

PREPARED FOR: Western Wake Partners
FROM: CDM/Hazen and Sawyer
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DATE: July 22, 2005
SUBJECT: Western Wake Regional Wastewater Management Facilities
 Western Wake Water Reclamation Facility
 PER Technical Memorandum No. 12 – Secondary Clarifiers/RAS
 Pumping Facilities

INTRODUCTION

This Technical Memorandum (TM) is one in a series of TMs being prepared for the Preliminary Engineering Report for the Western Wake Regional Wastewater Management Facilities project. This memorandum describes the proposed design for three new secondary clarifiers and associated return activated sludge (RAS) pumping facilities.

PROCESS REQUIREMENTS

The proposed design flows for the secondary clarifiers at the Western Wake WRF are shown in Table 12-1.

**TABLE 12-1
PROPOSED DESIGN FLOWS**

Plant Design Flow	Phase 1	Phase 2
Annual Average	15.3	25.5
Maximum Month	18.0	30.0
Peak Instantaneous	47.3	78.8

The secondary clarifier facilities will be designed to provide the following capabilities.

1. Provide sufficient clarification capacity to effectively remove solids from the Phase 1 peak flows and allow convenient expansion for treatment of Phase 2 peak flows.

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2. Provide for passive flocculation with inlet baffles designed to dissipate energy and promote flocculation.
3. Provide uniform RAS withdrawal and positive sludge blanket control for each clarifier.
4. Provide positive scum removal from the clarifiers.
5. Provide the capability to isolate individual aeration tank/secondary clarifier trains to allow each train to function as an independent BNR process.
6. Provide the capability to add polymer upstream of the clarifiers to enhance settling of solids.
7. Provide the capability to add coagulant upstream of the clarifiers for chemical phosphorus removal.

Table 12-2 provides the typical design criteria for secondary clarifier surface overflow rates following nitrification or BNR processes.

**TABLE 12-2
TYPICAL SURFACE OVERFLOW RATES FOR SECONDARY CLARIFIERS**

Average Flow	400 gpd/sf
Peak Flow	1,000 gpd/sf

The proposed process design for the Western Wake WRF allows for higher mixed liquor concentrations under maximum month conditions to optimize BNR tank sizing. Under these conditions, solids loading rates to the clarifiers often control the sizing of the units rather than surface overflow rates. Hazen and Sawyer has performed a state point analysis to evaluate clarifier performance at peak flows with maximum month mixed liquor concentration. This analysis indicates that the clarifier size should be increased to address the peak solids loading conditions.

ALTERNATIVES EVALUATION

Alternative secondary clarifier mechanisms have previously been discussed with the Western Wake Partners. The rotating hydraulic removal-type secondary clarifier mechanism was selected based on operator familiarity with this type of equipment.

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Several options are available for scum collection from the secondary clarifiers. The Western Wake Partners have indicated a desire for full-radius scum skimming. For larger tanks, full-radius scum collection is recommended in order to provide more effective scum removal. Two alternatives for full-radius scum collection are discussed below.

PROPOSED FACILITIES

SECONDARY CLARIFIERS

The state point analysis indicates that three 150-foot diameter clarifiers, as shown in Figure 12-1, will provide adequate capacity for settling and thickening solids at the proposed design. The clarifier equipment will include mechanisms for removal of settled solids from the bottom of the clarifier and for removal of scum from the water surface. The settled solids collection system will be the hydraulic removal type with a rotating header with orifices that collect solids evenly across the entire bottom slab of the clarifier. A sump will be provided near the center of each clarifier for collection of heavy solids. The proposed secondary clarifier equipment is shown in Table 12-3.

**TABLE 12-3
 PROPOSED SECONDARY CLARIFIER EQUIPMENT FOR PHASE 1 DESIGN**

Secondary Clarifiers	
Type	Flocculation
Number	3
Diameter	150 ft
Sidewater Depth	16 ft
Surface Area, each	17,671 sf
Total Surface Area (3 clarifiers in service)	53,014 sf
Type of Solids Removal	Uni-tube sludge removal header
Type of Scum Removal	Rotating Trough with Fixed Scraper Blade

The surface overflow rates provided by the proposed secondary clarifiers are shown in Table 12-4. When the plant is expanded to 30.0 mgd, two additional 150-foot diameter secondary clarifiers and an additional RAS/WAS pump station will be required to maintain the same surface overflow rates and RAS pumping capabilities.

**TABLE 12-4
PROPOSED SURFACE OVERFLOW RATES**

Plant Design Flow	Surface Overflow Rate (gpd/sf)
Annual Average (15.3 mgd)	289
Maximum Month (18.0 mgd)	340
Peak Instantaneous (47.3 mgd)	892

The secondary clarifier effluent troughs will be provided with either aluminum or fiberglass covers to prevent algae growth. Scum baffles will also be provided to prevent scum from passing over the effluent weirs.

SCUM HANDLING

Two types of full-radius scum removal equipment were considered: rotating scum trough-type and rotating scum pipe-type. The rotating scum trough has a full-radius trough that rotates with the clarifier rotating mechanism. Fixed skimmer blades attached to the clarifier bridge rake floating scum into the trough, from which it flows to a center-mounted wet well for removal by a pump. The rotating pipe arrangement is similar to the rotating scum pipe used for rectangular primary clarifiers. Automatic controls rotate the pipe to receive scum being conveyed by a skimmer mechanism that rotates with the clarifier mechanism. The skimmers duck underneath the water surface as they pass the scum pipe. The scum pipe conveys scum to a scum well at the clarifier sidewall. Scum is then pumped from the scum well(s). The rotating scum pipe mechanism removes a larger quantity of water with the scum than the rotating scum trough.

Scum disposal at the Western Wake WRF will be by means of a dedicated scum digester. Because the additional volume of liquid associated with the rotating scum pipe alternative would negatively impact scum digestion, the rotating scum trough mechanism is recommended.

RETURN ACTIVATED SLUDGE (RAS/WAS) PUMP STATION

One RAS/WAS pump station will be provided to serve all three secondary clarifiers. RAS pumping capacity for the new secondary clarifiers will be sized to provide a 100% RAS pumping rate at maximum month design flow (6.0 mgd per clarifier). The proposed RAS and WAS pumping equipment is shown in Table 12-5. The proposed layout for the new RAS/WAS pump stations is shown in Figure 12-2.

**TABLE 12-5
 PROPOSED RAS/WAS PUMPING EQUIPMENT FOR PHASE 1 DESIGN**

Return Activated Sludge Pumping	
Number of pumps	4 (3 duty, 1 standby)
Type	Submersible
Capacity, each	4,170 gpm
Firm Capacity	18.0 mgd
Waste Activated Sludge Pumping	
Number of pumps	4 (3 duty, 1 standby)
Type	Submersible

The proposed RAS/WAS pump stations will extend approximately 14 feet above grade. Pump removal access will be provided through top slab openings over each pump. During final design, consideration should be given to a slab on grade RAS/WAS pump station with horizontal centrifugal pumps mounted inside a building. This type of pump station may provide a more economical solution.

Each RAS and WAS submersible pump will be installed in a combined wet well compartment, allowing one RAS pump and one WAS pump to be dedicated to one clarifier for positive sludge blanket control and dedicated wasting from each clarifier. A variable frequency drive will be provided for each pump to control the sludge withdrawal rate from each clarifier. Magnetic flow meters are proposed on the discharge pipe of the RAS pumps for measuring the flow. Magnetic flow meters for the WAS pump discharge flow will be provided at the thickening facilities. Additional information on the WAS pumps is provided in TM 16, Waste Activated Sludge Pumping/Thickening Facilities.

ELECTRICAL REQUIREMENTS

All motors will be 460 V, 3 phase, 60 Hz. Starters for the clarifiers and variable frequency drives for the RAS pumps will be located in an electrical building located adjacent to the pump station

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INSTRUMENTATION AND CONTROLS

Secondary Clarifiers:

The clarifier drives will be provided with manual on/off controls and will run continuously when in service.

RAS Pumps:

The RAS pumps will operate automatically to maintain the RAS flowrate as a proportion of the plant influent flowrate or at a constant RAS flow rate as determined by operator input. The plant control system will monitor magnetic flow meter readings and adjust pump speed, as required. A manual mode will be provided to allow manual speed control from the operator workstation. Manual controls will be provided for maintenance and troubleshooting.

WAS Pumps:

The WAS pumps will operate automatically to maintain a constant WAS flow rate as determined by operator input. The plant control system will monitor magnetic flow meter readings and adjust pump speed as required. A manual mode will be provided to allow manual speed control from the operator workstation. Manual controls will be provided for maintenance and troubleshooting.

Scum Pumps:

The scum pumps will operate automatically based on level in the scum wet wells. Manual controls will be provided for maintenance and troubleshooting.

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Cost Estimate

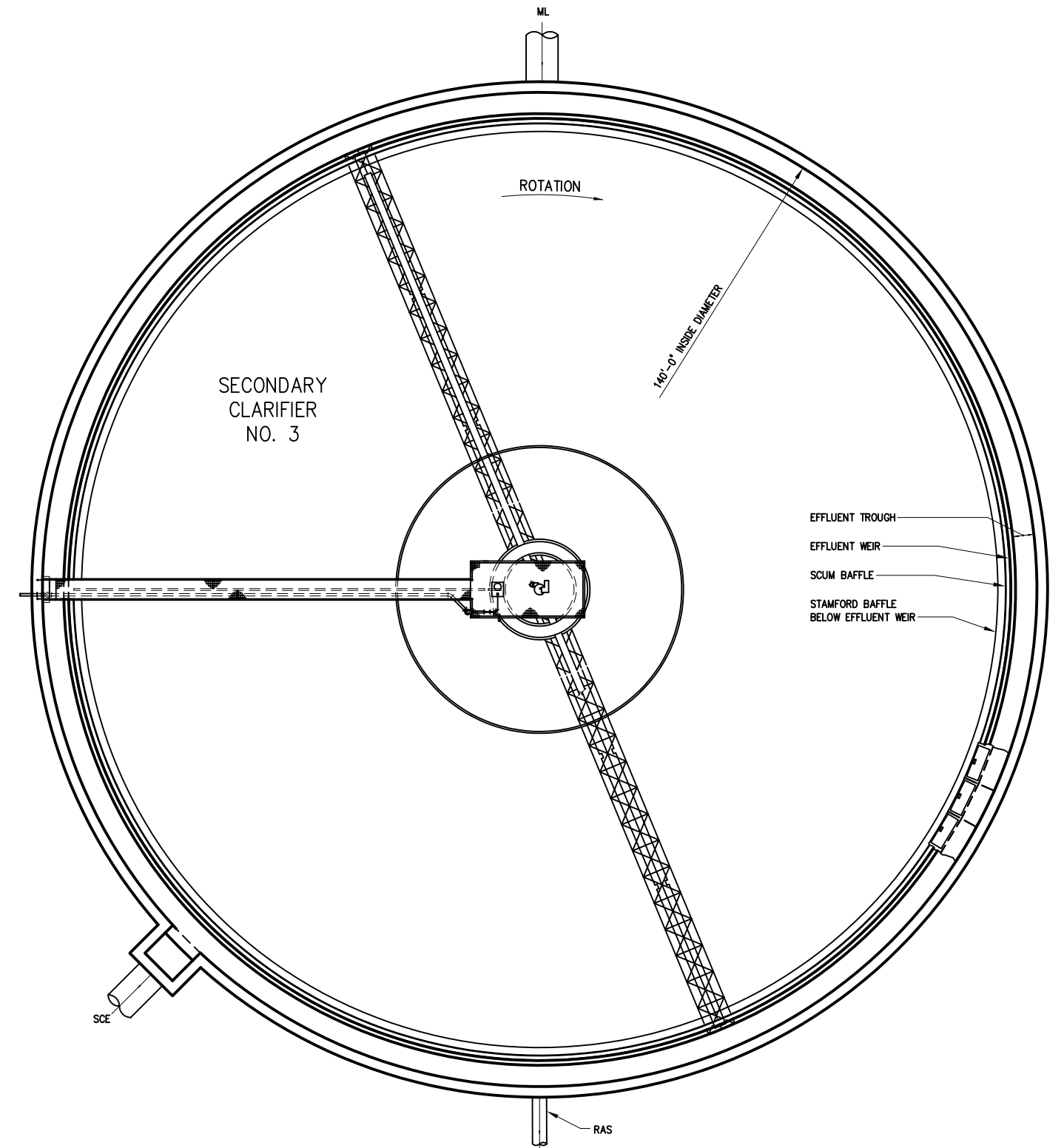
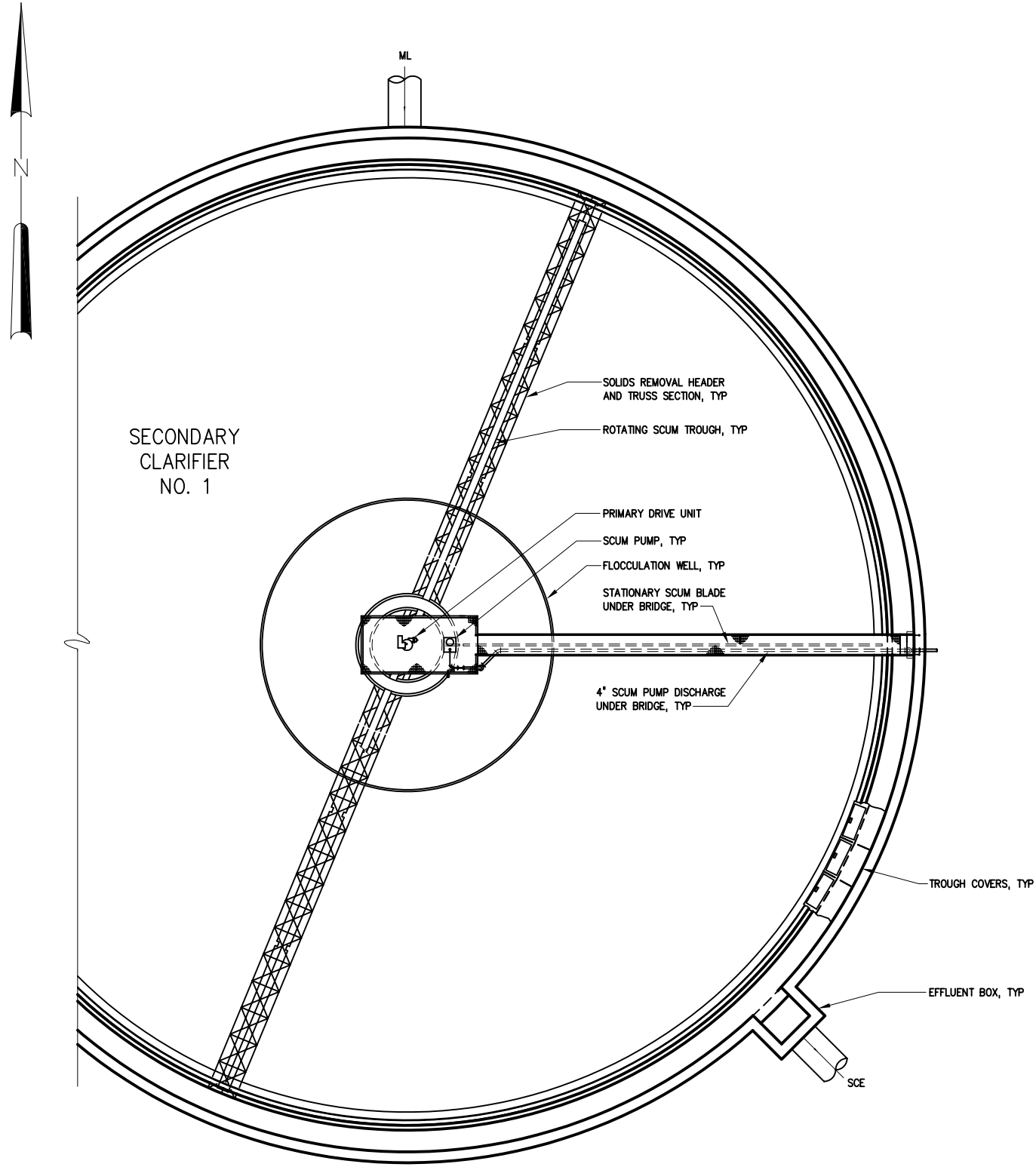
Costs for the proposed facilities are included in Tables 12-6 and 12-7 below:

**TABLE 12-6
 PRELIMINARY COST ESTIMATE
 SECONDARY CLARIFIERS**

Sitework	\$191,000
Structural	\$3,315,000
Mechanical	\$1,546,000
Electrical and Instrumentation	\$47,000
Subtotal	\$5,099,000
Construction Contingencies	\$765,000
Engineering and Construction Services	\$586,000
Legal and Financial	\$323,000
Total Construction Cost	\$6,773,000

**TABLE 12-7
 PRELIMINARY COST ESTIMATE
 RAS/WAS PUMPING FACILITIES**

Sitework	\$26,000
Structural	\$456,000
Mechanical	\$730,000
Electrical and Instrumentation	\$353,000
Subtotal	\$1,562,000
Construction Contingencies	\$234,000
Engineering and Construction Services	\$180,000
Legal and Financial	\$99,000
Total Construction Cost	\$2,075,000



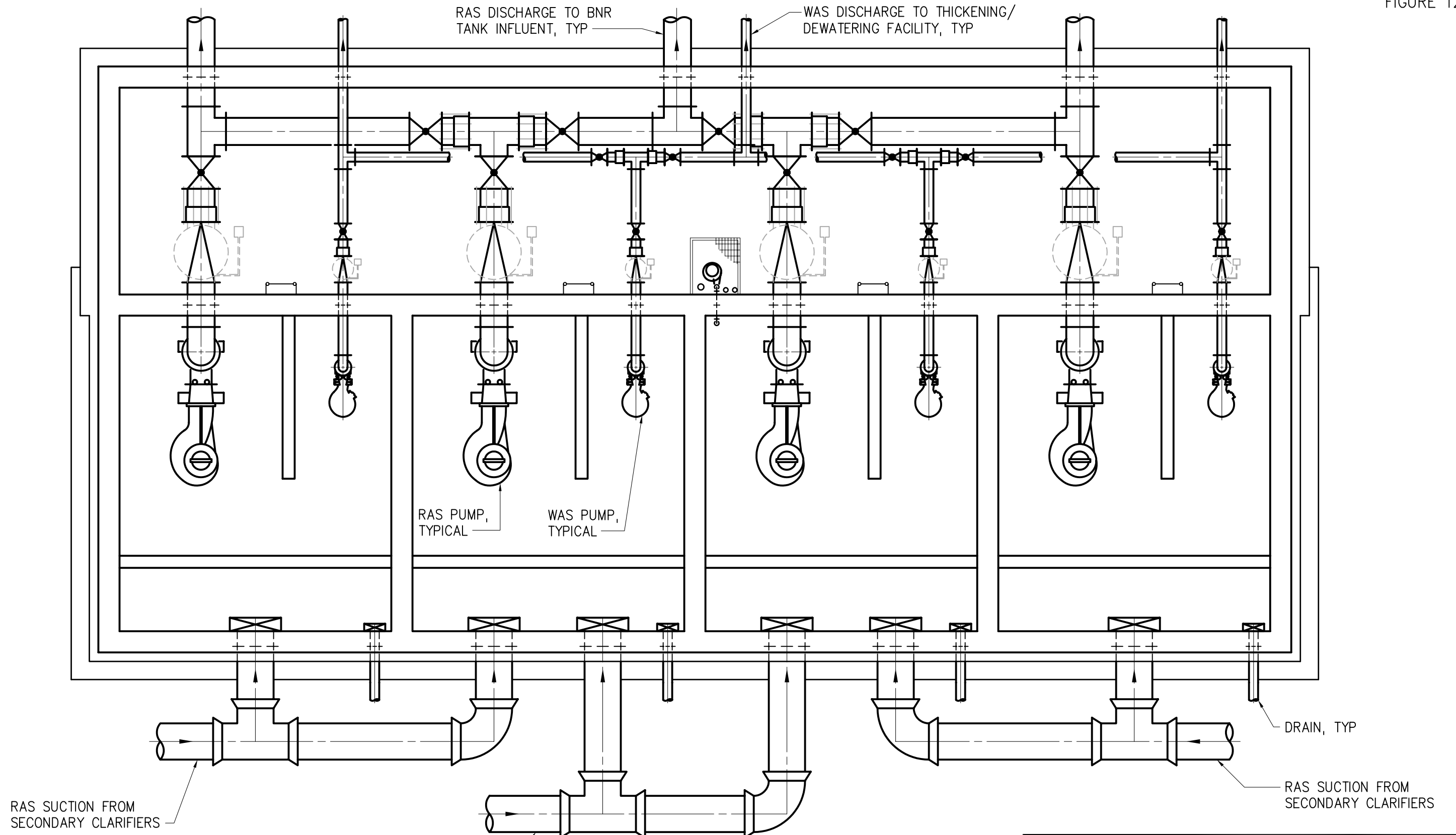
PLAN

1" = 20'

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SECONDARY CLARIFIERS
PLAN





PLAN

3/16"=1'-0"

WESTERN WAKE REGIONAL WASTEWATER MANAGEMENT FACILITIES
RAS/WAS PUMP STATION PLAN