APPENDIX I

Conceptual Basis of Design

Conceptual Basis of Design

Introduction

The overall recommended master plan includes new wastewater treatment facilities at Roger Road; upgrades and expansion at the Ina Road Wastewater Reclamation Facility; a plant interconnect pipeline; expansions and consolidation of non-metro facilities, and augmentation of the existing conveyance system for future growth. Each of these is comprised of a number of elements.

The Pima County Regional Wastewater Reclamation Department (PCRWRD) treats raw wastewater by removing undesirable constituents through a series of physical, biological, and chemical liquid stream processes. These processes produce an effluent that can be beneficially reused. Solids removed from the wastewater as sludge are stabilized to produce biosolids that can be beneficially reused.

Effluent quality objectives, discussed in Chapter 2, are established by:

- AZPDES permits, which regulate surface discharges
- State Surface Water Quality Standards and Reclaimed Water Quality Standards
- APP, which regulates discharges that ultimately reach the groundwater
- Arizona Administrative Code

The existing liquid stream processes include influent conveyance and measurement, preliminary treatment, primary treatment, secondary treatment, disinfection, and effluent conveyance. All wastewater facilities employ at least secondary biological treatment to remove conventional pollutants (biochemical oxygen demand and total suspended solids), and chlorine disinfection (with dechlorination) for pathogen reduction. The Ina Road WRC has one process train that partially removes nitrogen from the effluent.

Sludge quality objectives are currently established by federal sewage sludge regulations (*40 CFR Part 503*), which regulate land application of sludge. The existing solids stream processes include thickening, digestion, and dewatering. PCRWRD employs single-stage high-rate anaerobic digestion to meet federal requirements for Class B biosolids.

There is a potential for more stringent biosolids treatment requirements, but these are not on the immediate horizon. Future sludge quality objectives will be shaped by beneficial reuses. As new markets for biosolids are identified, it is envisioned that the specific demands of these markets could alter the form in which biosolids are delivered. At buildout biosolids could receive further treatment by temperature phased digestion, pelletization, CAMBI process or other market-driven processes.

Because the beneficial reuse markets for biosolids are largely unidentified and undeveloped, the primary function of master planning in this regard is to reserve sufficient space to accommodate future systems and a variety of processes and treatment components.

The conceptual basis of design for the major metro wastewater treatment facilities is described below.

Water Reclamation Campus - 32 MGD

Recommendations for Roger Road are to construct a new 32-mgd wastewater treatment facility using Bardenpho technology to meet the stringent standards imposed by the Arizona Department of Environmental Quality. The new facility will be located adjacent to the existing operating facility in a clear area between the plant and Sweetwater Drive or at a location north and west of the existing plant operations. The existing facilities would be demolished after commissioning the new operation. The facility will be constructed as a 32 mgd wastewater treatment facility with sludge sent to the Ina Road WRF for processing. The basic treatment system components include:

- Headworks Facilities
  - Influent Pump Station
  - Influent Screening Facilities
  - Influent Grit Removal Facilities
- Odor Control Facilities
- Aeration Tanks (Bardenpho Process)
- Blower Facilities
- Secondary Sedimentation Facilities
- Disinfection
- Sludge Thickening
- Sludge Transfer Pump Station

The conceptual basis of design for the new Water Reclamation Campus at Roger Road is attached.

Ina Road WRF Expansion and Upgrades

Ina Road WPCF will have onsite facilities upgraded and expanded to meet the regulatory and growth needs of Pima County over the next 25-years. The wastewater treatment process will be based on Bardenpho technology to meet the stringent standards imposed by the Arizona Department of Environmental Quality. The plant will handle and treat the solids from both the Roger Road WRF and the Ina Road WRF. In the near-term Pima County wastewater treatment operations will produce a Class B biosolids. These biosolids will be distributed from the Ina Road WRF. In the future the plant may produce a Class A biosolids .which also would be centrally distributed from Ina Road. Cost and space requirements for Class A biosolids is based on the temperature phased anaerobic digestion technology. The basic treatment system components include:

- New Influent Pump
- New Influent Grit Removal Facilities
- Odor Control
- Primary Clarifiers
- Aeration Tanks (Bardenpho Process)
- Blower Facilities
- Secondary Sedimentation Facilities

- Disinfection
- Sludge Thickening Facilities
- Sludge Digestion Facilities
- Sludge Dewatering Facilities
- Sludge Transfer Pump Station

The conceptual basis of design for the expanded and upgraded Ina Road WRF is attached.

Water Reclamation Campus – 32-mgd

Description and Detail	Quantity
Wastewater Quantities	
Gallons Per Capita per Day	85
Annual Average Flow, mgd	24
Monthly Peak (1.1 x an. avg. flow), mgd	26
Daily Peak (1.4 x an. avg. flow), mgd	33
Hourly Peak (2.0 x an. avg. flow), mgd	48
Raw Influent Wastewater Characteristics	
Total Suspended Solids – mg/L	286
lbs/day	57,000
Chemical Oxygen Demand - mg/L	648
lbs/day	130,000
5-day Biochemical Oxygen Demand - mg/L	294
lbs/day	59,000
Soluble 5-day Biochemical Oxygen Demand - mg/L	121
lbs/day	24,000
Volatile Suspended Solids - mg/L	225
lbs/day	45,000
Total Kjeldahl Nitrogen - mg/L	47
lbs/day	9,400
Total Phosphorus - mg/L	10
lbs/day	2,000
Influent Screening Facilities	
Bar Screen Type	Mechanically cleaned
Coarse, number of units	2
Clear opening, in.	2.5
Fine, number of units	3
Clear opening, mm	3

Water Reclamation Campus – 32-mgd

Description and Detail	Quantity
Screenings Removal	
Screenings Removed	
cu ft/MG	10
cu ft/day (an. avg.)	240
Screenings removal support equipment	
Screen Belt Conveyors	
Screenings Compactor	
Influent Grit Facilities	
Type	Vortex
Number of units	2
Capacity per unit, mgd	24
Grit Removal	
Grit Removed	
cu ft/MG	6
cu ft/day (an. avg.)	144
System Performance	95% of 65 mesh grit
Odor Control	
At preliminary treatment, wastewater treatment, and sludge thickening facilities	

Water Reclamation Campus – 32-mgd

Description and Detail	Quantity
Treatment Wastewater Characteristics[1]	
Total Suspended Solids, mg/L	310
lbs/day	62,000
Chemical Oxygen Demand, mg/L	659
lbs/day	131,800
5-day Biochemical Oxygen Demand, mg/L	301
lbs/day	60,200
Soluble 5-day Biochemical Oxygen Demand, mg/L	121
lbs/day	24,200
Volatile Suspended Solids, mg/L	243
lbs/day	48,600
Total Kjeldahl Nitrogen, mg/L	47
lbs/day	9,400
Total Phosphorus, mg/L	10
lbs/day	2,000
Aeration Tanks[2]	
Number of tanks	4
Volume per tank (new)	702,000 cu. ft
Number of Stages per Tank	5
Return sludge, %	50
Internal recycle,%	400

[1] Includes plant recycle
[2] Include future biological phosphorus removal provisions (based on Bardenpho process)

Water Reclamation Campus – 32-mgd

Description and Detail	Quantity
Final Clarifiers	
Type	Circular
Number of Tanks	4
Clarifier diameter. ft.	150
Sidewater Depth, ft.	12
Total Surface Area of Tanks, sf	53,000
Surface Loading	
An. Avg., gal/sf/day	450
Peak, gal/sf/day	900
Final Clarifier Tank Effluent	
Suspended Solids, mg/L	7
BOD, mg/L	7
NH_3-N, mg/L	< 1
TN, mg/L	< 8
Disinfection (Chlorine Technology)	
Number of Basins	4
Detention Time @ an. avg. flow, min.	90
Sodium Hypochlorite Dosage, @ max. capacity, mg/L	15
Bisulfite (De-chlorinate), @ max. capacity, mg/L	22

Water Reclamation Campus – 32-mgd

Description and Detail	Quantity
Sludge Thickening Facilities	
Waste Activated Sludge to Thickening, Avg. Values	
Flow, mgd	1.72
Mass, lbs/day	100,600
Conc., mg/L	7,000
Gravity Belt Thickeners	
Thickener Effective Width, m	2
Design Sludge Flow per Thickener, gpm	500
Number of Existing Units (relocated)	1
Number of new units	3
Number of Thickeners Operating	3
Number of Thickeners Installed	4
Future Provision	2 units
Capture Efficiency, %	90
Polymer systems, number	2
Thickened Sludge Pumped to Ina Road	
Flow, mgd	0.26
Mass, lbs/day	65,600
Conc., % solids	3
Sludge Transfer Pump Station	
Thickened Waste Activated Sludge to Ina Road	
Number of pumps	2
Rate, gpm	400

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Wastewater Quantities	
Gallons Per Capita per Day	85
Annual Average Flow, mgd	50
Monthly Peak (1.1 x an. avg. flow), mgd	55
Daily Peak (1.4 x an. avg. flow), mgd	70
Hourly Peak (2.0 x an. avg. flow), mgd	100
Raw Influent Wastewater Characteristics	
Total Suspended Solids, mg/L	286
lbs/day	120,000
Chemical Oxygen Demand. mg/L	663
lbs/day	278,000
5-day Biochemical Oxygen Demand, mg/L	318
lbs/day	133,000
Soluble 5-day Biochemical Oxygen Demand, mg/L	123
lbs/day	52,000
Volatile Suspended Solids, mg/L	254
lbs/day	107,000
Total Kjeldahl Nitrogen, mg/L	55
lbs/day	23,000
Total Phosphorus, mg/L	11
lbs/day	4,600
Influent Screening Facilities	
Bar Screen Type	Mechanically cleaned
Coarse, number of existing units	2
Clear opening, in.	2.5
Fine, number of existing units	3
Clear opening, mm	3
Screenings Removal	
Screenings Removed	
cu ft/MG	10
cu ft/day (an. avg.)	500
Screenings removal support equipment	
Screenings Belt Conveyors	
Screenings Compactor	

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Influent Grit Facilities	Aerated Grit Channels
Type	
Number of units	
Existing	3
New	1
Grit Removal	
Grit Removed	
cu ft/MG	6
cu ft/day (an. avg.)	300
System Performance	95% of 65 mesh grit
Odor Control[1]	
At primary treatment, wastewater treatment, sludge dewatering, sludge thickening, and sludge loading station facilities	
Raw Sewage Pumping Station	
Pumps, type	Archimedes screw
Existing units	3
New	1
Capacity, mgd	35

[1] Preliminary treatment odor control exists.

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Primary Influent Wastewater Characteristics[2]	
Total Suspended Solids – mg/L	358
lbs/day	149,000
Chemical Oxygen Demand - mg/L	689
lbs/day	287,000
5-day Biochemical Oxygen Demand - mg/L	324
lbs/day	135,000
Soluble 5-day Biochemical Oxygen Demand - mg/L	123
lbs/day	51,000
Volatile Suspended Solids - mg/L	282
lbs/day	118,000
Total Kjeldahl Nitrogen - mg/L	63
lbs/day	26,000
Total Phosphorus - mg/L	15
lbs/day	6,300
Primary Clarifiers	
Type	Rectangular
Existing	6
New	2
Clarifier Length, ft	216
Clarifier Width, ft	40
Sidewater Depth at influent end, ft	12
Total surface area, sf	69,000
Surface Loading @ an. avg. flow, gal/sf/day	725

[2] Includes plant recycle

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Primary Effluent Wastewater Characteristics	
Total Suspended Solids, mg/L	146
lbs/day	61,000
Chemical Oxygen Demand, mg/L	456
lbs/day	190,000
5-day Biochemical Oxygen Demand, mg/L	229
lbs/day	96,000
Soluble 5-day Biochemical Oxygen Demand, mg/L	126
lbs/day	53,000
Volatile Suspended Solids, mg/L	123
lbs/day	51,000
Total Kjeldahl Nitrogen, mg/L	61
lbs/day	26,000
Total Phosphorus, mg/L	14
lbs/day	5,900
Aeration Tanks[3]	
Number of tanks	
Existing (with modified stages)	2
New	6
Volume per tank	752,000 cu. ft.
Number of Stages per Tank	5
Return sludge, %	50
Internal recycle, %	400

[3] Includes future biological phosphorus removal provisions (based on Bardenpho process)

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Final Clarifiers	
Type	Circular
Number of Tanks	7
Existing (4 @ 115 ft dia., 3 @ 135 ft. dia.)	3
New (2 @ 115 ft. dia., 1 @ 135 ft. dia.)	12
Sidewater Depth, ft.	119,600
Total Surface Area of Tanks, sq. ft.	
Surface Loading	420
An. Avg., gal/sf/day	840
Peak, gal/sf/day	
Final Clarifier Tank Effluent	
Suspended Solids, mg/L	7
BOD, mg/L	7
NH_3-N, mg/L	< 1
TN, mg/L	< 8
Disinfection (Chlorine Technology)	
Number of Basins	
Existing	2
New	2
Detention Time @ an. avg. flow, min.	90
Sodium Hypochlorite Dosage, @ max. capacity, mg/L	15
Bisulfite (De-chlorinate), @ max. capacity, mg/L	22

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Primary Sludge Thickening Facilities	
Primary Sludge, Avg.	
Flow, mgd	1.14
Mass, lbs/day	94,700
Conc., %	1
Gravity Thickeners for Raw Primary Sludge	
Number of Units	4
Diameter, ft.	40
Sidewater Depth, ft	10
Area per Tank, sf	1,260
Total Area	5,040
Active Volume per tank, MG	0.094
Volume, MG	0.38
Overflow Rate, gpd/sf	
Solids Only	225
Solids Only (1 out of service)	300
Solids and Max. Dilution Water	500
Maximum Dilution Water, mgd	1.38
Detention Time (@ max. dilution water, hr	3.6
Solids Capture Efficiency, %	90
Thickened Primary Sludge, Avg.	
Flow, mgd	0.23
Mass, lbs/day	85,300
Conc., %	4.5

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Waste Activated Sludge Thickening Facilities	
Waste Activated Sludge, Avg.	
Flow, mgd	1.35
Mass, lbs/day	78,700
Conc., mg/L	7,000
Gravity Belt Thickeners	
Thickener Effective Width, m	2
Design Sludge Flow per Thickener, gpm	500
Number of Thickeners Operating	2
Number of Thickeners Installed	3
Capture Efficiency	90%
Polymer systems, number	2
Thickened Waste Activated Sludge	
Flow, mgd	0.19
Mass, lbs/day	70,800
Conc., % solids	4.5
Sludge Digesters, type	Mesophilic
Ina Road Thickened Primary Sludge	
Flow, mgd	0.23
Mass, lbs/day	85,300
Conc., % solids	4.5
Ina Road Thickened Waste Activated Sludge	
Flow, mgd	0.19
Mass, lbs/day	70,800
Conc., % solids	4.5

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
WRC Thickened Waste Activated Sludge	
Flow, mgd	0.36
Mass, lbs/day	90,500
Conc., % solids	3
Total Influent Sludge	
Flow, mgd	0.78
Mass, lbs/day	247,100
Conc., % solids	3.8
Percent Volatile Solids	76
Volatile Solids, lbs/day	187,800
Total Number of Digesters	10
HRT, days	17.0
HRT (one unit out of service), days	15.3
Volatile Solids Loading, lb/d/1,000cf	105
Volatile Solids Loading (one unit out of service), lb/d/1,000cf	117
Volatile Solids Destruction, %	50
Digested Sludge	
Flow, mgd	0.78
Mass, lbs/day	153,200
Conc., % solids	2.4
Volatile Solids, lbs/day	93,900
Gas Production	
cf/lb Volatile Solids Destroyed	12
Total cf/day produced	1,100.000

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Sludge Centrifuge Thickening/Dewatering Facilities	
Influent Digested Sludge	
Flow, mgd	0.68
Mass, lbs/day	153,200
Conc., % solids	2.4
Centrifuges	
Operate for Thickening or Dewatering	
Number of Existing Units	3
Number of New Units	4
Future Provision	1 unit
Flow rate per Unit (24/7 operation), gpm	80
Flow rate per Unit (24/7 operation)	
one unit out of service, gpm	95
Flow rate per Unit (24/5 operation), gpm	110
Flow rate per Unit (24/5 operation)	
one unit out of service, gpm	132
Flow rate per Unit (8/5 operation), gpm	400
Flow rate per Unit (8/5 operation)	
one unit out of service, gpm	495
Capture Efficiency, %	95
Polymer systems, number	2
Thickened Sludge	
Flow, mgd	0.20
Mass, lbs/day	130,600
Conc., % solids	8
Dewatered Sludge	
Mass, lbs/day	130,600
Conc., % solids	20

Ina Road Water Pollution Control Facility (50-mgd)

Description and Detail	Quantity
Thickened or Pre-thickening Sludge Storage	
Digested Sludge (Unthickened)	
Flow, mgd	0.78
Mass, lbs/day	153,200
Conc., % solids	2.4
Thickened Sludge	
Flow, mgd	0.20
Mass, lbs/day	130,600
Conc., % solids	8
Storage Capacity, MG	2.5
Detention Time for Unthickened Digested Sludge, days	3.2
Detention Time for Thickened Digested Sludge, days	12.5
Sludge Loading Station	
Sludge pump, gpm	300
Units	2