Chapter 5 Treatment System

CHAPTER OVERVIEW

The Metropolitan Tucson Planning Area is defined for the Facility Plan as the sewer system that is tributary to the Metropolitan Treatment Facilities. The Metropolitan Area Wastewater Treatment Facilities are the Ina Road Wastewater Pollution Control Facility (WPCF), Roger Road Wastewater Treatment Plant (WWTP) and the Randolph Park Water Reclamation Facility (WRF). However, since Pima County Wastewater Management Department (PCWMD) treats wastewater flows for the Tucson Metropolitan Area and outlying communities within Pima County at eleven facilities, the Facility Plan includes a brief description and discussion of the outlying treatment facilities for context with the metropolitan area. This chapter is divided into current and future conditions for the Metropolitan Area Treatment Facilities, current and future conditions for the Outlying Treatment Facilities and Treatment Modeling.

Metropolitan Treatment Facilities – Current Conditions

The Roger Road WWTP is a trickling filter and activated sludge facility with a capacity of 41 million gallons per day (MGD). Ina Road WPCF consists of a 25 MGD high purity oxygen activated sludge facility and a new 12.5 MGD biological nutrient removal activated sludge train capable of nitrification/denitrification. The Randolph Park WRF is a 3 MGD Membrane Bioreactor facility capable of producing Class A reuse water for discharge directly into the Tucson Water reclaimed water system.

Condition assessments were performed at the Roger Road WWTP and Ina Road WPCF to identify deficiencies. The Roger Road WWTP, because it is the older facility, had the most deficiencies identified for improvement. Deficiencies at the existing Ina Road WPCF were less significant.

Metropolitan Treatment Facilities – Future Conditions

Capacity expansion of any of the metropolitan treatment facilities is not anticipated until the latter part of the planning period. Population growth is projected to be the greatest in the Roger Road WWTP Tributary Area; therefore, addressing the treatment concerns in this area is a high priority. To achieve this, the Plant Interconnect project, funded in the 2004 Bonds, will allow the significant increase in flows to the Roger Road WWTP to be transported and treated at the Ina Road WPCF. This is demonstrated by the "Managed Flows" in Table 5.2.2 which depicts wastewater flow balancing between the metropolitan area wastewater treatment facilities.

Nitrification/denitrification of the original 25 MGD Ina Road WPCF is a significant project in this planning period and will need to be followed by nitrification/denitrification at the Roger Road WWTP during the same period.

A new water reclamation facility in southeastern Tucson is also being evaluated for installation sometime between 2015 and 2020. Until adequate wastewater flow is available in the area, initial flows will be transported through the Pantano and/or Southeast Interceptors to the Metropolitan Treatment Facilities.

As discussed in Chapter 7, it is anticipated PCWMD will prepare an assessment of the most effective biosolids treatment options for the Ina Road WPCF in conjunction with relocation of the solids treatment from the Roger Road WWTP.

Finally, based on evaluation of flows to the metropolitan treatment facilities, PCWMD does not anticipate beginning treatment expansions at the Ina Road WPCF until 2020.

Outlying Treatment Facilities – Current Conditions

The Outlying Facilities are small capacity plants located throughout eastern Pima County in higher population density areas. A condition assessment was performed at these facilities to determine the short and long-term deficiencies at these facilities, including Avra Valley, Corona de Tucson, Fairgrounds, Green Valley, Marana, Rillito Vista, Arivaca Junction and Mt. Lemmon WWTFs.

Outlying Treatment Facilities – Future Conditions

Population is the critical driver for improvements at the eight Outlying Treatment Facilities. Numerous large home developments are being proposed throughout the PCWMD service area tributary to these facilities. This population growth is of greater concern at the smaller capacity treatment facilities that range from less than 0.01 MGD to 4.1 MGD which are more rapidly impacted by increasing populations. Expansions and upgrades are recommended to improve capacity and operational performance, especially at the Avra Valley, Corona de Tucson and Marana WWTFs.

Going forward, PCWMD will review the Pima Association of Governments population forecasts as they are issued. This information will be analyzed using the Facility Plan Model to assess impacts on the conveyance system and treatment capacity. PCWMD will work closely with the jurisdictions and area developers to anticipate growth for the outlying areas and update the Facility Plan, as necessary, to facilitate the schedule and funding for these capacity expansions.

Treatment Modeling

To evaluate the wastewater treatment processes and potential capacity at the Roger Road WWTP and Ina Road WPCF, PCWMD commissioned a process modeling effort utilizing GPS-X performed by Hydromantis Inc. by GPS-X. This process model was developed and calibrated to simulate process functioning and facility capacity. It also simulates the treatment capacity under a range of regulatory effluent quality requirements. Seven different capacity scenarios were developed focusing on process modifications at the metropolitan facilities. Each of the scenarios was evaluated on performance indicators and cost-effectiveness of the treatment process modifications. Results of the analysis will be used to guide operational strategies and investigations at the facilities.

CHAPTER 5.1 METROPOLITAN AREA TREATMENT FACILITIES CONDITION ASSESSMENT

Pima County Wastewater Management (PCWMD) provides wastewater treatment for the Pima County Metropolitan Area at three treatment facilities, the Roger Road Wastewater Treatment Plant (WWTP), The Randolph Park Water Reclamation Facility (WRF) and the Ina Road Water Pollution Control Facility (WPCF).

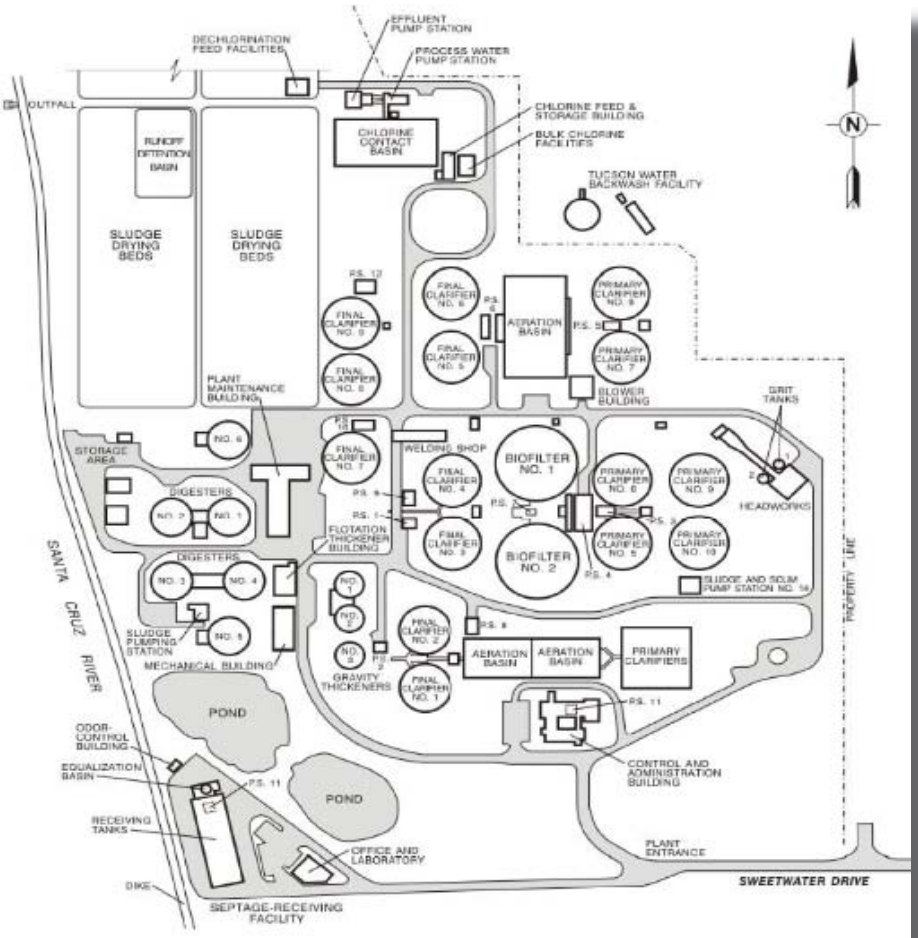
Condition Assessments

Condition assessments of the Roger Road WWTP and Ina Road WPCF were completed as part of this Facility Plan. The results were reviewed by the staff at each treatment plant. The determination of current conditions at these major facilities is the initial step in Asset Management. The results of these assessments are contained in the following discussion.

Roger Road Wastewater Treatment Plant (WWTP)

The Roger Road WWTP is currently rated as a 41 MGD average dry weather flow (ADWF) facility and uses biofilters with post-aeration for secondary treatment. The WWTP is located just north of Prince Road between Interstate 10 and the Santa Cruz River. The WWTP site is bordered on the north, east, and south by lands owned by the City of Tucson; and on the west by the Santa Cruz River. Available County owned land for any significant future plant expansion is limited to the northwest portion of the site, which is currently occupied by inactive sludge drying beds or by purchasing vacant property adjacent to the site. The WWTP present configuration is shown in Figure 5.1.1.

Figure 5.1.1 Roger Road WWTP Site Plan



The WWTP was operated in 1951 as a 12 MGD activated sludge treatment facility and was expanded with a separate 13 MGD trickling filter plant in 1960. A 13 MGD activated sludge/contact stabilization facility was added in 1967. In 1981 and 1982, the trickling filters were replaced with two large biofilters and the three individual plants at the facility were combined into a single facility re-rated at 30 MGD. A major retrofit was completed in 1997 after the addition of primary and secondary digesters, two primary and three secondary clarifiers and other components to the previously retired

activated sludge process resulting in a capacity increase of 11 MGD thereby increasing the plant capacity to 41 MGD.

Effluent Disposal

The majority of the effluent is discharged to the Santa Cruz River under Arizona Pollutant Discharge Elimination System (AZPDES) Permit Number AZ0020923. The remainder of the effluent is pumped to the Tucson Water Reclamation Plant or pumped directly to the Silverbell Golf Course for irrigation. A summary of the principal discharge limits for the plant is shown in Table 5.1.1.

The present process flow diagram for the Roger Road WWTP is presented in Figure 5.1.2.

Table 5.1.1 Roger Road WWTP AZPDES Permit Discharge Limitation

Parameter	Avg. Monthly	Avg. Weekly	Daily Max
Effluent Flow, MGD	41	---	---
BOD (5 day), mg/l (kg/d)	30 (4,654)	45 (6,984)	(14,299)
Total Susp. Solids, mg/l (kg/d)	30 (4,654)	45 (6,984)	(14,299)
Fecal Coliform Bateria	200/100 ml	---	800/100 ml
e-coli Bacteria	126 CFUs/100 ml	---	576 CFUs/100 ml
Settleable solids, ml/L	[1]	---	[2]
PH	Not less than 6.5 nor greater than 9.0		
Total Residual Chlorine			0.011 mg/l

Notes:

1. Effective November 2, 1999 through November 2, 2004.
2. This is not a comprehensive list as the actual permit includes limitations and/or monitoring and reporting requirements for 22 additional effluent characteristics (microbiological, inorganic and organic trace substances).

Process Description

The existing facilities at the Roger Road WWTP have been divided into three parts: Wet Stream Facilities, Sludge Stream Facilities and Other (non-Process) Facilities.

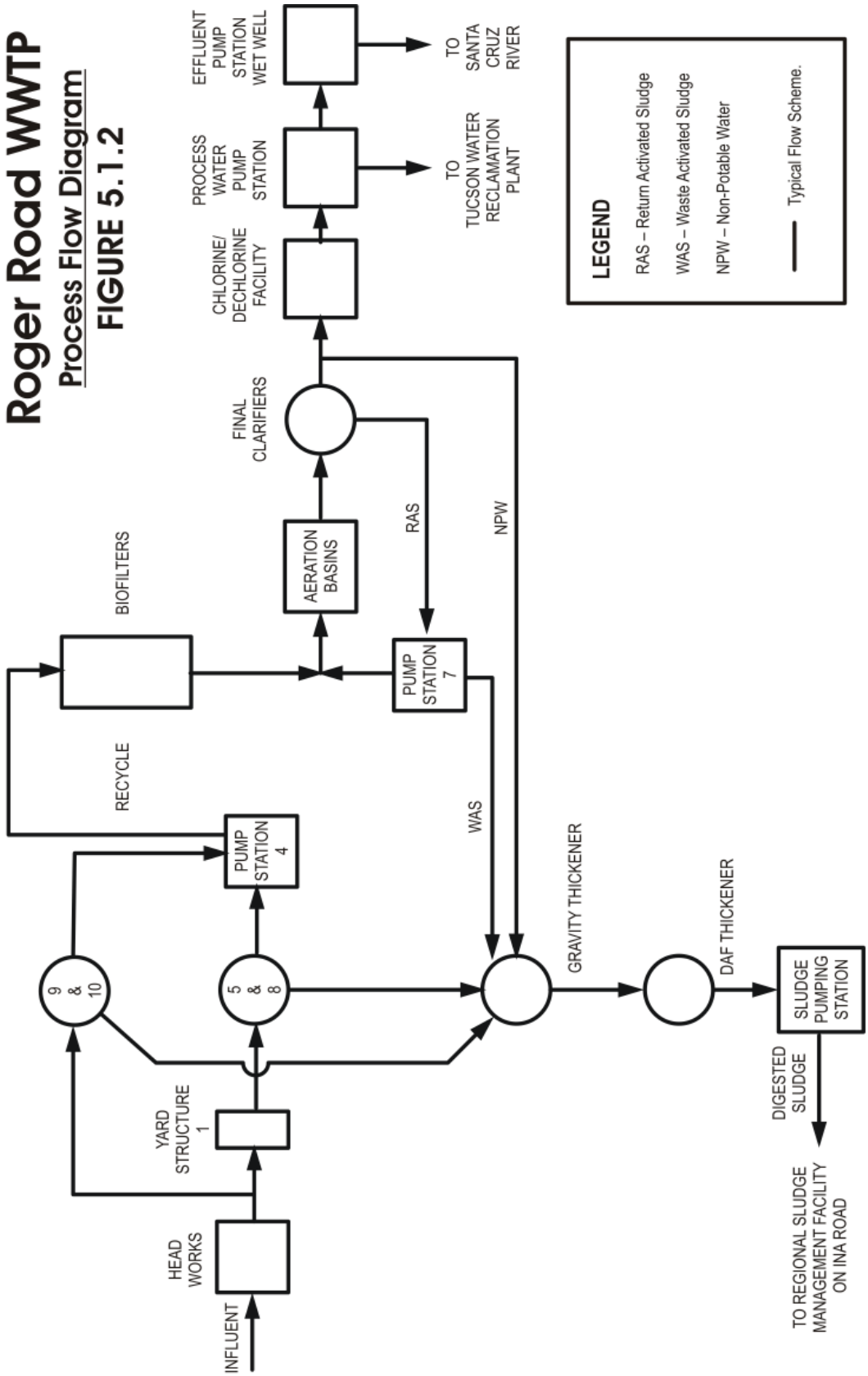
Wet Stream

- Headworks.
- Screening.
- Grit Removal.
- Primary Sedimentation (Primary Clarifiers).
- Biofilters.
- Activated Sludge.
- Final Sedimentation (Secondary Clarifiers).
- Effluent Disinfection with Liquid Sodium Hypo-Chlorite.
- Chlorine Removal with Sodium Bi-Sulfite.
- Process Water Pump Station.
- River Outfall or the City of Tucson Water Reclamation Plant.
- Septage Receiving Station.

Roger Road WWTP

Process Flow Diagram

FIGURE 5.1.2



Sludge Stream

- Gravity Thickening.
- Flotation Thickening.
- Anaerobic Digestion.
- Sludge Drying Beds (emergency only).
- Digested Sludge Pumping to the Ina Centrifuge Facilities.
- Energy Recovery/Power Production Facilities.

Other

- Administration Building.
- Warehouse/Maintenance Shop and Yards.

Wet Stream

Septage Receiving Station

Prior to the expansion to 41 MGD, septage was discharged in a number of selected manholes in the sewer system. Recognizing that unmonitored discharges could potentially have a significant effect on the WWTP's performance, a Septage Receiving Station was constructed at the Roger Road WWTP.

This facility allows for the collection, monitoring and pretreatment of septage prior to being pumped to the headworks of the WWTP.

The condition of the Septage Receiving Station was found acceptable however the Treatment Staff experiences time consuming cleaning and maintenance problems after each use. Due to these problems Treatment Staff are examining alternate ways of collecting Septage.

Headworks

Wastewater is conveyed by 66- and 48-inch interceptor sewers to an influent junction structure. The combined influent enters the headworks through an 7 foot square influent channel where chlorine can be added to oxidize odor-causing substances. The headworks have been renovated in several steps since the year 2000 including enclosing the screens and installing odor collection and scrubbing equipment as well as rehabilitating the influent channel. The headworks, downstream of the influent channel to the grit chambers, is experiencing accelerated corrosion. Rehabilitation is recommended.

Screening

Flow is split among the three bar screens which are located in separate channels. The three Parkson screens remove debris, rags, and other material, harmful to downstream process units (such as pumps and mixers). Operations personnel report that these screens are working well; however, large objects in the waste stream can cause problems. Treatment staff consider that manual coarse screens need to be installed ahead of the Parkson screens to minimize operational and maintenance issues with the fine screens. Screenings are discharged to a belt conveyor that deposits the screenings into a dump truck for hauling to a landfill. Additional odor control at the belt conveyor and dump truck loading areas is required. Screenings can be diverted from the belt conveyor to screenings compactors. Permanent operating platforms are required for access and maintenance. The current compaction system, which reduces water content from screenings prior to the dump truck, is considered inadequate and improvements/alternatives are being evaluated.

Grit Removal

After passage through the bar screens, the wastewater is routed through a vortex grit removal system. Grit removal is required to protect moving mechanical equipment from abrasion and normal wear, to reduce pipe clogging, to prevent the accumulation of grit in tankage and to reduce loading of treatment works with inert matter that might interfere with operation of the units.

Deposited grit is pumped to vortex grit separators and in turn directed to classifying screw conveyors. The classifying screw conveyors discharge onto the screenings conveyor for dump truck disposal along with screenings. Odor control equipment was recently installed at the headworks and additional improvements to the system, by covering the screenings and grit removal system, were provided to abate odor.

An emergency bypass to relieve possible blockage at the screens is required. The construction of a plant interconnect to the Ina Road WPCF is a project contained in the 2004 Bond Authorization, combined with the emergency bypass will provide this protection.

A future assessment of the pipes between the headworks and the primary clarifiers is recommended as the pipes could not be decommissioned for inspection during the condition assessment.

Liquid effluent from the grit tanks flows to three Parshall flumes (two active) for influent flow measurement. Flow continues on to Yard Structure Number 1 where all recycle flows are combined with the de-gritted wastewater. Primary Clarifiers Number 1 through Number 4 are no longer used as clarifiers but now function as equalization basins.

Primary Sedimentation (Primary Clarifiers)

This process removes settleable solids, floating material and some organic material contributing to BOD. Typically, primary sludge is pumped to the gravity thickeners, but it can also be sent directly to the anaerobic digesters. Scum is pumped directly to the anaerobic digesters. Primary effluent flows by gravity to the Biofilter Pump Station.

The primary clarifiers generally are in acceptable condition with no noticeable mechanical or structural problems, however it is suggested that one clarifier among the primary as well as secondary clarifiers be scheduled for maintenance and/or refurbishment every year. An allowance for purchase of major clarifier equipment component replacement is included in the plant recommended improvements.

Biofilter Pump Station

The Biofilter Pump Station receives flow from the primary clarifiers and is capable of receiving return sludge from the secondary clarifiers. This pump station sends all its flow to the two 165-foot diameter biofilter towers. There are three gas-engine driven pumps and one electric motor driven pumps. At the plant ADWF of 41 MGD, two of the three gas driven pumps are in-service with third gas driven pump and the electric motor driven pump on stand-by. Methane gas from the anaerobic digesters and natural gas are used to power the engines. Waste heat from the engines is recovered as part of the Roger Road WWTP energy recovery program.

The Biofilter Pump Station wet well and channels are severely corroded. The recirculation control valve stem was recently replaced, however the valve is constantly hunting for its set point. The valve has been closed (not used) as recent plant modifications have rendered it unnecessary.

The engine driven pumps have been difficult to reliably operate on digester gas. A second electric motor driven pump replaced one of the gas-engine driven pumps to improve reliability. Both the proposed new electric motor driven pump and the existing electric motor driven pump should be

equipped with Variable Frequency Drives (VFD) to allow pump performance to be matched to diurnal flow. In order to perform rehabilitation work, the proposed Plant Interconnect must be in place to reduce flows; however, additional internal bypasses will still be required.

Biofilters

The biofilters remove organic material from the primary effluent and form a flocculent that settles in the final clarifiers. The two biofilters are 165 feet in diameter and have a plastic media depth of 26 feet. Each biofilter has a maximum hydraulic capacity of 50 MGD. Influent flow is distributed equally between the two biofilters and discharged through six rotating arms on the top of each biofilter. As flow passes through the media, colloidal and soluble organics are consumed by the biomass growing on the plastic media. Biomass routinely sloughs off the media as it grows.

At the bottom of each biofilter is a grating system that allows wastewater to pass from the biofilter and air to move upward through the biofilter. Air provides oxygen for the microorganisms on the media and will normally move upward because of natural convection currents caused by the flow of water down the media and the temperature difference between the water and air. It becomes necessary to provide supplemental air when the natural air ventilation is low or when the organic loading on the biofilters increases. Four 18,250-cfm blowers at the base of each biofilter provide this supplemental air, as needed. The elevated walkway from the central stairway to the top of the biofilter shows signs of deterioration and require repair and/or replacement.

The biofilter towers and the media structural support system do not show any significant signs of deterioration. The media does not show obvious signs of deterioration, however it is of an age when media normally requires replacement. The media should be closely monitored and the Capital Improvement Program should plan for its replacement upon signs of deterioration. In order to change out the media; however, the proposed Plant Interconnect must be in service.

Aeration Basins

Effluent from the biofilter towers flows to the aeration basins where any remaining soluble BOD concentrations are reduced and form a better-settling biomass so that suspended solids and BOD concentrations in the final clarifier effluent are minimized. Air is supplied to the aeration basins from the Blower Building.

The south aeration basin's concrete is deteriorating and needs to be repaired. Operations states that the undersides of the concrete beams spanning both north and south aeration basins are deteriorating and in need of repair. Operations have reported some aeration basins have sidewall settling.

The aeration basins are being operated in the activated sludge mode to increase solids removal.

Natural gas fired engines power the blowers. The equipment appears in good condition. However, building modifications or system improvements to facilitate blower and engine operations and maintenance are necessary.

Secondary Sedimentation (Secondary Clarifiers)

The secondary clarifiers remove the suspended solids from the biofilters and/or aeration basin effluent. A portion of the secondary clarifier sludge and biofilter effluent mixture is returned under the biotower into aeration basins to increase the available microorganisms for removal of organic material. The sludge is pumped to the gravity thickeners where it is settled with the primary clarifier sludge.

The secondary clarifiers are generally in good condition. A scheduled maintenance program to examine and repair defective units is ongoing. Additional secondary clarifiers may be required to meet new permit requirements at maximum flow (41 MGD).

Disinfection

The plant, after a decision to move away from gaseous chlorine, uses liquid sodium hypochlorite for disinfection and liquid sodium bisulfite for chlorine neutralization to meet discharge limits for chlorine residual. The present system is classified as a “temporary system”, appears in good shape with no structural problems; however, the remainder of permanent facilities installations should be completed as liquid sodium-hypochlorite disinfection is a permanent part of plant operations.

The plant effluent flow is metered and sampled prior to final discharge to ensure its compliance with discharge permits. Additionally, there is an effluent pump station whose primary purpose is to provide flood protection. During major floods, effluent must be pumped to the Santa Cruz River in lieu of gravity flow to the outfall due to water levels in the Santa Cruz. There are three effluent pumps.

Sludge Stream Facilities

Gravity Thickening

The three gravity thickeners are used to concentrate the excess solids removed from the primary and secondary clarifiers. This reduces the sludge volume, thereby reducing the required size and operating costs of downstream solids treatment units. The gravity thickeners are 50-foot diameter covered concrete tanks and are ventilated to a sodium hypochlorite scrubber. Thickened sludge is pumped to the primary digesters, and supernatant is drained to the primary clarifier influent.

Dissolved Air Flotation Thickening

There are two, each 250-foot DAF, 300-GPM thickeners located in a building west of the gravity thickeners. These units are used for thickening waste secondary sludge only during biofilter sloughing events. These units are outdated, undersized and functionally in need of replacement.

Anaerobic Digestion

The existing anaerobic digester facility was designed as a two-stage high-rate anaerobic digestion system. The objectives of sludge digestion are the reduction of pathogens, the elimination of offensive odors, the inhibition of potential for putrefaction, and the reduction of solids to be disposed. There are four 80-foot diameter primary digesters heated by circulating digested sludge through heat exchangers maintain the digester temperature. These tanks have fixed covers and are equipped with mechanical draft tube mixers. Following the primary digesters are two similarly sized secondary digesters used for thickening and storage of digested sludge and gas collection. Each secondary digester has a floating gas-holder type cover that can provide 30,000 cubic feet of gas storage. Methane gas, a by-product of anaerobic digestion, is used as a part of the total fuel source for power generation equipment and pumps within the plant.

Operators report that scum, not effectively treated within the prior processes, accumulates in the digesters, reducing digester volume, thereby affecting the digester performance. Additionally, grit and rag accumulation within the digesters creates a problem requiring the routine isolation of the digesters for draining and cleaning.

The structural condition of the digesters is questionable as there is evidence of leaks through the walls of several of the units. The lack of digester gas storage is an on-going problem. The storage capacity of the floating covers on the secondary digesters is judged inadequate. The roof of Digester Number 3 reportedly leaks gas and repair attempts have been unsuccessful.

Sludge Pumping

Sludge from Digester Number 4 or Number 5 is pumped by two centrifugal pumps to the regional sludge management facilities at Ina Road through an 8 – inch diameter, 5.3 mile long ductile iron force main. The plant staff reports that although the pump impellers have been trimmed, it is still necessary to throttle a discharge valve to avoid pumping sludge at excessive velocities.

Sludge Drying Beds

PCWMD plans to demolish a majority of the beds retaining and upgrading only the concrete-bottom drying beds (Nos. 3 through 26).

Other (Non–process) Facilities

Energy Recovery/Power Generation System

The Roger Road WWTP produces power and heat using methane gas produced by the anaerobic digester as its primary fuel source. Methane gas is collected and piped to the three engine-generators and three engine-driven biofilter feed pumps. Commercial natural gas supplements the methane gas supply. Heat is recovered from the gas-operated engines and is used to heat the anaerobic digesters as well as to provide plant hot water and heat.

Additional electric power is purchased from Tucson Electric Power Company (TEP). TEP can supply all electrical needs should the on-site electrical generators fail. The digester gas supplies a portion of the fuel for on-site power generation

There have been some problems with the corrosive nature of the digester gas, and PCWMD is studying methods to clean the gas.

The structural adequacy of the basement walls of the building has been questioned as rebar is exposed in places and there are apparently voids that have been identified by sound.

The condition assessment contains several suggestions to upgrade the generators to increase capacity and match generation to plant load.

Electrical Distribution System

The Roger Road WWTP electrical distribution system was designed and installed in several stages over the past fifty years. There are many instances where the equipment and installation do not meet current codes. The Department has commissioned an engineering study to determine electrical system requirements and the 2004 Bond Authorization provides funding for the installation of electrical system upgrades. The electrical system upgrade is also required to proceed with additional process improvements.

Instrumentation and Control System

The plant instrumentation has been upgraded/modified during various plant expansions. The system is in operating condition. The Consultant Condition Assessment contains suggestions for improvements for the Departments consideration.

Administration, Warehouse and Laboratory Buildings

These structures date to the plant's origin in the 1950s and are inadequate for today's operations. The Administration Building contains limited space for staff and modern office equipment. The Laboratory and Warehouse have not been expanded to keep pace with the overall growth in the plant.

It is recommended that new Administrative and Maintenance facilities be constructed in the southeast corner of the plant site, outside the process area, adjacent to Sweetwater Road. The

old maintenance facilities could then be converted to warehouse facilities. The Department might consider a design/build approach utilizing the services of those companies who routinely install pre-engineered buildings at an economical price.

Odor Control

The Condition Assessment found a number of odor control problems and suggested a variety of improvements to the odor control system. Concurrently with this Condition Assessment, the Department commissioned a comprehensive study of odor problems at the Roger Road WWTP. These documents are to be combined into the basis for an engineering design to correct the problems. The study and corrective action are included in the 2004 Bond Authorization.

General

Current standards and recommendations for hazardous area classification will necessitate upgrades to older portions of the plant.

New regulations for treatment and discharge are expected to require nitrification/denitrification of plant effluent

Conclusion and Recommendations

Based on the discussion in this Chapter the following projects should be included in the Roger Road WWTP, elements of the long-range CIP using either System Development Funds (SDF) or Bond Authorizations as available. It should be noted that the $7.1 million Roger Road Biosolids Improvements project will involve relocating biosolids processing to the Ina Road WPCF.

Table 5.1.2 Recommended Improvements and Conceptual Costs Roger Road WWTP

Improvements	Conceptual Cost
Influent Conduits-between Headworks and Primary Clarifiers Condition Assessment	$150,000
Headworks Corrosion Rehabilitation	$1,000,000
Headworks (Grit Removal Area) Emergency Bypass	$500,000
Screening Odor Control Improvements	$1,500,000
Screenings Compactor Operating Platforms	$50,000
Primary and Secondary Clarifier Rehabilitation/Addition	$5,700,000
Biofilter Pumping Station Rehabilitation	$1,500,000
Biofilter Pump/VFD	$1,600,000
Biofilter Media Replacement	$6,000,000
Biofilter Elevated Walkway Repair or Replacement	$150,000
South Aeration Basins-Concrete Repairs (Allowance)	$100,000
Modify Aeration Blower Building to Facilitate Equipment Removal	$200,000
Gravity Thickener Rehabilitation/Ventilation and Odor Control Improvements	$800,000
Dissolved Air Flotation Thickener Replacement	$1,500,000
Biosolids Improvements	$7,100,000
Electrical Testing and Upgrades	$3,000,000
Hazardous Area Classification Improvements	$500,000
SCADA and Control System Improvements	$1,000,000
Nitrification/Denitrification	$50,000,000
Total	**$82,350,000**

Randolph Park Water Reclamation Facility (WRF)

The Randolph Park WRF was originally constructed by the City of Tucson and put into operation in 1975. In 1979 an Inter Governmental Agreement (IGA) between the City of Tucson and Pima County transferred all wastewater treatment responsibilities from the City of Tucson to Pima County. Pima County then operated the plant from 1979 until it was shut down in 1995 during construction of a flood control project on the adjacent golf course. The plant was originally rated at 1.5 MGD, but had an average flow rate of about 634,000 GPD.

In February 2000, the City of Tucson and Pima County entered into a Supplemental IGA. This agreement included restarting the Randolph Park WRF. A portion of the flow of the refurbished facility was designated for irrigation of the adjacent City-owned Golf Course. The remaining plant flows are to be wheeled by Tucson Water to Pima County facilities.

To maximize the reuse benefits from the Randolph Park WRF, it was decided to double the plant capacity on the small site, and thereby change the flow from 1.5 MGD to 3.0 MGD. Even though the plant site is very small, it is in an ideal location to take advantage of the City of Tucson's reuse system. This allows the effluent to be pumped directly into the Tucson Water reuse system without a long force main.

The plant consists of three major components, a lift station, a force main, and the main plant. The lift station is located approximately 2.3 miles to the west of the main plant. This location was needed in order to obtain enough wastewater for the 3.0 MGD facility. Wastewater is scalped from an existing 42-inch Aviation Corridor Interceptor. The remaining flow in that collection sewer continues downstream to the Roger Road WWTP for treatment.

To maximize the main plant site, screenings and grit facilities are also located at the lift station. This has the added benefit of minimizing solids depositions in the force main, as the main solids are removed before pumping. The force main conveys flows to the main plant, where the existing tankage has been re-engineered to allow for the installation of membranes for a membrane bioreactor (MBR) process. The MBR was also selected to maximize use of the existing acreage, as well as provide for a minimum of Class A quality reuse water. The facility is permitted for Class A, but is capable of producing Class A+ reclaimed water.

There are no solids handling facilities located on the site. All solids are conveyed back to the 42-inch Aviation Corridor Interceptor for treatment at the Roger Road WWTP.

Ina Road Water Pollution Control Facility (WPCF)

The Ina Road WPCF will soon be a 37.5 MGD wastewater treatment facility. After passing through newly constructed common Headworks, it was designed for an ultimate 50 MGD flow, consisting of an influent pump station, bar-screens and grit chambers, the wastewater is treated in two different treatment trains, the original 25 MGD High Purity Oxygen (HPO) activated sludge process treatment

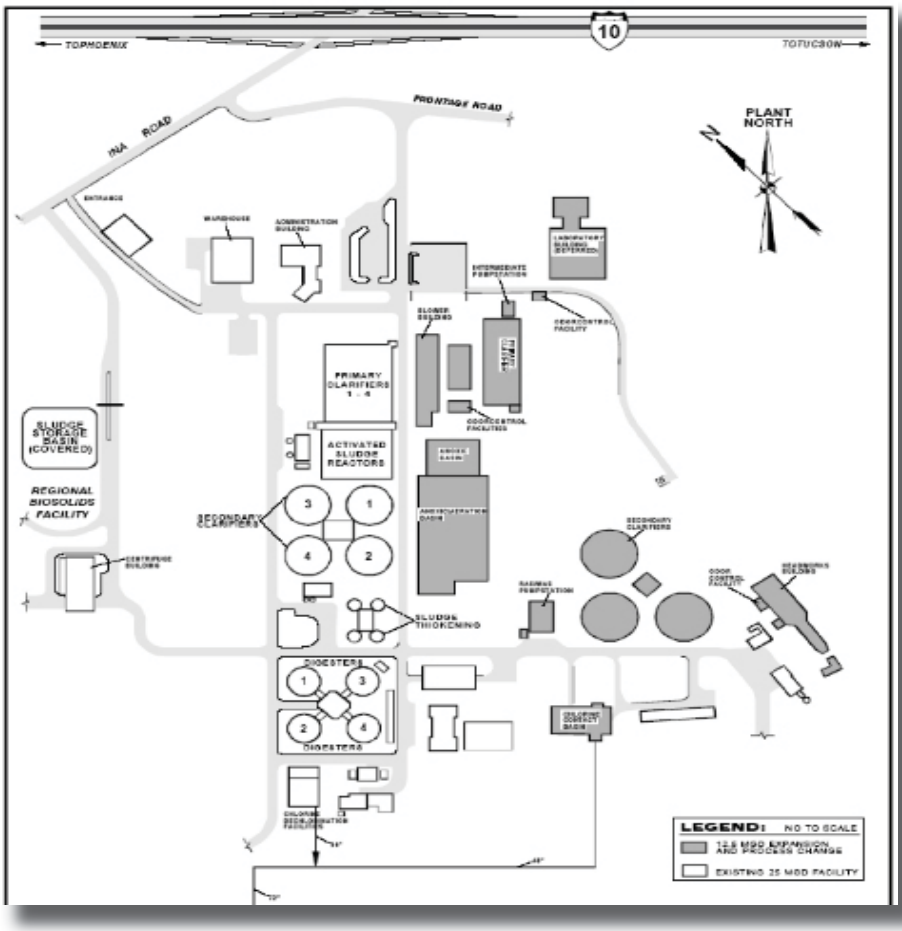
train and a recently completed 12.5 MGD Biological Nutrient Removal Activated Sludge (BNRAS) process. The Headworks, during emergencies, bypasses both trains by routing the wastewater to three emergency influent overflow storage basins.

The HPO-Activated Sludge (HPOAS) Process is a variation of the conventional activated sludge process that uses high purity (85 to 95 percent) oxygen. Typical oxygen concentrations in the reactor are 4 to 8 mg/l with common values as high as 16 mg/l. The original Ina Road WPCF was an EPA innovative technology grant project that influenced Pima County toward utilization of the HPO process.

The original (first) 25 MGD treatment train was designed in 1973 and constructed during the period 1975 to 1977. The treatment train consists of primary clarification, HPO aeration basin activated sludge process and secondary clarification and disinfection. The original plant also incorporates anaerobic digestion and centrifuge solids handling system to meet agricultural land application disposal criteria, and it provides an energy recovery system for on-site generation of electrical power. The original plant layout resulted from a concern for a planned and orderly future growth of the treatment works. The WPCF was designed as the first stage of a regional treatment facility.

In 1987, process modifications to the original design were initiated for operational flexibility and maintainability. Specifically, the modifications provided for normal plant operation when units were out of service for normal maintenance or emergency work. The modifications did not affect the methods of operation, the treatment capacity volume (except for biosolids treatment), or the characteristics of the discharge. The modifications were completed in 1990.

Figure 5.1.3 Ina Road WPCF Site Plan



The second treatment train is a two-stage Biological Nutrient Removal (BNR) or BNRAS process operating in parallel with the existing train. This second train, a 12.5 MGD expansion, was designed in the late 1990s and will be placed in service in 2005. This train consists of primary clarification, biological nutrient removal via nitrification-denitrification using anoxic and aerobic basins, secondary clarification and disinfection. The site plan for the Ina Road WPCF is shown in Figure 5.1.3 and the process diagram for the facility in Figure 5.1.4.

Effluent Discharges

The Ina Road WPCF was constructed to treat sewerage in the Tucson Metropolitan Area north of the Rillito River. The discharge from the WPCF complies with the permit requirements of the Clean Water Act-Arizona Pollutant Discharge Elimination System (AZPDES) and the State of Arizona Aquifer Protection program permit.

Effluent Disposal

The majority of the effluent is discharged to the Santa Cruz River under AZPDES Permit Number AZ0020001. The remainder of the effluent is pumped to the Arthur Pack Golf Course for irrigation. A summary of the principal discharge limits for the plant is shown in Table 5.1.3.

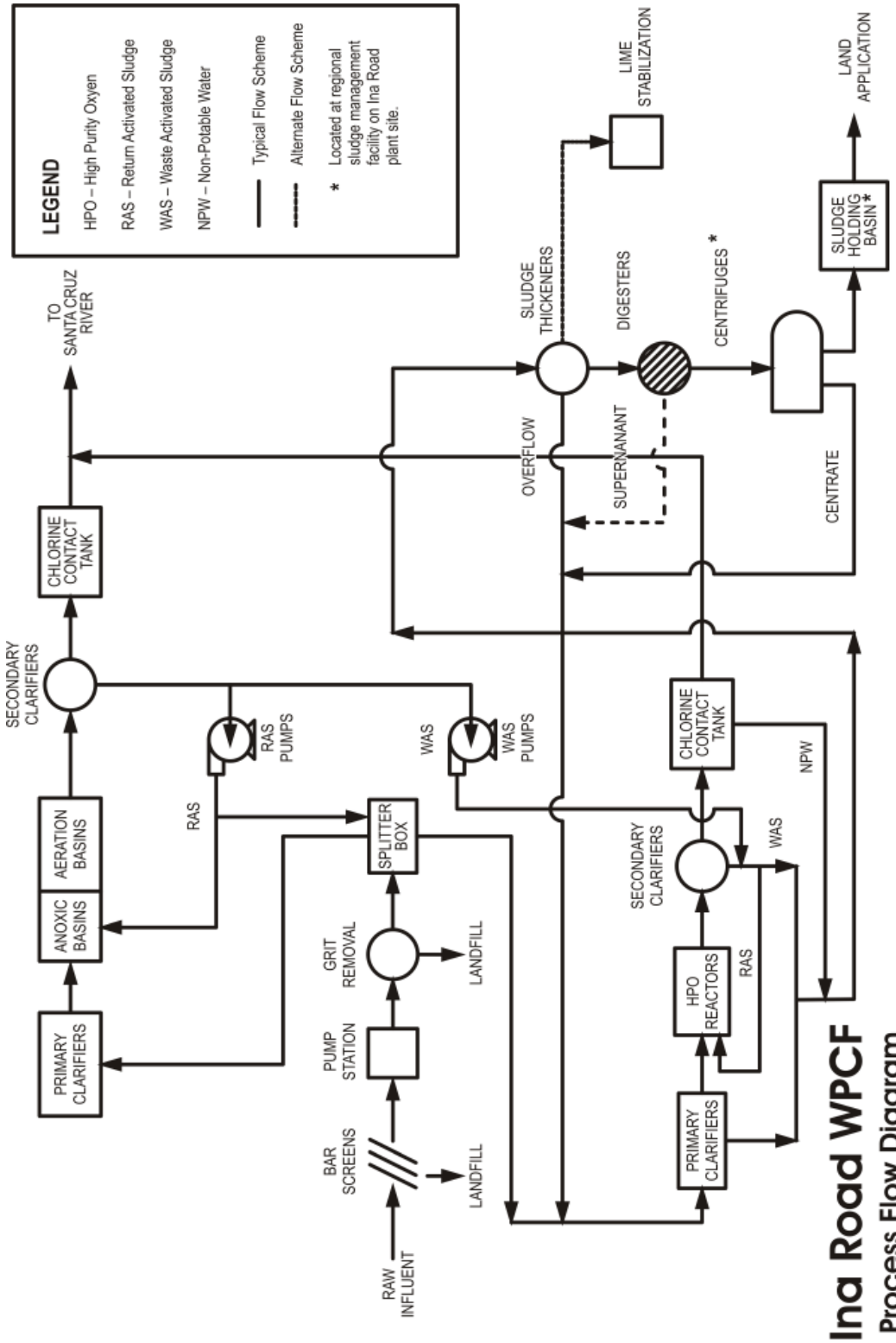
Table 5.1.3 Ina Road WPCF AZPDES Permit Discharge Limitation

Parameter	Avg. Monthly	Avg. Weekly	Daily Max
Effluent Flow, MGD	25	---	---
BOD (5 day), mg/l (kg/d)	30 (2,839)	45 (4,258)	(8,516)
Total Susp. Solids, mg/l (kg/d)	30 (2,839)	45 (4,258)	(8,516)
Fecal Coliform Bacteria	200/100 ml	---	800/100 ml
e-coli Bacteria	126 CFUs/100 ml	---	576 CFUs/100 ml
PH	Not less than 6.5 nor greater than 9.0		
Total Residual Chlorine			0.011 mg/l
Copper (as CU)			38 mg/l

Notes for Table 5.1.3:

1. Effective November 2, 1999 through November 2, 2004.
2. This is not a comprehensive list as the actual permit includes limitations and/or monitoring and reporting requirements for 22 additional effluent characteristics (microbiological, inorganic and organic trace substances).

The present process flow diagram for the Ina Road WPCF is presented in Figure 5.1.4.



Ina Road WPCF
Process Flow Diagram
FIGURE 5.1.4

Current Conditions

The existing facilities at Ina Road WPCF are divided into four parts for this presentation: General, Wet Stream Facilities, Sludge Stream Facilities and Other (Non-Process) Facilities.

The process description of the Ina Road WPCF is divided first into treatment trains and then into subsections for each treatment process. The subsections are Preliminary Treatment, Primary Treatment, Secondary Treatment, Disinfection and Dechlorination, and Sludge Stream and Solids Handling. Last is the discussion of Other (Non-process) Facilities including the power generation, electrical distribution and the Administration, Warehouse and Laboratory facilities.

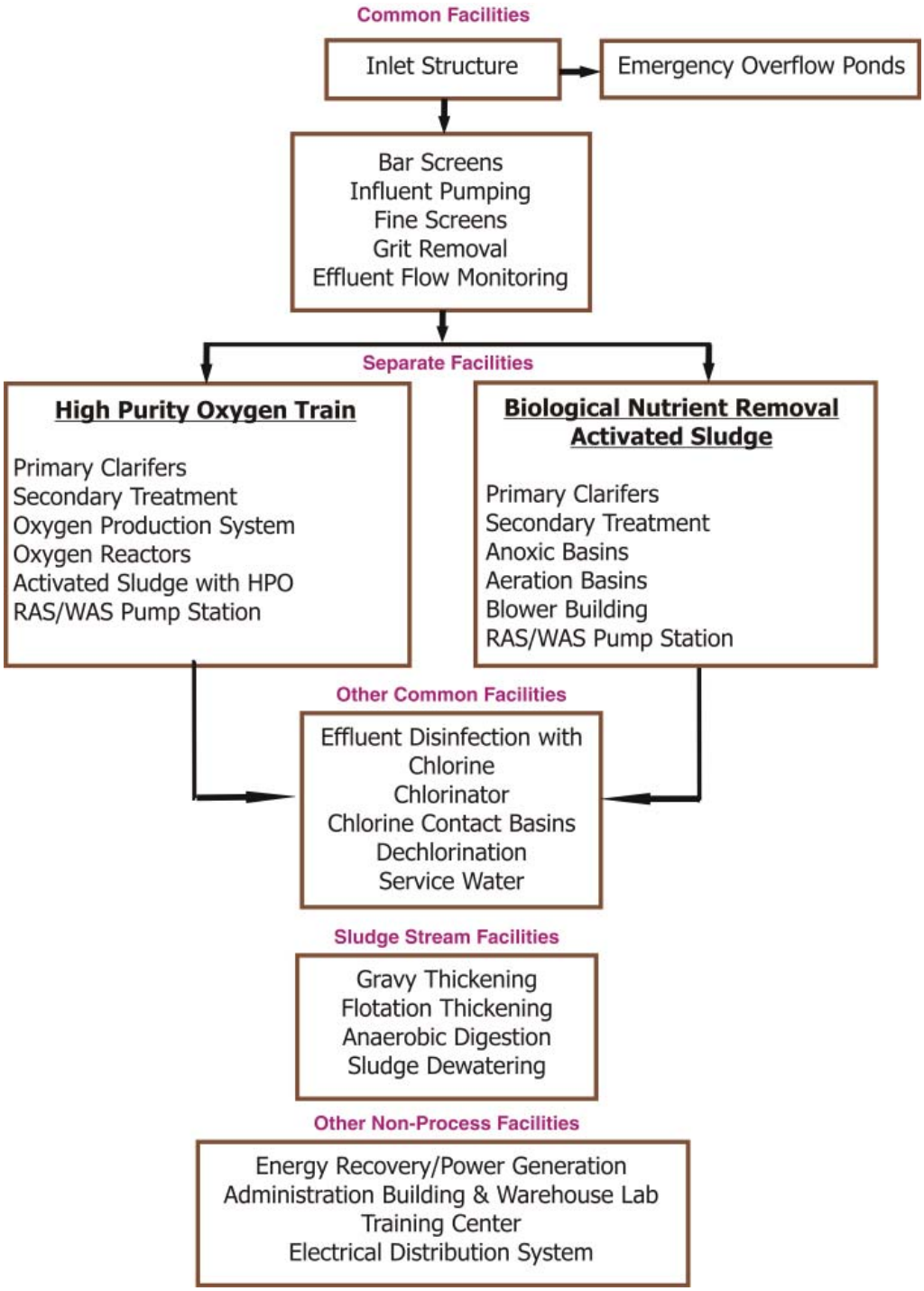
General

- Plant staff practice preventative maintenance on all major equipment. Pumps and small equipment tends to be reactive maintenance. A Computerized Maintenance Management System (CMMS), developed within the Synergen Asset Management system, is recommended.
- Enhanced physical barrier and a remote access control systems are desired to minimize public access to the site and reduce possible terrorism threats.
- New regulations for treatment and discharge are expected to require nitrification/denitrification of the 25 MGD HPO plant effluent. Funding from the 2004 Bond Authorization will provide a portion of the funding for this project.
- The regional Biosolids Facilities will be expanded to treat the combined sludge generated at the Roger Road WWTP. The combined sludge treatment facility will be upgraded to produce Class A biosolids.

Wet Stream

Preliminary Treatment

The preliminary treatment process consists of: Inlet Structure and Emergency Storage Basin; Bar Screens; Influent Pumps; Fine Screens (Headworks); Grit Removal; and Influent Flow Metering; Channel Aerators and a Splitter Structure. Each component is discussed on the following pages.



Headworks

A new headworks facility capable of handling 50 MGD average annual flow was constructed as part of the plant expansion. The new headworks includes larger grit chambers and bar screens, a larger and deeper influent pump station, improved odor control and improved and enlarged Emergency Overflow Basins. The new headworks are divided into three parallel trains of coarse bar screens, pumps, fine screens and grit chambers. This configuration allows one train to be taken out of service for maintenance. A Parshall flume is located in the single channel downstream of the grit chambers to measure total plant influent flow.

The headworks odor control system requires adjustment and balancing to better conduct odors in the area of the fine screens.

Inlet Structure and Emergency Overflow Basins

Wastewater is received via inlet sewers that discharge into a common inlet structure. The inlet structure, part of the original plant, was modified to feed the new headworks through a drop structure. Diversion to the Emergency Overflow Basins is through this structure. A new 72-inch pipe carries the coarse bar screens flow to the influent pumping station. The new headworks are 5 feet lower than the original plant inlet, which has improved the flow in the incoming sewers.

The Emergency Overflow Ponds are gravity fed with a total storage capacity of 18 million gallons (MG) at 2-feet of freeboard. There are three basins, the first of which is concrete lined. The remaining two are plastic lined with polypropylene sheets. If the basins are used, portable pumps deliver the contents of the basin back to the headworks.

Emergency Overflow Basin Number 2, presently plastic lined, should be re-lined with a hard surface to facilitate cleaning.

Bar Screens

Two mechanically cleaned bar screens remove large debris, such as rags, sticks, and various other items from the influent flow to prevent damage to downstream equipment. The bar screens consist of a series of parallel bar spaced 2-inch apart. Debris is trapped on the bars as wastewater passes through them. The bars are cleaned by a mechanical raking device, which carries the debris to a screening conveyor. The screenings are disposed of in the Tangerine Road Landfill owned by Pima County.

Influent Pumping Station

The influent pumps consist of three Archimedes constant-speed, inclined screw pumps. Each screw pump has a bottom bearing that is submerged and must be continuously lubricated during operation. The influent pumps are preceded by a raw wastewater forebay, which makes it possible to divert flow to a standby pump unit. Sluice gates installed in the forebay direct the influent flow to the active pumps. Each pump discharges to a fine bar screen for further removal of trash.

Fine Screening

The influent pumps discharge to three fine screens to complete the debris removal prior to entering the grit chambers. Sluice gates installed in the forebay divert flow to the active screens. The bars are cleaned by a mechanical raking device, which carries the debris to a screening conveyor. The screenings are washed to control odor and with fecal matter being wasted back into the flow stream before disposal at the Tangerine Road Landfill.

Grit Removal and Disposal

Grit removal is accomplished in three chambers. Sluice gates are installed to divert the flow to active grit tanks. Inlet velocity control gates provide a means to vary the flow speed from 0.7-1.3 feet per second (fps). The flow is aerated to keep organics in suspension and aid in sedimentation. While at this slower flow rate, the heavier inorganic solids (grit) will settle to the bottom where they are mechanically pushed to a sump. The grit is pumped to centrifugal grit separators with the grit deposited to a hopper and the water returning to the flow stream. The grit is then hauled to the Tangerine Road Landfill for disposal.

Influent Flow Monitoring

An ultrasonic flowmeter is installed in the conduit connecting the headworks and primary clarifiers. The flow information is transmitted to the WPCF monitoring and control center where the data are utilized for plant control.

Influent Conduit Blower (Channel Aerators)

This blower provides the air required to keep the solids in suspension in the influent channel, thereby preventing deposition, decomposition and odor.

Splitter Structure

The Splitter Structure allows for flow control and proper flow distribution between the new 12.5 MGD train and the existing 25 MGD train.

Headworks Odor Control Facilities

The Preliminary Treatment Section is new and has minimal problems. The presence of escaping odors throughout the facility requires correction by having the systems balanced and fine-tuned.

The following subsections detail the treatment process and components and are divided according to treatment train and further by processes within the trains.

Train A. High Purity Oxygen Activated Sludge (HPOAS) Process (25 MGD)

Primary Treatment

Primary Clarifiers

There are four rectangular, covered primary clarifiers. Primary Clarifiers are designed to retain the wastewater for several hours at minimum flows allowing solids to settle to the bottom for collection as primary sludge. Primary sludge is routed to the thickeners for further treatment. The primary clarifiers are covered to prevent odors and the gases generated are collected, treated and released to the atmosphere.

The clarifiers are designed to remove all the grit, a portion of the suspended solids, the settleable solids and the BOD_5 from the primary influent.

The Primary Clarifiers contain the following equipment aiding in the solids separation and handling:

- The influent baffle is a fiberglass unit that slows the flow and directs the flow downward, promoting settling.

- Collector mechanisms: each clarifier is equipped with drag chains to move the sludge to the sludge pit. A skimmer conveys the scum from the water surface into the scum trough.
- Effluent weirs are V-notched plates which control the wastewater level.
- Sludge pumps are used to pump to either the digesters or the sludge thickeners. There are six centrifugal sludge pumps for the four clarifiers of each train with four operating and two spares.
- Scum pumps are used to pump scum to either the digesters for further treatment or directly to trucks for removal to the landfill. There are two primary centrifugal scum pumps for each train.
- The dewatering pump is a single horizontal centrifugal pump, which drains the tanks. The pump suction can be valved into any of the four primary clarifiers while it discharges to the influent channel.

High levels of hydrogen sulfide, coupled with turbulence induced by the aeration, have caused corrosion in the primary clarifier influent channels. The concrete in this area is unprotected and showing signs of deterioration. Steel cover plates and frames are severely corroded and the inlet sluice gates are leaking.

The present odor control system design for the primary clarifiers requires improvement to efficiently control noxious fumes.

The building housing the scum collection equipment shows signs of corrosion accompanied by odor concerns. The doors and doorframes for the building are corroded to the point the doors are nearly inoperable. The areas around the primary thickeners require improvement to reduce the possibility of stormwater into the WPCF's tunnels during severe summer storms.

Secondary Treatment

Secondary treatment is accomplished by introducing pure oxygen into the primary clarifier effluent. A pressure swing adsorption (PSA) oxygen generation system supplies high purity oxygen. Four rectangular, three-stage, mechanically agitated oxygen reactor tanks provide aerobic conditions to ensure complete biological stabilization of the organic materials in the effluent.

Oxygen Production System

The oxygen production system has various components that are necessary to effectively produce and supply oxygen to the Secondary Reactors. These components are:

- Chilled water pumps.
- Instrument air compressors.
- Oxygen compressors.
- PSA skid.
- Liquid oxygen storage and vaporizer system.
- Storage Tanks for truck delivered oxygen for use during maintenance or emergencies.

The system is considered outdated and should be considered for upgrade.

Oxygen Reactors

There are four oxygen reactor tanks each consisting of three equally sized stages. The entire reactor deck is covered to maintain high purity oxygen in the vapor space for dissolution of oxygen into the mixed liquor, a combination of the primary effluent and return-activated sludge. Each reactor

stage has a surface mechanical aerator (mixer) to provide complete mixing and suspension of the contents and to dissolve the vapor space oxygen into solution. Each mixer includes a hydraulic vapor seal to prevent the loss of reactor oxygen to the atmosphere.

- Each reactor also has a Return Activated Sludge (RAS) line to convey return sludge from the secondary clarifier by way of the RAS/WAS pump station to each reactor first stage.
- The mixed liquor effluent leaving the reactor is designed so that a gas seal is created, preventing reactor vapor gas from escaping. The mixed liquor effluent flows to the secondary clarifiers.
- The individual reactor trains can be dewatered with the reactor dewatering system. The piping configuration at the dewatering pump provides the flexibility to dewater one reactor train and direct the flow to one or all of the other reactor trains.

The reactor concrete roof decks have numerous hairline cracks causing oxygen leakage from the tanks and the mixers need significant replacement/upgrades.

Secondary Clarifiers

There are four secondary clarifiers for the HPOAS process train. The clarifiers are circular tanks with a drive unit providing continuous rotation of the collection tubes and scum scraper arm. As the mixed liquor from the reactors enters the clarifier the solids settle to the floor of the tank. The collection draft tubes direct the settled sludge to the center collection pipe. This sludge is conveyed to the return and waste activated sludge pumps for return to the oxygen reactor inlet or directed to the sludge-thickener complex.

Clarifier scum (floating debris) is collected by a rotating arm that pushes surface scum to a collection trough for gravity flow to the RAS/WAS pumping station sump. It is pumped back to the primary influent channel.

The capacity of the scum and sludge equipment is limited. Operations have enlarged the sludge withdrawal pipes in one of the secondary clarifiers and plans to enlarge the same equipment in the other clarifiers. An engineering study of the capacities of the withdrawal systems should be undertaken.

Train B. Biological Nutrient Removal (BNR) Process (12.5 MGD)

The discussion of this train is limited, as this train is in the final construction stage and should have no repair issues.

Primary Treatment

The two primary clarifiers for train A and B operate similarly to those of the High Purity Oxygen Activated Sludge train.

Secondary Treatment

Secondary treatment in this train employs an anoxic/aerobic process to achieve nitrogen removal. The Modified Ludzack-Ettinger (MLE) is a two-stage nitrogen removal process that uses an anoxic reactor upstream of the BOD oxidation/nitrification reactor (aeration tanks). The MLE process recycles nitrates from the aerobic stage back to the anoxic stage.

Anoxic Basins

There are four equally sized, covered anoxic basins to remove naturally occurring nitrogen from the wastewater. Wastewater overflow from the primary thickeners is combined with Mixed Liquor Recycle (MLR) and RAS in an oxygen depleted environment.

Aeration Basins

The anoxic basin discharges flows to the aeration basins. Forced air is introduced into the five covered aeration basins to accomplish biological treatment of solids and wastewater in an activated sludge process.

Blower Building

The Blower Building is sized to handle the train expansion to 25 MGD. The blowers distribute forced air to the aeration tanks.

Mixed Liquor Suspended Solids (MLSS) Recycle

These horizontal centrifugal pumps collect transport flow from the aeration basin discharge, mix it with RAS flow from the RAS/WAS pump station, and pump it back to the anoxic basins.

Secondary Clarifiers

There are three new secondary clarifiers to service the BNR train, whose operation is the same as the secondary clarifiers for the HPOAS train.

Return and Waste-Activated Sludge Pumping Station

The RAS/WAS pump station is common to both Train A and Train B.

There are five RAS pumps to return clarifier sludge to the oxygen reactors and the anoxic basins. The basic purpose of returning clarifier sludge to the oxygen reactor and the anoxic tanks is to maintain an adequate quantity of microorganisms (biomass) to accomplish the incoming BOD removal.

RAS pumps, powered by a variable frequency drive (VFD) unit, allow the pump motor to vary its speed permitting the pump to maintain an optimum flow of return sludge.

The WAS pumps move activated sludge from the secondary treatment process to the sludge thickeners. The basic purposes of wasting sludge are to fine-tune the balance of a microorganism to the incoming BOD and to maintain a desired solids inventory concentration.

The remainder of the plant is either similar for Trains A and B or combines the flows from both trains, therefore will only be described once.

The existing WAS pumps are noisy and appear to vibrate excessively which could limit pump life. Operations staff had the pumps checked by the manufacturer who found no problems. Vibration mounting may help to limit noise and vibration. The condition assessment noted the crowded nature of this pump station.

Disinfection

The Ina Road WPCF, after a decision to move away from gaseous chlorine, uses liquid sodium hypochlorite for disinfection and liquid sodium bisulfite for chlorine neutralization to meet discharge limits for chlorine residual. The present system is classified as a “temporary system,” which appears in good shape with no structural problems; however, permanent facilities should be planned.

The plant effluent flow is metered and sampled prior to final discharge to ensure its compliance with discharge permits.

Chlorine Contact Basins

There are two chlorine contact basins; each with baffles that direct flow in a serpentine pattern to prevent short-circuiting. Each tank holds approximately 283,550 gallons of water. The tanks receive the mixture of chlorine solution and final effluent and provide a 30-minute contact period.

Dechlorination

There is a single dechlorination facility that receives the effluent of both chlorine contact basins. Dechlorination is achieved by feeding a sufficient amount of sodium bisulfate solution to the effluent prior to discharge to meet permit requirements for chlorine residual. Factors affecting dechlorination are: other oxidants in the effluent, rate of discharge, and the concentration of chlorine in the effluent.

Service Water Building

This Service Water Building houses effluent heat exchangers and an open-mixing chamber where sodium hypochlorite is added. There is some minor corrosion of the steel cladding; however, the structural steel appears to be in good condition. The shell and tube heat exchangers are a maintenance problem and should be repaired.

Sludge Stream Facilities

Existing Conditions

The Solids Handling Process area consists of the following major components:

Dissolved Air Flotation Thickeners

There are three units which use dissolved air to thicken the organic solids causing them to float to the water surface of the thickeners. The sludge collector and float skimmer mechanism collects both the settleable solids and the floatable solids and conveys accumulated solids through discharge piping to the sump pit.

There is one gravity thickener that receives primary sludge only. Large irregular particle sizes of the primary sludge makes gravity thickening the most effective way to dewater these solids. Solids are pumped from the bottom of the thickener to the centrifuges.

The overflow weir collects the supernatant from the unit and conveys the flow to the primary clarifiers.

The thickened sludge pumps move the thickened sludge from the sludge wet wells to the anaerobic sludge digester.

There is some minor concrete corrosion in these units. The concern is unprotected concrete may experience further corrosion, especially if the thickeners are covered to reduce possible odor emissions.

Anaerobic Sludge Digesters

The four digesters stabilize the sludge for easier dewatering and disposal. The organic matter in the thickened sludge is biologically broken down in the absence of oxygen. The process converts approximately 50 percent of the organic solids to liquid and gas. This greatly reduces the volume of the stabilized sludge for disposal. There are mechanical mixers that mix the sludge to maintain sludge consistency. The four hot water heat exchangers control the temperature of the internal contents of the digesters. Four centrifugal pumps supply the hot water from the power production facility to the sludge heat exchangers. Four centrifugal pumps circulate digested sludge through the heat exchanger.

Four centrifugal compressors transport the methane gas, created during sludge digestion, to the power production facility. Pumps transport sludge to the Centrifuge Building for dewatering. The concentration of hydrogen sulfide in the seal water, draining from the compressors, is considered high. It is recommended that compressor seal water be chemically treated by the addition of equipment to reduce the hydrogen sulfide.

The mechanical mixers, while providing adequate mixing, have experienced high failure rates creating inordinate maintenance expenses. Operations staff is replacing the gas piping from the digesters to the Recovery Building that have developed pinhole corrosion leaks; however, an overall gas piping system renovation is required. There is a concern the piping is undersized. Operations staff report delivery pressure to the compressors of 25 psig. The compressed digester gas delivery piping between the Digester Control Building and the Energy Recovery Building requires a capacity increase. It is recommended ladder access to the digester roofs be replaced with stairways.

Centrifuge Facility

The digested sludge from the Ina Road WPCF is joined by the Roger Road WWTP digested sludge at the Centrifuge Building, where three centrifuges thicken the digested sludge. The thickened sludge is pumped to a bladder equipped storage basin. Thickened sludge is then delivered to a disposal firm that uses the sludge for crop fertilization.

Due to piping constraints at the centrifuge facility, only one of the three centrifuges can be used at any one time. This severely limits the quantity of solids that can be thickened. In addition, if the solids are not thickened enough, PCWMD is required to pay a premium to the disposal firm. During periods of high solids production, the centrifuge facility has, at times, been unable to thicken the solids to avoid this premium. Having two centrifuges available for use will greatly enhance solids handling capabilities, and help to minimize operational costs of the facility.

Besides the solids handling issues, the centrifuge facility is also in need of additional odor control facilities, as well as building maintenance (roof). In addition, gas collection under the sludge storage bladder needs to be investigated.

Other (Non-Process) Facilities

Energy Recovery Building

The WPCF generates a portion of its own electrical power from the waste gas produced in the digesters. The methane gas is captured and used as fuel for engine generators, which in turn produce the electricity needed to operate the plant equipment. Natural gas is used to supplement the methane gas as a fuel source. Waste heat from the engines is used to heat the digesters and run an absorption chiller for plant building and process cooling requirements.

The chiller is unable to be used to full capacity as the return water temperature is too high in the summer months. The lack of a suitable overhead crane causes maintenance problems with servicing the generators.

The engine generator facility presently uses 74 percent natural gas and 26 percent digester methane to produce 50 million Kilowatt-hours of power yearly. There is a present project in the 2004 Bond Authorization to expand the Central Plant facilities.

Administration and Maintenance Building (Warehouse)

The functioning of the HVAC system in the combined Administration/Laboratory Building and in the Maintenance Building (Warehouse) has been questioned. It is possible under certain conditions for fumes from the Laboratory to enter the Administration Building ventilation system. The fumes from testing for toxic substances are exhausted with the possibility of re-entry into the office section of

the building providing the opportunity for contamination. The present HVAC system is unable to adequately cool the Laboratory during the summer months.

The plasma and welding areas in the Maintenance Building do not have exhaust hoods positioned to carry the fumes outside. The paint booth exhaust is too close to the building's fresh air intake.

There is a need for additional office, locker room and lunchroom facilities at WPCF. There are proposals to renovate the old Training Center, Filter Building and portions of the warehouse and Administration Building to provide these facilities following relocation of the present scattered laboratory functions to the 2004 Bond Authorization Laboratory Building.

Laboratory

The present WPCF Laboratory space was designed to meet regulatory testing requirements in the 1970s. Testing requirements have greatly expanded since that time. The present laboratory testing requirements have been accommodated in the Administration Building leading to crowded, inadequate facilities. In recognition of this, a new Laboratory Building was included in the 2004 Bond Authorization. A problem with the present completed engineering design was realized. The design for the Laboratory was completed prior to 2000 and the Uniform Building Code. Pima County has adopted the International Building Code since then. The present design will have to be redone to meet the new code requirements.

In the event the Laboratory Building must be redesigned, the possibility of relocating the building to the area between the Sports Park and the new Outlying Facilities Building should be reviewed. New Training facilities are to be incorporated in this design. A design/build pre-engineered building may prove the most economically feasible solution.

Training Center

New Training Facilities will be included in the new Laboratory facility. The existing Training Facility could possibly be converted to lunch and locker room facilities.

Electrical Power Distribution

The 2004 Bond Authorization contains a project to upgrade the electrical distribution system within the WPCF site. In addition, a program to assess and replace deficient outdoor substations and motor control centers is recommended. A study to replace manual transfer switches between regular and emergency power sources is recommended. In general, an upgrading of the electrical and control system, not covered by the 2004 Bond Authorization, is recommended.

Continental Ranch Pump Station

The Continental Ranch Wastewater Pump Station (CRWWPS) is located approximately one half mile east of Silverbell Road, halfway between Twin Peaks and Avra Valley Road. This facility presently serves the area downstream of the Ina Road WPCF, that area being roughly from Ina Road North along both sides of Silverbell Road to one-half mile south of Avra Valley Road, the area west of Camino de Oeste and east of an extension of Blue Bonnet Road. The main population in the area is concentrated in the Continental Ranch area east of Silverbell Road with the major future expansion expected to be between Camino de Oeste and Interstate 10 (I-10). This area expansion involves large parcels of State land whose release for development is dependent upon the State Land Department.

The Dove Mountain development, located west of Camino de Oeste, flow can reach the CRWWPS by gravity and currently is pumped to the Camino de Oeste trunk sewer at Tangerine Road. The Camino de Oeste trunk sewer is presently flowing below 50 percent capacity while conveying flow, including Dove Mountain, directly to the Ina Road WPCF by gravity.

The Continental Ranch pump station delivers wastewater to the Ina Road WPCF by means of a 26-inch diameter (18-inch Internal Diameter) HDPE pipeline routed generally along the west bank of the Santa Cruz River to Cortaro Farms Road, then runs along Silverbell Road to Ina Road and then along Ina Road to the WPCF. The majority of the route is under the riverside park close to residential areas. The pump station presently has three motor driven pumps with provisions for a fourth pump. The principal area of concern, due to the limitations of on-site storage, is the handling of diurnal flow. Presently, during peak periods of gravity flow to the pump station, the limitations of the wet well, pumps and pipeline set pumping capacity to between 4,000 to 4,400 gallons per minute (GPM) or 5.76 to 6.34 MGD respectively, Peak Wet Weather flow.

The Continental Ranch Pump Station has issues principally caused by the pump feed wet well being undersized. The operational size of the wet well from pump start to overflow is approximately 8,000 gallons. This is a relatively small retention time given the present inflow rate of 2,400 GPM. This allows only 3.3 minutes (8,000/2,400) for the operators to react should a pump fail or to switch to emergency power in case of an outage. This does not give a comfortable margin of safety before a Sanitary Sewer Overflow (SSO)would commence. There is a proposed project to rehabilitate and update this facility that should be undertaken as soon as possible.

Conclusion and Recommendations

Based on the discussion in this Chapter, the following projects should be included in the Ina Road WPCF elements of the long-range Capital Improvement Plan (CIP) using either SDF or 2004 Bond Authorizations as available.

Table 5.1.4 Recommended Improvements and Conceptual Costs for Ina Road WPCF

Improvements	Conceptual Cost
Computerized Maintenance Management System Implementation	$1,500,000
Facility Security Improvements	$210,000
Drainage Improvements at Existing Primary Clarifiers	$50,000
Emergency Overflow Basin #2 Lining	$2,000,000
Headworks Ventilation/Odor Control Improvements (Allowance)	$500,000
New Sluice Gates at Existing Primary Clarifiers	$400,000
Replace Cover Plates/Seat Angles at Existing Primary Clarifiers	$50,000
Rehabilitate and Protect Concrete/Retrofit Odor Control at Existing Primary Clarifiers	$1,500,000
Replace Skimmer House Doors/Retrofit Ventilation and Odor Control Improvements	$1,000,000
Nitrification/Denitrification (Existing Plant)	$27,000,000
Rehabilitate Oxygen Reators Concrete Deck	$3,500,000
Secondary Clarifier/RAS Pump/WAS Pump Improvements	$2,500,000
Permanent Chlorination/Dechlorination Facilities	$5,000,000
Waste Heat Exchanger Improvements at Service Water Building	$990,000
Digester Gas Piping System Renovation	$520,000
Digester Gas Piping Capacity Expansion	$500,000
Digester Gas Compressor Seal Water Drains/H2S Treatment	$100,000
Digester Roof Access Improvements/Minor Insulation Repairs	$200,000
Biosolids Improvements	$42,000,000
Centrifuge Building Odor Control Improvements	$730,000
Roger Road Sludge Fine Screening	$500,000
Energy Recovery Building Crane/Monorail Improvements (Allowance)	$300,000
Administration/Maintenance Building HVAC Improvements	$1,000,000
Office/Locker Room/Lunchroom Renovation	2,800,000
Electrical Improvements (Allowance)	3,000,000
Total	**$97,850,000**

SUB-CHAPTER 5.2 METROPOLITAN AREA TREATMENT SYSTEM FUTURE CONDITIONS

Treatment capacity is divided between the large Metropolitan Area treatment plants, Roger Road WWTP and Ina Road WPCF and the smaller facilities serving the outlying areas of Pima County. The Randolph Park WRF is within the Roger Road Tributary System. These treatment plants and their current conditions have been discussed in detail in Chapter 5.1.

The Drivers defined in Chapter 3.0 affect the future of the Metropolitan Treatment Facilities.

Regulatory Issues affecting the Roger Road WWTP and Ina Road WPCF facilities are increasing regulatory insistence upon de-nitrifying effluent. These increasingly stringent regulations are reflected in the AZPDES and Aquifer Protection Permits (APP). The effect of these permit requirements is the inclusion of projects to nitrify and de-nitrify the Roger Road WWTP and Ina Road WPCF facilities in the CIP. The new Randolph Park WRF is designed to de-nitrify discharge and further filters its discharge to provide Class A reclaimed water that discharges directly into the Tucson Water Reclaimed Water System.

Institutional Issues at the Roger Road WWTP concern the availability of surrounding land owned by the City of Tucson and the Arizona Department of Transportation. The City of Tucson operates a reclaimed water filter plant on its adjacent property while ADOT owns buffer property along I-10. An IGA identifying planned future uses of the involved government agencies and possible land exchanges would be beneficial. There is an IGA identified land exchange at the Ina Road WPCF giving the City of Tucson acreage to construct reclaimed water system facilities. The Randolph Park WRF is the result of the 2000 IGA between the City of Tucson and Pima County.

Asset Management is an outgrowth of the condition assessment of the treatment plant discussed in Chapter 5.1 that will be developed into an ongoing program.

Tributary Area and Sewer Basins

The population effects and resulting individual treatment facility capacity requirements are a major factor in any discussion of the future of the Metropolitan Treatment Facilities. The following narrative discusses the expected demands for capacity on Roger Road WWTP, Ina Road WPCF and Randolph Park WRF.

The tributary areas to Roger Road WWTP and Ina Road WPCF are shown in Figure 5.2.1. The Roger Road WWTP tributary area is shown in rose and the Ina Road WPCF tributary area in green. Although both these treatment plants are designated as urban facilities, the extent of the tributary systems to both plants encompass basins on the fringes of the urban areas expected to experience significant population growth in the next 25 years (see Figure 5.2.2). Basins 1B, 11, 25A, 36, 43A, 43B, 48, 49, 54, 73, 97 and 113 in the Roger Road WWTP tributary area and Basins 17, 50, 69, 84, 85,102 and 103 (see Figure 5.2.3) in the Ina Road WPCF tributary area are forecast to experience between 50 and 500 percent increases in population within the next 20 years (see Figure 3.4.8).

Roger Road WWTP Tributary Area

The basins in the Roger Road WWTP tributary system projected for greatest population increase by present PAG projections are located at the extreme ends of the conveyance system (in the case of Basin 43B approximately 24 miles away). Basin 43A and 43B serve the Rita Ranch, the Houghton Area Master Plan (HAMP) development and the Vail area. Any number of factors could lead to delays in development implementation in this area, such as delays in availability of state land or economic factors such as rising gasoline prices or rising mortgage interest rates.

The HAMP encompasses 10,800 acres or 16.9 square miles at the eastern boundary of incorporated Tucson. The boundaries are Irvington Road on the north, Harrison and Houghton roads on the west, approximately one mile north of I-10 on the south and three miles east of Houghton. The Arizona State Land Department owns a large portion (72 percent) of the area under the state trust.

The 2006 Metropolitan Area Facility Plan Update recommends evaluation of the need for a water reclamation facility to serve the far southeast area of the Metropolitan Area. The facility would be constructed as the Pantano Interceptor sewer approaches flow capacity. Based on current PAG population projections, the need for this facility is projected to occur sometime between 2010 and 2015. Therefore, as the development of the Houghton area continues and more specifically within the HAMP, construction of an eastside fully functioning wastewater treatment facility providing reclaimed water for distribution by Tucson Water's Reclaimed Water System may be appropriate. Initial flows from this area would be directed through the Pantano Interceptor and/or Southeast Interceptor until sufficient flows are developed to begin operation of this sub-regional facility. The facility would be expanded to meet increases in flows as the area grew.

PCWMD and the City of Tucson have agreed that a Community Facility District would be most appropriate to fund this facility, if the evaluation demonstrates need and feasibility. This would establish a funding mechanism to support this specific need and allow the facility to be expanded as the area develops.

The Randolph Park WRF, serving a sub-region of the Roger Road WWTP Tributary Area, reduces flow in the conveyance system to Roger Road WWTP by producing reclaimed water in the center of the City of Tucson while returning the solids portion (less than 5 percent) to the conveyance system for final treatment at Roger Road WWTP.

Ina Road WPCF Tributary Area

The basins in the Ina Road WPCF tributary area are somewhat closer but Basin 60 and 84, which represent Rancho Vistoso and Catalina respectively, are approximately 10 miles away from the Ina Road WPCF. The basins in the Ina Road WPCF tributary system, projected for less aggressive population growth by present PAG projections, and which had been impacted by the restrictions on development due to the Pygmy Owl presence, have become far more development-active in the past year following easing of Federal Pygmy Owl restrictions. Although not presently targeted by PAG for explosive growth, Basins 93 (Dove Mountain), and Basins 28, 59 and 8 (see Figure 5.2.4) are experiencing significant development activity. Should potential homeowners find these areas more desirable than areas in the Roger Road WWTP tributary system, flow growth would change from the Roger Road WWTP to Ina Road WPCF. Further, future population presently forecast as tributary to one of the Outlying Facilities may shift among these facilities or move into the Roger Road WWTP or Ina Road WPCF tributary areas.

Given the uncertainty of the location of development within the Metropolitan Area, PCWMD is pursuing a policy of providing maximum flexibility in directing flow and providing capacity at its treatment facilities.

Home Flows and Managed Flows

The Facility Plan Model Average Dry Weather Flow (ADWF) Excel spreadsheets have been developed for the Roger Road WWTP and Ina Road WPCF tributary areas. The ADWF spreadsheets, in addition to providing predictions for the conveyance system, also provide at their apex, predictions of the average dry weather flow to the Roger Road WWTP and Ina Road WPCF treatment plants.

The ADWF is the average daily flow calculated for a theoretical month with the average flow of the total year. However, treatment capacity is defined in the Arizona Administration Code under the

terms “Design Flow” and “Design Capacity.” Both terms essentially require sustained and reliable performance complying with permit conditions under peaking and contingency conditions. Permit conditions include discharge quality requirements and operational requirements. Design flow is the maximum average daily flow (MADF) (calculated in the month that has the highest total flow for the year) at which a facility can comply with discharge quality requirements.

It should be noted, the ADWF for this Facility Plan is conservative and will be used as equivalent to the MADF when discussing the treatment plant capacity. Preliminary calculations indicate the MADF occurs in the summer months and is approximately 1.1 times the ADWF. The methodology used for calculating ADWF was calibrated using collection system flows and treatment plant influent flows in November and December 2004. The ADWF was based on 85 gallons per capita per day based on ADEQ approved methodology. The actual average per person wastewater generated is closer to 65 gallons per capita per day for the Metropolitan Area. Therefore, the ADWF calculations are conservative by a factor of 1.3 (85/65 = 1.3). Since the MADF peaking factor of 1.1 is less than the conservative factor of 1.3, the ADWF for treatment should be calculated and used for implementation of wastewater treatment projects.

The Facility Plan Model forecasts the ADWF to the Metropolitan Treatment Facilities by totaling the individual flows at Roger Road WWTP and Ina Road WPCF. The total Metropolitan Treatment Facilities, the combined Roger Road WWTP and Ina Road WPCF tributary systems, flow in any month is relatively constant; however, the flow to Roger Road WWTP and Ina Road WPCF varies in accordance with the activities at the flow management structures within the Conveyance System. The Tucson Boulevard Flow Management Structure (TBFMS) is the significant management device currently used to manage flows between the two tributary systems. A meter at the TBFMS constantly monitors flow directed from the Roger Road WWTP tributary system to the Ina Road WPCF tributary system. The TBFMS permits PCWMD limited management of the flows going to the individual treatment plants. This flexibility allows PCWMD to utilize unused treatment capacity within the Metropolitan Area by directing flows away from either plant to permit maintenance and to stay within the design capacities of both plants. The current unused treatment capacity is located at Ina Road WPCF.

The TBFMS is limited in the volume of flow that can be directed away from Roger Road WWTP without adversely affecting the conveyance system as was shown in Chapter 4.2. The solution to this limitation is the Plant Interconnect project proposed in the 2004 Bond Authorization. The magnitude of the required diversion is best presented in terms of ”Home” versus “Managed” flows.

Home flows are defined as those flows arriving at a treatment plant by gravity barring any transfer between tributary systems. Managed flows are the flows arriving at either plant following flow transfer between the tributary systems. This concept is utilized to demonstrate how PCWMD intends to use the current capacity in the Metropolitan Treatment Facilities to treat future flows.

The data for ADWF at the Roger Road WWTP and Ina Road WPCF treatment plants for the years 2005 through 2025 is shown in table 5.2.1 and 5.2.2. Table 5.2.1 presents the “Home” flows. Table 5.2.2 displays the flows to Roger Road WWTP and Ina Road WPCF; however, 5.35 MGD of wastewater has been diverted from the treatment plants in 2005. This flow reduces to zero in 2015 upon installation of the plant interconnect. The 5.35 MGD value was chosen to match the actual average daily flow being transferred from the South to the North Rillito Interceptor in December 1 through 15, 2004 as recorded by PCWMD’s SCADA flowmeter located at the TBFMS.

The Facility Plan Model considers the Roger Road WWTP to Ina Road WPCF Plant Interconnect will be installed by 2015. The ADWF to Ina Road WPCF and Roger Road WWTP reflects the impact of the plant interconnect from 2015 to 2025.

The population tributary to the two treatment plants on sewer (no septic) for the year 2000 was obtained from PAG 2000 Traffic Analysis Zones (TAZ) data reduced by the basin population estimated to be on septic. The 2000 flows for both plants were taken from historical plant effluent records. These figures may not be "Home" flows as flows diverted from Roger Road WWTP to Ina Road WPCF were not recorded. This appears to be the reason for the reduction in flow at Ina Road WPCF from 2000 to 2005.

The flow values for 2005 and beyond displayed in the table are the calculated values from the Facility Plan Model based upon PAG population forecasts. The 2005 ADWF of 38.92 MGD (44.27 - 5.35) calculated for Roger Road WWTP, compares favorably with the 38.95 MGD obtained from plant records for early December 2004. The 22.25 MGD (16.90 + 5.35) calculated for Ina Road WPCF in 2005 compares closely with the 22.63 MGD obtained from plant records for early December 2004. The apparent decrease in flow between the recorded value in 2000 and December 2004 may be due to the decrease in total inflow and infiltration in these drought years.

Table 5.2.1 Home Flows

Wastewater Home Flows to the Roger and Ina Treatment Plants											
	Roger Road WWTP System						Ina Road WPCF System				
	Roger Rd WWTP Tributary System Total Population on Sewer	Randolph WRP	Plant Interconnect	Tucson Blvd Flow Management to Ina	Total Flow Treated at Roger Road WWTP MGD	Total Home Flow in Roger System MGD	Ina Rd WPCF Tributary System Total Population on Sewer	Plant Interconnect	Tucson Blvd Flow Management from Roger	Total Flow Treated at Ina WPCF MGD	Total Roger and Ina (From Plant Daily Records for 2000) MGD
2000	459,598	0.00	0.00	0.00	42.72*	42.72*	198,821	0.00	0.00	18.58*	61.3[1]
2005	503,037	0.00	0.00	0.00	44.71	44.71	225,142	0.00	0.00	17.36	62.1
2010	529,568	3.00	0.00	0.00	43.95	46.95	233,150	0.00	0.00	18.04	65.0
2015	569,202	3.00	0.00	0.00	47.29	50.29	243,099	0.00	0.00	18.84	69.1
2020	604,536	3.00	0.00	0.00	50.27	53.27	253,056	0.00	0.00	19.65	72.9
2025	640,506	3.00	0.00	0.00	53.31	56.31	262,811	0.00	0.00	20.43	76.7
2030	714,919	3.00	0.00	0.00	56.31	62.72	284,957	0.00	0.00	50.00	85.05

1. Flows taken from plant records for the year 2000 and adjusted by 5.35 MGD (added to Roger and subtracted from Ina) to account for flow management.

It should be noted that the percentage of Biological Oxygen Demand (BOD) and suspended solids (SS) in the Metropolitan Area flows has increased over the past five years.

Notes to Table 5.2.1

1. Roger Road WWTP Tributary System Total Population on Sewer is the total population whose wastewater would naturally flow to Roger Road WWTP if the flow were not directed elsewhere by the Tucson Blvd Flow Management Structure.

2. Randolph Park WRF is the wastewater treated at Randolph Park WRF and hence subtracted from the flow to the Roger Road WWTP.
3. Plant Interconnect is the pipeline that will connect the Roger Road WWTP and the Ina Road WPCF.
4. TBFMS makes possible the re-direction of flow originating in the Roger Road WWTP Tributary System to be treated at the Ina Road WPCF.
5. Total flow treated at Roger Road WWTP is the flow entering the WWTP after flow has been either treated at Randolph Park WRF or re-directed by means of the plant interconnect or the TBFMS.
6. Total Flow Home Flows in the Roger System are the sum of flows treated at Roger Road WWTP, flows treated at Randolph Park WRF and those re-directed by either the Plant Interconnect or the TBFMS.
7. Similar titles for Ina Road WPCF Tributary System have the same meanings when applied to the Ina System.
8. Total Roger Road WWTP and Ina Road WPCF is the total flows treated by the Roger Road WWTP and Ina Road WPCF Tributary Systems.

The current Metropolitan Treatment Facilities configuration is shown in Figure 5.2.5. Table 5.2.2 presents the "Managed Flows" to the Roger Road WWTP and Ina Road WPCF. The managed flows table considers that 5.35 MGD is transferred from the Roger Road WWTP to the Ina Road WPCF tributary area in each period considered from 2000 through 2015. In the periods 2015 to 2030 this flow reduces to zero while the Plant Interconnect transfers flow between plants. Randolph

Table 5.2.2 Managed Flows

Wastewater Managed Flows to the Roger and Ina Treatment Plants											
	Roger Road WWTP System						Ina Road WPCF System				
	Roger Rd WWTP Tributary System Total Population on Sewer	Randolph WRP	Plant Interconnect	Tucson Blvd Flow Management to Ina	Total Flow Treated at Roger Road WWTP MGD	Total Home Flow in Roger System MGD	Ina Rd WPCF Tributary System Total Population on Sewer	Plant Interconnect	Tucson Blvd Flow Management from Roger	Total Flow Treated at Ina WPCF MGD	Total Roger and Ina MGD
	(Estimate for 2000)						(Estimate for 2000)				
2000	459,598	0.00	0.00	0.00	42.72[1]	42.72[1]	198,821	0.00	0.00	18.58[1]	61.3[1]
2005	503,037	0.00	0.00	-5.35	39.36	44.71	225,142	0.00	5.35	22.74	62.1
2010	529,568	3.00	0.00	-5.35	38.60	46.95	233,150	0.00	5.35	23.39	65.0
2015	569,202	3.00	-18.66	0.00	28.63	50.29	243,099	18.66	0.00	37.50	69.1
2020	604,536	3.00	-17.85	0.00	32.42	53.27	253,056	17.85	0.00	37.50	72.9
2025	640,506	3.00	-17.07	0.00	36.24	56.31	262,811	17.07	0.00	37.50	76.7
2030	714,919	3.00	-27.67	0.00	32.05	62.72	284,957	27.67	0.00	50.00[2]	85.05

1. Flows taken from plant records for the year 2000.
2. Following the 2026/9 12.5 MGD expansion of Ina Road WPCF to 50 MGD capacity.

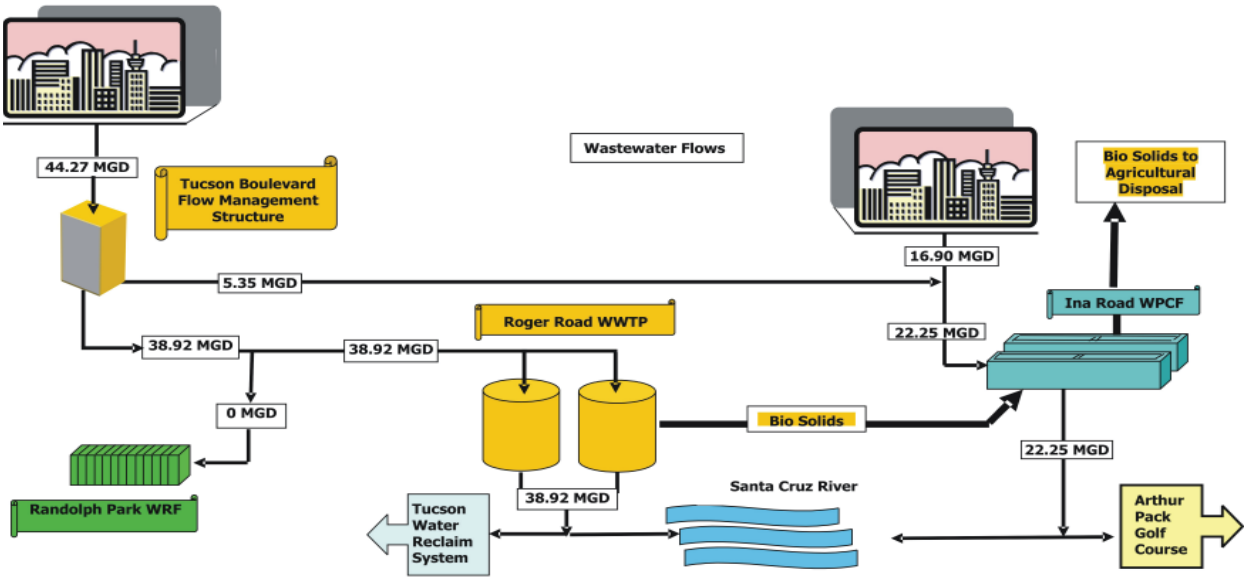
Park WRF, when fully operational, reduces the flow to Roger Road WWTP by 3.0 MGD in periods subsequent to 2005.

The management of flows between the two plants is obviously a key issue. Chapter 4.2 Conveyance Future Conditions displays the limits of continued flow management by using the North Rillito Interceptor (NRI) as forecast flows are presently causing capacity issues. However, by the use of a plant interconnect, PCWMD intends to manage flows to the two plants to utilize the combined in-place design capacity as one treatment entity.

The voters of Pima County approved a 2004 Bond Authorization Project for construction of a pipeline connecting the Ina Road WPCF and Roger Road WWTP. The Plant Interconnect will allow, in 2015, treatment of up to 18.7 MGD of wastewater tributary to Roger Road WWTP at Ina Road WPCF reducing flow through the Roger Road WWTP to approximately 30.2 MGD enabling PCWMD to proceed with the rehabilitation projects described in Chapter 5.1 Current Conditions for the Roger Road WWTP.

Figure 5.2.5

Metropolitan Treatment System
Status as of March 2005



Chapter 5.1 Treatment Current Condition presented current conditions at the Roger Road WWTP and Ina Road WPCF. The capacity of the Ina Road WPCF will reach 37.5 MGD in 2006 with the addition of the new BNR treatment train. The future expansion of the Metropolitan Treatment Capacity by 12.5 MGD for the years beyond 2025 is already planned at Ina Road WPCF by increasing capacity from 37.5 MGD to 50 MGD.

As noted in Chapter 5.1, the recently completed Ina Road WPCF headworks was designed and constructed for expanding the headworks to 50 MGD capacity. Likewise, the engineering design and construction of the new BNR treatment train considered its expansion from 12.5 MGD to 25 MGD. The plant layout provided space in all its parts for inclusion of additional tanks and equipment to accomplish this expansion to 25 MGD.

Roger Road WWTP, by comparison, has no present plan for a physical expansion beyond the 41 MGD. The Randolph Park WRF, when placed in service and the 3.0 MGD of reclaimed water produced is delivered to the Tucson Water Reclaimed Water system, will add an additional 3.0

MGD of capacity to the Metropolitan Treatment Facilities raising capacity to 81.5 MGD when the Ina Road WPCF expansion to 37.5 MGD is completed in 2006.

The foregoing discussions of plant flows and capacities consider the capacity of the plants at current permit discharge limits. The effect upon treatment capacity of more restrictive regulatory requirements is discussed in Chapter 3.1 Regulatory Drivers.

Dynamic Process Modeling

PCWMD is currently actively engaged in dynamic process modeling of the Roger Road WWTP, Randolph WRF and Ina Road WPCF together with several of the Outlying Facilities. This modeling effort will provide guidelines for optimizing the current plant process to realize their maximum treatment potential, and also allow PCWMD to further model treatment additions for plant upgrades to meet future regulatory permit requirements. PCWMD's dynamic modeling program is discussed in Sub-chapter 5.5.

Enhanced Activated Sludge Treatment Process

PCWMD is investigating methods to enhance the activated sludge processes used at the Ina Road WPCF and Roger Road WWTP. The enhancements are considered necessary to meet increasing regulatory discharge standards. Common names for these processes include: attached growth suspended integrated fixed film activated sludge, hybrid activated sludge, moving bed bioreactors, microfiltration and submerged attached growth bioreactors. These processes, if successful, promise to increase the capacity of the existing plants while providing a lower cost means to meet increased effluent regulatory requirements. A fixed film process will be investigated by dynamic modeling and demonstrated in the Marana WWTF in FY2005/06. The process demonstration will include field conducted pilot plant studies as needed to acquire ADEQ BADCT approvals. Should the outcome of the demonstration be successful its application to other PCWMD treatment facilities may be recommended.

PCWMD also plans to investigate the merits of several other processes such as high rate anaerobic reactors and pre-fermentation by dynamic modeling before further discussion.

The success of the demonstration project and BADCT acceptance by ADEQ allow the capacity issues at Roger Road to be readdressed. This may impact the selection of the process to upgrade Roger Road WWTP to a nitrifying-denitrifying facility.

Continental Ranch Pump Station (CRWWPS)

As of December 2004, the ADWF flow to the CRWWPS is approximately 1.6 MGD. The peak dry weather flow (PDWF) for the same period is approximately 1.83 MGD with the maximum pumped discharge reaching 2,400 GPM. These flow figures were obtained from Operations personnel. A basin study was performed for PCWMD in 2002, forecasts an ADWF of 2.34 ADWF and a PWWF pump discharge of 3374 GPM for 2005. The current recorded flows for are approximately 68 percent of those forecast in the basin study.

The basin study forecasts an ADWF of 8.36 MGD and a PWWF of 17.06 MGD at this facility in 2025. The Facility Plan Model forecasts for this facility in 2025 are 2.43 MGD ADWF and 4.12 MGD PDWF. Given the variations in flow forecasts and the variation of forecasts from actual data, PCWMD is carefully investigating the necessity for the addition of a second force main from CRWWPS to Ina Road WPCF.

Given the operational problems with the CRWWPS and the operating cost of power, staffing and maintenance the long-term solution to capacity problems is to extend the gravity sewer serving the pump station downstream to either a new treatment facility near Tangerine Road and I-10 or

to continue the sewer to the Marana Airport and join the 2004 Bond Authorization funded sewer from the airport downstream to an enlarged Marana WWTF.

Conclusion and Recommendations

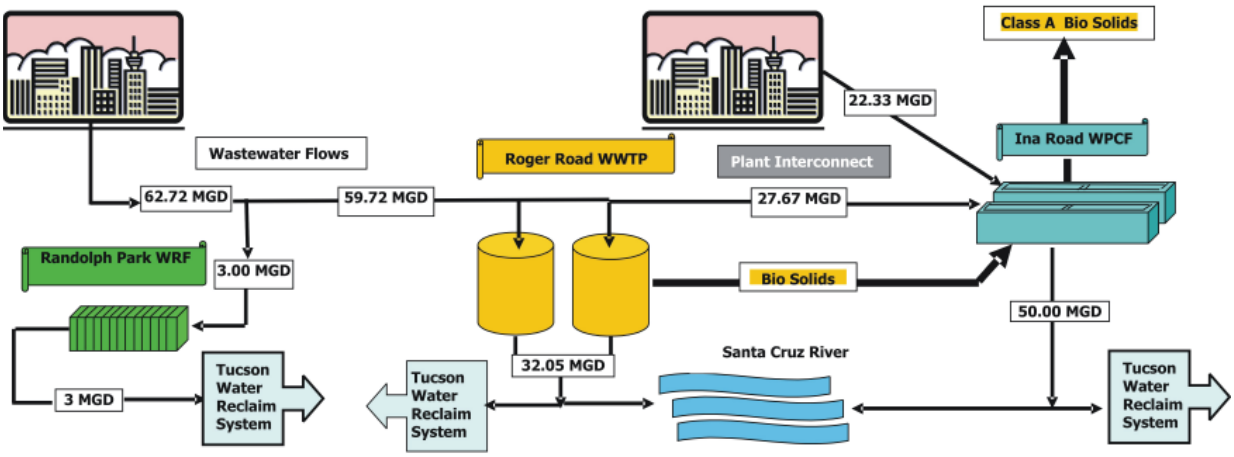
The major concepts in establishing an integrated Metropolitan Treatment Facilities are graphically presented in Figure 5.2.6.

The rehabilitation and upgrade program for the Metropolitan Treatment Facilities over the next twenty-five years involves the following elements:

- Place the new 3 MGD Randolph Park WRF and 12.5 MGD Ina Road WPCF in service in 2005/06.
- Rehabilitate Ina Road WPCF in accordance with the recommendations in Chapter 5.1.
- Construct the Plant Interconnect between Roger Road WWTP and the Ina Road WPCF expeditiously.
- Transport approximately 18.6 MGD of flow tributary to Roger Road WWTP initially for treatment at the expanded Ina WPCF Facility to allow rehabilitation of Roger Road WWTP.
- Convert the main electrical transformer at Roger Road WWTP from a Delta to a Wye system.
- Convert the Roger Road WWTP away from plant-generated gas to electric driven motors.
- Modify the Roger Road WWTP to allow half the WWTP to be taken out of service to facilitate rehabilitation and upgrade.
- Rehabilitate and upgrade the portion of Roger Roger WWTP that is off line following the suggestions contained in Chapter 5.1 Current Conditions for the Roger Road WWTP.

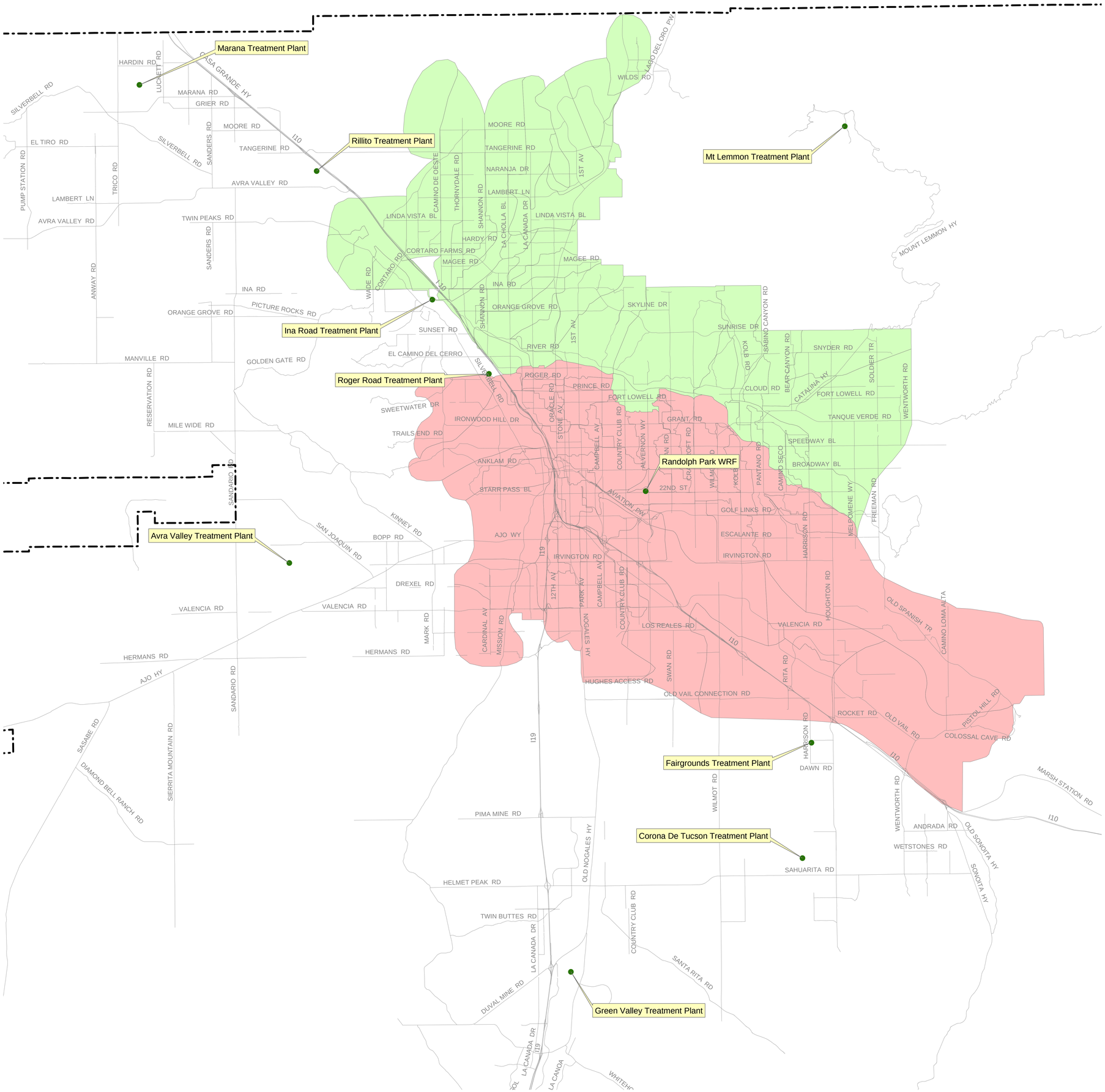
Figure 5.2.6

Metropolitan Treatment System
December 2030



- Determine if the present sludge pumping system is capable of pumping the total sludge produced at the Roger Road WWTP (from a maximum flow of 41 MGD at Roger Road WWTP and 3 MGD from Randolph Park WRF). Add new, if any, pumping and electric distribution equipment. The present pipeline, although it has the capacity to deliver the sludge for the 41 MGD WWTP, provides no back-up line and the pumping system would need to be modified to pump raw sludge.
- Upgrade the Ina Road WPCF powerhouse to gas turbine generators to utilize the total methane gas generated by the expanded Ina Road WPCF Biosolids.
- Following rehabilitation and upgrading of the first one half of the Roger Road WWTP, rehabilitate and upgrade the remainder of the WWTP.
- In 2020, begin engineering to expand Ina Road WPCF to 50 MGD.
- Initiate the 2004 Bond Authorization project, Ina Road WPCF Denitrification, and determine if additional funds will be needed to nitrify/denitrify the 25 MGD HPOAS train.
- Evaluate and implement nitrification/denitrification at the Roger Road WWTP.

Sewer Basins



Treatment Plants

BASINS

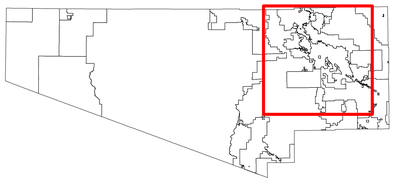
Ina Road

Roger Road

Major Streets

Figure 5.2.1

Pima County Index Map



Index Map Scale 1:1,500,000

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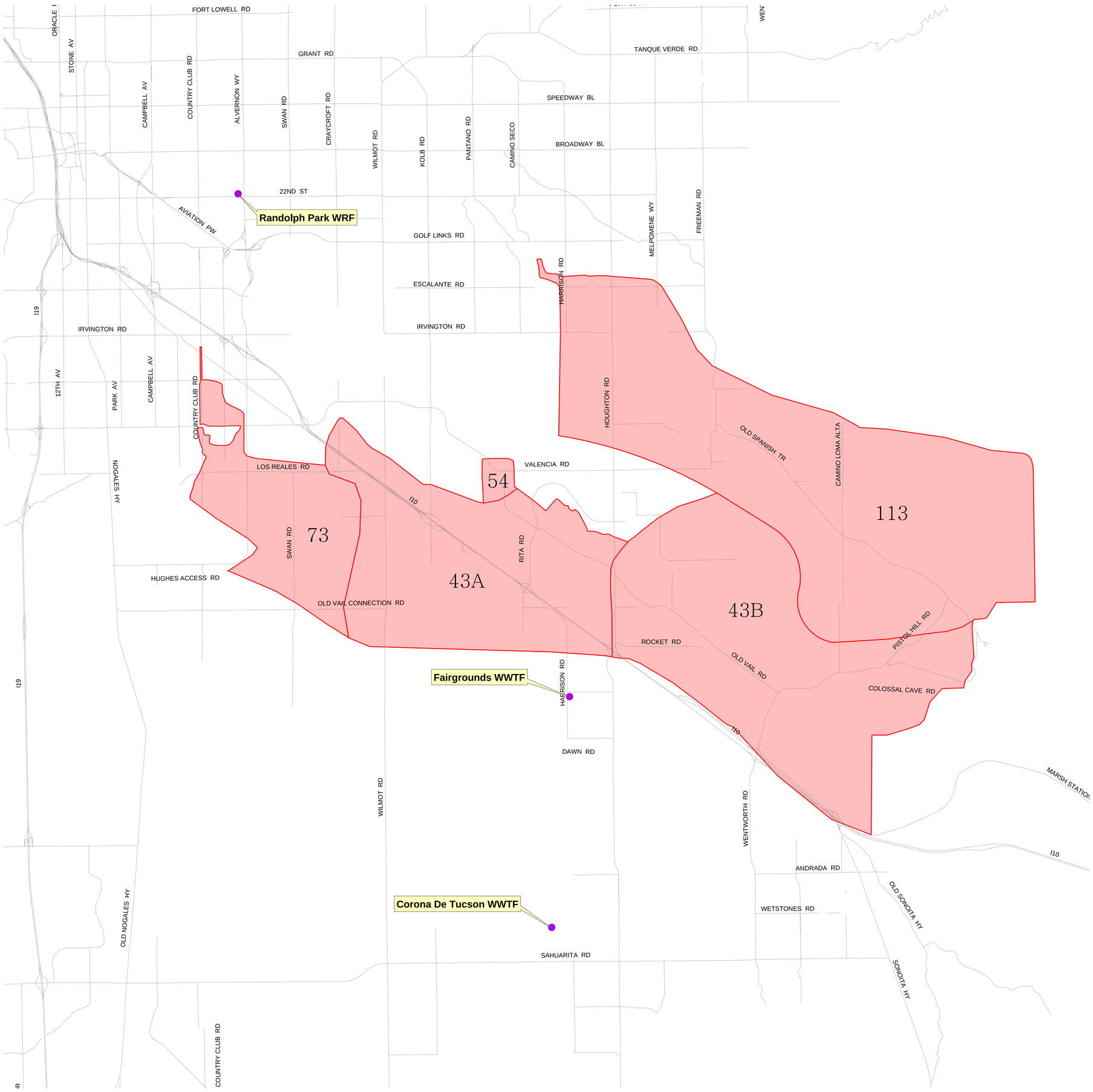
pygmyowl4/projects/wwm7/mxds/roger_ina.mxd mp 2/25/2005

Southeast Basins



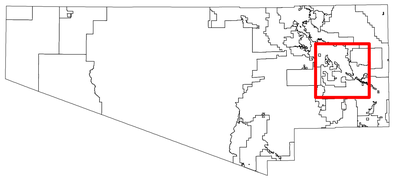
Treatment Plants

Selected Basins

Major Streets

Figure 5.2.2

Pima County Index Map



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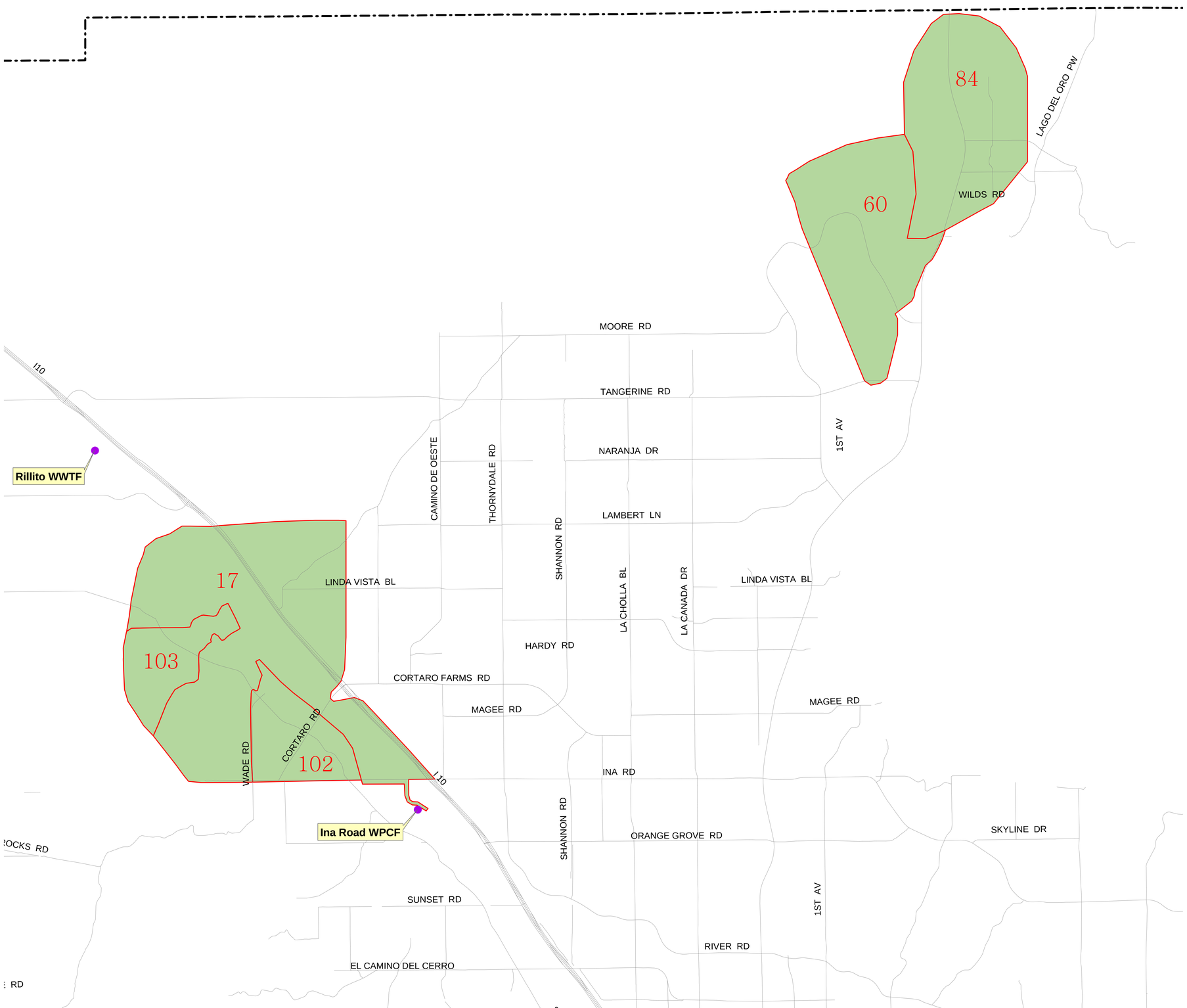
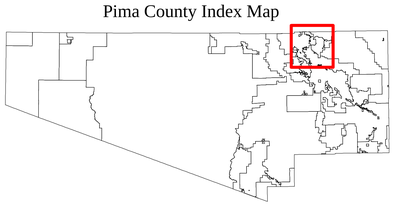
Northwest Basins



- Treatment Plants
- Selected Basins
- Major Streets

Figure 5.2.3

Pima County Index Map



Index Map Scale 1:1,500,000

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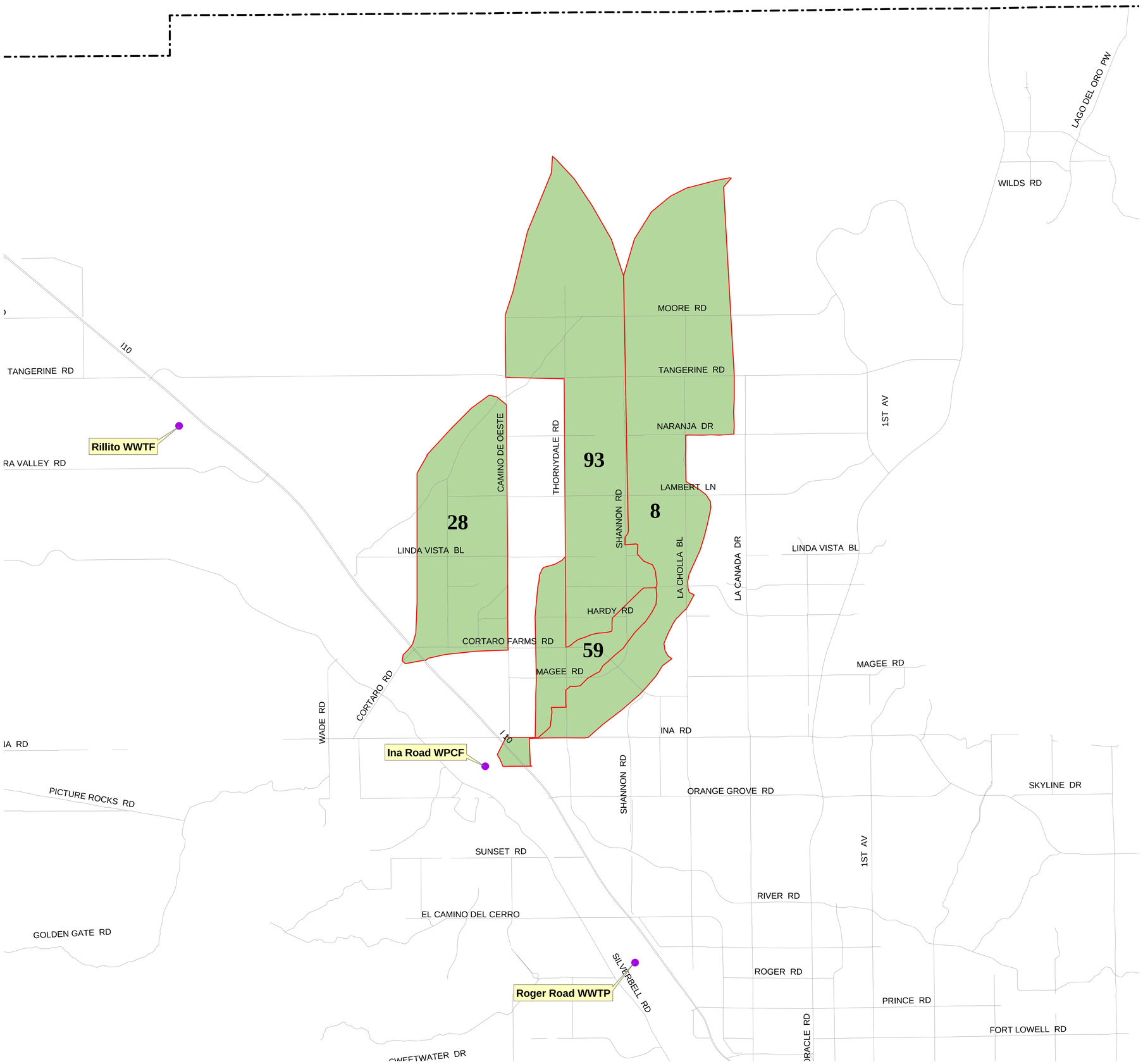
North Basins



Treatment Plants

Selected Basins

Major Streets

Figure 5.2.4

Pima County Index Map

Index Map Scale 1:1,500,000

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pygmyowl4/projects/wwm7/mxds/north_basins_b.mxd mp 12/5/2005

SUB-CHAPTER 5.3 OUTLYING FACILITIES CURRENT CONDITIONS

PCWMD provides service to the areas adjacent to the Metropolitan Treatment Facilities by operating several small capacity plants. These small capacity plants are located throughout eastern Pima County where population densities provide their economic justification. These small capacity plants are collectively known as the Outlying Treatment Facilities. Although not included in the scope of the 2006 Metropolitan Area Facility Plan Update, a brief discussion and overview is included to acknowledge their existence and functions.

The Outlying Treatment Facilities include Arivaca Junction WWTF, Avra Valley WWTF, Corona de Tucson WWTF, Ed Pastor Kino Environmental Restoration Project (KERP), Fairgrounds WWTF, Green Valley WWTF, Marana WWTF, Mt. Lemmon WWTF and the Rillito Vista WWTF.

The Facility Plan also considers the total area immediately south of the Roger Road WWTP Tributary System designated "The Southlands" that, upon development, could flow by gravity to the Roger Road WWTP. The Southlands tributary system does not currently culminate in a treatment facility but rather at a "collection point." The Southlands collection point concept is a planning tool to permit estimating future treatment needs of this area that is predicted to experience major growth in the coming decades and is not discussed in Current Conditions.

Site plans and flow diagrams are not included in this presentation (see Figure 5.3.1).

Arivaca Junction Wastewater Treatment Facility

Arivaca Junction WWTF is located in extreme southern Pima County at the Santa Cruz County line and Interstate 19 (I-19). This WWTF is a 66,000 GPD per day, aerated lagoon whose effluent is used to irrigate nearby pastureland. This facility will be closed upon completion of a combination gravity/pressure sewer line to the Green Valley WWTF.

No current repairs are needed at this facility.

Avra Valley Wastewater Treatment Facility

The Avra Valley WWTF is located roughly 10 miles southwest of Tucson at 10,000 West Snyder Hill Road. The site, which has a total area of 140.39 acres, has been the location of a WWTF since 1967. The population in the area served by the WWTF has expanded rapidly in the period from 2000 to 2005. During this period, a large casino operated by the Pascua Yaqui Tribe contributing flow to the WWTF was constructed. The ADWF and PDWF to the WWTF in December 2004, measured by the SCADA meter at the WWTF's entrance, was 0.90 MGD and 1.49 MGD respectively.

The WWTF's treatment and disposal capacity is rated at 1.2 MGD ADWF and 2.2 MGD PDWF. The main treatment component is an oxidation ditch installed in 1994.

The sewage enters the WWTF through a lift station discharging first to a screening channel then into a flow-equalization pond with a volume of 0.37 million gallons. Treatment by extended aeration, activated sludge, and biological nitrogen removal in an anoxic zone occurs within the oxidation ditch. Additional denitrification and stabilization is achieved using aquaculture. Disposal is completed through evaporation and percolation. The waste activated sludge is pumped into sludge holding tanks. The sludge is allowed to thicken during the fill and draw process. After it is concentrated it is hauled to the Ina Road WPCF for further processing and disposed of with processed biosolids from the Regional Biosolids Facility.

The oxidation ditch is designed for a flow of 1.2 MGD with a loading rate of 14 pounds BOD per 1,000 cubic feet of volume per day. This flow is at the lowest range of capacity for the equipment

to allow maximum operability for the manipulation of a denitrifying anoxic zone. The oxidation ditch is equipped with aerators to supply oxygen as well as submersible mixers.

The aerated mixed liquor from the oxidation ditch flows into two clarifiers via a distribution box. The settled sludge is returned to the oxidation ditch or sent to the sludge storage tanks for liquid-solid separation and hauled to the Metropolitan Treatment Facilities for further processing.

The clarified effluent can be discharged into the effluent reservoir or any one of the four peculation ponds. The percolation ponds are used in rotation with a fill and dry cycle for each pond. The effluent reservoir can also be discharged into the Black Wash spray field system.

Condition Assessment

Treatment capacity was reviewed to determine if additional capacity may be achieved with the same facility. It was determined the WWTF can reach the higher capacity ratings, currently estimated to initially be 1.6 MGD and ultimately 2.2 MGD with additional enhancements and equipment.

The WWTF presently has no outstanding repair issues; however, the integrity of the existing oxidation ditch requires evaluation. The evaluation will require emptying the present oxidation ditch. Therefore, the evaluation cannot be performed until this facility is expanded with an oxidation ditch of the same or larger capacity. There are areas of the current oxidation ditch considered likely to require repairs, particularly the sections of the ditch constructed of “gunite” concrete together with their supporting soils. Additionally, as the WWTF approaches the new design capacity (2.2 MGD), an additional percolation pond may be required.

The WWTF is considered a candidate for expansion in the immediate future to meet the growth in its tributary area, which will be discussed in Chapter 5.4.

Corona de Tucson Wastewater Treatment Facility

The 200-acre Corona de Tucson WWTF is located approximately 22 miles southeast of the City of Tucson at 1100 West Sahuarita Road. The present facility, rated at 0.117 MGD Disposal Capacity, was constructed in 1983. This facility may be incorporated into a larger regional facility in the rapidly growing region in the “Southlands” portion of the Tucson Metropolitan Area.

The WWTF consists of two soil cement lined stabilization ponds of 3.3 and 3.7 acres, operating at average of four feet depth of water. Mechanical aeration was not provided in the original design. The stabilization ponds can be operated either in parallel or series. The WWTF is designed so that the treated water from the stabilization ponds can overflow into an adjacent 10.2-acre lined evaporation pond. There is also a 6.1-acre unlined pond serving as a recharge basin.

Sewage enters the WWTF through a gravity interceptor and then passes through a Parshall flume flow-metering chamber. After passing through the flume, the flow enters a series of “splitter manholes” dividing flow between the stabilization ponds.

The flow enters the stabilization ponds through 18-inch diameter pipes, which extend out into each pond. Stabilization of organic material, a natural occurrence of biological, chemical and physical processes takes place here.

Discharge flows from the storage and stabilization ponds to the evaporation pond where the surcharge capacity and surface area of the ponds provides for storage and evaporation of all inflows. No discharge of effluent to surface or groundwater occurs at this site. The evaporation pond provides enough surface area to completely dispose of 117,000 GPD. Surface evaporation rates can be expected to vary from a maximum of 9 to 10 inches per month during the summer to a minimum of about two inches per month in the winter.

At present there are no repair requirements; however, the WWTF is in a rapidly growing area and is in need of expansion. The initial capacity expansion will be through the installation of mechanical aerators and will utilize Soil Aquifer Treatment for disposal and increase the capacity to 300,000 GPD. This expansion is complete and awaiting the required ADEQ permits to begin operation. The second stage of expansion, a 500,000-GPD-package plant oxidation ditch is currently being engineered for installation and commissioning in the fourth quarter of 2005. The effluent will be recharged and stored in the aquifer for future beneficial use.

Ed Pastor Kino Environmental Restoration Project (KERP)

The newly constructed Ed Pastor KERP provides innovative water conservation for Pima County. This project, built as a joint effort with the U.S. Army Corps of Engineers, utilizes stormwater and reclaimed water, stored in the 120-acre Ajo Detention Basin, to irrigate county owned facilities at the nearby Kino Sports Complex. The project also involves transforming the once concrete basin into a riparian habitat serving as a refuge for migrating and native wildlife. In addition to providing a riparian habitat, the stored water is used to irrigate ball fields and parks. Although the KERP is operated by Pima County's Stadium District, PCWMD provides testing of the waters and assists with the operation and maintenance of the onsite pump station. As this is not really a treatment facility with no plans for expansion, it will not be included in the discussion of the future for Outlying Treatment Facilities.

The recirculation pumps require modification and also the addition of a chlorination/dechlorination system is considered likely.

Fairgrounds Wastewater Treatment Facility

This WWTF, located at the Pima County Fairgrounds, is a 3,000 GPD evaporation pond facility operated for the convenience of the public during events such as the Pima County Fair, concerts, sporting competitions and specialty shows.

The WWTF needs improvements to the influent box and the addition of a SCADA recording flowmeter.

Green Valley Wastewater Treatment Facility

The Green Valley WWTF, the major facility serving southern Pima County, is located on a 52-acre rural site, 3/4 mile north of the Green Valley residential area at 2201 N. Old Nogales Highway, approximately 250 feet east of the Santa Cruz River. The original WWTF was constructed in December 1964, expanded in 1972 and again in 1981. The latest expansion, completed in 2004, added a 2.0 MGD Biological Nutrient Removal Oxidation Ditch (BNROD) increasing the total plant capacity to 4.1 MGD ADWF.

The Green Valley WWTF processes wastewater through two separate parallel treatment trains, the Original Train and the BNROD Train. The plant includes the following major components:

Headworks (screenings/grit removal and direct flow to either the emergency overflow basin or the influent pump station)

- Emergency Overflow Basin.
- Influent Pumping.
- Metering Station.

Lagoon Train (original treatment plant)

- Aerated Lagoons.
- Effluent Polishing Ponds.
- Percolation Beds.

BNROD Train

- Activated Sludge Process Oxidation Ditch with Biological Nutrient Removal (BNR).
- Secondary Sedimentation.
- Recycle Activated Sludge (RAS) / Waste Activated Sludge (WAS).
- Solids Handling.
- Filtration.
- Disinfection.

Influent flow passes through the headworks for screening and grit removal then flows to the influent Pump Station. Screenings and grit are disposed of at a municipal landfill.

The influent pump station is comprised of a wet-well and pump station. The Pump Station discharge divides flow between the original and BNROD trains. Should a power failure occur, the influent wastewater diverts to the emergency overflow pond. When power is restored, wastewater can be valved back to the pump station.

Lagoon Train

Influent directed to the original treatment train passes through primary aerated lagoons, secondary aerated lagoons, an effluent holding pond and percolation beds. The two primary, mechanically aerated lagoons may be operated in parallel. These lagoons are concrete lined, aerobic aerated units providing a high rate of oxygen transfer from air to wastewater and discharge to the secondary lagoons. The secondary, mechanically aerated facultative lagoons provide partial mixing and aeration by means of floating aerators and are capable of being operated in series or parallel.

The Aerated Lagoons discharge to two parallel effluent polishing (maturation) ponds providing natural aeration for biochemical oxidation and solids settling.

Effluent from the polishing ponds is disposed of through rotation to four percolation beds, totaling 11 acres, used alternately. The effluent is directed to one percolation bed at a time then the bed is allowed to dry while the effluent is directed to the next pond. Effluent discharged the percolation beds may be provided to local entities for reuse and/or recharge or may be discharged to the Santa Cruz River.

Once every 5 to 10 years, biosolids, which have settled in the bottom of the secondary aeration lagoons and polishing ponds, are removed and disposed of by land application or to the Tangerine Road Landfill.

BNROD Train

The parallel BNROD treatment train is an activated sludge with biological nutrient removal process carried out in an oxidation ditch wherein the influent flows around a loop and is aerated by a mechanical brush rotor system. Submersible mixers operate continuously to maintain the activated

sludge in suspension. To achieve nitrification, an aerobic zone is when the aerators are operated. Denitrification is achieved in an anoxic zone created when the aerators are off. The oxidation ditch overflows a weir to secondary clarifiers.

The secondary clarifiers settle the activated sludge. Return activated sludge is pumped to the oxidation ditch inlet structure while WAS is pumped to the gravity belt thickeners. Effluent flows to the filters where the multi-media filter of sand and anthracite reduces suspended solids/turbidity to less than 2 NTUs.

The WAS flow is pumped through polymer addition static-mixers and discharged onto two parallel gravity belt thickeners. The thickened WAS (TWAS) is pumped to parallel aerobic digesters. Digested (stabilized) solids are pumped through a static mixer to a belt filter press. The produced filter cake is discharged to a hopper and then moved to a sludge drying bed. Liquids decanted off the biosolids (supernatant) are returned to the head of the treatment process. The biosolids are transferred from the storage facility to the truck loading facility for disposal.

Filtered effluent flows by gravity to a chlorine contact tank where the required dosage of sodium hypochlorite is added to the mixing chamber. Flow passes over a weir to the reclaimed water pump station.

Reclaimed water can be used for off-site open access turf (golf course) irrigation and onsite for industrial water, fire protection, and landscape irrigation. Any effluent not used for reclaimed water is either recharged or discharged to the Santa Cruz River.

Other plant facilities include a control building with storage space for spare parts, a maintenance workshop area, and a motor control center.

The original treatment train requires the following repairs to continue to function at design capacity:

Table 5.3.1 Recommended Improvements and Conceptual Costs for Green Valley WWTF

Modify the headworks screens by replacing the manual screens with mechanical screens	$250,000
Replace secondary lagoon aerators	$180,000
Upgrades to electrical systems	$80,000
Replace the damaged street lights	$20,000
Earthwork to repair erosion damage to the pond and lagoon berms	$40,000
Re-grade, repair and repave site roads	$40,000
Total	**$610,000**

Marana Wastewater Treatment Facility

The 200-acre Marana WWTF is located 1 mile east of Trico Road and 1 1/8 miles north of Trico Marana Road. It presently serves the area of “central” Marana, the area adjacent to Trico-Marana Road and I-10, with a trunk sewer flowing west along Trico–Marana Road to the WWTF site. The original 23,000-GPD design capacity plant, comprised of two facultative/evaporation ponds (FEP) operated in series, opened in 1986. The WWTF proved adequate until year 2000, as growth was concentrated elsewhere in the town. Since 2000, development in the area served by the Marana WWTF has accelerated requiring plant capacity expansion.

A new 150,000 GPD facility composed of three 50,000 GPD packaged plants was placed in operation in the Fourth Quarter of 2001. Package plants are manufactured treatment plants previously been approved by permitting agencies. Presently the WWTF is operated at 70,000 GPD with flow being divided among the three package plants until influent flow exceeds 150,000 GPD. The east pond of the original FEP facility was converted to an emergency influent storage basin.

The resulting effluent quality meets discharge water quality standards for Class B effluent that can be discharged into the Santa Cruz River, used for agricultural irrigation, or recharged to groundwater.

The current WWTF capacity was increased, in 2005 by the addition of a fourth 50,000-GPD package plant. The present influent pump station will require enlargement together with the installation of a recording flow meter. The main equipment slab requires repair and voids under the slab need to be grouted. These repairs and additions are currently estimated to cost $385,000. The current expansion and long range plans for this facility are further discussed in Sub-chapter 5.4.

Mt. Lemmon Wastewater Treatment Facility

Background

The Mt. Lemmon WWTF, a 12,500 GPD package plant Oxidation Ditch Facility treats sewage from the small mountain community of Summerhaven in the Coronado National Forest. Unlike the remainder of PCWMD's system, the Mt. Lemmon experiences freezing wintertime temperatures. Aside from a few restaurants and gift shops, the WWTF serves a residential population. Effluent is disposed of through spray irrigation on 10 acres of U.S. Forest Service land.

The 2001 Bullock Fire heavily damaged the spray field as well as destroyed much of the residential community and commercial center of Summerhaven; however, the WWTF was undamaged. The main concern now is the aftermath of the Bullock Fire creating a hazardous environment due to dry and brittle timber.

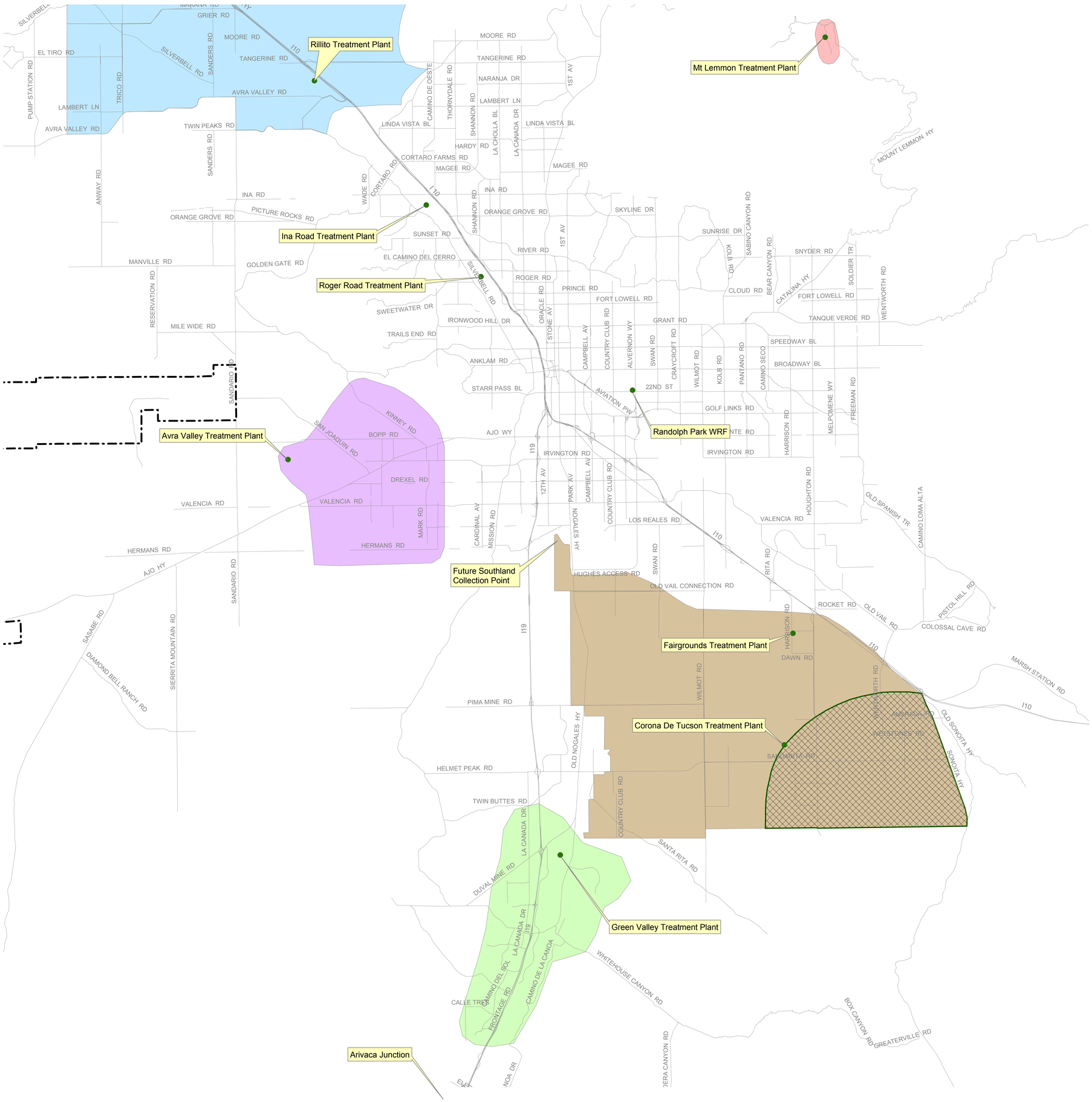
The WWTF's current needs are limited to re-coating the package plant oxidation ditch estimated at $100,000.

Rillito Vista Wastewater Treatment Facility

There are no current repair issues at this WWTF. An expansion of the WWTF in the long term to relieve the Continental Ranch Pump Station has been discussed and is under review also at this time. Flow-monitoring improvements are also needed.

The Southlands

The Southlands is a future treatment area containing only the Corona de Tucson Basin at this time.



Outlying Basins

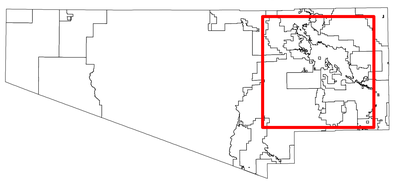
- Treatment Plants

BASINS

- Avra Valley
- Marana
- South Lands
- Green Valley
- Mt lemmon
- Corona de Tucson
- Major Streets

Figure 5.3.1

Pima County Index Map



Index Map Scale 1:1,500,000

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SUB-CHAPTER 5.4 OUTLYING TREATMENT FACILITIES FUTURE CONDITIONS

The Outlying Facilities are the Arivaca Junction WWTF, Avra Valley WWTF, Corona de Tucson WWTP, Ed Pastor KERP, Fairgrounds WWTF, the Green Valley WWTF, Marana WWTF, Mt. Lemmon WWTF and Rillito Vista WWTF. The current condition of these treatment facilities was discussed in Sub-chapter 5.3.

Given the uncertainty of the location of development within both the Metropolitan Area tributary systems as well as among the Outlying Treatment Facilities, PCWMD is pursuing a policy of providing maximum flexibility in directing flow and providing capacity at any of its treatment facilities.

Dynamic Process Modeling

PCWMD is currently actively engaged in dynamic process modeling of the Outlying Treatment Facilities Oxidation Ditch plants. This modeling effort is capable of providing guidelines for not only optimizing the current plant process to realize their maximum treatment potential, but also allowing PCWMD to model further treatment additions to upgrade the plants to meet future regulatory permit requirements. PCWMD's dynamic modeling program, its capabilities and modeling results are presented in detail in Sub-chapter 5.5.

New Planning/Design Processes for Outlying Facilities

PCWMD, as previously mentioned, maintains treatment facilities in eight suburban outlying locations with varying degrees of interdependence with the Metropolitan Area Treatment Facilities. Most of these eight facilities are being heavily impacted by projected population growth.

The development community has put forth plans for a number of substantial home developments throughout the PCWMD service area tributary to these facilities. The impact of these types of projects on the Outlying Treatment Facilities is more severe than on the Roger Road WWTP and Ina Road WPCF tributary areas previously discussed. The Outlying Treatment Facilities are smaller in size, ranging from the 10,000 gallon per day (GPD) Rillito Vista WWTF to the 4.1 MGD facility at Green Valley WWTF.

The impact on Outlying Treatment Facilities of a 500 home development with 2.7 persons per household, with each person contributing 85 GPD of wastewater, is an additional 115,000 GPD of flow. Developments of this size are envisioned for the areas tributary to Marana, Green Valley, Corona de Tucson and Avra Valley WWTFs and, in some cases, multiple such developments within the next decade. Given that a development of this size represents 50 percent of the 200,000 GPD capacity of the present Marana WWTF, 97 percent of the 117,000 GPD capacity of the present Corona facility, 10 percent of the 1.2 MGD capacity of the Avra Valley WWTF and 5 percent of the Green Valley WWTF (before its recent expansion), the impact of such a development on existing treatment facilities is extreme.

Planning to incorporate development of this magnitude in the Outlying Treatment Facilities is further complicated by the uncertainty of the schedule for this development. PCWMD's history contains numerous examples of planned developments that were never finalized. The Continental Ranch Pump Station was built in 1988 in response to urgent projections of immediate tributary development activity. The facility was not placed in full service until 1997 as area development was curtailed by economic factors. Designation as endangered species habitat can also significantly impact the magnitude and schedule of population growth in a given area. The curtailment of development on the northwest side of Tucson and its shift to Sahuarita, Vail and the southeast Tucson area from the late 1990s until 2004 is well documented.

A further example of the difficulty of forecasting future populations is demonstrated by the variance between the forecast of future development of the Marana WWTF put forth by PAG and the local jurisdiction/developer planning estimates. (See Table 5.4.1)

Table 5.4.1 Marana WWTF: PAG versus Developer Population Projections

	Forecast Based on Proposed Development				Forecast Based on PAG Projections			
			ADWF				ADWF	
	Population	Change in Population	Total Flow MGD	Flow Increase MGD	Population	Change in Population	Total Flow MGD	Flow Increase MGD
2000	9,819	6,880	0.03	0.13	9,819	5,028	0.03	0.55
2005	16,699	28,862	0.16	2.45	14,847	8,435	0.85	0.72
2010	45,561	13,502	2.61	1.15	23,282	8,439	1.57	0.72
2015	59,063	13,646	3.76	1.16	31,721	8,430	2.29	0.71
2020	72,709	10,753	4.92	0.92	40,151	8,441	3.0	0.72
2025	83,462		5.84		48,592		2.96	

PCWMD's reaction to this relocation of development to the smaller outlying facilities is hampered by the time it takes from the identification of an area of potential major development until the treatment plant capacity expansion is placed in service. The Department can only be sure that a potential development will become reality at the time a developer submits construction plans for the project. However, PCWMD must procure a design contract (a process designated in the 2004 Bond Authorization Implementation Plan as taking 6 months), design the project (12 months including the 35 percent, 70 percent, 95 percent and 100 percent reviews normally imposed on Department projects), secure ADEQ permits (8 to 12 months – design must be submitted as part of application), conduct construction procurement (2 to 6 months) and then build the expansion (18 to 24 months) in order to place new treatment capacity in service. The total process can take four years. In that time, any number of events may change development location, extend the development schedule or cancel the project entirely. In the meantime, PCWMD may have committed significant resources for the design and construction of a treatment facility that could remain unused or under-utilized for some time.

In an effort to respond more quickly to treatment capacity requests, PCWMD envisions following a procedure to pre-design and acquire permits rapidly for standard capacity treatment plants. The treatment process selected for treatment facilities less than 5 MGD will typically be a Biological Nutrient Removal Oxidation Ditch. The idea is to pre-design and permit several different capacity Oxidation Ditch treatment plants, or similar treatment concepts, and have the completed plans available to meet identified capacity needs. The process would be aided by utilizing a Construction-Manager-At-Risk design/build process whereby the successful contractor would also be responsible for the site-specific design, such as site grading, yard piping, electrical power distribution and etc., required to construct the plant. This method is envisioned to reduce the overall project time.

Flows to Outlying Facilities

The Facility Plan Model forecasts population and treatment plant flows in three suburban areas closest to the Metropolitan Treatment Facilities (Roger Road WWTP, Ina Road WPCF and the Randolph Park WRF). These three are the areas tributary to the Avra Valley and Marana WWTFs and the area south of I-10 and east of I-19, identified as the Southlands. The Corona de Tucson and Fairgrounds WWTFs are basins within the overall Southlands Tributary area. The relative

locations of these basins are shown on Figure 5.2.2, while the actual basin designations are shown in Figure 3.4.2.

The Facility Plan Model population forecasts for the Avra, Marana and Southlands sewer basins are graphically presented sewer basin percentage increases in Figure 3.4.8. The Avra, Marana and Southlands tributary areas are identified as among the most rapidly growing tributary areas within the PCWMD system. The Average Dry Weather Future Flows generated in each area are summarized in Table 5.4.2.

Table 5.4.2 Flow Projections for Outlying Areas

ADWF Projections for Avra, Marana, The Southlands and Corona de Tucson				
	Avra	Marana	Southlands	Corona de Tucson[1]
	ADWF	ADWF	ADWF	ADWF
2000	0.86	0.033		0.045
2005	1.10	0.16		0.11
2010	1.41	0.86	1.42	0.23
2015	1.71	1.56	2.70	0.35
2020	2.02	2.26	4.00	0.47
2025	2.32	2.96	5.29	0.59
2030	2.95	4.44	13.70	2.63

1. The Corona de Tucson treatment facility tributary area is Basin SL5 in the Southlands tributary area. Corona de Tucson flows are also included in the total Southlands flows for 2005.

Arivaca Junction WWTF

The Arivaca Junction WWTF will be closed upon completion of a connection to the Green Valley WWTF. Currently a gravity line runs north to Elephant Head Road. The completion of the section between Elephant Head Road and the Green Valley WWTF involves:

1. Constructing a gravity line from Elephant Head Road across I-19 to join a new developer installed gravity sewer leading to the Green Valley WWTF.
2. Locating an approximately 100,000 GPD Water Reclamation Facility at the north end of Canoa Ranch with the effluent being used for irrigating the Pima County owned park at Canoa Ranch. The solids would continue to flow to the Green Valley WWTF.

The Arivaca Junction WWTF will be de-activated upon completion of connection to Green Valley WWTF.

Avra Valley WWTF

Due to seasonal variations, February is the highest flow month at the Avra Valley WWTF. The February 2005 recorded flows matched the end of 2005 projected flows. These flows are approaching the 1.2 MGD rated capacity. A recently completed evaluation concluded that with the addition of some process equipment, the existing facility can be operated at flows up to 2.2 MGD.

The Facility Plan Model flow predictions, presented in Table 5.4.2, indicate that even with the additional treatment capacity, probable population growth in this tributary area may need added capacity. An additional factor in forecasting flow to this plant is the presence of the Yaqui Tribes gaming casinos and the possible addition of a resort complex and golf course at one of the casinos. A resort complex of that size would cause the flow to this WWTF to grow much more quickly than presently forecast. Therefore, the next expansion to this facility is currently forecast to add 4.0 MGD in 2008/09.

The future expansion of this WWTF is planned to be accomplished by the construction of a BNROD facility. Any additional plant expansion will also include provisions for reuse or recharge of the effluent produced as discussed in Chapter 6. The expansion must also include provisions for handling the total biosolids produced as discussed in Chapter 7. In planning for any expansion, the proposed site must be surveyed to position the facility to meet ADEQ setback rules with the possible requirement of an additional land purchase to meet these setbacks.

Corona de Tucson Wastewater Treatment Facility (see Figure 5.4.1)

The current Corona de Tucson WWTF is being expanded in two phases. The first phase to add aerators is complete. The second stage of the installation is the addition of a 500,000 GPD package plant to raise the total treatment plant capacity to 800,000 gallons per day. This second stage expansion will be funded by the developers in the basin tributary to the Corona de Tucson WWTF and was completed in September 2005.

The developers are anticipating utilizing this capacity within the next few years while PAG projects that the 0.8 MGD plant will be adequate for development through 2008-10. The February 2005 flow to the plant was close to 110,000 GPD. In order to utilize all of the 0.8 MGD capacity, new home construction would have to continue at a rate of 50 to 60 houses per month for 5 years. Developers are projecting construction of up to 100 houses per month.

PCWMD, in response to present development plans, has included a 0.5 MGD expansion of Corona de Tucson WWTF in the Capital Improvement Program (CIP) beginning in fiscal year 2006-07 to bring the capacity to 1.3 MGD. Further, following development forecasts, an expansion of the WWTF to 2.0 MGD is included in the CIP for 2011-12.

Given the disparity between development and PAG population forecasts, PCWMD will closely monitor growth in this region and coordinate with area developers to match the actual growth.

Ed Pastor Kino Environmental Restoration Project

There are no plans for expansion of this facility. PCWMD will continue to operate and maintain the pump house and water testing.

Fairgrounds Wastewater Treatment Facility

PCWMD has no current plans to increase the size of this facility. In the event that development of the Southlands follows PAG forecasts, this plant may be considered for inclusion in the overall area plan.

Green Valley Wastewater Treatment Facility

The Green Valley WWTF was recently upgraded by the addition of a 2.0 MGD BNROD facility. The original plant remains capable of treating its original 2.1 MGD capacity; however, the effluent from the original WWTF will not be suitable for use as reclaimed water.

The growth of flow to the Green Valley WWTF was not included in the 2005 Facility Plan Upgrade as it is more remote from the Metropolitan area. The southern Pima County area served by the Green Valley WWTF will be the subject of a near future project to coordinate the PAG census tract forecasts to the Green Valley tributary conveyance system. In the meantime, PCWMD is monitoring population growth in the region. PCWMD has included a CIP project to install a second 2.0 MGD BNROD facility at this location beginning in the 2009-10 fiscal year for completion in 2013.

Marana Wastewater Treatment Facility (see Figure 5.4.2)

Beginning in 2000, the farming area west of I-10 in northwest Marana came under active development planning. This was due in large part to the impact of the Pygmy Owl endangered species designation on developments being planned east of I-10. Wastewater conveyance and treatment infrastructure was in place or programmed to serve development on the east side of I-10. However, this was not the case west of I-10. An accelerated effort had to be put forth to plan and implement creation of the public wastewater system needed to serve the anticipated development west of I-10.

A collection and conveyance system was planned in cooperation with the development community and the Marana WWTF was expanded to a treatment capacity of 200,000 GPD in order to accommodate the first phase of the anticipated new development. Initial design efforts to plan for long-term expansion of the treatment facility that were begun prior to 2000 were accelerated.

After a 3-year delay in initiation of development, housing construction is now proceeding at a rapid pace and expansion of the treatment facility is progressing on an accelerated schedule in order to meet demand. As more developments are platted, the number of houses completed each month will increase. The current forecast based on development proposals presented to PCWMD is that average daily flows will reach 3.6 million gallons per day by 2015. In contrast, utilizing PAG TAZ predictions for population growth yield (as per the Facility Plan Model) a much lower flow number of 2.29 MGD by 2015 (see Table 5.4.1).

Regardless of the forecasting method used, the continued population growth in the Marana WWTF service area necessitates an increase in wastewater treatment capacity. This discussion considers the WWTF's expansion beyond the 200,000-GPD capacity reached in 2005 with the addition of a fourth 50,000 GPD package plant.

For the next phase of the expansion, the $10 million in the 2004 Bond Authorization will be added to the existing 1997 bond funds. The $2.05 million from the 1997 Bond Authorization originally envisioned the relocation and construction of a much smaller facility. The $12 million, combined with System Development Funds, will be used first to add a 0.5 MGD interim BNROD package plant in 2005-06. At the same time, design and construction of a 1.5 MGD BNROD will be initiated for completion in 2007-08. An additional 1.5 MGD expansion to the plant capacity is planned for 2010-11.

The U.S. Army Corp of Engineers funded preparation of plans for a multi-tank oxidation ditch facility. These plans are being updated and finalized for eventual expansion of facility capacity in stages to more than 3 MGD. The expansion planned in 2007/08 is the first phase of this facility.

Evaluation of disposal of effluent and biosolids from this expanded facility are discussed in Chapter 6.1 and 6.2.

Mt. Lemmon Wastewater Treatment Facility

The Mt. Lemmon sewage system upgrading was included in the 2004 Bond Authorization. This system is entirely within the boundaries of the Coronado National Forest. The US Forest Service has significant input into future plans for growth, water use and effluent disposal for this system. The long-range plans for the future of the Mt. Lemmon sewer system will be evaluated and discussed with the Forest Service and the Mt. Lemmon community prior to implementing any changes or improvements.

Rillito Vista Wastewater Treatment Facility

The future of the Rillito Vista WWTF has several alternatives:

1. The facility will continue as a limited service facility serving its present customers.
2. The facility will be abandoned with its flow incorporated in the larger Marana WWTF system as a tributary basin.

Present plans call for the WWTF to continue in its limited service role and ultimately be abandoned.

The Southlands

The Southlands in year 2005 is a conceptual area. The treatment facilities presently in the conceptual Southlands are Corona de Tucson, Fairgrounds and the Sahuarita WWTFs. The Sahuarita WWTF is not a part of the Pima County Wastewater System but rather owned and operated by the Town of Sahuarita. The Fairgrounds WWTF presently serves the Pima County Fairgrounds and basically treats event flow. Gravity flow to this facility from areas outside the Fairgrounds, not served by the Southeast Interceptor, Corona de Tucson or presently on septic is limited. There are no plans for an additional facility at the Fairgrounds.

The future of the Corona de Tucson WWTF is discussed above. Its future as a part of a larger Southlands region may:

- Include use as an upstream Water Reclamation Facility.
- Continue as an independent WWTF for its tributary basin.
- Abandonment in favor of a regional treatment facility.

The future of the Corona de Tucson WWTF will be greatly dependent upon future area development.

The developer of a large tract along Swan Road south of the airport has contacted PCWMD about the possibility of constructing an approximately 2.0 MGD treatment facility just west of Swan Road and south of Old Vail Road. The site is within Southlands Basin SL-2 and presumably could be located to serve the eastern half of Basins SL-2 and SL-7 as well as the upstream Basins SL-3, SL-4 and SL-6 (SL-5 being the Corona de Tucson WWTF). Assuming the development proceeds as outlined in the development agreement, a total of 2.84 MGD of capacity will be needed in the Southlands within the next 5 years.

Table 5.4.3 presents the population growth of the Southlands by sewer basin in 5-year increments.

Table 5.4.3 Population Growth in The Southlands

		Southland Basins						
Year	Total	SL-1	SL-2	SL-3	SL-4	SL-5 Corona de Tucson	SL-6	SL-7
2005	24,409	611	10,161	2,970	264	7,833	877	1,693
2010	46,709	746	21,612	6,159	1,531	12,581	1,191	2,889
2015	78,665	882	35,578	15,331	3,940	17,343	1,505	4,086
2020	110,612	1,017	49,541	24,503	6,350	22,101	1,818	5,282
2025	142,574	1,152	63,509	33,676	8,760	26,865	2,133	6,479
2030	174,515	1,287	77,471	42,846	11,169	31,622	2,446	7,674
Population 2005-30	150,106	676	67,310	39,876	10,905	23,789	1,569	5,981

Table 5.4.3 presents total population in the basin in the year stated. In calculating flows, the people on septic systems in 2005 are assumed to remain on septic systems for the remainder of the 20-year period. All growth, following 2005, is presumed to be on sewer as the density of building now is generally four residences per acre and higher due to the escalating value and scarcity of land.

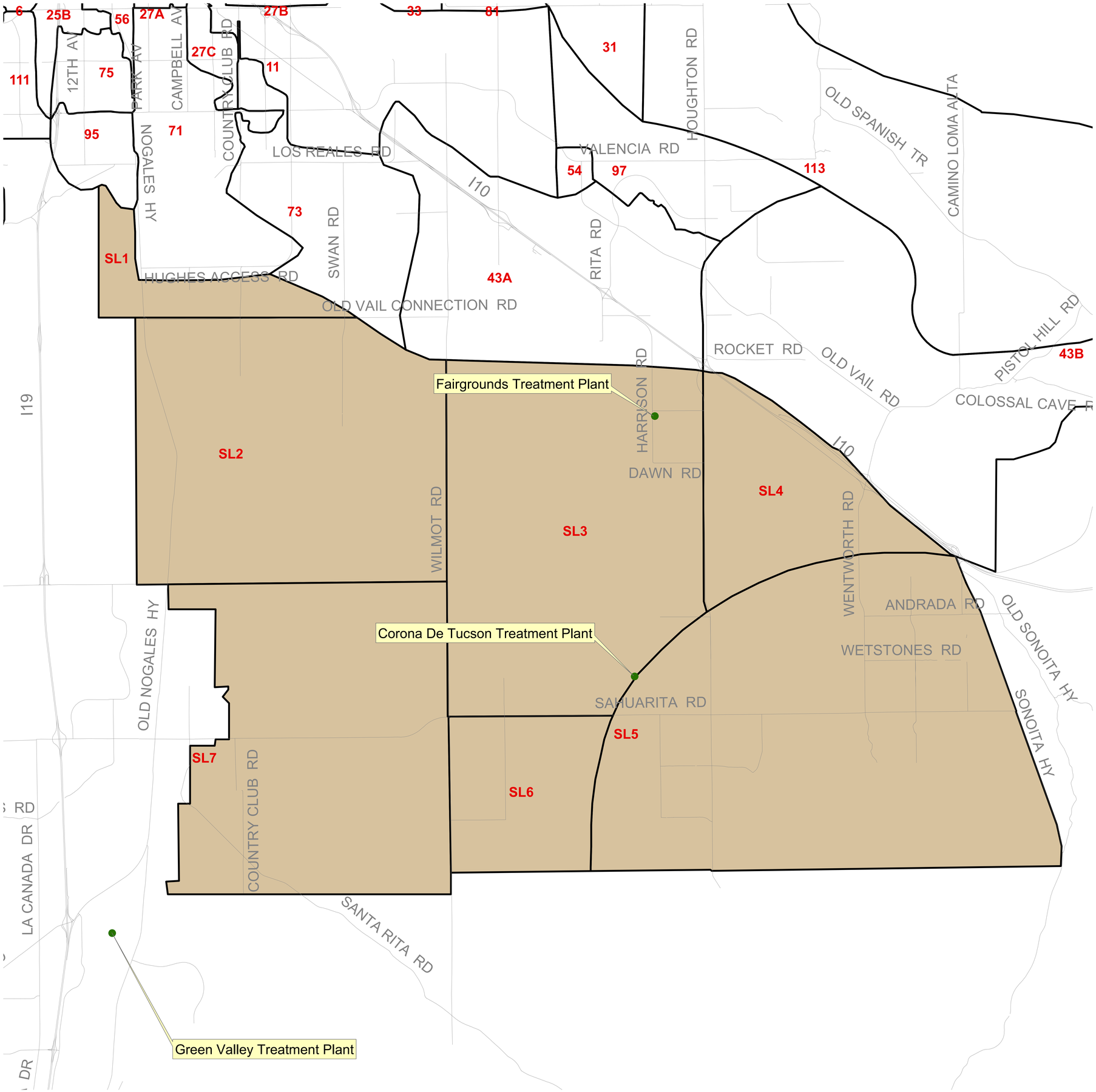
An examination of Table 5.4.3 shows the majority of population growth in the Southlands occurs in Basins SL-2, SL-3 and SL-5. Basin SL-2 and SL-3 are those basins in the center of the Southlands area with an estimated 60 percent of Basin SL-2 and 30 percent of Basin SL-3 being unable to reach the developer constructed treatment plant by gravity (Corona de Tucson being up gradient from these two basins). Basin SL-5 is the Corona de Tucson tributary area and could be expanded to suit population growth. Referring to Table 5.4.2, the total projected wastewater flow for the Southlands in 2015 is 5.55 MGD. Assuming the treatment plant constructions at Corona de Tucson and near Swan and Old Vail Road take place by 2015, the installed capacity will be 4.0 MGD. Again referring to Table 5.4.2, an additional 1.55 MGD (5.55 – 4.0) of treatment capacity will need to be planned and shortly constructed, or a total 1.55 MGD of wastewater flow will need to be connected to the Park Avenue sewer near the Old Nogales highway and Hughes Access Road. The sewer system will then convey the wastewater up Park Avenue to Euclid then north to 18th street and west to Osborne Avenue. The wastewater can then flow through the 2004 Bond Authorization funded Santa Cruz Interceptor, Prince to Franklin and to the Roger Road WWTP. The conveyance system may require augmentation between Hughes Access Road and Osborne Avenue.

Summary

The future development of the PCWMD Outlying Facilities will be greatly influenced by both population growth and distribution within its service area over the next 20 years. The population forecasts (based upon Pima Association of Governments (PAG) data presented in Chapter 3.4) are the foundation upon which the future system conveyance and treatment capacity planning is based. Going forward, as each new, revised PAG population forecast is issued; the new population information should be analyzed by the Facility Plan Model to assess its impact upon PCWMD's conveyance system, treatment capacity and distribution. The Department will use this data in the Facility Plan Model on a continuing basis and update the Facility Plan every two years. The

Department will work closely with the jurisdictions and area developers to anticipate and plan for growth in the outlying areas, especially with capital-intense treatment projects, and work with PAG to update special population data for high-growth areas on a more frequent basis.

Southlands Basins



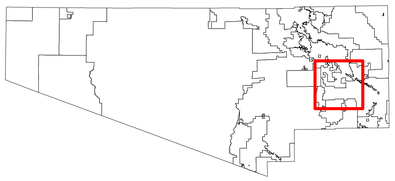
- Treatment Plants

BASINS

- Avra Valley
- Ina Road
- Marana
- Roger Road
- South Lands
- Major Streets

Figure 5.4.1

Pima County Index Map



Index Map Scale 1:1,500,000

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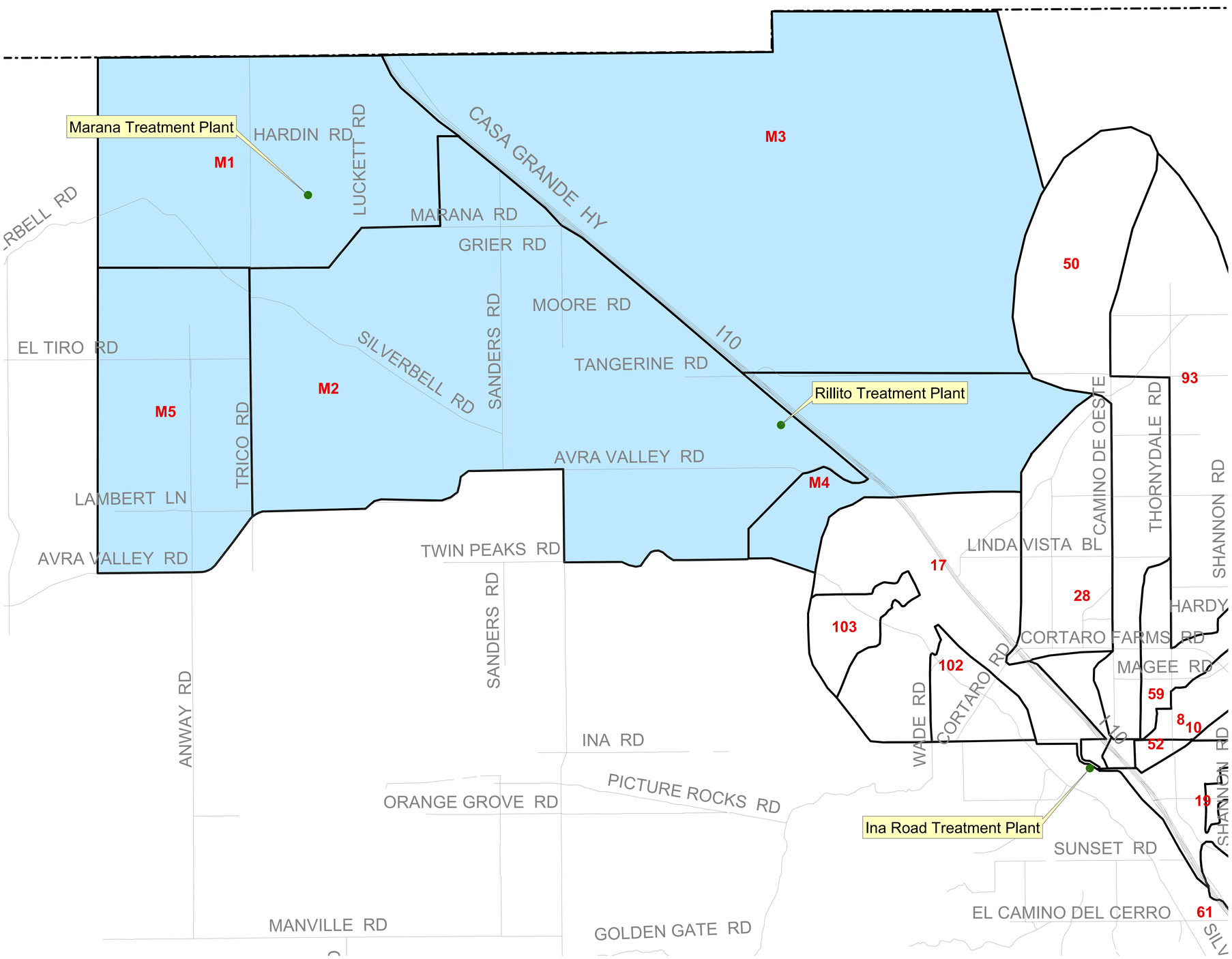
Marana Basins



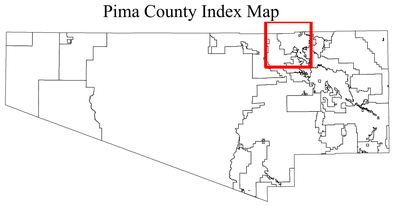
Treatment Plants

BASINS

- Avra Valley
- Ina Road
- Marana
- Roger Road
- South Lands
- Major Streets

Figure 5.4.2

Pima County Index Map



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4/29/2005

SUB-CHAPTER 5.5 TREATMENT MODELING AND PROCESS EVALUATION

The Technical Memorandums prepared by Hydromantis, Inc., Appendices E and F, present the evaluation of treatment capacity scenarios for the Roger Road WWTP as well as the Ina Road WPCF, including the HPO and BNRAS treatment trains. These treatment capacity evaluation were conducted by running scenario simulations using dynamic treatment process models in the Hydromantis GPS-X wastewater process modeling environment. The models were developed and calibrated under contract with Hydromantis to develop facility simulation tools for addressing departmental concerns regarding the capacity of existing and proposed facility expansions under a range of regulatory effluent quality requirements.

The scenarios evaluated include the capacity of the existing facilities and the capacity of the facilities with process upgrades and expansions requiring minimal additional infrastructure. The scenarios modeled evaluated the existing capacity of these facilities and were verified using actual plant data; however, the scenarios evaluating future capacity and nutrient removal will require additional simulations with adjusted condition assumptions to ensure the validity of the scenarios.

Treatment modeling shows a number of different options for both increased capacity, as well as nutrient removal for both the Ina Road WPCF and the Roger Road WWTP. The modeling completed to date can help PCWMD map future process modifications to meet regulatory requirements and additional capacity needs. Additional studies are necessary for the overall integrated treatment capabilities for both the Ina Road WPCF and Roger Road WWTP to identify the most cost-effective long term and interim upgrades at the facilities. The ultimate integrated treatment scenarios will be impacted by:

- The Plant Interconnect Pipeline between the Ina Road WPCF and the Roger Road WWTP.
- Solids handling modifications and upgrades at both facilities.
- Centrate treatment options.
- Operation of the two separate treatment trains at the Ina Road WPCF.
- Regulatory requirements at both treatment facilities.
- Process modifications at both facilities.

Modeling and Simulation for Treatment Process Analysis

To evaluate the wastewater treatment capacity of the treatment trains at the Roger Road WWTP and the Ina Road WPCF, dynamic process models were developed utilizing design and operational data. These treatment plant models were constructed using international standard mathematical models representing the mechanisms of the physical separations and biochemical reactions in each of the unit processes making up each treatment train. The unit processes are parameterized using design data, and, for operational plants, were calibrated using operation data and mass-balances. The influent flow was characterized using the analyses from the department's state certified laboratory.

The treatment plant modeling and simulation environment applied is GPS-X version 4.1, utilizing state-of-the-art process models. See Appendices E and F for the modeling results.

Serving the Tucson metropolitan area, PCWMD's metropolitan treatment facilities is presently capable of treating 66 million gallons per day to secondary treatment standards under Arizona's Aquifer Protection and Pollutant Discharge Elimination System permitting programs. The treatment facilities include the 41 MGD Roger Road WWTP and the 25 MGD Ina Road WPCF. A 12.5 MGD expansion is under construction at the Ina Road WPCF, and is expected to be operation by 2006.

In addition, a 3 MGD treatment facility at the Randolph Park WRF was placed into service in 2005. Both the expansion at the Ina Road WPCF and the Randolph Park WRF will be capable of nitrogen removal providing water meeting Class B+ and Class A+ water standards, respectively. This will bring the overall metropolitan treatment capacity up to 81.5 MGD.

The Roger Road WWTP treats wastewater with a screening and degritting headworks, primary sedimentation, trickling biofilter/activated sludge with secondary clarification and chlorination producing Class B water discharged to reuse and (de-chlorinated) to the Santa Cruz River. The existing Ina Road WPCF also uses a screening and degritting headworks, primary sedimentation, a high purity oxygen (HPO) activated sludge process with secondary clarification, and chlorination producing Class B water discharged (de-chlorinated) to the Santa Cruz River. As noted above, the Ina Road WPCF will start up a biological nutrient removal activated sludge (BNRAS) treatment train designed to treat 12.5 MGD to Class B+ reclaimed water standards. This train will share the headworks and influent pump station with the HPO treatment train and the combined effluent will be chlorinated and de-chlorinated prior to discharge to the Santa Cruz River. The combined biosolids produced from both the Roger Road WWTP and the Ina Road WPCF are dewatered at the Ina Road Regional Solids Handling Facility resulting in approximately 0.4 MGD of centrate. The centrate is now returned to the HPO train at the Ina Road WPCF. This centrate return is causing relatively high ammonia concentrations in the plant effluent.

The fundamental concerns in treatment facility assessment are condition assessment and process assessment. Since condition assessment has been discussed earlier in this plan, discussion here is restricted to the assessment of treatment process and capacity impacts. Operational requirements that pertain to capacity are wastewater containment (e.g. minimum freeboard conditions), hydraulic capacity (the design flow with associated peak wet weather flow at which a facility can both convey and contain all flows) as well as equipment limitations (such as limited aeration, or limited recycle rates). With adequate hydraulic capacity, PCWMD's main concern in the process assessment is the other parameters that limit treatment capacity.

The main process performance parameter that effectively determines treatment capacity for these facilities is the required nitrogen removal (total nitrogen and un-ionized ammonia). While aeration and recirculation flow limits are other major concerns, their implementation is easier in terms of the required infrastructure and costs compared to construction of new structures. Given the presumed ability to implement enhanced aeration and internal recirculation flows, the capacity to remove nitrogen is thus limited by reactor and clarifier volumes. Expansion of these structures does require relatively significant capital improvements. Thus, given these presumptions, the main item discussed in this section is nitrogen removal and its impact on treatment capacity.

Process Evaluation Scenarios

The fundamental questions associated with treatment train capacity assessment are:

(1) What is the capacity of the existing plant for given influent and effluent characteristics?

(2) Presuming that aeration, recycle rate, and other ancillary processes can be augmented, what process changes can be implemented to provide nutrient removal with minimal new infrastructure construction requirements?

(3) What are the capacity impacts to the BNRAS facility at the Ina Road WPCF associated with treating the centrate produced under existing conditions, and under future nutrient removal and biosolids processing scenarios at the Metropolitan Facilities?

In the context of the existing and expected future Aquifer Protection (APP) and Arizona Pollutant Discharge Elimination permit programs (AZPDES) Permitting, wastewater treatment, and reclaimed water production demands, the functional questions for this chapter become:

1. What influent (flow & quality) can the existing treatment trains treat to existing discharge standards at both the Ina Road WPCF HPO and BNRAS trains and the Roger Road WWTP?
2. What influent (flow & quality) can the existing treatment trains nitrify and denitrify with (a) existing equipment, (b) additional aeration, and (c) process changes that do not require significant additional construction at both the Ina Road WPCF HPO and the Roger Road WWTP?
3. How is the capacity of the Ina Road WPCF BNRAS treatment train impacted by centrate addition produced under the following scenarios:
   - ✓ Roger Road WWTP treating 41 MGD to secondary effluent standards, with 0.4 MGD of centrate directed entirely to the Ina Road BNRAS train.
   - ✓ Roger Road WWTP treating 20 MGD to less than 8 mg/liter total nitrogen and ammonia to less than 8 mg/liter, with 0.35 MGD of centrate to the Ina Road WPCF BNRAS train.
   - ✓ Roger Road WWTP treating 41 MGD to less than 8 mg/liter total nitrogen and ammonia to less than 6 mg/liter, with 0.5 MGD of centrate to the Ina Road WPCF BNRAS train.
   - ✓ Roger Road WWTP treating 50 MGD to less than 8 mg/liter total nitrogen and ammonia to less than 6 mg/liter, with 0.6 MGD of centrate to the Ina Road WPCF BNRAS train.

Capacity Scenario Evaluations

In order to address these questions, the two following sections deal with Roger Road WWTP and Ina Road WPCF respectively. In these sections we will describe the existing process, its capacity, evaluation of existing process capacity, description of alternate nutrient removal processes, and evaluation of the alternative nutrient removal process performance.

Simulations were conducted to evaluate capacity limitations of the existing processes and the nutrient removal process alternatives proposed for each facility while maintaining the required treatment performance. Diurnal flow patterns were applied in the influent flows used in each simulation. The calibrated models for the existing facilities are based upon several years of both summer and winter operational performance data.

It is important to define the existing treatment train capacity to establish a base of existing conditions against which to compare alternatives and to schedule required expansion. Since nitrification capacity typically determines nitrogen removal capacity, we focus on the nitrification capacity of existing trains. In the following sections, we will first evaluate the existing treatment capacity and then feasible treatment process modifications requiring minimal additional infrastructure to maintain capacity and comply with nutrient removal requirements at both the Roger Road WWTP and Ina Road WPCF.

Existing Treatment Trains

At the present time, the influent flow projections for the metropolitan area, when considered with the 3 MGD capacity relief for the Roger Road WWTP provided by the Randolph Park WRF and the 12.5 MGD increase for the Ina Road WPCF from the new BNRAS train, do not appear to indicate an immediate need for capacity increase at either the Roger Road WWTP, or the Ina Road WPCF. To provide perhaps both additional time and operational flexibility while under secondary treatment requirements, it may be desirable to re-rate the permitted capacity of these facilities

an additional 3.9 percent as allowed under the 2001 Arizona Aquifer Protection Permit program as minor permit amendments. Capacity increases of 4 percent or more are considered significant amendments and trigger Best Available Demonstrated Conventional Technology requirements that include nitrogen removal. The additional time and flexibility afforded by these amendments may provide the latitude required to remain in compliance while process modifications and-or the plant interconnect are implemented. The modeling performed for both facilities as well as recent operational demonstrations indicate that both facilities are capable of treating to their present discharge quality at least an additional 3.9 percent above their existing capacity limits,. For the Roger Road WWTP, this would allow a capacity increase of about 1.6 MGD (< 4 percent), and, for the Ina HPO, this would allow a capacity increase of about 1.0 MGD (<4 percent). These permit amendments would effectively extend the useful life of the unmodified existing processes by approximately two years, allowing additional time to implement process modifications.

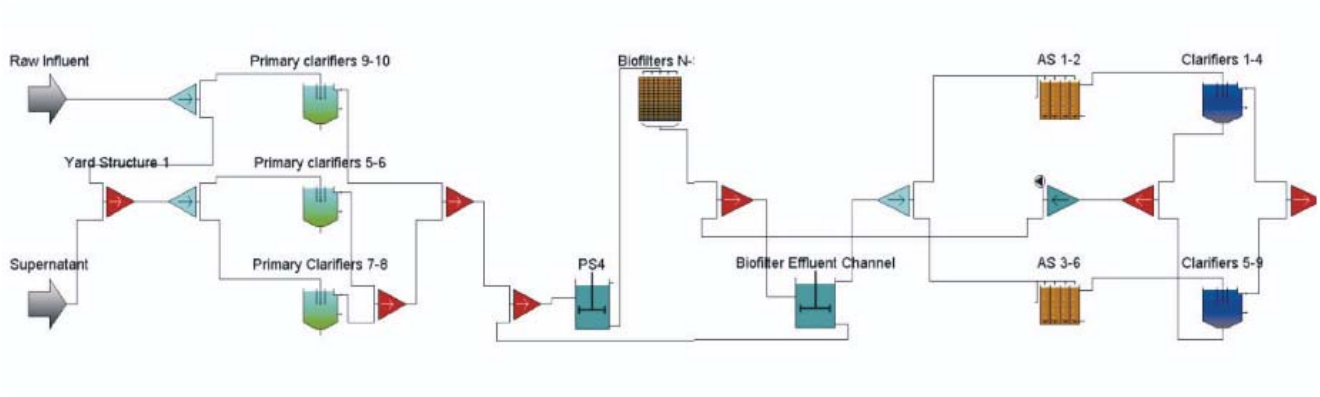
Roger Road WWTP

Existing Process

The Roger Road WWTP has two biofilter/activated sludge trains. It should be noted that the performance of these biofilter and the activated sludge process is not independent, since the two treatment units significantly commingle in the biofilter effluent / return activated sludge trough and in the secondary clarifier influent distribution channel. There are indirect controls over flow and aeration distribution. There is less than a 10 percent difference between the two operating trains at Roger Road WWTP in terms of aeration basin configuration and volume as well as secondary clarifier volumes. These units can be operated either as an activated biofilter (ABF) - when solids are returned and recirculated over the biofilters while the aeration basins may be in operation, or as a biofilter/activated sludge (BF/AS) process - when the aeration basins are in use and are receiving return solids from the secondary clarifiers while the biofilters do not.

For the purpose of the process/capacity simulation/study, the existing capacity for the Roger Road WWTP trains was assessed under operation as a BF/AS. This configuration has been demonstrated to provide more consistent plant performance than just the use of the biofilters alone. The following is a process schematic of the Roger Road WWTP as configured for modeling:

Table 5.5.1 Roger Road WWTP Process Schematic



Existing Process – Capacity Evaluation

As previously noted, the Roger Road WWTP can treat greater than 43 MGD to secondary standards under the current process configuration. This has been confirmed through modeling as well as actual operation of the facility at greater flows when flow needed to be redirected from the Ina

Road WPCF to the Roger Road WWTP to alleviate the HPO. As recommended above, the Roger Road WWTP should be re-rated under a minor APP permit amendment to provide an additional 1.6 MGD of flow, bringing the plant capacity up to 42.5 MGD.

Additionally, the results of simulating the existing process configuration for a nitrification capacity indicate that the facility cannot nitrify at 41 MGD. Additional simulations will need to be run to determine what the maximum nitrification capacity is with and without use of the biofilters and with an improved aeration system. Based upon probable clarifier loading limits and required solids retention time, the capacity of the existing system is between 10 and 20 MGD.

Alternative Nutrient Removal Processes

Under the BF/AS configuration, complete nitrification is probably not economically viable. Modeling shows that nutrient removal with the existing aeration basin and clarifier volumes is impractical because the mixed liquor concentrations required for the minimum solids retention time necessary for nitrification would overload the available clarifier capacity at the existing plant capacity. Nutrient removal could only be accomplished with significant process improvements. Some possible improvements to attain that nutrient removal, while maintaining the existing plant capacity of 41 MGD include:

1. Converting a number of the clarifiers to membrane separators and reducing the load to the remaining clarifiers.
2. Converting the aeration basins to moving-bed (MBBR) or integrated-fixed film-activated-sludge (IFAS) bioreactors.
3. Converting the activated sludge process to a membrane bioreactor.
4. Converting the aeration basins to biologically aerated nitrifying (n_BAF) and anoxic denitrifying (dn_BAF) filters.
5. Adding of post secondary clarification n_BAF and dn_BAF units while maintaining the existing aeration basins.

Each of these process modifications would require for reliable compliance with a total nitrogen effluent quality standard of less than 8 mg/l some minimum methanol feed rate and some type of post-denitrification process. Even for the membrane processes, there would need to be some post-denitrification filtration.

For modeling purposes, the moving bed bioreactor (MBBR) alternative was evaluated as being the least complex to operate, simplest and fastest to implement, allow retirement (or conversion) of the biofilters, the most economical and scalable, as well as compatible with augmentation any of the other process modifications including membrane separation.

The MBBR process configuration does not require RAS return and is effectively a two-sludge system. Internal recycle could be implemented with wall pumps installed in the aeration channel walls, and reactor cells can be established with baffle walls that could be seasonally adjusted for reactor cell volume adjustment, as needed to optimize the heterotrophic to autotrophic biomass ratio and distribution process over a range of influent temperatures and carbon to nitrogen ratios that can arise in methanol feed augmented processes. The MBBR process configuration, as well as any of the other options, would require at least an aeration distribution system replacement and probably at least augmentation of the blower capacity and controls. The preliminary estimated cost (+/- 30 percent) for this process conversion is $15,000,000. Construction of a portion of the modifications required by this process could be completed during the 5-month warm-weather period, during which time the plant could to continue to treat 41 MGD using only the biofilters.

Under secondary treatment requirements, the existing aeration basins are not needed to meet discharge limits between mid-April through mid-September.

The MBBR process configuration, once implemented, would also allow the biofilters to be taken offline for a packing upgrade or for those structures to be converted to tanks for anoxic flow equalization, equalizing prefermentation, or as high-rate anaerobic reactors (e.g. upflow anaerobic sludge blankets). Additional modeling and studies will be necessary to determine the most cost effective options for improving effluent quality and capacity (if needed) at the Roger Road WWTP.

Nutrient Removal Process Results

The two scenario alternatives evaluated actually demonstrate the technical feasibility of the other hybrid nutrient removal processes that are also based upon elevated effective biomass concentrations in the aeration and anoxic basins. The other hybrid nutrient removal process alternatives were enumerated above.

The scenarios evaluated the Moving Bed Bioreactor for reasons describe above as the hybrid nutrient removal process at the Roger Road WWTP. These scenarios include:

1) Convert the facility to an MBBR that can treat 41 MGD to less than 8 mg/l TN, with and without use of the Biofilters.
2) Convert the facility to an MBBR with a post-denitrification filter can treat 50 MGD to less than 8 mg/l TN with and without the Biofilters.

These options would necessitate some plant modifications including, but are not necessarily limited to:

- Methanol Feed Systems for both Pre- and Post- denitrification reactors.
- Post-denitrification filters.

Ina Road WPCF

Description of Existing Processes (HPO)

The existing HPO process receives primary effluent and return activated sludge from the secondary clarifiers in the first of three aeration cells in series that comprise each of four covered parallel trains. The aeration cells in each train share a common covered headspace connected by wall vents through which the which the introduced high-purity (~ 90 percent) oxygen (HPO) and respired carbon dioxide flow from the first cell to atmosphere through pressure regulated vents in the roof covering the third cell. The HPO is produced the pressure swing adsorption system (PSA) system and/or from stored liquefied oxygen that is first passed through a flash (vaporization) volume. Mechanical surface mixers that essentially splash the mixed liquor into the headspace containing the HPO accomplish aeration. Headspace pressure is maintained at between 2 and 4 inches of water column, and dissolved oxygen is measured at between 12 and 20 mg/liter in the effluent from the third aeration cell. The oxygen supply is controlled by the headspace pressure setpoint as well as the dissolved oxygen measurement.

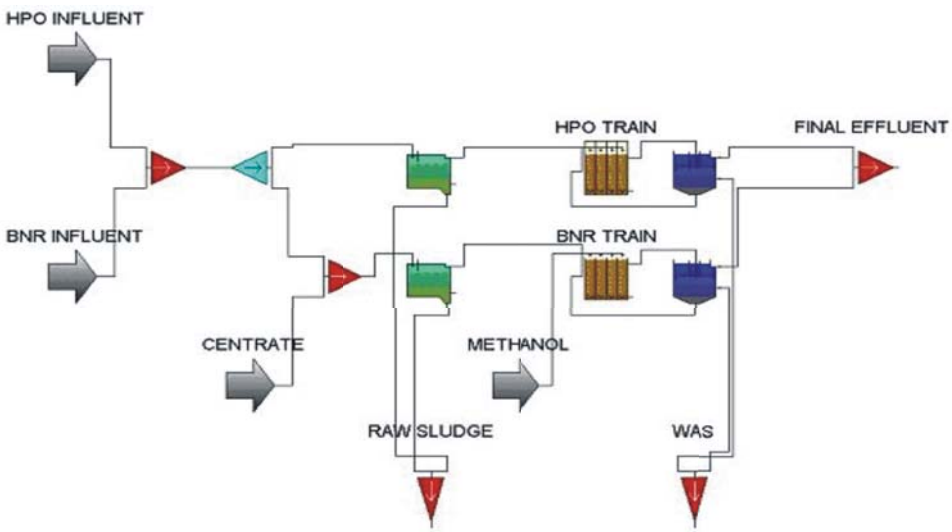
This mechanical aeration system and the associated controls contribute to a very inefficient system relative to currently available alternatives . The system's vendor (Lotopro) claims that an upgrade to this system could result in an 80 percent improvement in aeration efficiency. Additionally, over 50 percent of the HPO produced by the PSA is leaked through cracks in the deck covering the reactors. Further, during low flows in the early morning, the liquid level in the reactors lowers below the reach of the mechanical aerators as they partially emerge from the mixed liquor, which

reduces their aeration efficiency triggering the addition of liquefied nitrogen to maintain the dissolved oxygen concentration and headspace pressure set point.

Capacity Evaluation – Existing HPO

Modeling and actual operation of the existing Ina HPO shows that this facility under the current process configuration can treat greater than 26 MGD to secondary standards. This has been confirmed through modeling as well as actual operation of the facility at greater flows when flow needed to be redirected from the Roger Road WWTP to the Ina Road WPCF. If needed, the Ina Road WPCF HPO could be easily re-rated to provide an additional 1.0 MGD of flow, bringing the plant capacity up to 26 MGD, with only a minor permit modification. Again, at the present time

Figure 5.5.2 Ina Road WPCF Process Schematic



this additional capacity does not appear necessary, unless significant population growth moves to the Ina Road WPCF basin, since the new BNRAS facility is expected to be on line at an additional 12.5 MGD by the end of the year 2005.

Existing HPO Process Nitrification Capacity

Simulations were conducted to evaluate the performance of the existing HPO facilities to determine modifications needed to implement nutrient removal at the existing facility. This modeling did not include the impact of centrate addition to the HPO. treatment needs. Once solids handling treatment options are evaluated, the impact of those options on the existing treatment facilities will need to be evaluated, and additional studies will be necessary to determine additional modifications. The nutrient removal options that were evaluated for, and could be phased into, the existing HPO included:

1) Nitrification with the existing Activated Sludge

The existing system with improvements to mitigate the leaking HPO deck and an upgrade to the aeration system could nitrify up to 20 MGD (existing capacity is 25 MGD) and denitrify with a post-denitrification filter. The high methanol feed rates and costs associated with post-denitrification could be a relatively temporary, easily implemented option, installed until additional process changes could be made, that allow nitrification without the filter. This could be an interim measure to minimize upgrade costs.

2) Nutrient Removal with IFAS

With improvements to mitigate the leaking HPO deck and an upgraded aeration system (per the above item) and then conversion to an IFAS process, the HPO could treat up to 18 MGD (again, the existing HPO is rated at 25 MGD) to less than 8 mg/liter. This could be a secondary step in the improvements to meet nutrient removal, while minimizing costs. The BNRAS facility would need to handle the extra capacity until capacity could be increased at the HPO per the next option.

3) Nutrient Removal with MBBR

With improvements to mitigate leaking the HPO deck and an upgraded aeration system (per the above items) and then conversion to an MBBR process, the HPO could treat 25+ MGD to less than 8 mg/liter. This option would require about 2 million gallons of anoxic tankage, and appropriate internal recycle.

The above items do not need to be implemented in phases, but have been presented in phases to show options for cost reduction in the initial years of nutrient removal. Additional studies will be necessary to determine the best, most cost effective option for this facility. These studies need to take into account the BNRAS facilities, their capacity, and operation, as well as centrate treatment options.

A comprehensive study encompassing modifications at the Roger Road WWTP, as well as the Ina Road WPCF is recommended.

Existing Process (HPO) Capacity Evaluation and Alternate Nutrient Removal Processes

HPO process modifications to the existing process to provide nutrient removal were evaluated for feasibility in terms of diurnal flow treatment performance in simulations run on modified process models based upon a calibrated base model of the existing HPO treatment process. The process modifications evaluated include:

1) Nitrification Capacity of the Existing Process

This maintains the existing process configuration while increasing mixed-liquor concentrations to achieve the solids retention time required for nitrification. Prior single train pilot testing and calibrated modeling runs indicate that this is feasible however requires approximately a 20 percent de-rating of capacity without centrate addition and would also require post-denitrification not necessarily requiring filtration, yet would require substantial methanol feed rates to adequately denitrify to achieve less than 8 mg/liter of total effluent nitrogen.

2) Conversion to an integrated fixed film activated sludge (IFAS) process

This process modification requires conversion of the first aerobic cell to an anoxic cell and control of the headspace vent between the first and second cell. This modification also requires conversion of the aeration system to a simpler and yet extremely efficient jet aeration system that is relatively insensitive to level fluctuations and allows step feed of the HPO as well as the influent, individual cell control of DO and headspace pressure. Control of these together provides indirect control of reactor pH (inhibition control). In addition, screens would be required to maintain the carrier media within the each reactor cell. An internal recycle of flows of up to 3-times the influent flow would require a pump station and a conveyance piping to return flows from the third (aerobic) cell discharge back to the first (anoxic) cell. Returning RAS to the first anoxic cell would augment this internal recycle. Adjustments to the inter-tank flow weirs would also be required.

3) Conversion to a Moving Bed Bioreactor (MBBR) process

This process modification would require the same changes as in the IFAS system except that the first cell would be maintained as an aerobic cell and no activated sludge would be returned. A 2-million gallon pre-anoxic reactor volume would need to be constructed for this process modification. The anoxic tank would be divided with solid walls into several trains. Each train would be comprised of two completely mixed reactors in series. Additionally construction of a pump station and the conveyance piping to provide internal recycle flows of up to 3-times the influent flow from the third (aerobic) cell to the first anoxic cell would be required. Adjustments to the inter-tank flow weirs would also be required.

Description of new BNRAS treatment train

As mentioned above, the 12.5 MGD Ina Road BNRAS treatment train is expected to be operational in the 4th quarter of 2005. This process utilized by this treatment train is the Modified-Ludzack Ettinger (MLE) nutrient removal process. The MLE process implements a pre-denitrification anoxic reactor cell followed by a tapered multi-cell aeration basin and secondary clarification.

Following the flow, effluent from the primary clarifiers enters a pre-anoxic denitrification reactor and is blended (and reacted) with an internal recycle of nitrified mixed-liquor from the final cell of the aeration basin at up to 4 times the influent flow. Return activated sludge (RAS) is returned at up to 1.5 times the influent flow from the secondary clarifiers, in his case, to the first aerobic cell. (The MLE process is also used in the Marana Package Plants with the exception that the RAS is returned to the pre-denitrification anoxic cell.) The final aeration cell may be operated without aeration and still maintain suspended mixed liquor as it uses separate mixers when operated without aeration.

New BNRAS Capacity Evaluation

Simulation runs on the preliminary (un-calibrated) modeling of the BNRAS support the feasibility of re-rating the facility to 20 MGD with up to 0.35 MGD of centrate addition and up to 25 MGD without centrate addition - if the BNRAS is operated as an equalized facility. The equalization would only be required due to hydraulic limitations of the primary scum troughs. Equalization of the flow to the BNRAS would require shaving the diurnal peaks to the HPO train. Note that while the simulation results are based upon an un-calibrated model, the model is based upon the detailed design information and specified and tested equipment that is installed. Hence the predicted performance results of the simulations should be regarded as more rigorous than the design and as valid as the design in all regards except with respect to hydraulic restrictions on the range of internal recycle and return activated sludge flows expressed as a multiplier of the influent flow – for example the internal recycle limit is 3 times the influent if the facility operates at 20 MGD.

BNRAS - Performance Impacts with and without Centrate

Simulations to evaluate the nutrient removal performance of the BNRAS with and without centrate addition, with and without diurnal flows, and with varying centrate nutrient loads and flows have been conducted. The results indicate the following.

1) No Centrate Addition

Of course this scenario presumes a separate centrate nitrification process - which when all is considered and based upon first principles may be the final and best solution for the centrate processing.

Without centrate addition, simulation results indicate that maximum capacity of the facility will be determined by either hydraulic limitations in the primary clarifiers or due to solid loading limitations

in the secondary clarifiers. This conclusion is based upon results that indicate that the aeration basin for this train has abundant nitrification capacity at flows approaching even 30 MGD if the flow is equalized (and hydraulically feasible). The maximum capacity configuration would be achieved with equalized influent flow (diurnal peaks trimmed to the HPO) and with post-denitrification filters to polish the effluent nitrate and secondary suspended solids overflow excursions associated occasional operational fluctuations.

Hydraulic limitations associated with ancillary equipment, such as the scum troughs or control weirs have not been evaluated, and will need further investigation – perhaps best evaluated during model is calibration efforts.

In any event, a feasible and favorable phasing alternative for process upgrade at Ina may involve re-rating the BNRAS train under contingent operations (e.g. under trimmed influent flows with and without centrate and as a function of centrate flow and concentration). The elevated resulting re-rating of the BNRAS based upon operational conditions and centrate character would allow de-rating and upgrading the HPO facility in, perhaps prolonged, phases (e.g. post-denitrification filters, then IFAS, then MBBR) to provide nutrient removal capacity as required for a relatively low cost.

2) Sensitivity Analysis for Centrate Addition

The BNRAS facility was evaluated for treatment of various quantities of centrate, to determine the impact of this centrate on its treatment capabilities. Centrate concentrations similar to those presently encountered at the Ina Road WPCF were used. Changes to the solids handling system will affect both the quantity and concentration of the centrate at the facility, thus affecting treatment options, and additional treatment studies will be necessary. The centrate addition scenarios considered for the BNRAS capacity evaluation simulations included:

a. 0.35 MGD of centrate. This option of centrate addition was found to be feasible, with a post-denitrification filter. The combined dewatering facilities can produce 0.35 MGD of centrate, and solids handling modifications may increase that centrate production. As a result additional centrate addition was also modeled.
b. 0.5 MGD of centrate. It was found that the BNRAS facility was not capable to treating this centrate recycle volume, and a separate centrate nitrification process would likely be required.
c. 0.6 MGD of centrate. Again, it was found that the BNRAS facility was not capable to treating this centrate recycle volume, and a separate centrate nitrification process would likely be required.

The above sensitivity analysis shows that treatment of the centrate by recycle to the BNRAS is not feasible. Again, additional modeling/studies will be required to determine the most cost effective method of centrate treatment to meet the effluent ammonia limits. A centrate nitrification process will likely be necessary. This nitrification process could improve the performance of the other Ina Road nitrification reactors providing a means to receive the centrate nitrification reactor's waste activate sludge to augment the active autotrophic (nitrifying biomass) in these reactors.

The nitrified centrate could also be used as an oxidizing agent (while denitrifying – reducing the nitrate to nitrogen gas) as a chemical treatment to mitigate septic conditions and odor in the local conveyance system and in the facility headworks, thereby reducing chemical requirements.

Conclusions and Recommendations

Determination of the most appropriate conversion to allow the existing HPO facilities to meet nutrient removal requirements must be evaluated along with an overall evaluation of process and solids handling requirements at both the Roger Road WWTP and the Ina Road WPCF. The existing facilities cannot be effectively evaluated in a vacuum without determination of some of the following:

a. Treatment capacity and process at the Roger Road WWTP.

b. Solids handling facilities, at both Roger Road WWTP and the Ina Road WPCF.

c. Centrate treatment at the Ina Road WPCF.

Additional studies will be necessary to determine the most cost-effective nutrient removal options for the Roger Road WWTP.