7. Anticipated Changes due to the ROMP Upgrade

7.1 Introduction

Pima County Regional Wastewater Reclamation Department (RWRD) owns and operates two major wastewater reclamation facilities (WRF) located near Roger and Ina Roads. RWRD is currently implementing the $660 million Regional Optimization Master Plan (ROMP) which will upgrade the two major regional wastewater treatment plants discharging to the LSCR. Effluent discharged into the LSCR increases nitrogen and ammonia levels in both surface water and aquifer. Although nitrogen helps plant growth, high levels of nitrogen can be harmful. ROMP addresses the current and future regulatory requirements of the Arizona Department of Environmental Quality (ADEQ) to reduce the ammonia and nitrogen concentrations discharged into the LSCR by the year 2014 for the Ina Road Wastewater Reclamation Facility (WRF) and the year 2015 for Roger Road WRF. A significant element in effecting the ROMP strategy is building plant upgrades that incorporate denitrification. ADEQ's regulatory standards are based on Clean Water Act requirements set by the United States Environmental Protection Agency (EPA) and on state regulations regarding BADCT (Best Available Demonstrated Control Technology).

The objectives of ROMP are i) to expand the capacity of the Ina Rd WRF to meet anticipated population growth; ii) to replace the aging Roger Rd WRF; iii) to build an interconnect linking the plants; iv) to provide an effluent quality non-toxic to the aquatic environment; v) to develop a system-wide odor control plan to address the long lingering odor issues in the community.

This chapter summarizes existing conditions of the WRFs the changes in water quality and discharge from the ROMP upgrades, and the possible impacts of these upgrades on the LSCR.

7.2 Wastewater Reclamation Facility

7.2.1 Roger Road WRF

The location of the Roger Rd WRF is shown in Map 2. The capacity of the facility is 41 million gallons per day (MGD). Currently the average winter influent flow (peak season) is approximately 39.7 MGD. The Roger Rd WRF is the oldest metropolitan treatment facility in Tucson and was first operated in 1951 as a 12-MGD activated sludge facility. It was expanded with a separate 13-MGD trickling filter plant in 1960, and a 13-mgd activated sludge/contact stabilization facility was added in 1967. In

1979 the facility was consolidated into a single facility with the major biological treatment process, which increased the capacity to 41 MGD.

For the Roger Road WRF, process modifications and changes are required to lower ammonia and total nitrogen discharge levels to meet effluent quality regulations. Since complete rehabilitation is needed to repair process units, replace equipment and structures that are beyond useful service life, address odor control and safety issues, and be compliant with environmental, regulatory, and building code requirements, it is preferable to build a new facility.

7.2.2 Ina Road WRF

The original Ina Road WRF was constructed from 1975 to 1977. The location of the WRF is shown in Exhibit 3. The capacity of the Ina Rd WRF was recently increased to 50 MGD. Current average winter influent flow (peak season) is approximately 23.8 MGD. The facility was designed to produce a treated effluent meeting secondary treatment quality requirements as set forth by ADEQ. Modifications to the original design to enhance equipment performance and reliability were completed in 1990.

Process modifications/changes will be required to lower the ammonia and total nitrogen discharge levels to meet ADEQ regulatory requirements. Rehabilitation is needed to replace some equipment and upgrades are necessary for the facility to be compliant with environmental, regulatory, and building code requirements.

7.2.3 Upgrade of Treatment Facilities

Upgrade project for the Roger Rd WRF includes the following.

- Construct a new 32 MGD facility.
- Incorporate advanced Bardenpho treatment process.
- Incorporate state-of-the-art odor control and good neighbor features.
- Through an interconnect sewage conveyance line, manage flows to the facility in conjunction with flows to Ina Rd WRF for operational efficiencies.

Regulatory Compliance date for expansion and compliance with the regulatory effluent quality requirements for the Roger Rd. WRF is January 30, 2015.

Upgrade project for the Ina Rd WRF includes the following.

- Expand existing 37.5 MGD capacity to 50 MGD.
- Replace existing treatment processes with a Bardenpho system.
- Incorporate system-wide biosolids processing and handling for beneficial use.
- Incorporate biogas utilization program.

- Incorporate an Operations Control Center for process control and system-wide monitoring.
- Incorporate a plant security system.
- Incorporate state-of-the-art odor control system and good neighbor features.

Regulatory Compliance date for expansion and compliance with the regulatory effluent quality requirements for the Ina Rd. WRF is January 30, 2014.

7.2.4 Projected Capacity of Treatment Facilities

RWRD has designed upgrades the wastewater treatment facilities to meet the projected demand in 2030. As part of ROMP, the Ina Rd WRF will be upgraded with the Bardenpho technology and expanded capacity from 37.5 MGD to 50 MGD. The Roger Rd WRF will be replaced by a new 32 MGD wastewater reclamation plant with Bardenpho technology. The existing treatment facilities at Roger Rd will be decommissioned and demolished after the new plant is placed into service.

The projected capacities are as follows:

Future Capacities (by 2030)

Roger	32 MGD	35,847 AFY
Ina	50 MGD	56,011 AFY

Note: MGD: Million Gallon per Day; AFY: Acre-feet per year

While the projected capacity represents a significant increase over current reclaimed production, flow into the reclaimed system (influent) and effluent generation have been in a steady decline since peaking in 2007 (Table 7.1). The decrease in total effluent can be related to several factors:

- Growing water conservation
- Decreased economic activity and growth
- Drought

Based on these conditions, it is not clear whether flows into the sewage collection system will increase in the near term, even if population grows modestly.

Table 7.1 Historical Influent and Effluent Volumes by Metropolitan Treatment Facility

Year	Influent Received (AFY)	Effluent Reused On-site at County WRFs (AFY)	Effluent Discharged or Delivered to Reclaimed System (AFY)	Effluent Total (AFY)
2003	69,064	928	67,270	68,198
2004	69,786	1,205	67,049	68,253
2005	70,968	1,088	67,920	69,007
2006	72,021	1,356	67,711	69,067
2007	72,437	69	68,230	68,299
2008	71,989	139	68,402	68,540
2009	69,152	368	66,043	66,411
2010	67,000	119	64,420	64,539
2011	66,595	145	63,771	63,917

Note: Data Source: Effluent Generation and Usage Report, RWRD, 2011

7.3 Anticipated Changes in Effluent Quality

A significant element affecting the strategies in ROMP is the need for a reduction in ammonia and nitrogen concentrations discharged into the LSCR in order to comply with current and future environmental regulatory requirements mandated by ADEQ. Table 7.2 summarizes the existing pollutant efficiency. Table 7.3 summarizes the anticipated changes in average pollutant concentration. Nitrogen concentration will be reduced to approximately 10% of existing levels through improved treatment; Phosphorus may be essentially eliminated; and settleable solids will be reduced to less than half of present levels.

Table 7.2 Existing Pollutant Removal Efficiency

	Pollutant Removal Efficiency (%)	
	Ina Rd WRF	Roger Rd WRF
Nitrogen	48	34
Phosphorus	52	42
BOD	93	98
TSS	96	96

Note: Average Removal Efficiency based on 2010 data

Table 7.3 Existing and Anticipated Pollutant Concentration

	Existing Concentration (mg/liter)		Anticipated Concentration (mg/liter)	
	Ina Rd WRF	Roger Rd WRF	Ina Rd WRF	Roger Rd WRF
Nitrogen	26	31	2.5	2.3
Phosphorus	3.4	4	< 1	< 1
BOD	12	10	2.4	2.7
TSS	7	16	3.1	3.3

Data Source: RWRD, Compliance and Regulatory Affairs Office, April 2011

7.4 Possible Environmental Impacts by ROMP

7.4.1 Infiltration

Previous studies (Galyean, 1996; Lacher, 1996; Treese et al., 2009; Case, 2012) have documented that clogging layers ("schmutzdecke"; black anaerobic layer) exist in the LSCR. Clogging layers can be formed by biotic processes (microbial or algal growth on the substrate), abiotic processes (siltation of interstitial spaces or deposition of settled organic matter from effluent), or both (Case, 2012). Okubo and Matsumoto (1983) reported that suspended solids and organic carbon had to be maintained at low concentration to prevent clogging.

The clogging layers reduce infiltration of surface water from the river, causing disconnection between the river and underlying aquifer. Case (2012) reported that hydraulic conductivity increases with distance from the WRF outfall. Her study showed that hydraulic conductivity on the low-nutrient reach of the Santa Cruz River (where denitrified effluent is discharged) was 1.4 - 3.1 times higher than the high-nutrient reach (non-denitrified). Currently, effluent discharged at the Roger Rd. and Ina Rd. WRFs is not denitrified, but the ROMP upgrade will accomplish nitrogen removal. Case (2012) concluded that utilizing higher-quality effluent can be sufficient to reduce clogging. The findings of the previous studies suggest that water quality upgrade by ROMP will reduce the extent of the clogging layers and increase infiltration rate.

7.4.2 Sediment Transport

In sandy-bedded channels, the sediment itself has no cohesion, and sediment entrainment is assumed to be a transport-limited process, so that the amount of sediment in the water column is dependent on the discharge and velocity of the flow.

In the LSCR, the biotic components of the clogging layer include the development of algal and microbial films that provide cohesion to the sediment. These layers also may trap silt and clay size particles that may tend to fill interstitial voids (Case, 2012). In the absence of these cohesive elements, the fine sediment would be entrained at the velocity of the effluent flows discharged to the stream.

ROMP upgrades will discharge effluent with low nutrient content and minimal suspended matter. As a result, it is likely that the clogging layer and associated cohesion will diminish. It is expected that the fine sediment in the clogging layer will diminish as the clogging layers become less pervasive.

As the clogging layers diminish, infiltration rate will increase. Therefore, more effluent will infiltrate closer to the discharge points. This scenario will result in less effluent reaching the distal end of the project (i.e. anticipated decrease in flows at Trico Rd).

With the changes in cohesion, and decreased flows further from the treatment plant, the nature of the effluent flow channel will change. Because the cohesive elements of the biotic component of the clogging layers will diminish with decreased nutrients, the bed is likely to have fewer fines. The higher quality effluent with lower initial suspended solids may also be able to transport more sediment, because it enters with a capacity to entrain more fines. Furthermore, because the difference between effluent flow at the treatment plant and Trico Rd will be greater, the differences in channel geomorphology are likely to be greater (e.g. a narrower low flow channel downstream).

7.4.3 Vegetation

The ROMP upgrades will impact nutrients and the wetted extent of water in the LSCR, key components related to vegetation quality in this effluent dependent wetland area. Following the change of the Nogales International Treatment Plant to a modified Ludzack-Etinger system capable of nitrogen removal, the extent of open water decreased. As the discussion of clogging and infiltration noted, the upgrades from ROMP will likely result in similar decreased extent of open water and increased infiltration closer to the discharge points. Although it is difficult to predict unsaturated zone conditions without modeling, vegetation closer to the treatment plants may have increased access to water in the unsaturated zone beneath the river, while vegetation further away is likely to experience diminished water in the unsaturated zone.

Different plants have differing nutrient requirements. For example, many desert plants able to thrive in soils with relatively low nutrients and organic matter. With the decreased amounts of ammonia and total nitrogen following the ROMP upgrades, it is anticipated that water quality changes will impact the vegetation pallet in the LSCR. Effects due to water quality changes would be more likely to be noticed near outfalls. Reduced nitrogen loading may cause some shifts in the composition of wetland forbs, and increasing the salt load may favor tamarisk.

7.4.4 Macro Invertebrate

It has been reported that diversity of macro invertebrates in the LSCR was low, particularly in summer (Walker et al., 2009). Additionally, the study showed that there were at least 4 major limitations to diversity in the LSCR: ammonia-N, un-ionized ammonia, dissolved oxygen, and mean diel dissolved oxygen. As the study pointed out, it is possible that diversity of macro invertebrates will increase when water quality is upgraded.

7.4.5 Vertebrate

With the beginning of the upgrades at Ina Rd, mosquito fish have returned to the LSCR. Prior to that point, there were no fish of any kind in the river. As a point of comparison, following the upgrade in water quality from the Nogales International Treatment Plant, an increase in both native and non-native fishes were observed. Therefore, it is possible that increases in numbers and variety of fish will occur following the ROMP upgrades.

7.5 Possible Changes in Effluent Use

7.5.1 Effluent Entitlement

In 1979, the City of Tucson and Pima County entered into an agreement to merge the city wastewater system and the county wastewater system (Water Resources in Pima County; http://rfcd.pima.gov/wrd/planning/pdfs/wrpolicy01.pdf). The City transferred all their wastewater conveyance and treatment system assets to the County to operate as the regional wastewater management agency. In exchange for the wastewater conveyance and treatment assets, the County agreed that the City would have use of 90% of the effluent from the metropolitan treatment plants, leaving the remaining 10% for county to use.

In 1983, the City entered into an agreement with the US Secretary of the Interior to make available 28,200 acre-feet per year (AFY) of effluent to satisfy the Southern Arizona Water Rights Settlement Act (SAWRSA). The SAWRSA effluent water is discharged to the Santa Cruz River. The portion of this SAWRSA that is calculated to have been recharged to the aquifer in the Lower Santa Cruz River Managed Recharge projects is stored as groundwater recharge credits. Because these underground storage projects are identified as 'managed' recharge, only half of the water that reaches the aquifer is credited.

In 2000, the City and County agreed to supplement the original 1979 agreement. Largely due to the development of the Sonoran Desert Conservation Plan, a portion of the 2000 Supplemental Intergovernmental Agreement between the City and County was developed whereby the parties jointly agreed to set aside up to 10,000 acre feet per year of effluent (the Conservation Effluent Pool effluent or CEP) for use as part of a Habitat Conservation Plan (HCP) or on riparian projects. The CEP effluent is to be taken on a priority basis from the effluent produced by the County-operated metropolitan wastewater reclamation facilities. It is currently anticipated that City of Tucson and Pima County CEP projects could reach the maximum CEP allotment of 10,000 AFY of effluent by 2015 (PCWMD, 2006).

Before the effluent is discharged from the Roger Rd WFR to the LSCR, a portion of the flow is pumped to reclaimed water treatment facilities owned and operated by Tucson Water. The reclaimed water facilities are located on the east side and adjacent to the Roger Rd WRF.

Effluent is currently allocated to water providers including Tucson Water (TW), Oro Valley (OV), Flowing Wells Irrigation District (FWID), Spanish Trails Water Co.(ST) and Metro Water (Met) and Pima County (PC) (Figure 7.1). So far, no effluent has been used for CEP.

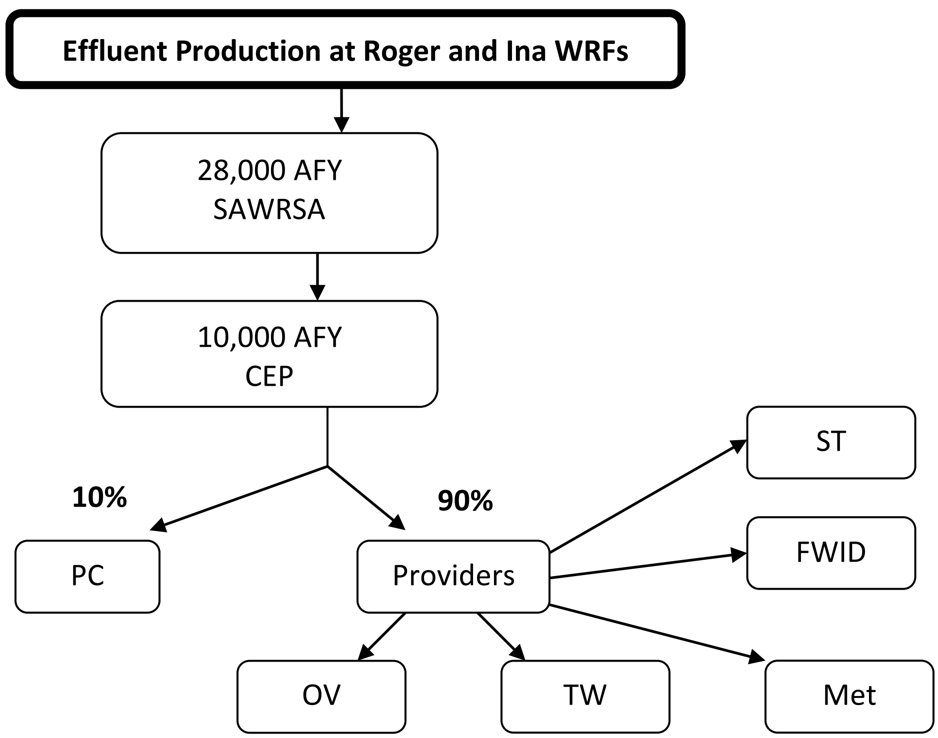

Fig. 7.1 Current Effluent Entitlement and Distribution (AFY: Acre-feet per year)

7.5.2 Plans for Effluent Use – Reclaimed & Recharge

i) *Tucson Water*: Tucson Water is currently preparing a 'Recycled Water Master Plan' that will clearly present their long-range goals for use of the water resource derived from treated effluent. Tucson Water expects limited expansion of use by reclaimed customers, because most of the larger turf facilities are already using reclaimed water.

Tucson Water also intends to develop capability for more extensive 'Indirect Potable Reuse,' which will require them to build additional capacity in constructed recharge facilities to recharge the treated effluent. With this capability, they will be able to take more reclaimed water for recharge any time throughout the year. However, it is likely that recharge will be greater when irrigation demand is less, because the current reclaimed system will be used to distribute water to recharge facilities, and flows in the pipes are below capacity in the winter.

Based on full effluent production available in 2030, Tucson Water expects to have an allocation of about 40,000 AFY of metropolitan effluent. Tucson Water estimates that about 15,000 AFY of that would be used in the reclaimed system, while the remaining 25,000 AFY would remain in the river, or be recharged. One such recharge facility will be the South Houghton Area Recharge Project (SHARP) which is expected to be receiving about 4000 ac-ft/yr of reclaimed water for recharge by mid-2017. If indirect potable reuse is employed, it is not clear how the new off-channel recharge facilities will be operated (i.e. throughout the year, recharge more in winter, recharge only in winter etc). There is still significant uncertainty in how and where Tucson Water may use and/or recharge their effluent.

ii) *Metro Water*: Metro Water has an agreement with Tucson Water to provide a portion of the reclaimed water. Metro Water is actively looking for users for their reclaimed water and expects that their full reclaimed allotment will be used for irrigation with five years. Metro has a max daily delivery rate defined by 3000 ac-ft/365 days. Therefore, these turf users cannot take all of Metro's water and will leave water in the river during the low water use demand periods. At this point, Metro has no plans to construct facilities specifically identified for indirect potable reuse. However, Metro Water is planning to recharge the balance of its effluent that is not taken as reclaimed water, and they will do so through groundwater savings facility (GSF) credits.

iii) *Oro Valley Water*: Oro Valley has an agreement with Tucson Water to wheel their effluent allocation through the reclaimed water system. Oro Valley Water has an allotment of reclaimed similar to that available to Metro Water and currently takes full allotment of reclaimed water.

iv) The Bureau of Reclamation: The Bureau of Reclamation (BOR) might prefer to keep all 28,200 AFY of SAWRSA water in the river. However, they are not accumulating full recharge credits possible. To get 100% recharge credits for their allotment, they either need to conduct off-channel constructed recharge, participate in a GSF, or secure a change to the statute regarding water accounting at Arizona Department of Water Resources (ADWR) that would allow them to get 100% credit for their share of the managed recharge.

7.6 Possible Socioeconomic Impacts by ROMP

The land uses adjacent to the LSCR have historically been commercial and industrial. Pima County has identified land adjacent to the river as an economic development zone by providing incentives for infill development. ROMP will restore water quality and improve wetland conditions in the river, which possibly leads to improved public perception of the river and the land adjacent to the LSCR. Water quality upgrade by ROMP will possibly provide socioeconomic impacts to the community.

7.6.1 Flowing Wells Neighborhood Association and Community Coalition

Flowing Wells is an economically stressed urban area with potential for economic development. A plan to amend the mixed used zoning to urban industrial planned land use designation will revitalize existing industries and encourage new developments. The water quality upgrade by ROMP will provide better environmental conditions, benefit neighborhoods and possibly encourage new development.

7.6.2 Corazon de Los Tres Rios Del Norte

The City of Tucson and Pima County recognize that upgrading the WRFs will transform the LSCR into an amenity. The Corazon project will convert an area adjacent to the river into a multi-use space providing recreation, wildlife habitat, and water storage credit. The goals of the project include reclamation and restoration of habitat, flood control, recreation and protection of cultural resources, water supply improvements and management. The water quality upgrade is essential to achieve the goals of the project.

7.6.3 Linear Parks

Tucson's increasing population and the need to accommodate a broad range of user groups from pedestrians to equestrians, has resulted in the creation of linear parks along urban waters such as the Rillito River Park and Santa Cruz River Park. The water quality upgrade will possibly encourage and accelerate the use of linear park along the LSCR.

7.6.4 Santa Cruz Managed Recharge Project

Two managed groundwater recharge projects are being operated in order to accrue credits for effluent recharge and storage: The Santa Cruz River Managed Underground Storage Facility and the Lower Santa Cruz River Managed Recharge Project. Increases in infiltration directly benefit communities with effluent allocation rights, described in “5.5. Possible Changes in Effluent Use”. However, as mentioned in 7.2.4, if effluent discharge will be reduced, the reduced flows could impair the recharge and restoration projects.

7.7 References

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