CHAPTER 3

Treatment Plant Evaluation

Chapter 3 - Treatment Plant Evaluation

3.1 Introduction

This chapter provides a overview of the two major existing treatment plants, Roger Road WRF and Ina Road WRF, including descriptions of:

- Existing treatment capacity
- Peaking factors and plant influent characteristics
- Plant recycle flows and loads
- Existing plant system arrangements and conditions

3.2 Existing Treatment Capacity

3.2.1 Roger Road WRF

The Roger Road WRF is the older of the two major treatment facilities and has a permitted capacity of 41 mgd. It is located at 2600 W. Sweetwater Drive, Tucson, Arizona 85705. It was first operated in 1951 as a 12-mgd activated sludge facility and was expanded with a separate 13-mgd trickling filter facility in 1960 and a 13-mgd activated sludge/contact stabilization facility in 1967. In 1979 the facility was consolidated into a single facility with new two, 165-foot diameter by 26-foot deep, plastic media biofilters with return activated sludge capability.

Digested biosolids are conveyed via force main to the Ina Road WRF and combined with digested biosolids from the Ina Road WRF for further processing prior to final disposal.

In the late 1980s, the activated sludge tanks were used only during the winter months when the biofilter alone could not handle the load due to lower temperatures and higher influent loadings. As the flow and influent loadings increased, the activated sludge tanks have been placed into continuous service to meet secondary treatment permit requirements.

3.2.2 Ina Road WRF

The existing Ina Road WRF was designed in 1973 and construction was completed in 1977. The facility is located at 7101 North Casa Grande Highway, Marana, Arizona, just South of Ina Road, between Interstate 10 and the Santa Cruz River. It consists of a 25-mgd HPO activated sludge process, a sludge digestion and centrifuge thickening/dewatering facility for solids handling, and a complete energy-recovery system for heating, cooling and on-site generation of electrical power from digester gas. Modifications to the original design to enhance equipment performance and reliability were completed in 1990.

Recently a BNRAS treatment facility with a design capacity of 12.5 mgd was added. The BNRAS process includes primary treatment and a multi-staged wastewater treatment system capable of partially removing nitrogen and ammonia from the waste stream. Flows to the HPO treatment system and BNRAS

treatment facility are treated and disinfected separately and then combined prior to dechlorination and discharge into the Santa Cruz River Roger Road WRF.

3.3 Peaking Factors

The plant operating data for Roger Road WRF and Ina Road WRF during January 2004 through April 2006 were used to analyze the peaking factors of the raw wastewater flow and characteristics parameters, including, BOD, TSS, total kjeldahl nitrogen (TKN) and total phosphorus (TP). The results are summarized in **Table 3-1**.

Table 3-1
Peaking Factors for Influent Wastewater Characteristics Parameters

	Roger Road WRF	Ina Road WRF
Wastewater Flow		
Average, mgd	37.8	23.9
Monthly Peak Flow (MPF)	1.10	1.14
Daily Peak Flow (DPF)	1.37	1.33
Hourly Peak Flow (HPF)	2.00	2.00 (3)
BOD(1)		
Average, mg/L	249	252
MPF	1.13	1.07
DPF	1.18	1.17
TSS(1)		
Average, mg/L	249	271
MPF	1.05	1.05
DPF	1.32	1.38
TKN(1)(2)		
Average, mg/L	33.5	47.8
MPF	1.28	1.11
DPF	-	-
TP(1)(2)		
Average, mg/L	5.4	7.3
MPF	1.31	1.03
DPF	-	-

(1) Mass loading based peaking factors adjusted with flow peaking
(2) TKN and TP data were available only once per month for both plants and daily peaking factors were not computed
(3) Assumed same as Roger Road WRF

The influent (raw) flow data were used to analyze the average flow, monthly peaking factor (MPF) and daily peaking factor (DPF). Although the average flow rate to the Roger Road WRF was substantially higher than that of the Ina Road WRF, the monthly peak flows and daily peak flow factors for the two

plants were similar. The diurnal flow data for the same operating period were available for the Roger Road WRF and were used to compute the average diurnal peaking factor (DUPF). Then the DUPF was multiplied by DPF to compute the hourly peaking factor (HPF). Diurnal operating data were not available for the Ina Road WRF and the HPF for the Ina Road WRF was assumed to be same as that of the Roger Road WRF due to the fact that the MPFs and DPFs factors of both plants were similar.

Peaking factors for BOD, TSS, TKN and TP were analyzed based on the mass loading, such as lbs/day, of each parameter. The peaking factor based on the mass loading was then divided by the flow peaking factor to obtain the flow adjusted peaking factor. Therefore, these peaking factors are concentration peaking factors adjusted with flow peaking.

The peaking factors for the two plants were similar for flow, BOD and TSS, but somewhat different for TKN and TP. While the operating data for flow, BOD and TSS were available on a daily basis, only a single value was available for each month for TKN and TP. Therefore, the peaking factors for TKN and TP may not be as reliable as other parameters. Monthly peaking factors only for TKN and TP were analyzed since only a single daily value was available for each month.

3.4 Recycle Flows and Loads

At the Roger Road WRF, the primary sludge and waste activated sludge (WAS) is gravity thickened or thickened by a gravity belt unit and anaerobically digested. The digested biosolids are conveyed via force main to the Ina Road WRF for further processing and final disposal. The thickener overflow is recycled to the plant influent stream.

At the Ina Road WRF, the primary sludge and WAS are thickened by gravity thickeners or with dissolved air flotation (DAF) thickeners and the anaerobically digested. The digested sludge (biosolids) is combined with the digested sludge (biosolids) from the Roger Road WRF and dewatered using centrifuges. The thickener and centrate recycle flows are returned to the plant influent stream. Due to the centrate return from the digested sludge dewatering operation, the BOD and TSS concentrations in the Ina Road WRF influent are moderately higher, but TKN and TP concentrations are substantially higher than those of the Roger Road WRF influent as shown in the above table.

3.5 Existing Plant Systems

For each of the two major wastewater treatment facilities, a detailed assessment of each system was performed to provide baseline information for developing alternatives and options for future consideration. The system descriptions are summarized below.

3.5.1 Roger Road WRF

3.5.1.1 Systems Description

The Roger Road WRF system descriptions are organized into the following areas:

- Septage Dump Station

- Headworks
- Primary Clarifiers
- Biofilter Pumping Station and Biofilters
- Aeration Basins
- Final Clarifiers
- Chlorination/Dechlorination Facilities
- Gravity Thickeners
- Digesters
- Odor Control
- Electrical
- Instrumentation and Control

3.5.1.2 Septage Dump Station

The Septage Dump Station was originally designed with multiple dump tanks where septage hauling trucks could discharge septage into these tanks and tests could be performed on the septage to determine the septage composition. The dump tanks are pitched the wrong way, so the dump tanks do not drain properly and consequently the dump tanks are no longer in use. Instead the septage is dumped into a wet well. Two Essco cyclone feed pumps pump the septage from the wet well to a grit separation unit. Two cyclones degrit the septage and send the liquid to an equalization basin. The grit is discharged to a dumpster. A mixer is used in the equalization basin to keep the septage from settling. Two Essco Degritted Septage Pumps are supposed to send the septage from the equalization basin to the front of the plant, but rags, greases, and other material continuously clog the equalization basin. Consequently once per month plant staff are required to enter the wet well and equalization basin and clean them out.

As stated above the Septage Dump Station does not work as originally designed. Therefore. consideration should be given to having the septage trucks dump into the influent stream upstream of the Headworks, rather than continuing to discharge into the Septage Dump Station. This would mean that the septage no longer needs to be degritted and pumped to the Headworks and that a crew of plant personnel would not have to monthly declog the wet well and equalization basin which would reduce maintenance. Furthermore, this would remove a source of odors identified at the facilities.

3.5.1.3 Headworks Facilities

Influent flows are split and conveyed through three Parkson Aquaguard influent climber screens. The influent screens discharge onto a belt conveyor that has manually adjustable plows that can send the screenings to one of two new JWC Washmonster washer/compactors. The screenings may bypass the compactors and travel straight to a dump body truck for landfill disposal. The screened wastewater flows to two Smith and Loveless Pista Grit Tanks. Grit is pumped to two cyclone grit separators where the grit is taken by two grit classifying screw conveyors. The grit is then discharged onto the screenings belt conveyor where the grit and screenings are then dumped into a dump body truck for landfill disposal. The screened and degritted wastewater then flows to a set of three parshall flumes. Parshall flumes No. 1 and No. 2 meter the influent flow to yard structure No. 1 and the primary clarifiers. Parshall flume No. 3 is provided for future flow to Ina Road WRF through the future plant interconnect and is not currently in service. The influent channels, screens, grit tanks, flow channels, and Parshall flumes are all totally enclosed with removable solid cover plates for odor control and will be discussed in greater detail later in

this chapter. Rodney Hunt sluice gates are used to isolate screens, grit tanks, parshall flumes, and flow to the primary clarifiers.

Plant personnel have indicated that the influent screens have worked very well since they were installed approximately 10 years ago. The screenings compactors, the cyclone grit separators, and the grit classifying screw conveyors were replaced in early 2007.

3.5.1.4 Primary Clarifiers

Rectangular Primary Clarifiers No. 1 though 4, which were constructed as part of the original plant, have been converted to emergency overflow basins. Normally the overflow basins are empty, but they are placed into service during July-August monsoon season when peak flows exceed the pumping capacity of pump station #4.

Primary Clarifiers No. 5 through 10 are 105-feet diameter circular clarifiers. Primary Clarifiers No. 5, No. 6, No. 7, and No. 8 are fed from yard structure No. 1 and Primary Clarifiers No. 9 and No. 10 are fed from the common influent channel downstream of the Headworks Parshall flumes. Pump Station No. 5 contains three Moyno Primary Sludge Pumps (PSPs) and one Dewatering Pump (DWP). Two PSPs pump sludge from Primary Clarifier No. 7 and No. 8 to the Biofilters and one PSP pumps scum from Primary Clarifier No. 7 and No. 8 to the Digesters. The Dewatering Pump is used to dewater Primary Clarifiers No. 7 and No. 8. Pump Station No. 3 contains three PSPs and one DWP that pumps from Primary Clarifiers No. 5 and 6 similar to Pump Station No. 5. Pump Station No. 14 contains seven Seepex PSPs. Five PSPs pump primary sludge from Primary Clarifiers No. 1, No. 2, No. 3, No. 4, No. 9, and No. 10 to the Digesters or the Gravity Thickeners. Two PSPs pump scum from Primary Clarifiers No. 1, No. 2, No. 3, No. 4, No. 9, and No. 10 to the Digesters. Due to a lack of motorized gates and flow meters, influent flow is visually split between the primary clarifiers. Primary Clarifiers No. 5 and No. 6 are deeper than the other primary clarifiers and consequently have a higher solids loading than the other clarifiers.

Hydraulically, the plant cannot take a primary clarifier out of service during the July and August period of high influent flows; therefore it is difficult to remove a clarifier from service for cleaning during this period. Plant personnel have noted that they are very pleased with the performance of all of the Moyno pumps. Noticeably absent were odor containment features on the primary clarifiers.

3.5.1.5 Bio Recirculation Building (Pump Station No. 4) and Biofilters

Primary effluent flows from the primary clarifiers to a wet well at the Bio Recirculation Building. The Bio Recirculation Building contains four Fairbanks Morse pumps, three of which are gas engine driven pumps (~25 mgd each) and one is a 350 hp motor driven pump (~33 mgd). The engine driven pumps can be run on either digester gas or natural gas. There are no scrubbers on the digester gas lines, so a “dirty” digester gas is used, which contributes to higher than normal maintenance for the engines. Additionally, concentrations of siloxanes in the sludge gas have recently increased and have become a problem at Roger Road WRF causing additional wear and tear on engines and other equipment that use digester gas. Consequently, the engines have not been operated on digester gas for nearly a year and operate on natural gas only. Plant personnel indicated that there is significantly less maintenance on the engines when they are fueled with natural gas rather than digester gas because the natural gas is cleaner than the digester gas.

Like most other facilities at Roger Road WRF, equipment at the Bio Recirculation Building is operated manually. The engine driven pumps are manually operated. Speed is adjusted manually to maintain the wet well level in an acceptable range. One engine driven pump is generally run until the engine reaches 900 revolutions per minute (rpm). Once the engine gets to 900 rpm a second engine driven pump is turned on. This occurs at approximately 32 mgd. The two engine drive pumps are then manually throttled to balance the flow. The motor driven pump is used for emergency backup or when plant flow gets above 55 mgd.

Originally, the control system modulated valve BF-7 which allowed return activated sludge (RAS) to flow back into the wet well to feed the biotowers. The Bio Recirculation pumps were to run at a constant speed and capacity while a bubbler system controlled the bleed-back of RAS through BF-7 into the wet well to satisfy the pumping rate and keep the wet well level in an acceptable range. This control is no longer used and as a result, the pump station must be operated manually with continual manual monitoring of the wet well level.

The discharge piping for the Bio Recirculation pumps does not contain any isolation valves to allow a pump to be taken out of service. The only valve separating a pump from the discharge header is the pump's power operated discharge valve. If that valve ever needed to be removed for service, the entire station would need to be shut down.

The pumps in the Bio Recirculation Building send flow to two Biofilters. Each Biofilter is 165 feet in diameter by 26 feet deep plastic media biofilters. At the top of the Biofilters a large rotary distributor arm sprays primary effluent over the plastic media in the biofilters.

The rotary distribution arms were replaced 5 or 6 years ago, and are reportedly in good operating condition. The media in the biofilters has not been changed since 1979. For the last two years plant operations have sent the biofilter effluent to the aeration tanks before the final clarifiers for additional treatment.

Pump Station No. 7 is located between the two biofilters and contains three ITT A-C WAS Pumps. Typically WAS Pump No. 3, which has a variable frequency drive (VFD), is used to pump WAS. If Pump No. 3 is out of service, then both constant speed Pumps No. 1 and No. 2 are used together to pump WAS. WAS is currently sent to the Ashbrook three meter gravity belt thickener .

3.5.1.6 Aeration Basins

There are two sets of Aeration Basins; the South Aeration Basins (Aeration Basins No. 1 and No. 2) and the North Aeration Basins (Aeration Basins No. 3, No. 4, No 5, and No. 6). The South Aeration Basins are single pass plug flow basins that were part of the original plant construction. The North Aeration Basins are dual pass plug flow basins; which have the capabilities of being run as step feed basins. Both the North and South Aeration Basins have inefficient coarse air diffusers. The Aeration Blowers are located in the Blower Building to the east of the North Aeration Basins. Three Turblex engine driven blowers are used to provide air to the aeration basins. The blowers are capable of being driven by digester gas or natural gas. Similar to the engines in the Bio Recirculation Building the blower engines are run on natural gas because of higher maintenance when run on digester gas.

Blowers are manually controlled by throttling the inlet guide vanes with the blowers operated at a constant 1,200 rpm. Of the available isolation valves on the main air header in the blower building, only one is reportedly operable. This limits which blowers can serve which aeration basins.

The air flow meters inside the Blower Building show 7,600 standard cubic feet per minute (scfm) of air being sent to the two South Aeration Basins and 3,250 scfm being sent to the four North Aeration Basins. There is only one operable isolation valve on the main air header in the building able to separate flow to the two aeration batteries.

Noticeably, there is a lack of overhead conveyance equipment and the doorways are inadequate for servicing the engine driven blowers and the engines.

The blowers are scheduled to be replaced with two new skid mounted blowers in 2007/2008. The existing blowers will remain as backups in case service from the new blowers is interrupted.

3.5.1.7 Final Clarifiers

There are nine 105 feet diameter Final Clarifiers each with two rake arms. Flow from the South Aeration Basins is sent to Final Clarifiers No. 1 and No. 2. Flow from the North Aeration Basins are sent to flow splitting structures that distribute flow to Final Clarifiers No. 3, No. 4, No. 5, No. 6, No. 7, No. 8, and No. 9. The splitting structures have downward operating gates that act as weirs to distribute flow to the various final clarifiers. Final Clarifiers No. 1, No. 2, No. 3, and No. 4 have a single exterior weir, while the newer Final Clarifiers No. 5, No. 6, No. 7, No. 8, and No. 9 have a double exterior weir. Pump Stations No. 6, No. 8, No. 9, No. 10, and No. 12 contain Fairbanks Morse, Pacific Pumping Co., and Allis-Chalmers return sludge pumps and Netzsch and Moyno scum pumps. Final Clarifiers No. 1, No. 2, No. 3, No. 4, No. 5, and No. 6 each have four floc mixers that can be used for polymer addition; however these have not been used for some time.

Plant personnel noted that the rake arm catches on welds on the weirs for Final Clarifiers No. 8 and No. 9. A temporary patch has been put on the welds, so the rake arms no longer catch on the welds. Similar to the primary clarifiers, hydraulically the final clarifiers can not be taken out of service.

There appears to be an unnecessary flow split structure for Clarifiers No. 1 and 2. It's similar to all the other splitters except the flow re-combines directly downstream from the two splitter gates and flows through a common conduit to yet another splitter structure between the tanks where the actual flow split occurs.

3.5.1.8 Chlorination/Dechlorination Facilities

The Roger Road WRF originally used gaseous chlorine to disinfect its effluent; however, a few years ago it was decided to switch to liquid sodium hypochlorite for disinfection and to use liquid sodium bisulfite for chlorine neutralization to meet chlorine residual discharge limits. Presently two temporary sodium hypochlorite storage tanks are located adjacent to the influent of the Chlorine Contact Tank in a temporary earthen berm in case of a leak. Roger Road WRF has two permanent sodium hypochlorite tanks on site that will be installed within a concrete containment area in the near future. The temporary sodium hypochlorite tanks will then be removed once the permanent tanks are in place.

Two U.S. Filter Water Champs are used in the Chlorine Contact Tank common influent channel to deliver the sodium hypochlorite to the liquid stream. The feed rate of hypochlorite to the Water Champs is controlled by two U.S. Filter liquid chemical feeders located in a chemical feed structure adjacent to the contact tanks. Feed rate is controlled to maintain a chlorine residual as discussed later under Instrumentation and Control. Two sample pumps send samples to analyzers located in the adjacent Chlorine Feed and Storage Building, previously used for gaseous chlorine.

The contact tank influent channel distributes flow to a North and South Chlorine Contact Tank each of which is comprised of two halves. The interior dividing walls of the Chlorine Contact Tanks are made of masonry block.

Effluent is extracted from the contact tanks with pumps prior to de-chlorination for use by Tucson Water in its reclaimed water system. The extracted effluent is transported to the nearby water reclamation facility where the effluent is filtered, disinfected and pumped into the reclaimed water distribution system, or is directed into soil aquifer treatment basins for underground storage, later recovery and use.

Adjacent to the Chlorine Contact Tank is a bulk sodium bisulfite storage tank that is enclosed with a concrete containment wall. The sodium bisulfite bulk storage tank is pumped into a sodium bisulfite day tank also within a concrete containment wall near the effluent end of the contact tanks. Two U.S. Filter Water Champs feed sodium bisulfite from the day tank into the effluent channel for chlorine neutralization. Chemical feeders, similar to those used for hypochlorite feed, are located in a chemical feed structure adjacent to the bisulfite day tank. These meter sodium bisulfite to the Water Champs in response to an effluent oxidation reduction potential (ORP) signal.

The effluent channel then discharges by gravity to the Santa Cruz River. In the event that the river is flowing high there are three Fairbanks Morse Effluent Pumps to pump the effluent to the river. Since the Effluent Pumps are not required very often, flap gates for each pump have a tendency to seal shut from nonuse. Consequently, when the pumps are operated, if the flap gates are not freed, they pump against these sealed gates and motor damage has occurred. The plant personnel indicated that it is planned to routinely operate the pumps and gates so that the gates will not seal shut.

3.5.1.9 Gravity/GBT Thickeners

Roger Road WRF has three covered circular Gravity Thickeners. Gravity Thickeners No. 1 and No. 2 have three Moyno Thickened Sludge Pumps and two Muffin Monster grinders on the scum lines. Gravity Thickener No. 3 has three Moyno Thickened Sludge Pumps and one Muffin Monster grinder on the scum line. The pumps are all located outdoors on a concrete slab exposed to the elements.

Emergency concrete repair work was performed on Gravity Thickeners No. 1 and No. 2 a few years ago. It was deemed at that time that the concrete had deteriorated to a point that the Gravity Thickeners were in imminent danger of collapsing. The existing three (3) gravity thickeners have been repaired and are in satisfactory condition for continued operation. Plant staff advised that the pumps and grinders are in good operating condition. The Gravity Thickening Tank Mixers could be susceptible to corrosion in the enclosed environment.

Adjacent to the Gravity Thickening Tanks is the Flotation Thickening Building. Two Komline Sanderson DAF Thickeners are located in this building. The DAF units have not been operated in a couple of years. The DAF units have some broken parts that can no longer be ordered from the manufacturer. The DAF units could be operated, but plant staff have advised that the DAF units require continuous monitoring and adjustments which is very labor intensive.

One (1) new three meter Ashbrook GBT has been added to the sludge thickening operations with startup in 2007. The GBT unit and associated pumping systems and piping are located outside on a concrete pad.

3.5.1.10 Digesters

There are six anaerobic digesters (four primary digesters and two secondary digesters). Digested sludge is pumped to Ina Road WRF for dewatering and disposal. Until recently the digesters could not be taken out of service due to hydraulic limitations until the GBT was placed into service. Prior to this the digesters had not been emptied and cleaned in approximately 20 years. There may be significant solids deposition within the digesters, effectively reducing the tank volume and hydraulic detention time. Each digester has its own associated waste gas burner. The engine generators in the On Site Power Generation Facility are the only equipment currently running on sludge gas. Since the engine driven pumps and blowers are not using digester gas, a significant amount of the gas is being flared. Since the onsite assessment PCRWRD modified their operating procedures to utilize more gas onsite. The waste gas burners all have a white ring around the top of the burners, which is indicative of siloxanes being present in the gas.

Digesters No. 1, No. 2, No. 3, No. 4, and No. 5 have roof mounted mixers. Digester No. 6 has external draft tube mixers for mixing. There are four Control Houses adjacent to the digesters that contain the heat exchangers, sludge gas equipment, and sludge pumps for all the digesters.

Digesters No. 1, No. 2, No. 4, No. 5, and No. 6 show signs of shrinkage cracks in the concrete structure. Also, Digester No. 3 has a gas leak on the top of the tank. When standing on the digester roof, gas could be heard hissing through the cracks. This could potentially be a dangerous location with the digester gas capable of being igniting or causing an explosion. This situation was promptly addressed by PCRWRD after the onsite assessment. Since the digesters haven't been emptied in 20 years, no one is certain of the condition of the inside of the tanks.

The Gravity Belt Thickener (GBT) for thickening Waste Activated Sludge (WAS) will permit primary and WAS sludges to be thickened separately. This process change is expected to increase the overall sludge concentration to the digesters so that a digester may be drained, cleaned and inspected. The external draft tube mixers in Digester No. 6 plug frequently with solids. The external draft tube mixers require excessive maintenance to keep unplugging and repairing the mixers. The heat exchangers, gas equipment, and pumps appear to be in fair to good operating condition, based on visual inspection. Plant personnel advised of no problems other than routine maintenance.

3.5.1.11 Odor Control

The Roger Road WRF has a history of odor complaints from the surrounding community. Odors appear to be released most noticeably from the sewage at the headworks, primary clarifiers, biotowers and sludge

thickening facilities. An odor control program confirmed these sites as primary contributors to offsite odors.. The System-Wide Odor Control Plan gave a more comprehensive look where nuisance odors are generated and what type additional odor control is required.

3.5.1.11.1 Septage Dump Station

A small chemical scrubber is located next to the equalization basin and draws air off of the equalization basin, pump room, and grit cyclone room for treatment; however, with the clogging problems, odors are noticeable in the pump room and around the Septage Dump Station. Additionally, the grit cyclones discharge grit to a dumpster that is partially open to the atmosphere located outside the Septage Dump Station. Relocating septage dumping would remove a source of nuisance odors.

3.5.1.11.2 Headworks

The influent channels, screens, grit tanks, and Parshall flumes are all totally enclosed with removable solid cover plates. Air is drawn off near the Parshall flumes and the influent channel and sent to three Envirogen biofilters. Neither the belt conveyor nor the screenings and grit dumpster are covered or treated, so there are fugitive nuisance odors around these areas. An enclosure and odor treatment was provided at these in accordance with the recommendations of the System-Wide Odor Control Plan.

3.5.1.11.3 Primary Clarifiers

The six (6) operating 105 feet in diameter primary clarifiers are uncovered and open to the atmosphere. Under certain localized climatic conditions these tanks are a considerable contributor to offsite odors. In 2007 the primary clarifiers were fitted with high density polyethylene covers and an odor treatment system to capture and treat the odors emanating from the tank surface.

3.5.1.11.4 Biotowers

The biotowers are another contributor to offsite odors under certain localized climatic conditions. The biotowers are 265 feet in diameter and approximately 30 above grade. The biotowers have an open top and a series of vent ports near grade. Noticeable odors have been detected at each of these locations. PCRWRD has a plan in place to capture the odors emanating from the biotowers and treat the odors..

3.5.1.11.5 Gravity Thickeners

Gravity Thickeners No. 1 and No. 2 are each covered with a concrete cover to contain odors. Gravity Thickeners No. 1 and No. 2 each have three odor draw off points above the overflow troughs from which air is drawn to a Rosswood wet scrubber. Each tank has its own fan that discharges into a common duct to the scrubber inlet.

It was noted during the onsite assessment that the supply air to the gravity thickeners was around the perimeter of the tanks. It would be desirable to have fresh supply air introduced over the walkway where plant personnel must have access to the center drive mechanism for operations and maintenance duties.

Gravity Thickener No. 3 has a similar arrangement as Gravity Thickeners No. 1 and No. 2. A single fan draws air off of the tank above the overflow troughs at three locations and blows the air to a Paramount Fabrications packed tower scrubber. The scrubber is approximately 10 years old. The unit appears to be sized to treat air from a future gravity thickener, so is oversized for treating just Gravity Thickener No. 3. The cover on Gravity Thickener No. 3 is an aluminum dome, so the supply air handler is located on the ground adjacent to the thickener, unlike Gravity Thickeners No. 1 and No. 2 which have roof mounted units. A chemical building adjacent to Gravity Thickener No. 3 contains a Milton Roy Sodium Hypochlorite Metering Pump that pumps sodium hypochlorite from a drum to the odor unit for Gravity Thickener No. 3. At the time of the visit, there was no caustic being pumped to the odor control unit. This has since been corrected.

3.5.1.12 Electrical

The Roger Road WRF power distribution system consists of many electrical elements which contribute to the distribution of power on the plant site. The incoming utility electric service is provided at 2400 volts, 3-phase, 3-wire, delta ungrounded from Tucson Electric Power (TEP). The plant power generation system consists of three 400 kilowatt (kW) sludge gas fired engine generators, producing power at 480 volts, 3-phase, 3-wire delta ungrounded. The on-site generated power is distributed on site via underground duct banks to several motor control centers (MCC). The TEP 2400-volt power is distributed onsite via underground duct banks to seven Power Center transformers which step the power down to 480 volts, 3-phase, 3-wire delta ungrounded and 480/277 volts, 3-phase, 4-wire. Five of the transformers are delta-delta connected and two are delta-wye connected. The Power Center transformers are substation type with some having additional primary distribution sections and most having secondary power distribution panels or secondary breakers. The secondary power distribution panels or secondary breakers provide utility power to motor control centers and other utilization equipment. Some motor control centers are sub-fed from other motor control centers. The majority of the motor control centers are arranged with dual feed main breakers with key interlocks; one source being utility power and the other on-site generated power. The power distribution system has been expanded and upgraded over the course of the last forty years due to plant upgrades and systems improvements. Assessments of the power distribution systems major components as observed on site are provided below.

3.5.1.12.1 2400-Volt Plant Switchgear

A bank of three 500-kilo-volt ampere (kVA) pole mounted TEP transformers connected 13.8 kilovolt (kV)-2400 volts (V) provide 2400 volts, 3-phase, 3-wire, delta ungrounded overhead power to the 2400V Plant Switchgear. The switchgear is configured in a hot sequence arrangement with six fusible switch/contactor feeder units which distribute power throughout the site. The line-up initially consisted of three units installed in 1963 and expanded to six units in 1979. The six units were refurbished by an off-site service contractor approximately 3 years ago. The condition of the equipment is considered acceptable as the equipment has been maintained.

3.5.1.12.2 Power Center Transformers

There are seven power centers located across the plant site which distribute 480-volt power from their secondaries to motor control centers and other utilizing equipment.

Power Center No. 1 is located near the Flotation Thickener Building and is rated 500 kVA, 2300 – 480V, 3-phase, connected delta/delta with a 65 degrees C temperature rise. The primary section consists of a non walk-in aisle outdoor switchgear line-up with a main fusible switch, a fusible switch serving Power Center No. 1 and a fusible switch serving Power Center No. 4. The secondary compartment has a molded case circuit breaker. Data from plant records indicates the line-up to be 1955 vintage General Electric equipment. The primary switchgear doors were difficult to open and need to be lubricated. The mechanical condition of the fusible switch units were not assessed as the equipment was energized.

Power Center No. 2 is located near the Blower Building and is rated 500 kVA, 2300 – 480V, 3-phase, connected delta/delta with a 65 degrees Celsius temperature rise. The primary section is configured similar to Power Center No. 1. with a main fusible switch, a fusible switch serving Power Center No. 2 and space for another fusible switch. The secondary compartment had no visible overcurrent device visible. Data from plant records indicate the line-up to be 1965 vintage General Electric equipment. The mechanical condition of the fusible switch units was not assessed as the equipment was energized.

Power Center No. 3 is located near Pump Station No. 3 and is rated 500 kVA, 2300 – 480V, 3-phase, connected delta/delta with a 65 degrees Celsius temperature rise. There is no overcurrent protection or disconnecting means on the primary compartment. The secondary compartment has a distribution panel with molded case circuit breakers consisting of a main breaker and four feeder breakers. Data from plant records indicates the line-up to be 1945 vintage General Electric equipment.

Power Center No. 4 is located adjacent to Power Center No. 1 and is rated 750 kVA, 2300 – 480V, 3-phase, connected delta/wye with a 55 degrees Celsius temperature rise and provisions for future fan cooling. There is no overcurrent protection or disconnecting means on the primary compartment. The secondary compartment has a distribution panel with molded case circuit breakers consisting of a main breaker and three feeder breakers. Data from plant records indicate the line-up to be 1993 vintage General Electric equipment.

Power Center A is located near the Administration Building and is rated 500 kVA, 2300 – 480V, 3-phase, connected delta/delta with a 65 degrees Celsius temperature rise. There is no overcurrent protection or disconnecting means on the primary compartment. The secondary compartment has a molded case circuit breaker. Data from plant records indicate the line-up to be 1965 vintage General Electric equipment.

Power Center B is located near Pump Station No. 7 at the Bio Towers and is rated 750 kVA, 2300 – 480V, 3-phase, connected delta/wye with a 65 degrees Celsius temperature rise and provisions for future fan cooling. There is no overcurrent protection or disconnecting means on the primary compartment. Data from plant records indicate the line-up to be 1995 vintage General Electric equipment.

Power Center C is located near the Process Water Pump Station in the vicinity of the Chlorine Facility and is rated 500 kVA, 2300 – 480V, 3-phase, connected delta/delta with a 55/65 degrees Celsius temperature rise. There is no overcurrent protection or disconnecting means on the primary compartment. The secondary compartment has a distribution panel with molded case circuit breakers consisting of three feeder breakers. Surface corrosion was visible on parts of the assembly. Data from plant records indicate

the line-up to be 1979 vintage General Electric equipment. In general all power centers exterior finishes are faded and chalky due the heat and environmental conditions. Where enclosure ground connections were visible, cables were black, likely due to the present of H_2S corrosion. Aside from the deficiencies noted, all of the power centers were functional and no major malfunctions were noted.

3.5.1.12.3 On Site Power Generation Facilities

The engine generators and associated equipment are located in the Mechanical Building. The generators consists of three natural /methane gas dual fuel engine driven generators with each rated 400 kW at 480 volts, 3-phase, 3-wire delta ungrounded. Engine Generators EG-1 and 2 are 1982 vintage Waukesha units with 12 cylinder engines operating at 900 RPM. Engine Generator EG-3 is a 1995 vintage Waukesha unit with a 6 cylinder engine operating at 900 RPM. Each generator is connected to a Generator Distribution Center (GDC) identified as GDC No. 1, 2 and 3. The Generator Distribution Centers are interconnected with electrical operated tie circuit breakers. If generator sets are to be paralleled, this is accomplished with the use of a synchronizing scope and manual breaker control switches. It appears that the generators are normally operated isolated from each other. Physical space is provided for a fourth future generator. GDC No. 1, 2 and 3 are located in the same room as the generators. GDC No. 1, 2 and 3 distribute 480 volts, 3-phase, 3-wire delta ungrounded power to the plant motor control centers. GDC No. 1 is a 1982 vintage switchboard. GDC No. 2 and 3 is a continuous line-up of 1998 vintage switchboard. Though not confirmed, record drawings indicate that EG-1 and EG-2 may both have initially been connected to GDC No. 1 and perhaps split during the 1998 upgrade with EG-3. Main breakers for each of the generators are aligned in a continuous arrangement between GDC No. 1 and 2. Condition of the GDCs, generator main breakers and paralleling equipment shows average wear. Exteriors are dirty due to the environment in which they are located. Maintenance personnel advised that the overhead bus tie to GDC No. 1 from the associated generator main breaker has had a continuing problem with a loose connection as noted by a thermal graphically survey Aside from a loose connection, the equipment has functioned satisfactorily.

3.5.1.12.4 Motor Control Centers

There are two styles of motor control centers used throughout the plant and are located adjacent to and within the process structures. Outdoor motor control centers are provided in National Electrical Manufacturer's Association (NEMA) 3R enclosures with front access weatherproof doors. Doors are provided with filters in the ventilation slots to prevent the infiltration of dirt. Some enclosures have roof top mounted exhaust fans that are thermostatically controlled and others are not ventilated. Due to their physical location, most are dirty on the exterior.

The majority of all motor control centers are configured with two main breakers; one from the utility source and the other from the generator source. The breakers are key interlocked so that only one breaker can be closed at a time. The two equipment design vintages for all of the motor control centers on site are General Electric 7700 Line and General Electric 8000 Line. Some are provided with or retrofitted with transient voltage surge suppression (TVSS) and others have no protection. Protection has been provided in line-ups where loads served include sensitive or electronic equipment. MCC CA is an outdoor line-up located at the Effluent Pump Station. The line-up consists of early vintage variable frequency drives which no longer function satisfactorily. The line-up and associated Effluent Pumps are currently scheduled for replacement. MCC 2B is located at the Chlorine Feed and Storage Building. The line-up is NEMA 1 construction located outdoors in a covered area. As the associated building is not in service and

the remaining electrical load is minimal, replacement is not imperative at this time. **Table 3-2** provides a list of each motor control center.

3.5.1.12.5 Plant Grounding System

Plant maintenance personnel confirmed that there are problems with the existing plant grounding system. The system has been professionally examined and tested in the past with the results on file in the plant's maintenance library. This is an ongoing issue which will be addressed in forthcoming service upgrade alternatives being presented by another consultant under a separate contract agreement.

3.5.1.12.6 Electrical Feeders

There are no records to indicate that the medium voltage feeders have been tested since their original installation. Plant maintenance personnel did not indicate there being any feeder problems on the 2400 volt (V) system. Insulation resistance tests were performed in 2003 on the motor control center feeders by Electro Test an independent testing service. The results were published in Technical Memorandum 1 dated July 2003 by Kennedy/Jenks Consultants. The results of the tests recommended replacement of B and C phase feeder cables to MCC-C and B phase feeder cable to MCC-BC. It was not determined if these feeders had been replaced.

Table 3-2
Pima County Roger Road WRF – Motor Control Centers Assessment

EQUIPMENT TAG	LOCATION	MANUFACTURER	VOLTAGE	TYPE	BUS AMPS	YEAR BUILT	MAIN CIRCUIT BREAKER
MCC-1	FLOTATION THICKENER BUILDING (INDOOR)	GE 7700	480 V	3PH, 3W	600 A	1955	600 A
MCC-1B	DIGESTER NO. 3 (OUTDOOR)	GE 8000	480 V	3PH, 3W	600 A	1982	300 A
MCC-1C	PUMP STATION 1 (OUTDOOR)	GE 8000	480 V	3PH, 3W	600 A	2000	100 A
MCC-2	BLOWER BUILDING (INDOOR)	GE 8000	480 V	3PH, 3W	600 A	1995	600 A
MCC-2A	HEADWORKS (INDOOR)	GE 8000	480 V	3PH, 3W	600 A	1989	250 A
MCC-2B	CHLORINE BUILDING (OUTDOOR COVERED)	GE 7700	480 V	3PH, 3W	600 A	1982	150 A
MCC-2BE	CHLORINE BUILDING (OUTDOOR COVERED)	GE 8000	480 V	3PH, 3W	600 A	1995	
MCC-2C	PUMP STATION 9 (OUTDOOR)	GE 7700	480 V	3PH, 3W	600 A	1965	200 A
MCC-2D	PUMP STATION 12 (OUTDOOR)	GE 8000	480 V	3PH, 3W	600 A	1995	200 A
MCC-3A	PUMP STATION 2 (OUTDOOR)	GE 8000	480 V	3PH, 3W	600 A	2002	100 A
MCC-3B	PUMP STATION 8 (OUTDOOR)	GE 7700	480 V	3PH, 3W	600 A	1982	200 A
MCC-3C	MECHANICAL BUILDING (INDOOR)	GE 7700	480 V	3PH, 3W	600 A	1982	200 A
MCC-3D	PUMP STATION 10 (OUTDOOR)	GE 7700	480 V	3PH, 3W	600 A	1982	200 A
MCC-3E	GRAVITY THICKENER NO. 3 (OUTDOOR)	GE 8000	480 V	3PH, 3W	600 A	1995	200 A
MCC-4A	DIGESTER NO. 5 (INDOOR)	GE 8000	480 V	3PH, 3W	600 A	1982	200 A
MCC-4B	DIGESTER NO. 6 (INDOOR)	GE 8000	480 V	3PH, 3W	600 A	1995	200 A
MCC-AA	ADMINISTRATION BUILDING (OUTDOOR)	GE 8000	480 V	3PH, 3W	600 A	1996	200 A
MCC-AB	PUMP STATION 14 (OUTDOOR)	GE 8000	480 V	3PH, 3W	600 A	1999	200 A
MCC-BC	PUMP STATION 4 (INDOOR)	GE 7700	480 V	3PH, 3W	600 A	1982	200 A
MCC-BF	PUMP STATION 7 (OUTDOOR)	GE 7700	480 V	3PH, 3W	600 A	1982	100 A
MCC-BG	DIGESTER NOS. 1 AND 2 (INDOOR)	GE 7700	480 V	3PH, 3W	600 A	1982	250 A
BRP-4BR (MCC-BH)	PUMP STATION 4 (INDOOR)	GE 8000	480 V	3PH, 3W	600 A	1993	800 A
MCC-C	PROCESS WATER PUMP STATION (OUTDOOR)	GE 7700	480 V	3PH, 3W	600 A	1982	600 A
MCC-CA	EFFLUENT PUMP STATION (OUTDOOR)	GE 7700	480 V	3PH, 3W	600 A	1982	400 A
MCC-CB	DECHLORINATION BUILDING (INDOOR)	GE 8000	480 V	3PH, 3W	600 A	1995	200 A
MCC-CBE	DECHLORINATION BUILDING (INDOOR)	GE 8000	480 V	3PH, 3W	600 A	1995	

3.5.1.12.7 Comments on Electrical System

There are numerous upgrade projects in the planning, design and implementation stages which may impact the existing electrical distribution system. The impact of the upgrades has not been factored in the evaluation of the existing equipment. The issues discussed herein before relate only to the condition assessment of the equipment as installed at the time of the onsite assessment. All electrical distribution equipment is thermal graphically inspected annually and problems corrected upon completion of the inspections. There is some electrical equipment which is probably more susceptible to problems or possible failure due to its age, but at present is functioning satisfactorily. Equipment falling into this category would be the 2400V Plant Switchgear, 7700 Line motor control centers and older 480V feeders. It is suggested that this equipment be considered for systematic replacement if the existing system is to remain viable. Also, a short circuit and coordination study is suggested as numerous electrical changes have been made over the years and the study would be beneficial in identifying problem areas in the plant electrical distribution system.

PCRWRD undertook an extensive evaluation of the electric system at Roger Road WRF in 2006 to address short and long term power issues. Numerous actions resulted from the evaluation. However, considering the long term fate of the existing electrical system at Roger Road WRF, PCRWRD was able to consider interim power/electrical measures in several areas and was able to save $6 million dollars in capital construction that would have not have had value in the future facilities. The interim electrical measures will provide adequate service over the life of the facility.

3.5.1.13 Instrumentation and Control

The process instrumentation at Roger Road WRF consists mainly of open channel flow meters, sludge flow meters, tank level transmitters, digester gas and air flow meters and chlorine residual and ORP instruments for disinfection. Most instruments are operational. The instruments are discussed below in their respective process areas.

3.5.1.13.1 SCADA System

The plant has a rudimentary SCADA backbone that is fully functional but is under-utilized. The backbone consists of a fiber optic trunk network that runs throughout the plant and connects a number of Allen-Bradley PLCs using a DH-Plus™ network protocol. The fiber optic PLC network interconnects the following facilities:

- Chlorination Facility
- Dechlorination Facility
- Digesters
- Generator (Maintenance) Facility
- Biotowers (Pump Station No. 4)
- Blower Building
- Headworks
- Administration Building

The entire plant has less than 600 monitored and computed parameters, many (~120) of which are from the abandoned chlorination and dechlorination facilities. The SCADA system has two computer workstations at the Administration Building running Rockwell RS-View™ HMI software that the operators use primarily to monitor real-time trends of various analog inputs and also equipment and process alarms using process graphic displays. The system is fully functional.

There is virtually no information monitored regarding equipment running status or the positions of the various valves and gates. While the PLCs have the capability of being programmed for remote control, that capability has not been implemented. There is presently no ability to remotely start or stop any equipment using the SCADA system. There is some automatic control being performed locally, but for the most part, the plant is operated completely manually.

In summary, there is a sound hardware foundation and network backbone to the SCADA system that has not been adequately developed to provide a useful real-time aid to Operations personnel. What was installed is adequate for as far as the system was developed. But the overall system is in need of a significant upgrade to fully utilize the system's capabilities. At the very least, the addition of remote control of equipment would serve the operations personnel well after a power interruptions by eliminating the need to go all over the plant to restart equipment.

3.5.1.13.2 Headworks

There are three Parshall flumes that measure the plant influent downstream from the screens and grit tanks. Two of the flumes are active and operate as parallel meters to measure influent flow. Flow is combined immediately downstream of the flumes and sent to the primary clarifiers. The third flume is provided to measure to the flow into the future plant interconnect with Ina Road WRF. That flume is not in use. The two active flumes are equipped with ultrasonic level transmitters which compute flow through each flume.

3.5.1.13.3 Primary Clarifiers

The only instrumentation associated with the clarifiers is the flow meters on the sludge lines to the gravity thickeners. Although some of the meters are quite old, they appear to be in good working condition and are installed properly with respect to upstream and downstream piping runs.

Scum pumps are manually controlled locally and scum discharge lines to the digesters are not metered.

Primary sludge pumps are controlled locally based on time cycles.

- Primary tanks Nos. 1-4, 9 and 10 are on a repeating cycle of 7 minutes running, 3 minutes off.
- Primary tanks Nos. 5-8 are on a repeating cycle of 9 minutes running, 1 minute off.

3.5.1.13.4 Biotowers and Biotower Pump Station

The biotower feed pumps all discharge into a common header which feeds the biotowers in two directions. Although there is manually operated butterfly valve at the feed point to each biotower, there is no way to determine the flow split to each tower. As a result, Operations personnel report having

observed instances where the biotower distribution arms were not moving in one of the biotowers at low flows. Because of piping arrangement, flowmeters would have to be added to the underground piping to measure the flow split, which could then be controlled by the manual butterfly valves.
The original control system which blended RAS back into the feed pump wet well based on wet well level is no longer in use. The original system was configured to run the pumps at a constant speed and maintain the wet well level by blending RAS back into the wet well to make up the difference between pumping rate and influent to the wet well from the primary tanks. This control system has been abandoned and the pumps are now manually adjusted in response to wet well level changes as measured by a pneumatic bubbler system. RAS is no longer returned to the biotowers.

The pump engines each have dedicated control panels with IDEC PLCs. Status and control signals are hardwired from each panel to a master panel (FID-BR) which contains an Allen-Bradley PLC acting as a data concentrator on the SCADA network. The system is operational and the bubbler system for the wet well is reportedly trouble-free.

3.5.1.13.5 Aeration Tanks

There is no way to measure or control the wastewater flow split to the various aeration tanks.

Aeration Tanks No. 1 and No. 2 have orifice plates installed to measure the flow of air to the diffusers. There is a flow control valve located only five feet upstream from each meter. This lack of sufficient straight upstream piping can distort the flow profile and makes the accuracy of these meters questionable. The orifice plates have no transmitters to allow remote monitoring of the flow. Instead, they have local differential pressure gauges calibrated to read in scfm. The gauges were pegged at maximum flow when observed. The indicators appear to be quite old.

Aeration Tanks Nos. 1 and 2 each have Hach LDO dissolved oxygen probes located at the end of each pass. These were newly installed meters. Each tank was reading between 3 and 3.3 mg/L dissolved oxygen (DO) when observed. These meters are state of the art and require significantly less maintenance than earlier generation DO meters.

Aeration Tanks Nos. 3 through 6 also have orifice plates installed to measure air flow to the diffusers. However, these meters have the proper unobstructed upstream piping runs. The flow control valves for these lines are located roughly four feet downstream from the meters. These meters also have no transmitters. They are equipped with old Foxboro differential pressure indicators. These flow meters should provide acceptable accuracy.

Aeration Tanks Nos. 3 through 6 also have newly installed Hach LDO dissolved oxygen meters. The probes are installed at the end of the second pass in each tank. The probe for Tank No. 3 was removed for repair during the onsite assessment. The remaining tanks had DO readings ranging from 2.41 to 3.05 mg/L when observed.

3.5.1.13.6 Blower Building

Each of the three engine driven blowers have a dedicated package control panel with an Allen-Bradley PLC. Blowers are controlled by modulating the inlet guide vanes with the engine driven blower running

at a constant speed. The blower panels are connected to the fiber optic SCADA network at master panel remote terminal unit (RTU)-BB which converts the copper interface signals from each panel's PLC to fiber optic signals.

The north and south air discharge headers from the blowers are isolated and separately metered. Air flow meters are thermal mass flow elements and are functioning properly and installed with the recommended straight upstream piping run. When observed, Blower 2 was serving the south feed to Aeration Tanks Nos. 1 and 2 and was reading 7,600 scfm. Blower 3 was serving the north feed to Aeration Tanks Nos. 3 through 6 and was reading 3,250 scfm.

3.5.1.13.7 Flow Split to Final Clarifiers

Each of the flow split structures have down-opening gates that act as flow control weirs. The gates are hand operated. With this arrangement there is no accurate way to control the flow split to the clarifiers. Plant I&C staff are in the process of equipping each gate mechanism with an ultrasonic level/flow transmitter to measure the flow over the movable control weir. This is considered to be a very good approach to achieving better flow distribution to the final clarifiers. Flow control weirs are not extremely accurate, however, as long as they are all configured the same way, they should be very repeatable. This approach should allow Operations personnel to more accurately control the hydraulic loading to the clarifiers.

Plant staff is also considering adding motor actuators to the weirs to be able to control the flow split in real-time.

3.5.1.13.8 Final Clarifier RAS and WAS Flow Metering

All return and waste activated sludge lines from the final clarifiers are well instrumented. All sludge lines are equipped with magnetic flowmeters. These meters all appear to be operating properly and are installed with the correct piping configuration upstream and downstream from the meter.

Scum pumps are manually controlled locally and scum discharge lines to the digesters are not metered.

3.5.1.13.9 Disinfection Facility

Disinfection is achieved by feeding sodium hypochlorite in response to chlorine residual at the contact tank. There are two U.S. Filter liquid chemical feeders located in the hypochlorite feed building that meter the hypochlorite under vacuum to the two U.S. Filter Water Champs in the common contact tank influent channel. A sample pump taking suction from the east contact basin a short distance downstream from the Water Champs conveys a sample to a chlorine residual analyzer in the old chlorination feed and storage building. When observed, this analyzer was reading 5.59 mg/L total chlorine. This was the analyzer being used to control the hypochlorite feed rate.

A second chlorine analyzer was assigned to monitor the residual of the process water which was pumped from the contact tanks effluent channel. This analyzer indicated 3.6 mg/L total chlorine when observed. The controls are configured with a selector switch to allow either of these two analyzers to control the hypochlorite chemical feeders.

Each contact tank has an ultrasonic level transmitter located in the first pass of the tank, well upstream from the effluent weirs, to compute flow. It is unclear why these transmitters were located so far away from the effluent weirs.

Dechlorination is achieved using a sodium bisulfite feed system which is identical to the hypochlorite liquid chemical feeders. The bisulfite feeders are located in a small dedicated structure adjacent to the day tank. Sodium bisulfite is fed to two Water Champs located just upstream from the two effluent Parshall flumes. Each flume has an ultrasonic level/flow transmitter. Chemical feeders are paced by the flume flow readings and control to an ORP probe reading immediately downstream from the flumes. There is an alternate ORP analyzer at the outfall sampler location which can also be used for control. The ORP transmitters are located in the old dechlorination feed facility. The flume outlet probe was reading 105-107 millivolts when observed. ORP control of dechlorination is becoming very common and is considered appropriate technology for accurate control.

3.5.1.13.10 Thickener Metering Building

Magnetic flowmeters are provided in the metering building for the measurement of makeup water, primary sludge and WAS to the gravity thickeners. All meters are functioning and installed properly.

3.5.1.13.11 Gravity Thickeners

Combustible gas detectors located inside the covered thickener reportedly foul rapidly due to sulfide contamination, requiring replacement every few months.

Thickener No 3 has two thickened sludge magnetic flowmeters, whereas Thickeners No. 1 and No. 2 have no thickened sludge metering.

3.5.1.13.12 Sludge Digesters

All digesters have thermal mass flowmeters which measure the flow of service gas and gas to the waste gas burners. These are appropriate meters for this application and functioning correctly.

Digesters No. 4 and No. 5 are secondary digesters and are equipped with liquid level transmitters and gas holder cover position transmitters. Although relatively old, these appear to be functioning properly.

3.5.1.13.13 Sludge Pumping Station

The sludge transfer pumps have a magnetic flowmeter to measure the flow of sludge transferred daily to the Ina Road WRF. This meter is installed in a pit and is functioning properly.

3.5.2 Ina Road WRF

3.5.2.1 System Description

The Ina Road WRF systems descriptions are organized into the following chapters:

- Emergency Overflow Basins
- Headworks
- High-Purity Oxygen Activated Sludge Process
  - Primary Clarifiers
  - Activated Sludge Reactors
  - Secondary Clarifiers
  - Sludge Thickeners
  - Chlorination Facilities
  - Digesters
  - Odor Control
- Biological Nutrient Removal Activated Sludge Process
  - Intermediate Pump Station
  - Primary Clarifiers
  - Anoxic/Aeration Basins
  - Secondary Clarifiers
  - Chlorination Facilities
  - Odor Control
- Centrifuge Building
- Covered Sludge Storage Basin
- Dechlorination
- Electrical
- Instrumentation and Control
- Laboratory Facilities

3.5.2.2 Emergency Overflow Basins

There are three concrete lined Emergency Overflow Basins at the Ina Road WRF. The three basins can hold approximately 19 million gallons of overflow. In case of an emergency, flow can be diverted from the Headworks to the overflow basins. Overflow Basin No. 1 will fill and then overflow a weir into Overflow Basin No. 2 which will fill and then overflow a weir into Overflow Basin No. 3. There is a drain that sends flow back from Basin No. 3 to Basin No. 2 then to Basin No. 1, which has a pump that pumps the overflow back to the Headworks. The Overflow Basins are used only a couple of times per year to hold overflow from the Headworks, usually during monsoon season.

In addition to holding plant overflow, the Emergency Overflow Basin No. 1 is used to store and dewater plant screenings that are too wet to be disposed of at a landfill, the contents of vactor trucks hauling from scum pits and sump pumps at the plant, and also the contents from vactor trucks that are cleaning out clogs in the collection system. From these sources grease, raw sludge, solids, and other highly odorous materials are dumped into the basins to dry. Once the materials have dried, front end loaders transfer the material to trucks which remove the material for landfill disposal. By doing this, the Emergency Overflow Basins have become a major source of offsite nuisance odors. There have been numerous odor complaints from patrons of a sports park that is located a couple of hundred feet from the basins. Since late 2006, some of the sports park complaints are attributed with the landfill operation adjacent to the Emergency Overflow Basins. Ina Road WRF personnel have begun a regiment of applying a sodium hypochlorite solution into the stored materials in the basins to curb odors.

3.5.2.3 Headworks

Influent flow is split through two U.S. Filter Rake Arm style Coarse Screens. There is room for a future third Coarse Screen. The Coarse Screens discharge onto a Serpentex style belt conveyor. The belt conveyor carries the coarse screenings to a coarse screenings hopper that stores the coarse screenings until disposal. When a disposal truck drives underneath the coarse screenings hopper a gate opens and the disposal truck is loaded for landfill. If the coarse screenings belt conveyor were to be out of service, plant personnel would use a bypass chute off the coarse screens into a manual dumpster.

The coarse screened wastewater is then pumped up approximately 20 feet in elevation by three Influent Screw Pumps capable of pumping 32 mgd each. There is room for a future fourth Influent Screw Pump. Usually one pump and sometime two pumps are running. The pumps are capable of running in Auto mode from SCADA but are generally run in local manual mode.

The pumped influent flows through three Parkson Aquaguard moving media Fine Screens. The Fine Screens discharge onto a belt conveyor which discharges onto a shorter reversible cross belt conveyor. If the fine screenings belt conveyor were to be out of service, plant personnel would use a bypass chute off the fine screens into a manual dumpster. One screen is always run continuously in Computer Manual mode. Manual operation does not interlock the screen with the conveyor. A second screen runs in Computer Auto mode (repeating timed cycle), which does interlock the screen with the conveyor. The screens are set to operate in this manner to prevent the conveyor, screenings washer/press and reversible cross conveyor from operating continuously when little amounts of screenings are being collected.

The reversible cross conveyor discharges the screenings into one of two Waterlink Hycor Screenings Washers. The Screenings Washers discharge the washed screenings into an associated Waterlink Hycor Screenings Press. The two Screenings Presses each discharge screenings into a fine screenings hopper. The fine screenings hopper works similar to the coarse screenings hopper.

The screened wastewater flows to three Aerated Grit tanks. The grit tanks have chain and flight collector mechanisms. Four blowers located in the blower room beneath the grit tanks are used to aerate the grit. Grit is then pumped by five Wemco Grit Pumps to three Wemco Hydrogritters Grit Washers where the grit is removed from the wastewater, washed and discharged to a grit hopper. The grit hopper is used in a similar capacity to the screenings hoppers.

The screened and degritted wastewater then flows through a single Parshall flume discharging to the conduit feeding the HPO system and BNRAS system. This flume measures the total influent flow to the treatment plant.

The influent channels, Influent Screw Pumps, Aerated Grit Tanks, Parshall flume, and grit tank effluent channels are all covered with solid cover plates and concrete. This is for odor control and will be discussed in greater detail under odor control below.. Rodney Hunt sluice gates are used to isolate screens, grit tanks, parshall flume, and flow to the rest of the plant. An Ingersoll Rand service air compressor was installed in the basement of the Headworks facilities underneath the stairwell. Plant personnel indicated that the compressor worked, but code will not allow for a compressor in the stairwell, so they will be relocating the compressor to another location in the Headworks.

Plant personnel have indicated that the Coarse Screens, belt conveyors, Influent Screw Pumps, Fine Screens, and gates all work well and are in good condition. The only problem experienced is that the coarse screen rake mechanism bounces excessively during travel. This has caused the metal support structure to suffer fatigue breaks on different occasions. Plant staff has been able to weld and reinforce the metal support frame. The Screenings Washer is experiencing problems with stones and rocks. Stones and rocks that are caught by the screens are wearing away at the brushes within the Screenings Washers. Consequently the Screenings Washers brushes need frequent replacement and the cycle times for the washing are longer. Plant personnel also mentioned that there are high levels of grease in the influent. The Screenings Presses would run and the grease would be extruded and dumped back into the Headworks. Consequently the grease levels would keep increasing since the grease would never leave the system. To solve this, plant personnel have removed the plate that the press would compress against, so now the press simply extrudes uncompressed screenings to the hopper. Because the screenings are not being pressed, the screenings are much wetter than is acceptable for land fill disposal. Occasionally a truck will have to dump the screenings into the Emergency Overflow Basin to dry, prior to being disposed of at a landfill. This practice has been discontinued. Another problem that occurred with the Screenings Presses is rock accumulation. As rocks build up within the press area, the press is unable to compact the rocks and the unit faults out on “incomplete press cycle”, resulting in the washer and screens faulting out due to interlocks with the press.

The grit and screenings hoppers drains are sloped the wrong way, so liquid does not drain away from the hoppers, resulting in a wet load for the disposal trucks that occasionally need to empty the hopper loads into the Emergency Overflow Basins to dewater. Plant personnel noted that the grit pumps send grit to the grit washers in two lines; however, there are three units. As a result, there is not enough flow capacity so that all three units could run at one time. It was also noted that the drains on the Grit Washers were all undersized, so if too much flow is sent to the Grit Washers, the room containing the grit washers, screenings washers, and screenings presses will flood.

3.5.2.4 High-Purity Oxygen Activated Sludge Process

The older portion of the Ina Road WRF treats wastewater flows up to 25 mgd using a HPO process. The facilities that are part of the HPO process are described below.

3.5.2.4.1 Primary Clarifiers

There are four concrete covered rectangular Primary Clarifiers that have two sections per clarifier. Each clarifier has plastic chain and flight collectors. Ten years ago, helical scum skimmers were installed at the effluent weirs of the clarifiers. Centrate from the Centrifuge Building was originally pumped to the Headworks, however, the centrate line became plugged by struvite. Centrate is now being pumped directly to the influent box of the Primary Clarifiers. The common influent channel also receives all other recycle flows. Six Wemco Primary Sludge Pumps are located in the tunnels beneath the Primary Clarifiers. There are four Muffin Monster grinders on the headers of the Primary Sludge Pumps. There is one Allis-Chalmers Dewatering Pump that can dewater the clarifiers.

Plant personnel indicated that the drives for the collector mechanisms have been rebuilt over the years and appear to be in good condition. The concrete tanks appear to be in good condition with only normal shrinkage cracking evident, based on external visual inspection. Severe corrosion was evident at the

scum skimmer building, to the point of making the doors difficult to open and close. The scum skimmings are often so thick that the two scum pits at the Primary Clarifiers can not be pumped out by the existing scum pumps. Either a vactor truck must vacuum the scum from the scum pits and then empty the scum in the Emergency Overflow Basins or plant personnel must spray a hose into the pit to dilute the scum enough to be pumped.

3.5.2.4.2 Activated Sludge Reactors

Flow from the Primary Clarifiers goes to the four Activated Sludge Reactors where high purity oxygen is introduced to the space above the liquid surface. The four Activated Sludge Reactors each have three stages. Each stage has a Lightning surface aerator to transfer the high purity oxygen into the mixed liquor. Sample ports and access manways are located by each surface aerator. A foam suppression system is provided at the discharge end of the reactors, but plant personnel stated that the system had never been used. In the tunnel beneath the Reactors, there is an Aurora Reactor Dewatering Pump that can be used to dewater the Reactors. Along the North side of the Activated Sludge Reactors is the Oxygen Production Facility which produces all on the oxygen that is introduced into the Activated Sludge Reactors. The oxygen facility equipment consists of three Pressure Swing Absorption (PSA) type HPO generators. Three Union Carbide PSA Oxygen Generators are located outside the blower building. Within the blower building, there are three Joy Manufacturing Co. Oxygen Generation Compressors, two Joy Manufacturing Co. Instrument Air Compressors, two Chilled Water Pumps, one Basco Inc. Air Cooler, and one Wilkerson Refrigerated Air Dryer. Also located outside the building are two liquid oxygen (LOX) storage tanks. The plant normally receives one delivery load of liquid oxygen per week.

The concrete top of the Reactors has normal shrinkage cracks, but in one location, a very large chunk of concrete has broken off the rest of the concrete top. Plant personnel advised that because of the concrete cover on top of the Reactors, no one is certain of the condition of the concrete beneath the tank cover.

3.5.2.4.3 Secondary Clarifiers

Flow from the Activated Sludge Reactors is distributed to four 115-foot diameter circular Secondary Clarifiers. The Secondary Clarifiers all have Dorr-Oliver collector mechanisms. Due to the hydraulics of the plant, the clarifiers are located approximately 5-feet below grade so that the wastewater stream may flow by gravity to the clarifiers. The RAS Pump Station is located between the four Secondary Clarifiers and contains five vertical centrifugal RAS pumps and five vertical centrifugal WAS pumps. The VFDs for the RAS Pumps and the WAS Pumps are located in the adjacent Vacuum Filtration Building. The Vacuum Filtration Building no longer is used for filtration; instead it is now used to house the VFDs, electrical gear, and a laboratory.

The clarifiers still have their original Dorr-Oliver collector drives, so some signs of wear are evident on the drive and bridge. The Plant personnel indicated no operational problems however. The concrete of the clarifiers, based on visual inspection only, appears to be in good condition. The RAS Pump Station had recently flooded and all the pumps were submerged. Plant personnel advised that the pumps have been sent to the manufacturer for cleaning and maintenance and have been reinstalled by staff.

3.5.2.4.4 Sludge Thickeners

Four 40-foot diameter Gravity Thickeners were constructed as part of the original construction at Ina Road WRF. In the 1980's Gravity Thickeners No. 2 and No. 4 were converted into DAF Thickeners. In the 1990's Gravity Thickener No. 1 was converted into a DAF Thickener. At present there are three DAF Thickeners, each with Eimco drives and one Gravity Thickener with a Westech drive. Between Tanks No. 1 and No. 3 there are two Peerless DAF Recirculation Pumps with a spot for a future third pump if Gravity Thickener No. 3 is converted to a DAF Thickener. There are also two Kaeser Air Compressors and one Westech Pressurization Tank. Between Tanks No. 2 and No. 4 there are three Peerless DAF Recirculation Pumps and two Pressurization Tanks. The basement of the Thickener Building contains six Carter Pump Thickened Sludge Pumps. These pumps were replaced in the late 1980's. At the top of the tanks is an influent splitter box. The sludge is split to either Tanks No. 1 and No. 3 or to Tanks No. 2 and No. 4. After this split, dedicated pipes to a particular tank feed each tanks influent feed box. Due to open hatches atop the tanks and open air splitter boxes and feed boxes, odors are very noticeable within the Thickening Building.

Plant personnel indicated that rehabilitation of the tanks has been performed within the last four years, so the tanks, based on visual inspection and the testimony of plant staff, appear to be in good condition. Thickener No. 1 has a new pump and accessories. All of the equipment between the remaining tanks is showing signs of excessive wear and tear. Between Tanks No. 2 and No. 4, new DAF Recirculation Pumps and a new Pressurization Tank are scheduled to be installed by in-house personnel to replace the existing equipment. This could be the result of the equipment being exposed to a corrosive environment. The tanks are closely placed to one another so not a lot of air flows between the tanks. Combine the open air splitter boxes and feed boxes with the lack of fresh air and a corrosive environment is created that can result in premature degradation of the equipment and higher than normal maintenance.

3.5.2.4.5 Chlorination Facilities

The Chlorination Facilities of the HPO system disinfect only the HPO system effluent. The BNRAS system has its own chlorination facility. Dechlorination of the combined effluent from both systems occurs together and will be discussed in a later chapter.

The HPO system has two Chlorine Contact Tanks. A Service Water Building is located upstream of the Chlorine Contact Tanks. The Service Water Building contains three Worthington Cooling Water Pumps, four Fairbanks Service Water Pumps, one Superchanger heat exchanger (providing cooling water for engines), two Chlorine Water Booster Pumps, a sodium hypochlorite flash mixer, and a sampler pump. The flash mixer injects sodium hypochlorite into the HPO plant effluent stream. The HPO plant effluent then is split to the two Chlorine Contact Tanks. After going through the Chlorine Contact Tanks, the HPO plant effluent travels through a parshall flume. The parshall flume is undersized for the current flow, so flow measurements are no longer accurate from this flume. Adjacent to the Service Water Building, two sodium hypochlorite storage tanks are located within a concrete containment area and two sodium bisulfite storage tanks are located within a separate concrete containment area.

3.5.2.4.6 Digesters

There are four anaerobic digesters, all presently being operated as primary digesters. Three Digesters have four external draft tube mixers (which are only used when the Digester are being fed) and one center mixer. The fourth digester has only an Enersave Fluid Mixers Inc. center mixer. Digesters No. 1 and No. 3 have fixed covers. Digesters No 2 and No. 4 have floating covers. The four Digesters share a waste gas burner. A Digester Control Building is located between the four Digesters and contains four National Welding and Manufacturing Co. Digester Gas Compressors, four EIMCO heat exchangers (two new and two originals), Varec sludge gas equipment, four Peerless Hot Water Pumps (for Heat Exchangers) two Peerless Service Water Pumps, four Wemco Heat Exchanger Pumps, and five Watson Marlow Sludge Pumps (two originals and three from the 1980's).

Based upon visual inspection, the digesters show signs of shrinkage cracks and some wear but generally appear to be in good condition. Plant personnel indicated there has been discussions regarding the replacement of the existing external draft tube mixers and center mixers on the three Digesters with an Enersave center mixer similar to what is on the fourth Digester.

3.5.2.4.7 Odor Control

The Ina Road WRF has not had a history of odor complaints from the surrounding community as it has primarily been isolated from the surrounding community. With construction of the sports park adjacent to the plant and community growth encroaching upon the facility, odor complaints are rising. Some facilities at Ina Road are uncovered tanks and the influent wastewater is high in hydrogen sulfides (H_2S) and other odor causing compounds. A comprehensive air sampling program gave a comprehensive look where nuisance odors are generated and what type of additional odor control is required. The odor control program undercovered several areas where odor containment and treatment could be improved. PCRWRD is undertaking a program to address the areas in need of additional odor control.

3.5.2.4.7.1 Headworks

The influent channels, screw pumps, aerated grit tanks, and parshall flume are all totally enclosed with concrete covers and provided with removable solid cover plates for access. Air is drawn off the influent channel, the coarse screen room, the influent screw pumps, fine screen room, grit tanks, grit tank effluent channels, and Parshall flume and sent to two Metpro Corp. chemical scrubbers. Each chemical scrubber has an inlet fan. Each chemical scrubber discharges to three carbon units (total of six carbon units).

Plant personnel indicated that the chemicals from the chemical scrubbers were causing a scummy buildup that was plugging the drain lines. Consequently the chemical scrubbers were taken out of service about 3 years ago. There is no bypass, so air still must flow through the chemical scrubbers on its way to the carbon units. The carbon units, based on external visual inspection, appear to be in good condition. Plant personnel advised that the carbon life was estimated to be five years. The carbon units have been running for longer than five years and the carbon has not experienced an odor breakthrough. In the screenings rooms there are noticeable odors.

Staff noted that there is no way to get inside the scrubber ducting to inspect it or clean it.

3.5.2.4.7.2 Primary Clarifiers

The primary clarifiers have a concrete cover over them to contain odors. Multiple odor draw off points located along the side of the clarifiers draw off air and send the air to a biological scrubber that is located adjacent to the clarifiers for treatment. The Primary Clarifier effluent weirs and skimmers are located in the Skimmer House. The Skimmer House originally had rolling overhead doors to bring equipment in and out of the Skimmer House. These doors have since corroded away and the openings have been boarded up. Also, the access doors are showing signs of heavy corrosion and will have to be replaced in the near future. The environment within the Skimming House is highly corrosive and odorous.

3.5.2.5 Biological Nutrient Removal Activated Sludge Process

The new portion of the Ina Road WRF treats wastewater flows uses a BNRAS process. This process was placed in service in late 2006. The different facilities that are part of the BNRAS process are described below.

3.5.2.5.1 Intermediate Pump Station

The screened and degritted wastewater that is not sent to the HPO System is sent to the BNRAS system for treatment. Four Fairbanks Morse vertical turbine submersible pumps are provided to pump the wastewater to the new Primary Clarifiers. Gates are provided to isolate the pumps. A jib crane is provided to remove the pumps when service or repair is needed.

At the time of the field inspection, the Influent Pump Station had not yet been placed into service for pumping sewage. During startup, while pumping water instead of wastewater, plant personnel indicated that they discovered that the influent magnetic flow meter measuring flow between the Pump Station and the Primary Clarifiers was oversized. As a result, low flow measurements taken by this magmeter may be inaccurate, a smaller magmeter should be installed in its place.

3.5.2.5.2 Primary Clarifiers

There are two new rectangular Primary Clarifiers with two sections in each tank. U.S. Filter chain and flight collector mechanisms are installed in each clarifier. Three Wemco Primary Sludge Pumps are located in the gallery beneath the Primary Clarifiers. Two scum pumps are installed at the effluent end of the Primary Clarifiers. Helical scum collectors, similar to the helical collectors on the Primary Clarifiers in the HPO process, perform the scum skimming.

3.5.2.5.3 Anoxic/Aeration Basins

Wastewater from the Primary Clarifiers flows by gravity to the Anoxic Basin Pre-Mixer Chamber. The Pre-Mixer Chamber contains two Chemineer mixers. From the Pre-Mix Chambers, the wastewater flows to the Anoxic Basin influent channel for distribution to the four Anoxic Basins. Gates are provided to isolate flow to each Anoxic Basin. Each Anoxic Basin has four Chemineer Anoxic mixers (sixteen total). After the wastewater flows through the Anoxic Basin it then flows through the Aeration Basins. There are five aeration basins that have five air header pipe drops per tank to provide air to fine pore diffusers. At the end of each Aeration Basins are two Chemineer Aeration Mixers (ten total). The aerated

wastewater then discharges to the effluent channel and to the Mixed Liquor Splitter Structure. Four Fairbanks Morse vertical turbine submersible Mixed Liquor Pumps are used to pump the wastewater to the new Secondary Clarifiers. There is room for three Mixed Liquor Pumps in the future. A jib crane is provided at the Mixed Liquor Splitter Structure to remove the Mixed Liquor Pumps for maintenance and repair. The new Blower Building contains four 600 hp Lamson Blowers to provide process air to the Aeration Basins. Each Blower has a filter. Two Xchanger Inc. Heat Exchangers are also located in the Blower Building to dissipate the heat in the process air from the blowers.

3.5.2.5.4 Secondary Clarifiers

The BNRAS plant has three 135-foot diameter circular Secondary Clarifiers with Walker Process drives and two rake arms per tank. The liquid level of the Secondary Clarifiers is approximately 12 feet below grade making it very difficult to clean the effluent weirs. To the North of the Secondary Clarifiers is the RAS/WAS Pump Station. The RAS/WAS Pump Station contains four Fairbanks RAS Pumps (with room for two future RAS pumps) for pumping RAS to either the Anoxic Basin or upstream of the Intermediate Pump Station. There are also four Fairbanks WAS Pumps (with room for one future pump) for pumping WAS to the Thickening Tanks. Two Gorman Rupp Scum Pumps are provided to pump Scum to the Thickening Tanks. The Tank Drain Sump contains two submersible pumps and a bubbler system that can be used to drain the Secondary Clarifiers and Chlorine Contact Tank back to upstream of the Influent Pump Station.

3.5.2.5.5 Chlorination Facilities

The Chlorination Facilities for the BNRAS system disinfect only the BNRAS system effluent. The HPO system has its own chlorination facility as discussed above. Dechlorination of both systems occurs together and will be discussed in a later chapter.

The BNRAS system has two Chlorine Contact Tanks. The BNRAS plant effluent splits to the two Chlorine Contact Tanks. Each tank uses a flash mixer to inject sodium hypochlorite into the BNRAS plant effluent stream. After flowing through the Chlorine Contact Tank the chlorinated BNRAS plant effluent comes back together and flows to the dechlorination equipment. Three Fairbanks Morse Service Water Pumps use the chlorinated plant effluent as service water for the plant. There is room for a future fourth Service Water Pump.

3.5.2.5.6 Odor Control

3.5.2.5.6.1 Influent Pump Station

A chemical scrubber is located adjacent to the Influent Pump Station to treat odors exhausted from the Influent Pump Station and influent channels.

3.5.2.5.6.2 Primary Clarifiers and BNRAS Tankage

Air is exhausted from the Primary Clarifiers, Skimmer Building and the BNRAS Anoxic Basins and is sent to a chemical scrubber located next to the Primary Clarifiers. Air is exhausted from the BNRAS Aeration Basins and is sent to a chemical scrubber located next to the BNRAS Primary Clarifiers.

3.5.2.6 Centrifuge Building

Sludge from Ina Road WRF and Roger Road WRF is handled within the Centrifuge Building. There are five Sludge Holding Tanks capable of storing 120,000 gallons each. Sludge Holding Tank No. 1A, 1B, and 1C hold Ina Road WRF and Roger Road WRF digested sludge separately. Sludge Holding Tank No. 2 holds centrate and dilution water from Roger Road WRF that is sent back to the primary clarifiers. Sludge Holding Tank No. 3 holds thickened sludge that is sent to the Sludge Storage Bladder. Two Moyno pumps are used to pump the thickened sludge from Sludge Holding Tank No. 3 to the Sludge Storage Bladder. Four Hydromatic pumps are used to pump sludge from Sludge Holding Tank No. 1A, No. 1B, No. 1C, and No. 2 to the associated locations.

Two Sharples centrifuges installed in the mid 1980's and one Alfa Laval centrifuge installed 2-1/2 years ago thicken the Ina Road WRF and Roger Road WRF sludge to about 8 percent solids. Normally one centrifuge is run at one time. Four Reeves Feed Pumps pump sludge to the centrifuges. Two Reeves Cake Pumps installed in the mid 1980's and one Schwing Cake Pump installed 2-1/2 years ago pump cake solids to Sludge Holding Tank No. 3. The Schwing Pump was installed in case the plant decides to go to dewatering with the centrifuges at some time. Three Reeves Polymer Feed Pumps installed in the mid 1980's and one Viking Polymer Feed Pump installed 2-1/2 years ago pump polymer from totes along the wall to the centrifuges.

On the roof of the Centrifuge Building is the pig receiving station in the sludge pipeline from Roger Road WRF. A splitter box with a bar screen receives the sludge pumped from Roger Road WRF. Plant personnel manually switch valves to direct the flow of sludge and dilution water to different holding tanks when a pig appears. They also rake the bar rack to remove rags and any other solids that are caught by the bar screen and dispose of them in chute to a dumpster along the north side of the Centrifuge Building.

At the time of the Greeley and Hansen site assessment, one of the Sharples centrifuges had been sent back to the shop for routine maintenance. The pumps, centrifuges, and polymer equipment, based on visual inspection and reports by plant personnel, all appear to be in good shape.

Before going onto the roof to look at the pig receiving station, a handheld gas detector was required to make sure that no gases were at hazardous levels on top of the roof. This is because odorous air escapes from the sludge holding tanks through the candy cane shaped intake vents located only a foot or so above the roof slab at many locations across the top of the roof. These vents allow escaped gas to collect along the slab below the roof parapet.

3.5.2.6.1 Centrifuge Building Odor Control

One small carbon unit adjacent to the East side of the Centrifuge Building and two large carbon units adjacent to the North side of the Centrifuge Building are used for odor control at the Centrifuge Building. Plant personnel indicated that the odor system was originally designed to treat odors eight hours per day; however the units are now treating odors twenty four hours per day and, in the opinion of plant personnel, are undersized for this application. Plant personnel have moved the chemical scrubber that was no longer in service at the Vacuum Filter Building to the North side of the Centrifuge Building. There have been discussions of connecting the chemical scrubber to the existing carbon odor control system at the Centrifuge Building to supplement the existing treatment capacity.

Odors are noticeable within, around, and on top of the Centrifuge Building. PCRWRD took action to improve odor capture and provide acceptable levels of odor treatment at the centrifuge building.

3.5.2.7 Covered Sludge Storage Bladder

Thickened Sludge is pumped from Sludge Holding Tank No. 3 in the Centrifuge Building to a rubber covered Sludge Storage Bladder located nearby within an earthen berm. The sludge is stored here for disposal trucks to remove and haul away. The disposal trucks are filled at a truck loading station that is adjacent to the storage bladder. The truck loading station pumps sludge out of the storage bladder to the disposal trucks.

Due to the age of the bladder (>25 years) the structural integrity is a concern . The bottom of the bladder is not visible for inspection. It is not possible to determine the condition of the bottom and interior of the bladder. Based upon visual observation, the top of the bladder appears to be in good condition. No leaks or tears are evident on the top of the bladder.

3.5.2.8 De-chlorination

Chlorinated plant effluent from the BRNAS system and the HPO system comes together in a large vault just to the west of the HPO Chlorine Contact Tanks. At this point, de-chlorination is achieved by feeding Sodium Bisulfite to this vault and injecting it into the combined flow. Just downstream of this vault is a sampling structure where effluent ORP is measured for control of the de-chlorination chemical feeder.

The combined plant effluent discharge flow meter structure is located northwest of the plant and along Ina Road north of the landfill. A 6-foot Parshall flume nested within a 10-foot parshall flume measures the effluent flow. Future flows require a 10-foot Parshall flume; however, current flows would not register accurately on such a large parshall flume. The 6-foot Parshall flume nested within the 10-foot parshall flume is able to measure current flows. In the future, when the flows increase to be in excess of the 6-foot parshall flume capacity, the 6-foot Parshall flume will be removed from the larger flume. At that point, the 10-foot Parshall flume will measure flow.

There is also a duplicate measurement of effluent ORP made at this metering structure.

These structures are all new, and based on visual inspection, concrete and equipment appear to be in good condition.

3.5.2.9 Electrical

The Ina Road WRF electrical power distribution system is served from utility sources and on site generators. The HPO plant constructed during the 1970's and the Centrifuge Building added in the 1980's are powered by the generators at the plant power generation facility. The current plant expansion is powered from three separate TEP incoming utility electric services.

The plant power generation system consists of seven 650 kW, 4160 volts, 3-phase generators connected in parallel to 4.16 kV Switchgear "A/B". Switchgear feeder breakers distribute power to six outdoor unit substations and three 400 horsepower Oxygen Compressors. The unit substations are connected delta-wye with their secondaries rated 480-volts, 3-phase. The secondary of each unit substation serves a close coupled walk-in aisle 480-volt switchboard with the exception of the two at the Centrifuge Building. The Centrifuge Building unit substations serves a motor control center directly from the secondaries of the substation transformers. Those configured with secondary switchboards distribute power to motor control centers and other utilization equipment.

The three TEP incoming utility electric services are located at the Headworks, New RAS/WAS Pump Station and the Blower Building. TEP provides incoming power at 13.8 kV, 3-phase that is stepped down at each location to the required utilization voltages using Plant owned transformers and unit substations. The utility electric services are autonomous from each other and are individually metered for billing. The power distribution system at each facility is further described in detail within this assessment.

3.5.2.9.1 Plant Power Generation System

The plant power generation system is housed in the Energy Recovery Facility which has been renamed to the Powerhouse. The engine generator units with heat recovery equipment are located on the ground level floor with associated 4.16 kV Switchgear "A/B" located on the upper level floor.

Each of the 650 kW, 4.16 kV, 3-phase plant generator units is driven by a 12 cylinder Waukesha engine capable of operating on methane, natural, or propane gas. The generators are by Electric Machinery Co. which they no longer manufacture. The plant is normally operated with five units generating power to the plant, one unit in the standby mode and one unit down for maintenance. Two units are normally operated on methane and three units on natural gas. The amount of methane gas currently produced by the plant determines the number of units operating on methane. Propane is provided as a back-up source for the natural gas pipeline. Each unit has been re-built four times since the initial installation which equates to approximately 7 years or 43,000 hours of operating time between overhauls. Presently, operating times have been extended to 45,000 hours. Removal of the units for major overhauls requires the use of "A" frames and fork lifts as there is no overhead crane in the building. Due to the limitations in the machining tolerances of the engine blocks and the subsequent operational failure of Unit #5, the blocks for Units #5, 6 and 7 have been replaced. A local outsource maintenance shop has been providing maintenance on the generators which has proven to be satisfactory. As part of the overall energy system, heat is scavenged off the engines for use in HVAC systems, production of chilled water, domestic hot water and heating sludge in the digesters. The heat recovery system is not addressed herein as the focus of this assessment is the electrical equipment and systems.

The 4.16 kV Switchgear "A/B" has line-up air magnetic circuit breakers and generator paralleling controls manufactured by Waukesha Engomatic Control. The air magnetic circuit breakers are manufactured by ITE which is no longer in business. A local outsource maintenance shop has been providing maintenance on the circuit breakers which has proven satisfactory. The bussing of 4.16 kV Switchgear "A/B" is arranged with two generators on the Section "A" bus, four generators on the Section "B" bus and a single generator on a third bus isolated by tie breakers connected to Sections "A" and "B ". The Section "A" bus primarily feeds the three 400 horsepower Oxygen Compressors with Section "B" serving the majority of the remaining plant loads. The original design intent was for Sections "A" and "B" to operate independently of each other with the single generator assigned to either Section "A "or Section "B". However, a subsequent upgrade to the lineup allows both tie breakers to be closed with all of the generators operating in parallel on a common bus. All paralleling operations are manually achieved using synch scopes on each line-up. Previously, there was a surging issue on the Section "A" bus due to the cycling of the Oxygen Compressors. The upgrade was made to better manage load sharing among all of the operating units. Additional upgrades to 4.16 kV Switchgear "A/B" include digital metering, electronic governor controls, updated excitation controls and two new feeder breaker sections added to each section for serving the Centrifuge Building.

The engine generators have been maintained since the initial installation. Replacing the remaining original engine blocks as the units come due for overhaul should continue as part of the ongoing maintenance. 4.16 kV Switchgear "A/B" has likewise been meticulously maintained. Despite the age of the line-up, the equipment appears to be in excellent condition. The conditioned environment of the Electrical Room has probably contributed to the switchgears overall condition and serviceability. The area of concern is the non-availability of ITE air magnetic circuit breakers. Vacuum circuit breakers are currently available from various manufacturers which would be suitable for use as replacements in the existing switchgear.

The location of the switchgear in the upper floor level Electrical Room of the Powerhouse presents physical limitations for removing equipment from the building for maintenance. The doorways and associated clearances allow for limited access. New vertical sections added to serve the Centrifuge Building were moved through the existing doorways one section at a time. If partial or full replacement of the switchgear were required, movement of equipment to and from the room would be slow and time consuming.

The unit substations discussed herein were provided as part of the original 1970's treatment plant and the 1980's addition of the Centrifuge Building. These unit substations distribute power throughout the plant site from 4.16 kV Switchgear "A/B".

Unit Substations Nos. 2, 3, and 4 have redundant feeds on the primary from 4.16 kV Switchgear "A/B". Each is configured with an outdoor substation type transformer with a secondary close coupled walk-in aisle 480V Switchboard. The primary for each has dual main circuit breakers which are key interlocked to allow only one source to be energized at a time. Unit Substations US-CEN1 and US-CEN2 are each fed on the primary from 4.16 kV Switchgear "A/B". The configuration of each consists of an outdoor substation type transformer with the 480V secondary connected directly to Motor Control Center MCC-CEN in the Centrifuge Building using bus duct.

Plant maintenance staff indicated that problems have been experienced with the secondary 480V switchboard breakers. Problems have been attributed to internal corrosion of the breaker mechanisms by the hydrogen sulfide in the plant's atmosphere. Events have included false trips and inability to close breakers. Described herein are the assessments of the individual unit substations associated with the plant generation power distribution system.

3.5.2.9.1.1 Unit Substation No. 1

Unit Substation No. 1 is located in an outdoor yard area enclosed with masonry walls adjacent to the Sludge Thickeners. The substation assembly was manufactured by Westinghouse. The transformer section is rated 2000 kVA, 65 degrees Celsius, 4.16 kV-480V, 3-phase, delta-wye. The 480V secondary switchboard provides individual redundant feeds to the secondary switchboards at Unit Substations No. 2, No. 3 and No. 4. Previously, it also provided a redundant 480V feed to Unit Substation No. 5 at the original plant Headworks. However, Unit Substation No. 5 was removed from service when the current plant expansion Headworks was constructed. The overall substation assembly is in poor condition with severe exterior corrosion. Door filters are missing from the exterior access doors and the interior aisle is extremely dusty. It appears that the unit substations physical location does not allow for sufficient circulation of air around the equipment as process equipment in the same vicinity shows similar signs of corrosion. This unit substation should be considered for replacement and possible relocation. An alternative to relocation would be to provide an indoor unit substation in a new building at the existing location with suitable filtered ventilation.

3.5.2.9.1.2 Unit Substation No. 2

Unit Substation No. 2 is located in an outdoor yard area enclosed with masonry walls adjacent to the Digester Tanks. The substation assembly was manufactured by Westinghouse. The transformer section is rated 2000 kVA, 65 degrees Celsius, 4.16 kV-480V, 3-phase, delta-wye. The 480V secondary switchboard provides power to the majority of the original plant process areas including the Vacuum Filters, Digesters, Thickeners, Service Water Pumps, Powerhouse and Training Building. The overall assembly is in acceptable condition. Some of the nameplates for the individual feeder breakers in the switchboard are missing. The transformer oil temperature gauge indicates that the transformer is operating at the upper temperature limit setting. This condition should be investigated to determine the cause and appropriate measures taken to rectify any potential problems.

3.5.2.9.1.3 Unit Substation No. 3

Unit Substation No. 3 is located in an outdoor yard area enclosed with masonry walls adjacent to the Oxygen Production Building. The substation assembly was manufactured by Westinghouse. The transformer section is rated 1500 kVA, 65 degrees Celsius, 4.16 kV-480V, 3-phase, delta-wye. The 480V secondary switchboard provides power to the Oxygen Production process. The overall assembly is in acceptable condition. Some of the nameplates for the individual feeder breakers in the switchboard are missing. A large industrial fan was being used to circulate air around the transformers cooling fins which would indicate that the transformer is operating at or above its nameplate rating. This condition, if left unchecked could contribute to the shortening of the transformers operational life. An accurate reading of the operating electrical load should be taken to determine if the transformer is a candidate for a permanent cooling fan upgrade or possible replacement with a larger unit.

3.5.2.9.1.4 Unit Substation No. 4

Unit Substation No. 4 is located in an outdoor yard area enclosed with masonry walls adjacent to the Warehouse Building. The assembly was manufactured by Westinghouse. The transformer section is rated 750 kVA, 65 degrees Celsius, 4.16 kV-480V, 3-phase, delta-wye. The 480V secondary switchboard provides power to the Warehouse Building and Administration/Lab Building.

3.5.2.9.1.5 Unit Substation US-CEN1 and US-CEN2

Unit Substation US-CEN1 and US-CEN2 are located in an outdoor yard area enclosed with masonry walls adjacent to the Centrifuge Building. Each assembly was manufactured by General Electric in the mid 1980's. The transformer section for each is rated 1500 kVA, 55 degrees Celsius, 4.16 kV-480V, 3-phase, OA, delta-wye. The substations are physically configured on the secondary to directly feed 480V motor control center MCC-CEN using metal enclosed bus duct. MCC-CEN is configured with key interlocked Main-Tie-Main breakers which allows any two breakers to be closed at the same time. It was not determined if secondary overcurrent protection was present at the transformers. The shortcomings of the present electrical configuration are as follows: There is some corrosion on the secondary transition bus duct connections. The bus duct feeders from the substation transformers to MCC-CEN may not be properly protected if overcurrent protection is not provided at the secondary of US-CEN1 and US-CEN2.

3.5.2.9.1.6 Comments on the Plant Power Generation System

Given the condition of the engine generators and associated switchgear, the system is capable of generating power for the foreseeable future. The comparative overall costs for generating power versus purchasing utility power has to be weighed when deciding whether to continue generating power on site. The cost of fuel is always an issue when generating power. Methane is obviously the preferred source. But with its limited availability and the volatility of natural gas prices, this is a factor which needs to be analyzed carefully. In addition to fuel cost, equipment maintenance and manpower costs need to be factored in for generating power.

The 1970's vintage unit substations with the exception of Unit Substation No. 1 are acceptable. The correction of the shortcomings noted for each and perhaps additional secondary breaker maintenance could increase their reliability. Unit Substation No. 1 should be replaced. The issue of replacement versus repair should be weighed in as the age of the equipment progresses. Regardless, the unit substations could be integrated into an overall utility powered distribution system if the county elected not to continue generating power autonomously. Electric service and rate options should be discussed with TEP exploring the possibility of utilizing the engine generators in a different role such as co-generation and peak shaving.

3.5.2.9.2 TEP Incoming Utility Electric Services

The utility electric services described herein were provided under the current plant expansion. All of the equipment is less than 5 years old unless otherwise noted. The following describes each in detail.

3.5.2.9.2.1 Headworks

The TEP 13.8 kV, 3-phase incoming power service cables are routed underground to the primary of a pad mount service transformer. It appears that the TEP overhead incoming power service cables enter the plant site from the southeast but, the transition point to underground could not be confirmed. The service transformer was provided by TEP but, purchased by the Plant. The associated utility metering CT's and revenue meter are located approximately forty feet away from the pad mount service transformer. The service transformer does not have a data nameplate but, it was determined that the voltage on the secondary was 4.16 kV, 3-phase. It was not apparent if the service transformer had primary or secondary overcurrent protection as the compartments were not accessible. The 4.16 kV, 3-phase secondary of the service transformer feeds two Outdoor Unit Substations US30-1 and US30-2 manufactured by Cutler-Hammer. The primary section consists of a primary line selector switch for selecting either the utility source (pad mount service transformer) or plant power generation system source. The transformer section is rated 2000/2340 kVA-2300/2576 kVA, 55/65 degrees Celsius, 4.16 kV-480/277V, 3-phase delta-wye with fan cooling. The secondary consists of a close coupled non walk-in aisle 480V Pow-R-Line Switchboard. How the 4.16 kV feed from the Plant power generation system was configured to serve both unit substations on the primary was not determined. The secondary 480V switchboard at each unit substation provides power to the motor control centers in the Headworks Electrical Room. The motor control centers are arranged with key interlocked dual main breakers with feeders from each of the unit substations 480V switchboards. All of the electrical equipment at the Headworks is in excellent condition. The shortcomings of the present electrical configuration are as follows: The feeders from the pad mount service transformer to Unit Substations US30-1 and US30-2 may not be properly protected if overcurrent protection is not provided at the secondary of the pad mount service transformer. The primary line selector switch on the unit substations must be manually transferred to the second source if the preferred source fails. All of the 480V loads could possibly be connected to one unit substation if the same main breaker source for each of the motor control centers was selected at the unit substation 480V switchboard. This would leave the second unit substation unloaded which is not beneficial to the transformer.

3.5.2.9.2.2 New RAS/WAS Pump Station

The TEP 13.8 kV, 3-phase incoming power service cables enter the plant site from the southeast and are routed overhead to a drop pole in the vicinity of the New RAS/WAS Pump Station. The overhead cables make a transition at the drop pole to underground and are routed to the primary of a substation service transformer. The transformer is a Westinghouse Insulated Unit Substation rated 1000 kVA, 65 degrees Celsius, 13.8 kV-480V, 3-phase delta-wye. It was not apparent if the transformer had primary or secondary overcurrent protection nor was the utility metering apparent. The transformer secondary feeds two motor control centers MCC37A and MCC37B located in the RAS/WAS Pump Station Electrical Room. The Electric Room is located below grade at a mezzanine level above the Pump Room. Each motor control center is arranged with key interlocked dual main breakers with a feed from the substation service transformer and the Plant power generation system. Where the 480V feed from the Plant power generation system is derived for each motor control center could not be determined. The substation service transformer was purchased used for the project and its age could not be determined. All of the electrical equipment appears to be in excellent condition. The shortcomings of the present electrical configuration are as follows: The feeders from the substation service transformer to MCC37A and MCC37B may not be properly protected if overcurrent protection is not provided at the secondary of the

substation service transformer. The main breakers on each of the motor control centers must be manually transferred to the second source if the preferred source fails. The Electrical Room is located below grade thus having the potential for flooding. The motor control centers were installed in the Electrical Room prior to the installation of the pump station roof. The catwalks and stairways for accessing the Electrical Room would prove extremely difficult to use for removing electrical equipment. In addition, the height of the doorways is not sufficient for removing a section of motor control center in the upright position.

3.5.2.9.2.3 Blower Building

The TEP 13.8 kV, 3-phase incoming power service cables enter the plant site from the east and are routed overhead to a drop pole in the vicinity of the Blower Building. The overhead cables make a transition at the drop pole to underground and are routed to the primary of a substation service transformer. The transformer is a General Electric Silicone Fluid Unit Substation rated 5000/7000 kVA, 65 degrees Celsius, 13.8 kV-4.16 kV, 3-phase delta-wye with provisions for future fans. It was not apparent if the transformer had primary or secondary overcurrent protection nor was the utility metering apparent. The service transformer secondary feeds Outdoor 4.16 kV Switchgear (SWGR-BB). The switchgear is a weatherproof line-up manufactured by S&C Electric consisting of four medium voltage fusible switches in a hot sequence arrangement. Two of the fusible switches feed 4.16 kV motor control centers MCC34C and MCC34D. Each of the motor control centers contains the starters for two of the process air blowers. The other two fusible switches each feed Outdoor Unit Substations US34-1 and US34-2. The unit substations are manufactured by Square D Company and configured similar to those used at the Headworks. The primary section differs in that a main fusible switch is provided between the primary line selector switch and the primary of the transformer. The transformer section is rated 1500/1680 kVA, 55/65 degrees Celsius, 4.16 kV-480/277V, 3-phase delta-wye with provisions for future fan cooling. When fan cooling is added, the transformer will be rated 1932 kVA. The secondary consists of a close coupled non walk-in aisle switchboard. How the 4.16 kV feed from the Plant power generation system was configured to serve both unit substations on the primary was not determined. The secondary 480V switchboard at each unit substation provides power to motor control centers MCC33A, MCC33B, MCC34, MCC35A and MCC35B. The 480V motor control centers are arranged with key interlocked dual main breakers fed from each of the unit substations 480V switchboards. The 4.16 kV and 480V motor control centers are located in the Electrical Room on the upper level floor of the Blower Building. The substation service transformer was purchased used for the project and its age was not determined. All of the electrical equipment appears to be in excellent condition. The shortcomings of the present electrical configuration are as follows: The feeder from the substation service transformer to the Outdoor 4.16 kV Switchgear (SWGR-BB) may not be properly protected if overcurrent protection is not provided at the secondary of the substation service transformer. The primary line selector switch on the unit substations must be manually transferred to the second source if the preferred source fails. The main breakers on each of the 480V motor control centers must be manually transferred to the second source if the preferred source fails. All of the 480V loads could possibly be connected to one unit substation if the same main breaker source for each of the motor control centers was selected at the unit substation 480V switchboard. This would leave the second unit substation unloaded which is not beneficial to the transformer. The 4.16 kV motor control centers do not have a redundant source of power. If the utility source fails, the Process Air Blowers will be off line. The location of the motor control centers in the upper floor level Electrical Room of the Blower Building presents physical limitations for removing equipment from the building for maintenance or replacement.

3.5.2.9.2.4 Comments on Utility Electric Services

The present service arrangement with three separate TEP incoming utility electric services is neither desirable nor beneficial to the overall operating scheme for the plant electrical system. The present arrangement does not allow the possibility for obtaining a more favorable rate from TEP as each service is independent from the others and billed separately for its energy usage. The three services are not configured to provide the flexibility needed for future plant expansion. Likewise, a common methodology for interfacing with the plant power generation system has not been established. It was not confirmed if the plant power generation system connections described for each of the electrical services are physically provided. The provisions may only have been made for future interfacing with the plant power generation system or other alternate power sources. Plant staff reported that an overall plant-wide electrical distribution system diagram has never been created. The present overall electrical distribution system needs to be properly documented with up-to-date one-line diagrams. These documents need to be provided to the electrical maintenance and power generation staff to ensure efficient and safe operation of the system.

3.5.2.9.3 Motor Control Centers

There are two styles of motor control centers used throughout the plant. They are located adjacent to and within the process structures. Outdoor motor control centers are provided in NEMA 3R and NEMA 4 stainless steel non walk-in enclosures with front access weatherproof doors. The NEMA 3R outdoor enclosures show some light surface corrosion. Some of the indoor motor control centers show corrosion on the face of the line-ups and the control devices. Motor control centers located indoors are NEMA 1 construction with the majority located in the same area as the process equipment. Due to their physical location, most are soiled on the exterior. The recent plant expansion provided Electrical Rooms within the structures to house the motor control centers. The majority of the motor control centers are arranged with key interlocked dual main circuit breakers which allow only one source to be closed at a time. Others are arranged main-tie-main with key interlocks which allow any two breakers to be closed. The power sources in either arrangement may be redundant generator feeds, redundant utility feeds or combinations of both. The breakers are key interlocked so that only one breaker can be closed at a time. Five equipment design vintages are present for all of the motor control centers on site. The five are Westinghouse Type W, Cutler-Hammer Series 2100, General Electric 8000 Line and Square D Models 4 and 6. Overall, the condition of the motor control centers falls in the range of acceptable to excellent with a few exceptions. **Table 3-3** provides a list of all the motor control centers.

3.5.2.9.4 Plant Grounding System

Plant maintenance personnel confirmed that plant grounding system is adequate and that there have not been any grounding related issues.

3.5.2.9.5 Electrical Feeders

Plant personnel did not indicate that there were any electrical feeder related issues.

3.5.2.9.6 Summary of Overall Assessments

The assessments made address the existing electrical equipment as it relates to the present plant electrical distribution system and its serviceability. Any upgrades or future expansions of the plant will impact the existing overall electrical distribution system as provisions for expansion have not been accounted for in the present systems. The impact of future expansions has not been factored into the assessments of the existing equipment. The issues previously discussed relate only to the conditional assessment of the equipment as presently installed.

All electrical distribution equipment is thermographically inspected annually and the problems corrected upon completion. There is some electrical equipment which is possibly more susceptible to problems or failure for various reasons but, at present, is functioning satisfactorily. This equipment has been identified herein. It is suggested that this equipment be considered for systematic replacement if the existing systems are to remain viable. A short circuit and coordination study is suggested as electrical changes have been made over the years and the study would be beneficial in verifying that the electrical equipment is proper coordination and provided with suitable interrupting ratings. In addition, the study would be useful for identifying potential problem areas in the plant electrical distribution system.

Table 3-3
Pima County Ina Road WRF – Motor Control Centers Assessment

EQUIPMENT TAG	LOCATION	MANUFACTURER	VOLTAGE	TYPE	BUS RATING	YEAR BUILT
MCC 05W1	OXYGEN PRODUCTION BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 05W2	OXYGEN PRODUCTION BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 08W1	SLUDGE THICKENERS CONTROL BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 08W2	SLUDGE THICKENERS CONTROL BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 08W3	SLUDGE THICKENERS CONTROL BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 08W4	CHLORINE BUILDING (OUTDOOR COVERED)	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 09W1	VACUUM FILTRATION BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 09W2	VACUUM FILTRATION BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 11W1	DIGESTER TANKS	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 11W2	DIGESTER TANKS	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 11W3	DIGESTER TANKS	WESTINGHOUSE 2100 LINE	480 V	3PH, 4W	600 A	1986
MCC 11W4	DIGESTER TANKS	WESTINGHOUSE 2100 LINE	480 V	3PH, 4W	600 A	1986
MCC 12W1	CHLORINATION BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 14W1	POWER HOUSE (ENERGY RECOVERY BUILDING)	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 14W2	POWER HOUSE (ENERGY RECOVERY BUILDING)	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 14W3	POWER HOUSE (ENERGY RECOVERY BUILDING)	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 17W1	SERVICE WATER BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC 17W2	SERVICE WATER BUILDING	WESTINGHOUSE TYPE W	480 V	3PH, 4W	600 A	1976
MCC A	SULFUR DIOXIDE BUILDING	SQUARE D MODEL 6	480 V	3PH, 4W	600 A	2002
MCC B	SULFUR DIOXIDE BUILDING	SQUARE D MODEL 6	480 V	3PH, 4W	600 A	2002
MCC-CEN	CENTRIFUGE BUILDING	GE 8000 LINE	480 V	3PH, 4W	600 A	1986
MCC-30A	HEADWORKS BUILDING	CUTLER-HAMMER SERIES 2100	480 V	3PH, 4W	600 A	2000
MCC-30B	HEADWORKS BUILDING	CUTLER-HAMMER SERIES 2100	480 V	3PH, 4W	600 A	2000
MCC 33A	BLOWER BUILDING	SQUARE D MODEL 6	480 V	3PH, 3W	600 A	2002
MCC 33B	BLOWER BUILDING	SQUARE D MODEL 6	480 V	3PH, 3W	600 A	2002
MCC 34	BLOWER BUILDING	SQUARE D MODEL 6	480 V	3PH, 3W	800 A	2002
MCC 34C	BLOWER BUILDING	SQUARE D ISO-FLEX MODEL 4	4160V	3PH, 3W	600A	2002
MCC 34D	BLOWER BUILDING	SQUARE D ISO-FLEX MODEL 4	4160V	3PH, 3W	600A	2002
MCC 35A	BLOWER BUILDING	SQUARE D MODEL 6	480 V	3PH, 3W	800 A	2002
MCC 35B	BLOWER BUILDING	SQUARE D MODEL 6	480 V	3PH, 3W	800 A	2002
MCC 37A	RAS/WAS PUMP STATION	SQUARE D MODEL 6	480 V	3PH, 4W	1200A	2002
MCC 37B	RAS/WAS PUMP STATION	SQUARE D MODEL 6	480 V	3PH, 4W	1200A	2002

3.5.2.10 Instrumentation and Control

The Ina Road plant is well instrumented. Process instrumentation includes open channel flow meters, sludge flow meters, aeration system analytical instruments, tank level transmitters, digester gas and air flow meters and chlorine residual and ORP instruments for disinfection. Most instruments in the older HPO train are operational. Instruments in the new BNRAS train are newly installed and some are operational, but there are a number of instruments that had not been fully commissioned at the time of our site assessment. Certain instruments are discussed below in the respective process chapters.

3.5.2.10.1 SCADA System

The plant SCADA system is very new, having been commissioned in 2002 and fully operational in 2004. The SCADA network backbone consists of an Ethernet fiber optic trunk running between the Administration Building and the Energy Recovery Building where the two main core switches and redundant SCADA servers are located. The two network core switches connect the following plant areas:

- Admin Building Server/Core Switch
  - Maintenance Building
  - Centrifuge Building 23
  - East-West Tunnel
  - BNRAS Train Building 34
  - HPO Oxygen Production Building 5

- Energy Building Server/Core Switch
  - Vacuum Filter Building 9
  - RAS/WAS Building 7
  - Thickener Building 8
  - Digester Building 11
  - Disinfection Building 12
  - BNRAS Train RAS/WAS Building 37
  - Training Building
  - Operations Trailer 29
  - Headworks Building 30

The Administration Building Information Technology (IT) Room houses the backup supervisor control and data acquisition (SCADA) server and the SCADA historian. The system is tied to the County network backbone through a firewall. The primary SCADA server is located at the Energy Building. Various view node workstations are located throughout the plant and communicate with the servers over the Ethernet network.

Numerous PLCs throughout the plant act as the input/output (I/O) connections to the process areas. Most PLCs are Allen-Bradley ControlLogix series with Ethernet ports to communicate with the SCADA servers. Package control systems generally include Allen-Bradley SLC-5/04 connected to the ControlLogix PLCs using DH-Plus data links. There are some other PLC models in the plant but all are

part of the Allen-Bradley product family. The system is easily expandable. Instrument technicians are able to troubleshoot and maintain the PLCs over the network backbone from the Maintenance Building. Local view nodes throughout the plant typically obtain their information form the primary SCADA server. These workstations have two backup modes. In the event the primary SCADA server fails, the view node will fail over to communicate with the backup server. In the event of a complete communication failure between the servers and view nodes, the view node will fail over to "Island Mode" where it turns into a local I/O server for just its facility. In this mode, the workstation still has monitoring and control capability for its own local process area, but can't see any data regarding other process facilities.

This SCADA system is functioning well and operators use it extensively. This type of configuration is considered state-of-the-art for today's wastewater treatment plants.

3.5.2.10.2 Headworks

Ultrasonic level transmitters are used extensively to monitor chamber levels, bin level, wet well levels and the plant influent parshall flume flow. Thermal mass flow meters are used to measure air flow to the aerated grit tanks. These are all functioning properly.

3.5.2.10.3 HPO Train Liquid Sewage and Sludge Meters

For the HPO process all sludge flow meters for closed pipe sewage and sludge located at the primary clarifiers, final clarifiers, thickeners, centrifuges and digesters are magnetic flow meters. Many of these meters are new technology, having been replaced in the 1990s. These are appropriate and are reported functioning properly.

3.5.2.10.4 HPO Aeration Tanks

The original dissolved oxygen meters have been replaced with ATI self-cleaning DO monitors. These probes are configured to go through a cleaning cycle every 20 minutes and reportedly work well.

The oxygen generation and oxygen distribution feed control system is automated through a local dedicated PLC which sequences the compressors and cycles the adsorption beds. The system requires periodic attention from the instrument staff but reportedly still functions well.

Control of return sludge to each of the aeration tanks is fully automated through the SCADA system and reportedly works well.

3.5.2.10.5 HPO Train Disinfection

Disinfection is now achieved using liquid sodium hypochlorite. U.S. Filter liquid chemical feeders control the rate of hypochlorite feed to the old injectors at the contact tanks. Plant staff is currently troubleshooting and fine tuning the automatic controls using a combination of flow pacing, chlorine residual and ORP analysis of the contact tank effluent. These parameters were being monitored by a

Great Lakes (now owned by Hach) chlorine analyzer and a Stantrol ORP probe. When observed, the chlorine residual was reading 5.8-6.3 mg/L total chlorine and the ORP was reading 450 millivolts.

3.5.2.10.6 Plant Effluent Dechlorination

Dechlorination is now being achieved using liquid sodium bisulfite. U.S. Filter liquid chemical feeders control the rate of hypochlorite feed to combined effluent vault just west of the HPO Train contact tanks. Similar to the disinfection system, plant staff is currently troubleshooting and fine tuning the automatic controls based on ORP analysis of the plant effluent just downstream from the point of bisulfite addition. When observed, the ORP was reading 90-100 millivolts. There is a second ORP probe located at the new plant effluent parshall flume metering station that was reading 80 millivolts when observed.

3.5.2.10.7 Sludge Digesters

Sludge gas flow is still measured using orifice plates and differential pressure transmitters. This technology is now outdated and would be better replaced with thermal mass flow meters which have better rangeability and accuracy.

3.5.2.10.8 New BNRAS Train Instrumentation

All instruments are new and have not yet been fully commissioned. As such, no evaluation is warranted except observation of installation practice. All instruments appeared to be installed in accordance with industry accepted guidelines.

3.5.2.10.9 Plant Effluent Flow Metering

The new plant effluent flow meter is a Parshall flume located well off the plant perimeter to the northwest of the plant site. This metering chamber is in a separately fenced area. It consists of an open channel meter entrance run and nested Parshall flume. The flume is a 6-foot parshall flume nested inside a 10-foot parshall flume. This is done to increase the sensitivity and accuracy of the flume at low initial flows while still being easily expandable for higher flows in the future. Since this is a flow measurement used for reporting, there are redundant level/flow transmitters installed. One transmitter is a Milltronics ultrasonic open channel level/flow transmitter. The backup level measurement is provided by a bubbler type level system mounted in the flume. The bubbler tube assembly appeared to be incorrectly located in the flume due to high velocities having bent the tube. The bubbler tube should be straightened and securely anchored to the flume wall. This flume installation is functioning properly.

3.5.2.10.10 Laboratory Facilities

The Laboratory Facilities were originally housed in a portion of the Administration Building at the Ina Road WRF which was specifically constructed (1977) to serve as laboratory space. Staff indicated that up until approximately ten years ago the Laboratory at the Ina Road WRF was providing process control and permit related analytical services for four facilities/permits. Currently, the Laboratory provides process analytical support for eight wastewater treatment/water reclamation facilities and permit compliance/reporting analyses for approximately 37 permits associated with the wastewater/water

reclamation, aquifer protection, and storm water programs. As the laboratory analytical requirements increased over the ensuing time, additional building space (Administration Building and Training Center) was converted to laboratory use.

Currently, laboratory facilities are located in three general areas at the Ina Road WRF. Sample receiving, microbiological, and organic analysis functions are conducted at the Administration Building. Inorganic and nutrient analyses and laboratory quality assurance and quality control (QA/QC) functions are located at the former Training Center. Laboratory management staff offices are located in a trailer adjacent to the Administration Building. In the past the Ina Road WRF laboratory facilities included the capability to perform whole effluent toxicity (WET) testing. This WET testing laboratory was located in the basement of the Vacuum Filtration Building. Currently, the Ina Road WRF laboratory has a staff of 30 (33 budgeted positions).

In fiscal year 2005/2006 the budget for outside laboratory services was $225,000 (expended $110,000). The majority of this budget was for WET testing services which the Department no longer conducts, as discussed above. Currently there are a very limited number of laboratories that have the proximity and capability to perform reliable WET testing for the PCRWRD. The Department needs to make certain that it has access to reliable WET testing capabilities, internal or contract laboratory, as it is anticipated that the volume of this testing will increase in the future.

Generally, laboratory equipment was in good condition. The Department has replaced/upgraded analytical instruments as a component of its annual operating budget. Over the years, as analytical sensitivity and reporting limits of detection have lowered, the number and sizes of analytical equipment have increased. This has resulted in the laboratory equipment (incubators, drying ovens, analytical, and others) competing for bench-top space with the chemists and technicians and the sample preparation, handling, functions required in the laboratory. Currently, the ability to consider enhancement of laboratory efficiency through automation of appropriate preparatory and analytical equipment is hindered due to the space constraints. Additionally, the space needed to adequately receive and store (refrigerated) samples has been exceeded.

The laboratory work areas were extremely cramped and the layout of the laboratory areas was not conducive to work flow. Narrow aisles, crowded bench-tops, limited data entry/desktop space, and storage space were not conducive to efficiency. The crowded conditions do not easily support the type of conditions needed to maintain appropriate laboratory QA/QC.

The support facilities associated with the laboratory areas were being stressed. Much of the space currently occupied by laboratory was not designed to address the specific electrical, heating, ventilation, and cooling (HVAC), plumbing, personnel, and specialty needs associated with an analytical laboratory. This condition was exacerbated as the volume and level of required accuracy of testing along with the sophistication of the analytical equipment all increased. Electrical power supply to most laboratory areas was close to capacity leading to instances of circuit overload.

HVAC systems were not generally able to maintain appropriate room temperature, humidity, and overall quality conditions. Particularly, most analytical testing protocols and instrumentation require very specific temperature conditions as a component of the QA/QC process. These temperature criteria cannot

be reliably accomplished with the existing HVAC systems. Fume hood space was inadequate leading to inadequate ventilated bench space. Further, most HVAC systems were not designed to accommodate the specialized air handling demands that fume hoods impose on a space. In some areas corrosion of equipment, instrumentation, and other fixtures was indicative of inadequacy of ventilation.

Plumbing systems serving the laboratory spaces were not arranged to support the work areas that have been arranged to address the increased workload demand. Deionized (DI) and ultra pure water required for analyses must be transported by hand cart to many areas of its use. Building temperature in the areas where the DI water systems are located results in production/distribution of water that exceeds the temperature (20 degrees Celsius) required for direct use in most analyses.

Personnel facilities related to the laboratory functions were limited. Desk space available for staff to accomplish data entry and related functions was not adequate. Locker/changing room space was limited and further complicated by the gender balance of the current workforce.

Other specialty systems associated with the laboratory areas include safety equipment (showers, eyewash stations, and fire blankets), walk-in refrigeration (current samples and sample retention for QA/QC purpose), chemical/supplies storage, and records storage. Safety systems were adequate but access is complicated due to the overall space/layout constraints. Refrigerated sample storage was not optimal for the purpose of prevention of sample cross-contamination during storage. Storage areas for chemicals, supplies, records, and other items was “full-to-the-brim” presenting a challenge whenever access to these items was required.

3.6 Summary

The Roger Road WRF is an older of the two major wastewater treatment plants and symptoms of aging are apparent. From an operational and maintenance point of view, there are several drawbacks in the existing facilities, including:

- Primary Clarifiers 5-8 are shallower (8-foot depth) than Primary Clarifiers 9-10 (12-foot depth). The shallower depth does not meet the current norm of design standard.
- The final clarifiers have various side water depths: 9-foot depth for clarifiers 1-2; 9-foot depth for clarifiers 3-4; 11-foot depth for clarifiers 5-6; and 12-foot depth for clarifiers 7-9. The 9-foot depth does not meet the current norm of design standard.
- Due to the inadequacies of several of the primary and secondary clarifiers and current flows and loading to the Roger Road WRF, individual tanks from primary clarifiers, final clarifiers or anaerobic digesters can not be taken out of service without jeopardizing the ability of the plant to meet permit effluent standards.

The BNRAS system at the Ina Road WRF is relatively new (operation started up in the fall of 2006) and is in excellent physical and operating condition. However, the HPO system is an older part of the plant and has some signs of aging in the structures and equipment, particularly the HPO Reactors.

To meet the future permit requirements, process modifications and changes will be required to lower ammonia, total nitrogen and phosphorus discharge levels. Rehabilitation is needed to repair process units,

replace equipment and structures that are beyond useful service life, address odor control and safety issues, and upgrade the facility to be compliant with environmental, regulatory and building code requirements. Laboratory facilities need to be expanded and upgraded with better integration of facilities. The potential need for added capacity and treatment capability at Roger Road WRF and Ina Road WRF is addressed in Chapter 4.