphorus concentrations.



And ammonia nitrogen effluent concentrations ranged between 1 and 10 mg/L. It did appear that the fixed film/activated sludge processes lowered effluent ammonia to consistently lower levels than did the packed bed system. Figure 14 shows these ammonia nitrogen results.

Overall, treatment performance was adequate in each of the systems. Each produced and effluent quality appropriate for subsurface drip irrigation.

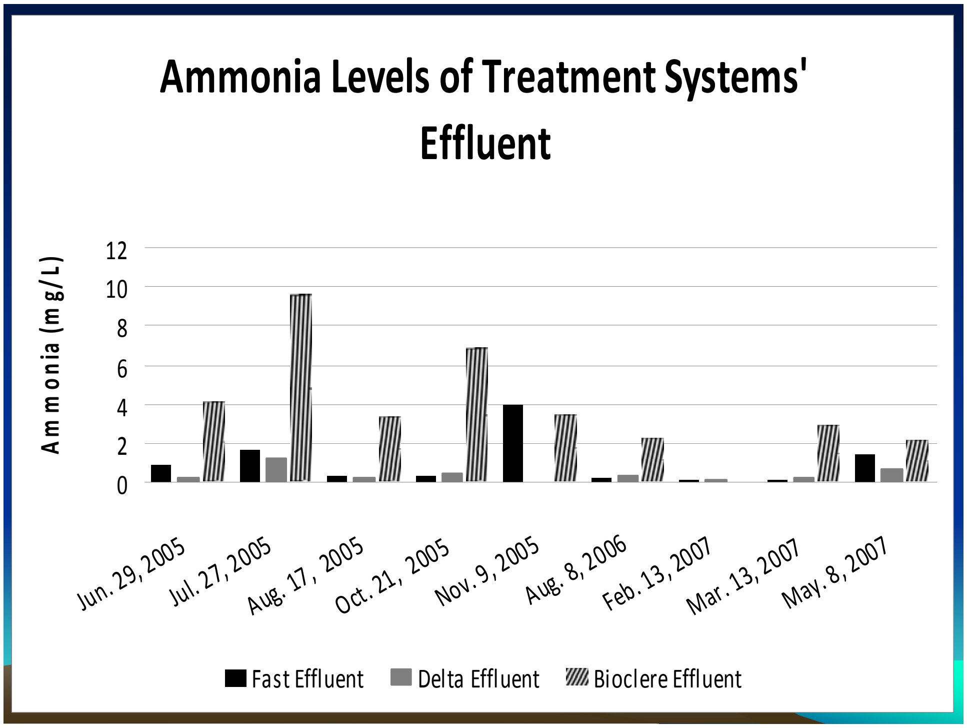


Figure 14. Effluent ammonia concentrations.

Costs

Capital and operating costs were documented for the project. Total installation costs were documented to be $1,037,000 and included all equipment and installation costs. Power costs were documented and based on design flows, showed that the fixed film/activated sludge systems used about 3 times the power (air blowers) than the packed bed system. Figure 15 shows these power cost numbers.

Figure 15. Power cost estimates for each treatment unit.

What We Learned

1.Complete raw wastewater characterization is necessary to properly select screening and pumping equipment.

2.The rotary screen had mechanical problems throughout the project and selection for this type or raw wastewater screening should be reconsidered.

3.The construction/installation of the subsurface drip irrigation is critical to performance and should be properly overseen. Old driveways and underground piping in the area disrupted installation in some areas that may have led to operational problems (seeps/leaks).

4.The drip irrigation loading rates suggested by manufacturer literature appear to be liberal. Ground saturation during normal operation suggests that a lower, more conservative loading rate should have been used.

5. With no onsite operator, small problems (such as screen clogging and pump clogging) became large problems. Better, more robust selection of equipment is necessary.

6.Treatment technologies selected are adequate and produce effluent quality appropriate for use in a subsurface drip irrigation system. Some technologies (i.e. the packed bed system) was significantly lower in terms of power costs to operate (3 times less costly).

7. Shallow ground water quality was not shown to be impacted by the drip irrigation dispersal of secondary effluents on a continuous basis.

Appendix

Raw data ….to be added.

Table 1. Monitoring Well Data

MW #	Date	Temp. oC	Nitrate mg/L	phosphorus mg/L	Sp. Cond. uS/cm	FC col./100 mL
C	10/15/04	23	ND	0.03	569	ND
(Background Well)	10/29/04	25	ND	0.17	469	ND
	12/03/04	20	ND	0.01	700	ND
	01/14/05	17	ND	0.02	682	ND
	02/15/05	18	ND	0.01	631	ND
	03/06/05	18	ND	0.03	616	ND
	04/14/05	22	0.05	0.02	607	ND
	05/12/05	22	ND	0.01	615	ND
	07/10/05	25	ND	0.03	607	ND
	10/12/05	23	0.05	0.01	597	ND
	12/13/05	20	ND	0.01	619	ND
	02/11/06	22	ND	0.05	627	ND
	05/12/06	23	ND	0.03	515	ND
	07/12/06	24	0.05	0.05	622	ND
	10/09/06	23	0.10	0.01	601	ND
	01/12/07	21	ND	0.08	625	ND
	04/13/07	22	ND	0.05	619	ND
E	10/15/04	24	0.1	0.13	562	ND
	10/29/04	241	0.01	0.10	611	ND
	12/03/04	23	0.0	0.1	615	ND
	01/14/05	21	0.0	0.04	630	ND
	02/15/05	20	0.01	0.05	631	ND
	03/06/05	22	0.02	0.06	529	ND
	04/14/05	24	1.5	0.08	625	ND
	05/12/05	24	ND	0.02	615	ND
	07/10/05	25	ND	0.11	607	ND
	10/12/05	23	0.05	0.13	593	ND
	12/13/05	21	ND	0.11	624	ND
	02/11/06	22	0.10	0.04	617	ND
	05/12/06	23	ND	0.05	548	ND
	07/12/06	24	0.07	0.16	562	ND
	10/09/06	23	0.10	0.11	611	ND
	01/12/07	21	0.12	0.05	633	ND
	04/13/07	22	ND	0.05	624	ND

F	10/15/04	27	ND	ND	524	ND
	11/05/04	25	0.0	0.25	594	ND
	12/14/04	20	0.0	0.05	600	ND
	01/15/05	18	ND	0.02	582	ND
	02/26/05	17	0.0	0.0	584	ND
	03/03/05	20	0.0	0.05	575	ND
	04/15/05	24	0.0	0.03	561	ND
	05/12/05	22	ND	0.10	619	ND
	07/10/05	25	ND	0.12	602	ND
	10/12/05	23	0.05	0.05	594	ND
	12/13/05	20	ND	0.02	615	ND
	02/11/06	22	ND	0.05	604	ND
	05/12/06	23	ND	0.04	585	ND
	07/12/06	24	0.05	0.05	602	ND
	10/09/06	23	0.10	0.02	612	ND
	01/12/07	21	ND	0.07	605	ND
	04/13/07	22	ND	0.13	608	ND