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WASTEWATER COLLECTION AND TREATMENT INSPECTION FOR THE GUAM WATERWORKS AUTHORITY

Wastewater Collection and Treatment
Guam, United States Territory
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Project Manager:

Trent Rainey, Environmental Engineer

Authors:
Trent Rainey, P.E., Environmental Engineer
Daren Vanlerberghe, Environmental Engineer

Prepared for:

EPA Region 9
75 Hawthorne Street
San Francisco, California 94105

Authorized for Release by:

Suzanne Schulman, Civil Services Section Chief

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
P.O. Box 25227
Building 25, Denver Federal Center
Denver, Colorado 80225-5227

NEIC

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PURPOSE OF INSPECTION OF THE GUAM WASTEWATER COLLECTION AND TREATMENT SYSTEMS

As authorized under Section 308 of the Federal Clean Water Act, Trent Rainey, P.E., and Daren Vanlerberghe, duly commissioned enforcement officers of the U.S. Environmental Protection Agency (EPA), performed an inspection of the Guam Waterworks Authority (GWA) wastewater collection and treatment system. The primary purpose of this inspection was to evaluate the management, operations, and maintenance of the wastewater collection system and the five National Pollutant Discharge Elimination System (NPDES)-permitted sewerage treatment plants (STP) owned and operated by GWA.

A brief summary of findings were presented to GWA and Guam Environmental Protection Agency (GEPA) management on May 4, 2012.

PREPARATION FOR THE GWA WASTEWATER COLLECTION AND TREATMENT SYSTEM INSPECTION

The inspectors reviewed and evaluated the following information before performing the inspection:

- *Guam Water Resources Master Plan* (WRMP), October 2006
- Stipulated Order for Preliminary Relief, United States District Court Territory of Guam, Civil Case No. 02-00035
- Quarterly Stipulated Order Compliance Progress Report No. 30

KICKOFF MEETINGS

A preliminary meeting with GEPA was conducted on April 23, 2012, at the GEPA headquarters facility at Building 17-3304, Mariner Avenue, Tiyan Barrigada. In attendance were GEPA Director Eric Palacios, GEPA Acting Chief Engineer Angel Marquez, and the following GEPA personnel: Maricar Quezon, Johnny Abedania, Benny Cruz, and Jerry Aquino. Also attending were Michael Mann from EPA Region 9 and Trent Rainey, Kacy Sable, Daren Vanlerberghe, and David Parker from EPA's National Enforcement Investigation Center (NEIC). The purpose of this meeting was to introduce the EPA NEIC water and wastewater inspection team members, review the goals of this inspection, and to discuss matters of relevance to this inspection with the GEPA regulators.

An opening conference took place on April 24, 2012, at the GWA administrative office. In attendance for GWA included Martin Roush (general manager, David Fletcher, Daniel Aguon, Thomas Cruz, Prudencio Aguon, Geigy Salayon, Nicole Quan, Ann Borja, Marc Lopez, and Grace Cruz. EPA NEIC inspectors attending included Trent Rainey, Kacy Sable, Daren Vanlerberghe, and David Parker. Also present were Angel Marquez and Jerry Aquino from GEPA. For a complete list of participants in the opening conference, see **General Appendix A – Opening Conference Sign-in Sheet**. The purpose of the inspection was explained, and the schedule was discussed. EPA inspectors presented a copy of the inspection notification letter (dated April 17, 2012) and credentials to M Roush. Arrangements were made for GWA personnel to accompany EPA and GEPA during the field portion of the inspection over the next two weeks.

Additional meetings and discussion took place during the course of the inspection, primarily with GWA managers and operating personnel.

GWA WASTEWATER SYSTEM: OVERVIEW AND GENERAL DESCRIPTION

ORGANIZATIONAL STRUCTURE

The Congress of Guam passed Public Law 1-12 on June 30, 1950, which gave the Department of Public Works the authority to administer all utility services. As a result of the need to expand utility services, the 1st Guam Legislature passed Public Law 1-88 on June 6, 1952, thereby creating the Public Utility Agency of Guam (PUAG) to administer the drinking water and wastewater utilities. The Guam Waterworks Authority was formed as a semi-autonomous, self-supporting agency on July 21, 1996, with the passage of Public Law 23-119.

GWA is responsible for all aspects of the engineering, operation, and maintenance of the wastewater system, including the collection system and treatment plants.

GWA is managed by the elected, non-partisan, five-member Consolidated Commission on Utilities, which oversees the operations of both GWA and the Guam Power Authority (GPA). Day-to-day management of GWA is under the oversight of M. Roush, who serves as the general manager. Paul Kemp serves as the assistant general manager of GWA. The GWA organizational structure is illustrated in Figure 1.

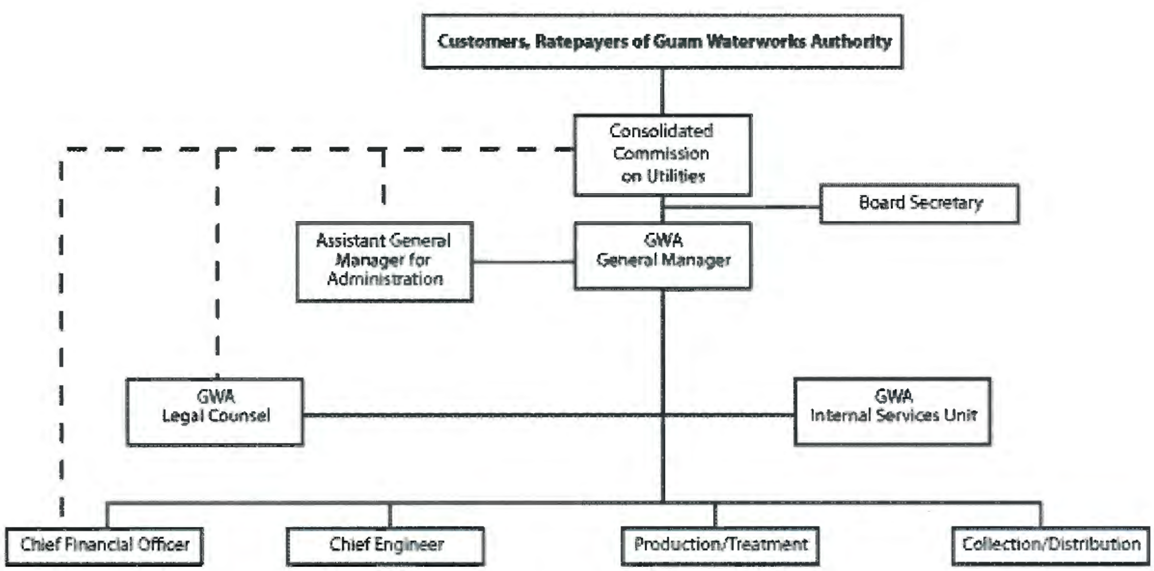

Figure 1. Guam Waterworks Authority organization chart
Guam Waterworks Authority
Guam, United States Territory

WASTEWATER SYSTEM - POPULATION AND COVERAGE

Guam is the southernmost island in the Mariana chain and is also the largest island in Micronesia. It is 30 miles long and varies between 4 to 12 miles wide. The island has a total area of approximately 212 square miles. The island does experience tropical cyclones and earthquakes on occasion.

GWA is charged with providing wastewater services to the civilian population of the island. According to the 2010 U.S. census, the islands population was 159,358. The heaviest concentration of the population is in the northern and central portions of the island.

GWA provides wastewater collection services, as described in the "GWA Wastewater Collection System" section of this report. Wastewater treatment is provided by seven sewerage treatment plants (also referred to as wastewater treatment plants [WWTP]) operated by GWA, as described in the "GWA Sewerage Treatment System" section of this report.

GWA WASTEWATER COLLECTION SYSTEM INSPECTION

NEIC conducted an inspection of GWA's wastewater collection system from April 24 through May 4, 2012. The objective of the inspection was to observe and document the physical condition, operation, and maintenance of GWA's collection system. The inspection consisted of discussions with GWA staff, observation of collection system components and associated operation and maintenance activities, and review of documents and records. Photographs of the collection system taken by NEIC during the inspection are included in **Appendix Collection System (CS)-A**.

COLLECTION SYSTEM OVERVIEW

According to GWA staff, the description of the wastewater collection system included in the 2006 *Guam Water Resources Management Plan* (2006 WRMP) is still mostly current. The 2006 WRMP states that GWA's collection system consists of approximately 1,420,000 feet of gravity sewer, 77 force mains that total approximately 240,000 feet, approximately 6,480 manholes, and 77 pump or ejector stations (73 at the time of the inspection). According to the 2006 WRMP, the construction of the existing collection system began in the mid-1960s and pipe diameter sizes range from 4 to 48 inches, with the majority 8 inches in diameter. The pipe material is mostly polyvinylchloride (approximately 580,000 feet) and asbestos concrete pipe (approximately 460,000 feet); approximately 360,000 feet of pipe material is unknown.

COLLECTION SYSTEM OPERATION AND MAINTENANCE

GWA's wastewater operations and maintenance (O&M), including the wastewater collection system and the STPs, is managed under a Performance Management Contract by Veolia Water Guam LLC. Veolia establishes operating procedures and schedules for conducting maintenance activities. GWA staff perform day-to-day collection system O&M activities. GWA's wastewater O&M management structure consists of a wastewater division with three superintendents and associated staff: wastewater treatment, wastewater collection system, and wastewater maintenance. Pump station operation and sewer cleaning/inspection activities are managed by the wastewater collection system superintendent. Wastewater maintenance is centralized; therefore, both wastewater collection system and wastewater treatment plant maintenance activities are managed by the wastewater maintenance superintendent.

For operational purposes, GWA's wastewater system is divided into three districts, designated as the Northern, Central, and Southern Districts. The three wastewater districts each are aligned with the service area of GWA's STPs. The Northern District is served by the Northern District STP; the Central District is served by the Hagatna and Pago Socio STPs; and the Southern District is served by the Agat, Umatac-Merizo, Baza Gardens, and Inarajan STPs. Figure 2 shows the three wastewater districts and associated STPs.

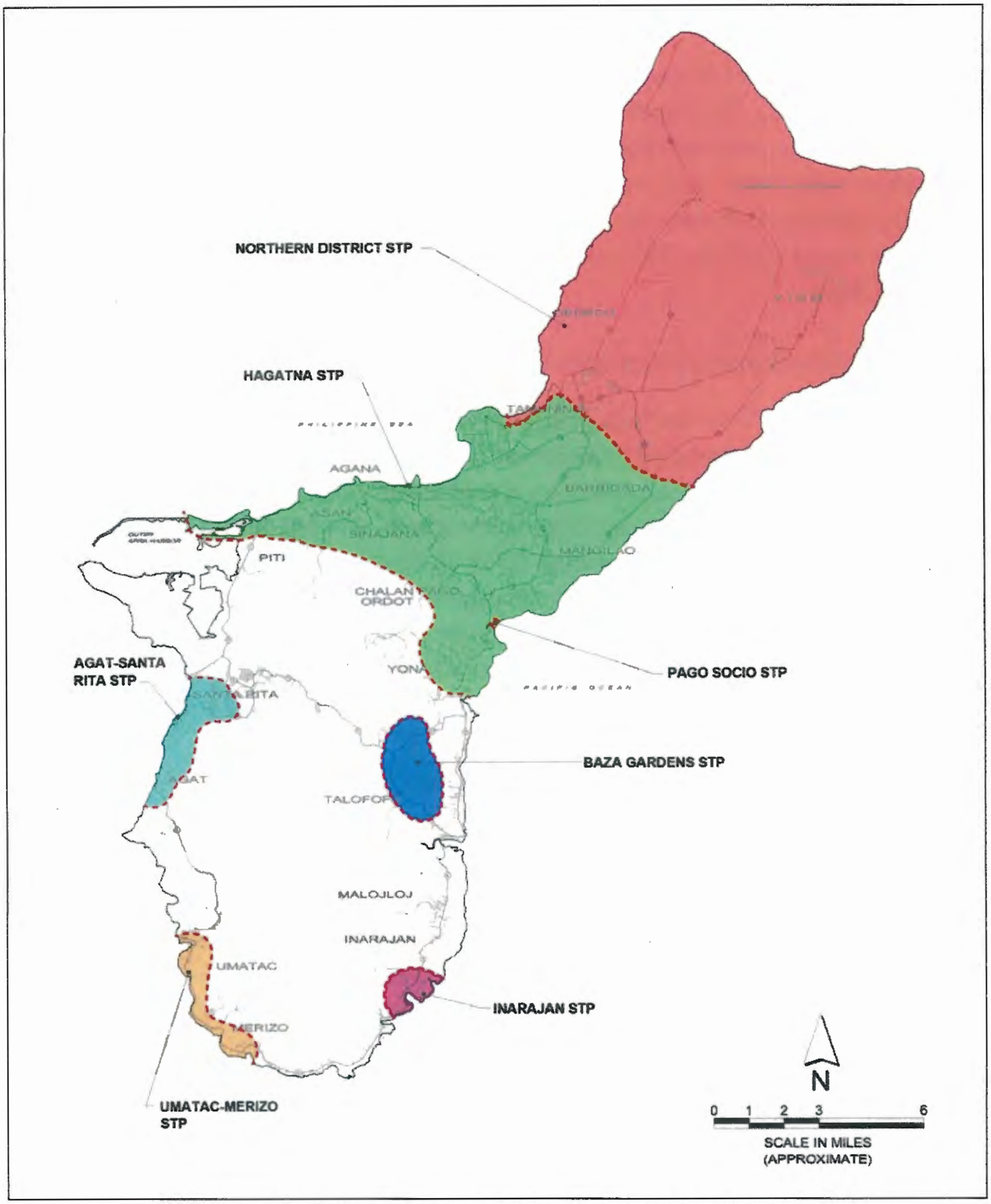

Figure 2. GWA wastewater districts and associated STPs
Guam Waterworks Authority
Guam, United States Territory

Pump Station Operation and Maintenance

GWA operates and maintains 73 pump stations to convey wastewater to one of the seven STPs operated by GWA. **Appendix CS-B** contains a list of GWA's pump stations organized by associated STP. **Appendix CS-C** contains a block flow diagram of the pump stations organized by wastewater district and showing the flow path from the pump stations to the associated STPs.

Standard operating procedures (SOPs) have been developed for pump station operation, ejector pump station operation, pump station alarm inspections (for those stations with alarm systems), monthly pump station audits, and pump station emergency response. The SOPs state that all pump stations are to be routinely monitored and checked and refer to daily system checks.

GWA operators, also called "rovers," are responsible for the day-to-day operation of the pump stations. Rovers are assigned to one of the three wastewater districts and work days are divided into three 8-hour shifts—day, swing, and night (graveyard). Rovers work in two-person crews, with one crew for each wastewater district for each assigned shift. Rover crews work all three shifts in the Northern District, while crews work only the day and swing shifts in the Central and Southern Districts. While not specified in the SOPs, according to discussions with GWA staff, rover crews are scheduled to visit each pump station in each wastewater district once per assigned shift each day. Rovers complete travel sheets to document pump station visits and also maintain notes regarding pump station visits in logbooks kept at each station.

At the time of the inspection, only seven of the GWA pump stations were equipped with telemetry and alarm systems for remote monitoring and operation. The remaining pump stations had no alarms systems (remote or local) at the time of the inspection. The seven pump stations with telemetry were:

- Fujita
- Southern Link
- Tai Mangilao
- Umatac-Merizo PS 19
- Tipaleo
- Gaan
- Chaligan

The telemetry systems were installed within the past year, and GWA is considering installation at three more pump stations by the end of 2012. The systems consist of programmable logic controllers (PLCs) with variable-frequency drive (VFD) pumps. The telemetry system is monitored remotely by computer at the central maintenance warehouse near the Hagatna STP. The system allows for remote pump operation and monitoring of wet well levels, and includes alarms for overflows, power failures, high and low wet well levels, pump trips, and generator failures. **Appendix CS-D** contains an SOP for "Wastewater Pumping Facilities PLC Controller and VFD Alarm Inspections." **Appendix CS-E** contains various wet well set points for the seven pump stations equipped with telemetry.

Pump Station Inspection Observations

NEIC inspected 29 pump stations, including pump stations in all three wastewater districts and stations tributary to six of GWA's seven STPs (the Pago Socio STP has no associated pump stations). NEIC selected the 29 pump stations for inspection partially based on GEPA sewage spill data and frequency of sewage spills associated with pump station locations, as well as selecting pump stations associated with all six of the receiving STPs. **Appendix CS-F** is a summary table of the pump stations inspected by NEIC. The following are observations and issues associated with GWA pump station operation and maintenance identified during the NEIC inspection.

- GWA's ability to respond to pump station failures and operational issues in a timely manner is a major concern. Of GWA's 73 pump stations, only 7 were equipped with telemetry and alarm systems, while the remainder had no alarm systems to alert GWA of pump system failures and other problems. In the absence of telemetry and/or alarm systems, GWA is relying on the system of rovers to physically visit the pump stations to identify issues. However, the rover system is not a reliable means for detecting all pump station issues and spills. In the Central and Southern wastewater districts, rovers do not visit pump stations during the 8-hour graveyard shift. A review of rover travel sheets for all three wastewater districts for January through April 2012 shows numerous instances when no visit to certain pump stations was documented during a given shift, including shifts when no pump station visits were documented in a given district (**Appendix CS-G**). In some instances, it appears on the travels sheets that rovers may be called to respond to other collection system issues (e.g., sewer backups), affecting their ability to visit all of the pump stations during a shift (**Appendix CS-G**). During one incident, GWA staff discovered a spill at the Yigo pump station on January 25, 2012 that was estimated to have been occurring for at least two days, following the failure of the rovers to make a documented scheduled visit to the pump station. (See page 23 of this report for more detail on the Yigo pump station spill.)
- Several instances of inoperable equipment were observed during the inspection of the pump stations (e.g., inoperable pumps, pumps out for repair, lack of a backup power source, etc.). Seven of the 29 pump stations inspected had one or more pumps out of service for periods ranging from 1 week to more than 1 year. Three of the inspected pump stations had no backup power. The following observations were made during the NEIC inspection:
    - Two of four pumps at the Route 16 (Liguan Terrace) pump station were out of service. The pumps had been out of service for more than 1 year.
    - No backup power was available at the Santa Ana pump station. Backup power has not been available at the pump station for at least 2 years.
    - One of two ejector pumps was out of service at the Namo pump station. The ejector pump had been out of service for approximately 6 months. In addition, no backup power was available at the Namo pump station.
    - No backup power was available at the Casimero pump station.
    - One of four pumps at the Agana Main pump station was out of service. The pump had been out of service for about 1 week due to a bearing issue.
    - One of three pumps at the Mamajanao pump station was out of service. The pump had been out of service for about 1 year.

- One of two pumps at the Umatac-Merizo pump station 20 was out of service. The pump had been out of service for about 1 month.
- One of two pumps at the Inarajan Main pump station was out of service. The pump had been out of service for about 2 months.
- One of two pumps at the Talafofo pump station was out of service. The pump had been out of service for about 1 week.

- Despite several requests during and after the NEIC inspection, GWA staff were unable to produce pump station specification sheets for all pump stations. During the inspection, GWA rovers provided specification sheets for six of the pump stations and stated that the sheets should be available for all of the pump stations. The specification sheets include information on pumps and pump capacities, wet well capacities, level controllers, standby generators, and inlet and outlet piping, among other items.
- Asset management issues associated with the pump stations were discussed during the inspection, such as lack of a robust spare parts and equipment inventory and the inability to repair certain pieces of equipment in a timely manner. GWA staff acknowledged that work is needed on their asset management system and began working with Camp Dresser and McKee Inc. (CDM) regarding asset management in January 2012. As an example, GWA staff stated that the asset inventory at the time of the inspection is not listed by facility (e.g., number of parts listed, but not number of parts listed for a specific pump station).

The November 2011 Court Order (2011 Order) requires GWA to report a summary of all sanitary sewer overflow (SSO) occurrences on a quarterly basis to EPA and to include the location, cause, and estimated volume of each SSO, among other items. (See page 21 of this report for a detailed discussion of SSO identification, response, reporting, and notification issues.) **Appendix CS-H** contains a summary of SSOs from October 2011 through September 2012 reported by GWA to EPA under the Court Order. Of the 136 total SSOs reported by GWA during that time frame, 44 SSOs were associated with pump stations, and 31 SSOs (23 percent of the total) were attributed to pump station equipment failure or power outages. The following are observations associated with GWA pump stations based on a review of the SSOs reported by GWA to EPA from October 2011 through September 2012. (Note: GWA does not always identify the specific pump station by name in the quarterly SSO reports submitted to EPA.)

- 8 SSOs were reported at the Harmon pump station (identified as "Rojas Dr."), 7 of which were attributed to high flows exceeding the capacity of the pump station.
- 5 SSOs were reported at the Astumbo No. 1 pump station (also identified as "Ch. Fago or Chalon Fago St."), all of which were attributed to equipment failures.
- 4 SSOs were reported at the Yigo pump station (identified as "Chn. or Chln. Nanalao"), all of which were attributed to repeated bubbler level control compressor failures.
- 3 SSOs were reported at the Mangilao pump station, all resulting in the overflow of sewage from a nearby baseball field restroom.
- 3 SSOs were reported at the Mongmong Toto pump station for varying causes.
- 2 SSOs were reported at the Namo pump station, both attributed to equipment failures. As noted previously in this report, one of two ejector pumps was out of service at the Namo pump station at the time of the NEIC inspection and had been out of service for

approximately 6 months. In addition, no backup power was available at the Namo pump station.

Infiltration and Inflow Analysis

GWA was scheduled to conduct infiltration and inflow (I/I) analyses with follow-up sewer system evaluation surveys (SSESs) beginning in May/June 2012, following the NEIC inspection. GWA acknowledged that significant I/I problems exist, particularly in the Southern District sewer system, and that the I/I analyses and SSESs are necessary to determine the extent of the problems. During the time frame of October 2011 through September 2012, GWA reported 22 SSOs that were attributed to capacity-related issues and heavy rainfall (**Appendix CS-H**).

Per the 2011 Order, GWA is required to conduct I/I analyses for all portions of the sanitary sewer system tributary to the Hagatna, Agat, Baza Gardens, and Umatac-Merizo WWTPs. For those sanitary sewer system basins determined to be subject to excessive I/I as defined by the 2011 Order, GWA is required to conduct SSESs. GWA submitted a draft I/I and SSES Work Plan to EPA in October 2011. GWA submitted a revised I/I Analyses and SSES Work Plan to EPA on March 26, 2012. In June 2012, EPA disapproved GWA's plan as inadequate.

Because GWA has not conducted any recent I/I analyses and had not yet conducted the I/I analyses required by the 2011 Order at the time of the inspection, NEIC was not able to conduct a formal evaluation of GWA's I/I issues. A wastewater collection system assessment was conducted by a GWA contractor as part of the 2006 WRMP. As part of the assessment, short-term rainfall and flow monitoring of the collection system was conducted during August and September 2005 and a limited hydraulic model of the collection system was developed. PG Environmental's (PG) January 29, 2010 *GWA Master Planning Technical Assessment* report (2010 PG Assessment Report) (**Appendix CS-I**) included an assessment of the hydraulic model used in the 2006 WRMP. In the assessment report, PG stated that the hydraulic model used for the WRMP was inadequate for the following reasons:

- It did not accurately model sewer surcharge conditions.
- Only 35 percent of the existing sewers were represented, and portions of that system were inaccurately modeled.
- The flow data collected for model calibration was inaccurate because they did not include SSO volumes.
- Because of its steady-state hydraulic engine, the software could not accurately model some of the complex configurations present in the sanitary sewer system.
- GWA personnel were not fully trained in use of the software.

As stated in the PG assessment report, the deficiencies in the hydraulic model significantly compromise its usefulness.

Through the course of the inspection and during discussions with GWA staff, potential sources of I/I were identified. One likely major source is through manholes. GWA does not have a current manhole inspection program. Approximately 300 manholes were inspected as part of the 2006 WRMP. Approximately 24 percent of the manholes inspected were found to have no seal between the manhole cover frame and the manhole ring, a potential source of inflow. Seven manholes showed evidence or active infiltration from the manhole wall. As an example of the types of manhole structure defects that allow infiltration to the sewer system, on April 25, 2012, NEIC observed a large hole in a manhole structure adjacent to a roadside storm ditch (**Appendix CS-A, Photographs RIMG0009–RIMG0011**). Another source of inflow identified by GWA was the direct connection of yards drains into the sewer system, most prevalent in the Southern District. GWA has conducted sewer smoke tests in the Southern District that have identified residential yard drains/cleanouts directly connected to the sanitary sewer system.

Limited STP influent wastewater concentration data was provided during the NEIC inspection. A review of influent wastewater data for the Agat and Umatac-Merizo STPs (**Appendix CS-J**) shows that relatively low strength influent wastewater was being discharged to those two STPs, which may be indicative of potential I/I problems. Table 1 summarizes the average influent biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations reported on GWA's monthly operations reports for the Agat and Umatac-Merizo STPs for February 2011 through August 2011. The typical composition of untreated domestic wastewater has a low strength BOD concentration of 110 mg/L and a TSS concentration of 120 mg/L.[1]

Table 1. INFLUENT WASTEWATER CONCENTRATION DATA
Guam Waterworks Authority
Guam, United States Territory

	Agat STP Influent Concentration		Umatac-Merizo STP Influent Concentration	
	BOD (mg/L)	TSS (mg/L)	BOD (mg/L)	TSS (mg/L)
February 2011	59	68	37	40
March 2011	66	72	53	70
April 2011	74	74	34	53
May 2011	71	68	49	93
June 2011	57	68	22	70
July 2011	44	58	14	26
August 2011	66	52	18	34

[1] "Wastewater Engineering: Treatment and Reuse" 4th Edition. Metcalf and Eddy. 2003 McGraw-Hill

Sewer Cleaning and Televising

The 2011 Order requires GWA to implement a sanitary sewer system cleaning program that includes cleaning each gravity sewer main at least once every 5 years and cleaning at least 55 unique miles of gravity sewer main each calendar year. The 2011 Order also requires GWA to implement a hot spot cleaning program to address sewer areas with recurring blockages with more frequent sewer cleanings. In addition, the 2011 Order requires GWA to implement a closed-circuit television (CCTV) sewer inspection program to include inspection and assessment of 40 percent of the gravity sewer mains within 2 years and all of the gravity sewer mains within 5 years. NEIC discussed GWA's sewer cleaning and CCTV inspection program and observed GWA's sewer cleaning and CCTV inspection crews in operation on May 2, 2012.

At the time of the NEIC inspection, GWA had two combination vactor/jet cleaning (vactor) trucks and one CCTV truck. One vactor truck was out of service for repairs at the time of the inspection. GWA staff stated that contract sewer cleaning vendors are also used as needed. GWA staff stated that a second CCTV truck and a replacement camera for the existing CCTV truck is anticipated to be in place by the end of summer 2012. Sewer cleaning and CCTV status reports are already being submitted to EPA as required by the 2011 Order; therefore, NEIC did not conduct a comprehensive review of sewer cleaning and CCTV inspection records. In general, GWA staff stated that they were on schedule for 2012 to meet the sewer cleaning requirements, but behind schedule on meeting the CCTV inspection requirements.

A compliance report submitted by GWA on April 9, 2012, as required by the 2011 Order, states that GWA currently has two sewer cleaning crews consisting of four staff for each crew and one CCTV inspection crew consisting of three staff. According to Efrin Alano, GWA wastewater construction maintenance superintendent, cleaning crews consist of two staff per crew and the CCTV inspection crew consists of two or three staff, depending on the amount of traffic in the inspection area.

NEIC observed one cleaning crew and the CCTV inspection crew in operation on May 2, 2012, in the Southern District along Route 2 south of the Agat WWTP and north of the Chaligan pump station (sewer line from Agat manhole No. 7254 to Agat manhole No. 7257). The following are observations and issues associated with GWA's sewer cleaning and CCTV inspection programs identified during the NEIC inspection.

- According to E. Alano, GWA's existing vactor trucks cannot be used to clean 4-inch sewer lines because the vactor nozzles are too big. GWA contracts with sewer cleaning vendors to clean 4-inch lines. The 2006 WRMP states that GWA has 110,000 feet of sewer less than 8 inches in diameter, but there is no estimate for the amount of 4-inch sewer lines.
- During the inspection on May 2, 2012, GWA staff did not clean the sewer line prior to televising, resulting in delays and operational issues with the CCTV camera. Joe Aguon, GWA CCTV operator, stated that GWA does not typically clean the sewer lines prior to CCTV inspections. Because the sewer line had not been cleaned, the CCTV camera became stuck in the line and had to be retrieved. The sewer line was subsequently cleaned, and the

CCTV camera was reinstalled, causing delays in the CCTV inspection schedule. Standard industry practice is to have the sewer lines cleaned prior to televising to remove material that could interfere with the operation of the CCTV camera and to allow for better observation of pipe conditions.

- The motorized winch used to install and retrieve the CCTV camera was out of service; therefore, the camera was installed and retrieved manually. According to GWA staff, the winch had been out of service for about 1 week.
- Once reinstalled, the CCTV camera became inoperable as the forward/reverse function of the camera transporter was not responsive. The camera was retrieved and was to be repaired. J. Aguon stated that the wire connections may be getting wet and that this was the third such equipment issue in the last 4 months. J. Aguon stated that if GWA maintenance staff cannot make the required repairs, the camera will need to be sent to a contractor for repair, which could take several days.
- During the CCTV inspection, heavy buildup of sand in the sewer line was observed, which is an indicator of I/I.
- At the time of the NEIC inspection, CCTV inspection data was being sent exclusively to Veolia at an off-island location for analysis. GWA engineers were not receiving CCTV inspection data. GWA was in the process of providing for internal review of the CCTV inspection data.
- At the time of the NEIC inspection, GWA staff stated they had inspected 9 miles of sewer in calendar year 2012. GWA's goal is to inspect 1,112 feet of sewer per day, 5 days per week. GWA's CCTV inspection goals are compatible with the 2011 Order which requires inspection of approximately 108 miles of pipe in 2 years and 269 miles in 5 years. However, GWA's actual CCTV output is behind their goal and will need to be accelerated to accomplish the 2011 Order requirements.

Fats, Oils, and Grease (FOG) Management Program

NEIC discussed fats, oils, and grease (FOG) management with GWA staff during the on-site inspection. M. Roush stated that GWA does not have a formal FOG management program and that grease trap and interceptor enforcement is handled by the Guam Public Health Department and GEPA. M. Roush stated that GWA is seeking to hire a source control manager position whose duties would include FOG management program oversight, industrial pretreatment, and flood control. The source control manager position would include conducting grease trap/interceptor inspections. **Appendix CS-K** contains an excerpt from GWA's 2011-2012 *Draft Pretreatment and Source Control Interim Plan* related to grease control at food service establishments.

M. Roush stated that grease traps are required by Guam public health code. He also stated that GWA is not able to enforce grease trap requirements, and that the Guam Public Health Department and GEPA are the agencies responsible for grease trap enforcement. However, a review of GWA's rules (Title 28, Public Utilities, Guam Administration Rules [GAR]) during the inspection showed that GWA has the authority to require installation of grease traps, and that establishments without effective grease traps shall be subject to termination by GWA of water and/or sewer services (28 GAR § 2105(p)).

PG's 2010 assessment report included an assessment of GWA's FOG program. PG's 2010 assessment report (**Appendix CS-I**) includes the following excerpt:

> *"It was explained to PG that Guam EPA has primary authority and responsibility for regulating grease discharges. However, both Veolia and GWA representatives stated that GWA's sewer use ordinance contains the necessary language to prohibit the introduction of grease into the sewer. Veolia has identified grease as a major concern and has previously requested authorization for hiring and deployment of a grease inspector. In its request, Veolia estimated the payback for this hire to be less than three months (possibly even one month), which is attributed to reduced time and expense responding to blockages and maintaining equipment. The request was denied and the position remains unfilled."*

PG's 2010 assessment report also states that grease problems in the collection system and at the STPs are evident across the entire island, and Veolia representatives stated that grease was the cause for more than 50 percent of all SSOs. Based on a review of the SSOs reported by GWA to EPA from October 2011 through September 2012 (**Appendix CS-H**), GWA reported 61 SSOs as attributed partially or exclusively to grease blockages, accounting for 45 percent of the 136 total SSOs reported by GWA during that time frame.

M. Roush and D. Fletcher, GWA wastewater treatment superintendent, both stated that large amounts of grease are being discharged to the STPs, specifically mentioning that grease is causing effluent issues at the Hagatna STP. During the inspection of the Dairy Road pump station, which serves the Guam Department of Corrections and discharges to the Hagatna STP, GWA rovers stated that overflows have occurred from the pump station due to grease and debris blockages in the force main. NEIC inspectors observed a trash bin used to collect debris from the pump station wet well was about half full of grease on April 30, 2012 (**Appendix CS-A, Photograph RIMG0087**). SSOs occurring on December 11, 2011 and January 6, 2012 at the Dairy Road pump station were reported by GWA to EPA and attributed to grease and debris obstructions.

Overflow Locations

During the course of the inspection, GWA staff identified known recurring SSO locations. The following describes the major recurring SSO locations identified by GWA during the inspection, as well as one location observed during the inspection showing evidence of a recent overflow.

- GWA rovers identified a manhole located in Route 4 in the sewer line downstream of the New Chaot pump station as a frequent overflow point during wet weather conditions. The manhole (identified as No. 940 during the inspection, but also identified as No. 941 in GWA SSO reports) is located on the downslope side of a hill on Route 4 in Hagatna, downstream of the New Chaot pump station force main. Wastewater flowing west enters manhole No. 940

through a 15-inch sewer line and takes an immediate right angle turn south to an adjacent manhole (No. 7635) approximately 8 feet south. The wastewater enters manhole No. 7635 which discharges into a 12-inch sewer line, making a right-angle turn west, and flows by gravity, eventually to the Agana Main pump station. Therefore, insufficient capacity of the gravity sewers downstream of the New Chaot pump station is likely a major contributing cause of the overflows at manhole No. 940. Aerial images of the area with the sewer lines and manholes overlaid on the images are included in **Appendix CS-L**. Photographs of the area and manholes are included in **Appendix CS-A (Photographs RIMG0097–100)**. Figure 3 depicts the wastewater flow and arrangement of the two manholes. According to GWA rovers, the pumps at the New Chaot pump station are operated manually during wet weather high-flow conditions to prevent surcharging of manhole No. 940. The New Chaot pump station has three pumps rated at 3,800 gallons per minute (gpm) each. According to GWA rovers, during high-flow conditions, one pump is operated for 4 minutes at a time. One rover is stationed at the pump station to operate the pumps, and one rover is station near manhole No. 940 to observe the manhole. When manhole No. 940 is observed to be surcharging, the rover at the manhole tells the rover at the pump station to turn the pump off. There was no data available regarding how this operational practice affects the frequency and magnitude of wet weather overflows at manhole No. 940 or other parts of the sewer system in this area. During the time frame of October 2011 through September 2012, GWA reported 7 SSOs from this location (identified as manhole No. 941)(**Appendix CS-H**).

- According to GWA rovers, similar surcharging conditions exist at the Mamajanao pump station as at the New Chaot pump station. If two pumps are operated during high-flow conditions at the Mamajanao pump station, a manhole downstream of the pump station will surcharge and overflow. Similar to the operation at New Chaot, one rover is stationed at the Mamajanao pump station and one rover is stationed near the downstream manhole during high-flow conditions. According to GWA rovers, if conditions require the operation of two pumps, the second pump is operated for 3 minutes at a time, while surcharge conditions are observed at the manhole. There was no data available regarding how this operational practice affects the frequency and magnitude of wet weather overflows at the manhole or other parts of the sewer system in this area. Because the New Chaot and Mamajanao pump stations are both located in the Central District, GWA may not have enough rovers to conduct these manual operations at multiple pump stations during wet weather. Improvements to the Mamajanao pump station were scheduled to begin during May 2012, including the installation of VFD pumps and telemetry.

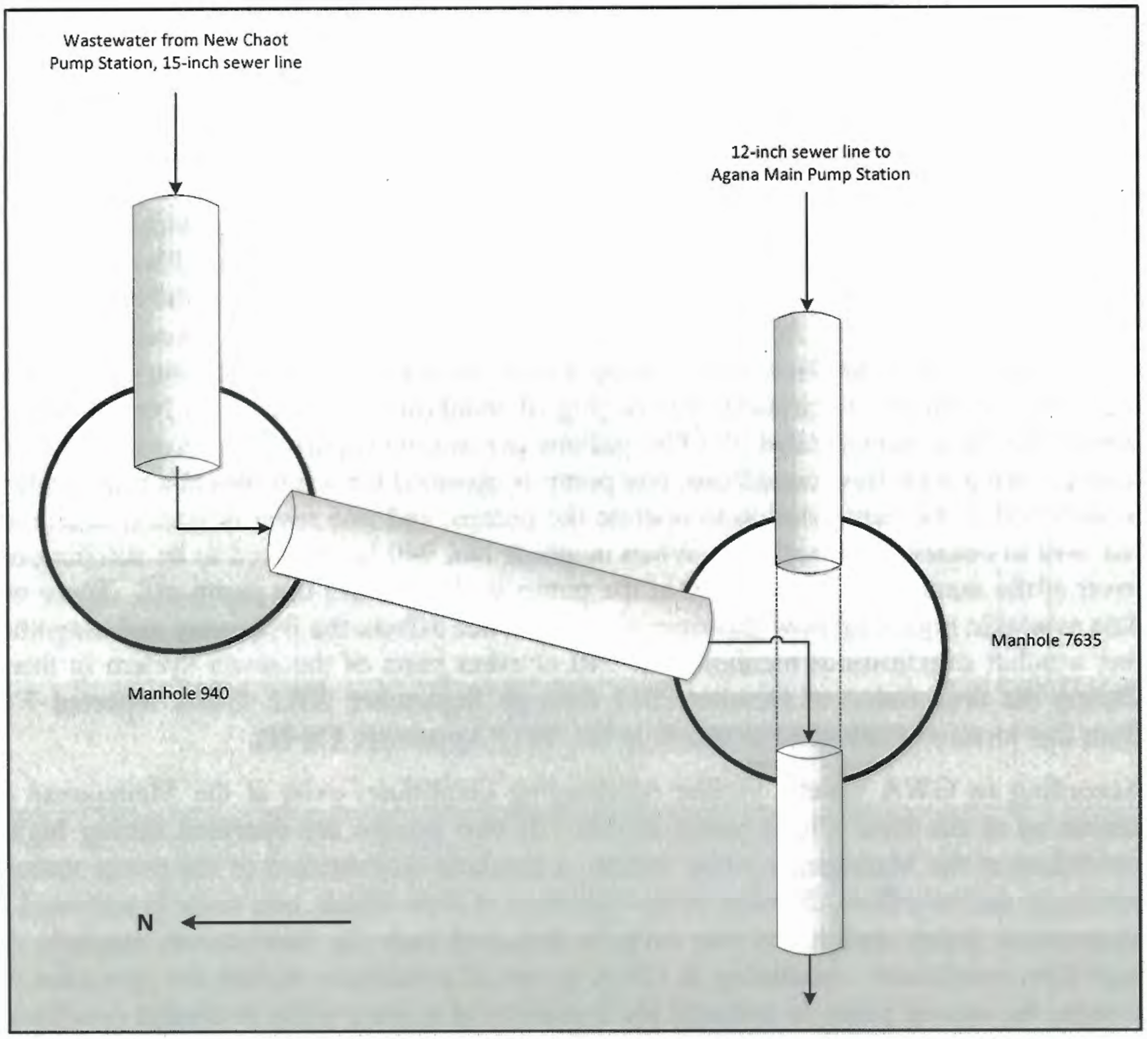

Figure 3. Manhole No. 940 and manhole No. 7635 wastewater flow and configuration.
Guam Waterworks Authority
Guam, United States Territory

- According to GWA rovers, the Harmon pump station in Agana Basin Village is subject to frequent SSOs. The Harmon pump station is maintained by Northern District personnel, but discharges to the Hagatna STP in the Central District via the Agana Main pump station. The overflow point is typically from the nearest manhole on the incoming sewer line to the pump station, located in the road adjacent to the pump station (**Appendix CSA A, Photograph RIMG00126**). As mentioned earlier in this report, for the time frame of October 2011 through September 2012, GWA reported 8 SSOs at the Harmon pump station (identified as "Rojas Dr."), 7 of which were attributed to high flows exceeding the capacity of the pump station. The SSO reports identify the overflow location as manhole No. 7905. The SSO reports also identify another SSO from manhole No. 7905 not specifically related to the Harmon pump station.

- Evidence of a recent SSO was observed at a manhole in the sewer line just upstream of the New Chaot pump station on April 30, 2012. The manhole lid was observed propped open by a branch with signs of an SSO toward an adjacent ditch (debris, toilet paper, stressed vegetation) (**Appendix CS-A, Photographs RIMG0073, RIMG0074, RIMG0075, and RIMG0078**). The ditch was dry at the time of the inspection. GWA rovers could not provide an explanation for the observation or why the manhole lid was propped open. No

SSO in this area or time frame was reported by GWA as part of the quarterly SSO report submitted to EPA as part of the 2011 Order.

Sanitary Sewer Overflow Identification, Response, Reporting, and Notification

NEIC discussed SSO identification, response, reporting, and notification procedures with GWA staff during the on-site inspection. GWA's written SOPs for SSO identification and reporting were not available for review during the on-site inspection; therefore, NEIC did not have the benefit of reviewing the written SOPs for purposes of the on-site inspection discussions. NEIC received GWA's SSO-related SOPs following the inspection. In addition, Paul Kemp, GWA assistant general manager for environmental and safety compliance, who has primary responsibility for GWA's SSO reporting, was not available during the inspection.

During the inspection, E. Alano described GWA's process for responding to SSOs. While GWA rovers may identify SSOs during normal rounds, it appears that the main mechanism for identifying SSOs is through customer calls and complaints. For a customer to trigger GWA's SSO response process, a call to emergency dispatch must occur. The GWA website lists a customer service phone number on the home page for billing questions; however, the emergency dispatch phone number is located on a secondary webpage under "Contact Us." According to GWA staff, the emergency dispatch number is also located on customer utility bills. Also, GWA staff mentioned that the public may call the mayor's office in the various villages, who then know to contact emergency dispatch. As described, once notified, the dispatcher calls the supervisor of the appropriate wastewater district, who then calls the district rovers for incident response. The rovers prepare an incident notification report (INR).

The following five SOPs related to SSO response, reporting, and notification were provided by GWA following the NEIC inspection and are included in **Appendix CS-M**.

- *Sewer Backup and Spill Incident Response*, Version 0, dated September 8, 2009 (SOP 1)
- *Reporting Requirements for Significant GWA Wastewater Utility Issues*, Version 1, dated March 18, 2011 (SOP 2)
- *Sanitary Sewer Overflow Calculation*, Version 1, dated April 2, 2012 (SOP 3)
- *Collection, Managing and Reporting Incident Notification Report and Unique Miles Data*, Version 0, dated April 26, 2012 (SOP 4)
- *Incident Notification Report and Unique Miles Report*, Version 0, dated April 26, 2012 (SOP 5)

The SOPs provided by GWA appear to be duplicative in purpose and/or scope in some instances. SOP 4 and SOP 5 appear to be newer versions of SOP 2 in purpose, with the scope of SOP 2 including road closures. The reporting sections of SOP 1 and SOP 3 have similar, but not identical language, to that in SOP 4 and SOP 5. SOP 4 and SOP 5 appear to be identical in purpose and scope, with slight differences in formatting. GWA provided a list of active SOPs, and GWA considers all five SOPs to be active. The existence of multiple SOPs with similar, but not identical, concurrent provisions could create confusion.

Figure 4 is a schematic for managing and reporting incidents, including SSOs, from SOP 3 and SOP 4. According to the SOPs, the general process consists of field incident response; preparation of an INR; verbal and written reporting of individual incidents; and summary reporting of incidents in monthly, quarterly, and annual reports. While section 4.1 of SOP 2 refers to internal notification when SSOs may have consequence to public use areas and government-owned facilities, cause significant environmental damage, or represent a significant public relations concern (e.g., damage claim, potential press coverage, extremely agitated customer, etc.), GWA does not have a public notification process for informing the public of SSO incidents and the potential associated health impacts. During the inspection, GWA management acknowledged that they have no public notification process for actual SSO occurrences.

The 2011 Order requires GWA to report all SSO occurrences on a quarterly basis to EPA and to include the estimated volume of each SSO, among other items. SOP 3 is the GWA procedure for calculating the volume of an SSO. The SOP includes the following language taken directly from the 2011 Order:

> *"If an SSO or Bypass is reported by someone other than a member of GWA's inspection crew and a GWA inspector determines, upon inspection, that a SSO or Bypass is occurring, the initial timing of the SSO or Bypass, for purposes of determining the volume of discharge, shall commence at the date and time that GWA received the report of the SSO or Bypass event."*

The SOP contains various methods for calculating or estimating the volume of an SSO depending on the nature of the SSO and whether or not the SSO is actively occurring. For SSOs discovered after the fact, the SOP recommends estimation of the volume using the area and depth of the wetted or affected area.

As mentioned above, GWA provides a quarterly SSO summary report to EPA. GWA also provided NEIC individual SSO reports from March 2007 through March 2012 (**Appendix CS-N**). For individual SSO tracking and reporting, GWA currently uses an incident notification form (INF). The INF is referenced and included in SOP 3, which states that all SSOs must be reported using the standard INF. The INF is not referenced in the other four SOPs. SOP 1 and SOP 2 refer to an incident report. SOP 4 and SOP 5 refer to an INR. Based on review of the individual SSO reports, it appears that GWA started using the INF in March 2010.

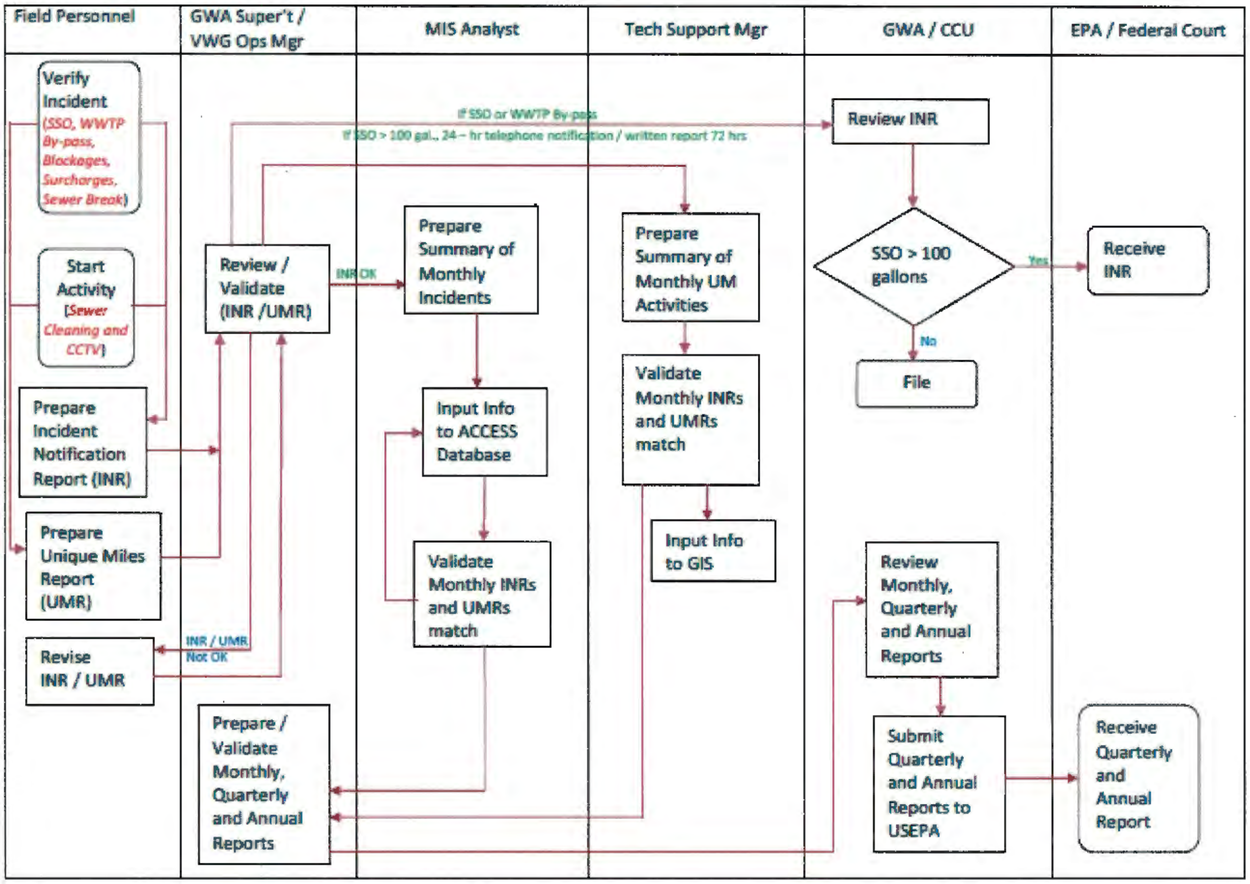

Figure 4. Schematic of managing and reporting incidents.
Guam Waterworks Authority
Guam, United States Territory

During the inspection and discussion with GWA regarding SSO reporting, example INFs were reviewed. One incident reported on January 25, 2012, involved an overflowing manhole near the Yigo pump station due to a pump station failure (**Appendix CS-O**). As described by GWA staff, the incident was "discovered accidentally" and was estimated to have been occurring for at least 2 days. GWA provided a video of the overflowing manhole and surrounding area (**Appendix CS-P**). The INF reports an incident duration of 45 minutes and a total spilled volume of 180 gallons, while GWA's quarterly SSO report submitted pursuant to the 2011 Order reports a total spilled volume of 680 gallons for this incident. GWA staff acknowledged during the NEIC inspection that the incident was of significantly greater duration and volume. A review of rover travel sheets for the time around the incident (**Appendix CS-Q**) shows that the incident was noted at the Yigo pump station on January 25, 2012, with a start time of 3:45 p.m. According to the travel sheets, the last documented visit to the Yigo pump station prior to the incident was on January 23, 2012, at 10:23 a.m. As mentioned earlier in this report, rover crews are supposedly scheduled to visit each pump station in each wastewater district once per assigned shift each day, and crews work all three shifts in the Northern District where the Yigo pump station is located. Due to the lack of pump station failure alarms and the limitations of the rover system, this spill appears to have continued for days before being discovered and controlled.

As described earlier, GWA reported a total of 136 SSOs from October 2011 through September 2012 to EPA as part of the 2011 Order. One metric used to evaluate the relative performance of sanitary sewer systems is the number of SSOs per 100 miles of sewer pipe per year (i.e. sewer spill rate calculated by multiplying the number of SSOs per year by 100 miles and dividing the result by the total miles of sewer pipe in the system). According to the 2006 WRMP, GWA has 1,420,000 feet of gravity sewer and 240,000 feet of force main (or 314.39 miles of pipe). Therefore, GWA's spill rate for October 2011 through September 2012 was 43.26 SSOs per 100 miles per year. By comparison, the California State Water Resources Control Board reported in August 2011 that the average spill rate for the state of California, for data collected from 2007 through 2011, was 8.2 SSOs per 100 miles per year and the median spill rate was 3.4 SSOs per 100 miles per year (Appendix CS-R). For similar sized municipal sewer systems to GWA (200 to 999 miles of sewer pipe), the average spill rate for the state of California was 4.32 SSOs per 100 miles per year and the median spill rate was 1.48 SSOs per 100 miles per year. Based on a 2004 EPA report to Congress, the national average spill rate was 4.5 SSOs per 100 miles per year.

GWA SEWERAGE TREATMENT PLANTS

GWA owns and operates seven separate sewerage treatment plants, as shown in Table 1. During the inspection, each of the STPs was visited. The physical condition of each STP was evaluated and the hydraulic loading to each plant was compared to the recommended standards described in the reference "Wastewater Engineering: Treatment, Disposal, and Reuse, 4th Edition" by Metcalf and Eddy (Metcalf and Eddy), as well as the standards established for each STP in its Process Management Plan (PMP).

Appendices STP-A through STP-G contain NEIC photographs of the STPs, Appendices STP-H through STP-Q contain the NPDES permits and PMPs for the STPs, Appendix STP-R contains an excerpt from the 2006 *Water Management Resources Plan,* and Appendices STP-S through STP-V contain monthly operating reports for the STPs.

Table 2. GWA-OPERATED SEWERAGE TREATMENT PLANTS
Guam Waterworks Authority
Guam, United States Territory

Facility Name	NPDES Permit No.	Design Capacity (million gallons per day	Treatment	Risk Assessment
Northern District STP	GU0020141	12	Primary	Medium
Hagatna STP	GU0020087	12	Primary	Low
Agat-Santa Rita STP	GU0020222	0.75	Secondary	High
Inarajan STP	None	0.191	No discharge	Low
Umatac-Merizo STP	GU0020273	0.391	No discharge/ facultative lagoon	Medium
Baza Gardens STP	GU0020095	0.6	Secondary	High
Pago-Socio STP	None	N/A	Aerated Tank/No discharge	Low

INDIVIDUAL STP RISK ASSESSMENTS

As part of the overall evaluation of the wastewater treatment system operated by GWA, NEIC conducted a risk assessment of each sewerage treatment plant. The risk assessments were based on the following criteria: (1) overall condition of the plant, including structures, mechanical components, and loading (rated on a scale of poor, moderate, or good); 2) existence of parallel treatment trains or backup facilities; and (3) consequences of major failure of individual components. Findings and areas of concern also were identified.

Northern District STP

The Northern District STP is located on the northwestern coast of the island west of Anderson Air Force Base (AFB). It has an average design flow rate of 12.0 million gallons per day (MGD), with a peak flow rate of 27.0 MGD. When the WRMP was written in 2006, the plant provided primary treatment with chemical disinfection. At the time of the inspection, the plant was undergoing major modification to provide enhanced primary treatment.

Influent Waste Water Characteristics

Plant process control data for the months from January 2011 through April 2012 was reviewed to assess waste water characteristics to the plant. The average monthly flow rates varied from a low of 1.31 MGD in April 2011 to a high of 5.04 MGD in February 2011. Samples were analyzed for both Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) at Northern STP; however only 7 of the 16 months records reported influent BOD. Each month reported COD and this can be used as a proxy for BOD, as the months both were reported indicated the ratio of BOD to COD was approximately 0.32. The monthly average COD ranged from a low of 439 mg/L (corresponding to a BOD of 140 mg/L) in April 2012 to a high of 770 mg/L (246 mg/L BOD) in June 2011. The highest single day COD reported was 1331 mg/L in June 2011. The monthly average suspended solids concentration ranged from a low of 169 mg/L in February 2011 to a high of 241 mg/L in March 2012.

The ratio of BOD to COD in typical municipal waste water is 0.3 to 0.8. When this ratio falls below 0.5, the ability of activated sludge systems to effectively treat the waste diminishes. A low ratio may indicate the presence of toxic compounds, or the need for specially acclimated microorganisms. The current plant configuration at Northern does not include biochemical treatment of the wastewater. If the plant were to be modified for secondary treatment in the future, this issue would need to be taken into account.

Head Works

Before major modification began, a Parshall flume and ultrasonic probe were used to measure influent into the plant. The flow could then be split into two separate channels. Each channel was outfitted with a manually cleaned bar screen. After passing through the bar screens, wastewater was treated in aerated grit chambers (two per channel, one chamber following the other). After grit removal, the wastewater was combined in a single wet well before it was discharged to the primary clarifiers.

At the time of the inspection, only one influent channel was in operation. The other channel was out of service and being bypassed to allow installation of an automatic mechanically cleaned bar screen and conversion of the aerated grit chambers into a mixing tank for flash mixing of polymer and flocculant to the waste water and a flocculation tank. According to D. Fletcher, the unmodified grit chamber will be permanently removed from service once the grit chamber modifications are complete. Although the Parshall flume was still in service, the influent flow rate was being monitored from a temporary installation. Influent flow rate was being monitored with an ISCO Model 2150 area velocity meter installed in the influent discharge pipe upstream of the bar screens, and connected to a programmable data logger. The data logger was downloaded every two weeks and the data used to construct a flow chart. The calibration of the meter is reportedly checked when data is downloaded from the data logger. The meter had no readout to check the instantaneous flow on site so the accuracy of the system could not be checked during the inspection. Flow readings could be checked by measuring the flow depth in the Parshall flume and comparing it to the reading measured by the area velocity meter.

Primary Clarifiers

The Northern District STP uses two circular clarifiers for settling solids. Each clarifier is 130 feet in diameter with a sidewall depth of 7 feet and a surface area of 13,267 square feet. The clarifiers are fed from the center and discharge over saw-toothed weirs at the perimeter of the basin. A rotating sweep collects settled solids at the bottom of each basin and deposits the solids in a sump pit. A surface arm attached to the sweep boom directs floating material into a scum box.

As part of the planned plant modifications, the clarifiers were to undergo an overhaul to replace worn out components and refurbish the basins and weirs. Six months before the inspection, the drive system for one clarifier failed, requiring it to be taken out of service for repair. At the time of the inspection, only one of the clarifiers was in operation, with the other being by-passed. The out-of-service unit was being overhauled as per the modification plan. The center column and solids sweep had been completely removed. A new effluent weir and scum box had been installed. According to D. Fletcher, the replacement boom was on-site. GWA was still awaiting delivery of the replacement drive motor and gear box at the time of the inspection.

Northern STP has reported frequent effluent limit violations for BOD and TSS. Substantial amounts of solids were observed passing over the weir at the clarifier and were observed being discharged at the plant out fall. This is generally a consequence of either excessive hydraulic loading or maintaining too high a sludge blanket in the clarifier. The second condition can lead to solids wash out, especially during higher flow conditions. Loss of solids from the clarifier would be represented as higher BOD and TSS in the effluent.

Anaerobic Digesters

The Northern District STP has two anaerobic digesters for stabilization of settled solids and surface scum from the primary clarifiers. Each clarifier has a capacity of 789,169 gallons and a surface area of 5024 square feet. At the time of the inspection, both digesters were being used as sedimentation tanks only and for storing solids. Based on a prior inspection by PG in 2006, this condition had been ongoing since 2006. The gas recirculation systems and sludge heating systems were not operational. Under these conditions, solids stabilization would be minimal at best. Supernatant was pumped back to the head works of the plant. Because the digesters were not operating to stabilize the solids and thereby reduce the concentration of BOD, the BOD loading to the plant would be increased beyond what the influent wastewater would supply.

Solids Handling

Sludge from the digesters was being dewatered on eight sand drying beds at the time of the inspection. According to the October 2006 *Water Resources Master Plan*, the plant was equipped with two centrifuges for dewatering solids. The centrifuges had been removed at the time of the inspection and the building housing them was under reconstruction to accommodate the planned installation of replacement units. Under the current procedure, the sand drying beds are used 6 months of the year, during the dry season. During the rainy season, solids are pumped from the secondary digester into tanker trucks and shipped to the Hagatna STP for dewatering.

A sludge holding tank was planned as part of the plant modification project. The base for the tank was under construction at the time of the inspection.

Disinfection

At the time of the inspection, no disinfection was taking place. The combined effluent from the primary clarifiers discharged through a Parshall flume. In the past, the flume has been used for measuring effluent flow rate, but it was not in use at the time of the inspection. All plant flow was being reported based on the temporary flow measurement system at the head works. The effluent was split between two chlorine contact tanks. Both tanks appeared to be receiving approximately equal volumes of inflow. A surface skimmer was installed at the discharge weir for each tank. Considerable amounts of floating solids were present in each tank and in the effluent from the tanks. The discharge from each tank is collected in a common concrete channel, which then discharges into a 48-inch line.

Effluent Sampling

Samples of effluent are collected from the chlorine contact tank discharge channel immediately above the invert to the 48-inch discharge line. A Hach Sigma 900 automatic sampler, with refrigerated sample storage, was installed at this location. The sampler and refrigerator were functional, and the sample collection line appeared clean.

Hydraulic Loading

From the Northern STP Process Management Plan, the design average flow rate is 12 MGD. NEIC examined flow data for the period January 2011 through March 2012. The average flow rate during this period was 5.21 MGD, or less than half the design average. At that flow rate, the surface loading rate for the two clarifiers together is 196.4 gallons per square foot per day (gal/ft^2-day). Even with one clarifier out of service, the hydraulic loading rate would be 393 gal/ft^2-day, which is less than the design peak loading rate of 452 gal/ft^2-day. The maximum single-day flow rate reported during this period was 12 MGD, which yields a surface loading rate of 452 gal/ft^2-day with both clarifiers, or 904.5 gal/ft^2-day with one clarifier out of service. At that flow rate, the design peak hydraulic loading rate is just met with both clarifiers in service; it is greatly exceeded when only one clarifer is in operation. Under those conditions, there is an increased risk of solids wash out, which could lead to permit effluent limit violations for BOD and Total Suspended Solids (TSS). The plant has reported violations for both of these parameters.

Risk Assessment

1. Overall condition: The influent head works were operating with only a single train in service, due to modifications associated with the plant head works. Having only a single train in operation puts an additional load on the operating train, increasing the grit loading in particular to the operating grit chamber. The single operating clarifier has the capacity to handle the incoming flows. However, that unit was scheduled to be taken off-line for upgrading when the other clarifier drive system failed. Failures of these kinds have historically taken several months to years to correct on Guam. If the operating clarifier fails, there will be no alternative but to bypass partially treated sewage. The anaerobic digesters have not operated in their intended roles since at least 2006. The unstabilized solids must be treated off-site, placing an increasing load on the Hagatna STP.

2. Parallel treatment/backup: The Northern District STP was constructed as a two-train system. Each train has the capacity to handle the historical flows and loadings to the plant. Failure of a single train should not result in overloading of the functional train or failure to meet permit limits under normal conditions. However the plant has reported violation of BOD and TSS, indicating that either loading conditions are more severe than the records indicate or there are operational problems within the plant that are affecting performance. David Fletcher stated that the acquisition of parts for the plant takes months, suggesting that major component failures may take considerable time to correct.

3. The out of service condition of the digesters poses several risks for the plant. Because the primary treatment system is not designed to deal with soluble BOD, any supernatant from the digesters containing BOD will add to the overall BOD discharged from the plant. Self monitoring data produced by GWA shows that Northern STP has experienced repeated violations of BOD effluent limits, even though the loadings to the plant are within the design specifications. In addition, the digesters are the only effective means of treating the high strength septage waste discharged to the plant. Finally, the inability to stabilize the solids at Northern STP places the burden of doing so on the facility at Hagatna STP. If the digesters were in service, than the stabilized solids could be dewatered at Hagatna without going through the digesters there.

Findings

1. Appendix STP-N, NPDES Permit No. GU0020141, Part I.A.1.c., "*The receiving waters shall be substantially free from visible floating materials grease, oil, scum, foam and other matter not attributable to sewage.*" and Part I.A.1.d., "*The receiving water shall be free from materials attributable to sewage that will produce visible turbidity or settle to form deposits.*" See also **Appendix STP-F**, Pictures 28, 31, and 35. There were visible solids in the effluent from the treatment plant.

Areas of Concern

A. Appendix STP-N, NPDES Permit No. GU0020141, Part II A.1., Proper Operation and Maintenance, "*The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit.*" The primary clarifier has been out of service for more than 6 months.

B. Appendix STP-N, NPDES Permit No. GU0020141, Part II A.1., Proper Operation and Maintenance, "*The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit.*" The plant is incapable of adequately treating waste septage. Septage is received at a manhole above the head works, and flows with the influent wastewater through the primary clarifier to the outfall. The primary clarifier is not designed to remove highly concentrated dissolved organics or oil and grease, which are typically found in septage waste. The two digesters are not in service and cannot provide effective treatment to the settled solids from the clarifier.

Hagatna STP

The Hagatna STP is a primary wastewater treatment plant with an average design flow rate of 12 MGD and a design peak flow rate of 21 MGD.

Influent Waste Water Characteristics

Plant process control data for the months from January 2011 through April 2012 was reviewed to assess waste water characteristics to the plant. The average monthly flow rates varied from a low of 3.47 MGD in June 2011 to a high of 7.0 MGD in September 2011. The highest reported peak flow day was 11.6 MGD in April 2012. Samples were analyzed for both BOD and COD at Hagatna STP; however only 8 of the 16 months records reported influent BOD. The months both were reported indicated the ratio of BOD to COD was approximately 0.28. The monthly average COD ranged from a low of 326 mg/L (corresponding to a BOD of 92 mg/L) in April 2012 to a high of 712 mg/L (203 mg/L BOD) in January 2012. The highest single day COD reported was 1208 mg/L in January 2012, corresponding to a BOD of 344 mg/L. The monthly average suspended solids concentration ranged from a low of 169 mg/L in February 2011 to a high of 241 mg/L in March 2012.

The ratio of BOD to COD in typical municipal waste water is 0.3 to 0.8. When this ratio falls below 0.5, the ability of activated sludge systems to effectively treat the waste diminishes. A low ratio may indicate the presence of toxic compounds, or the need for specially acclimated microorganisms. The current plant configuration at Hagatna STP does not include biochemical treatment of the wastewater. If the plant were to be modified for secondary treatment in the future, this issue would need to be taken into account.

Influent Head Works

Influent wastewater is screened for large debris by a manually raked bar screen, which screens out objects greater than 2 inches in size. Sand and grit is settled in a grit tank, which deposits the settled solids into a dumpster via a screw auger. A 36-inch Parshall flume with an ultrasonic probe measures influent flow rate. There was no staff gauge installed at the time of the inspection to allow a calibration check of the ultrasonic device.

Primary Clarifiers

The Hagatna STP uses three rectangular clarifiers for solids settling. Each clarifier is 120 feet long, 34 feet wide, with a 10-foot side water depth. Each clarifier has a maximum volume of 305,204 gallons and a surface area of 4,080 square feet. The hydraulic residence time for each clarifier is just over 1 hour at the design peak flow rate and just less than 2 hours at the design average flow rate. The surface settling rate is 1716 gal/ft^2-day at the design peak flow rate and 980 gal/ft^2-day at the design average flow rate. Each clarifer uses a chain-and-flight system for moving settled solids to the sludge sump at the bottom of the clarifier and for skimming floatables from the surface.

At the time of the inspection, one of the three clarifiers was out of service and being by-passed. According to D. Fletcher, the bolts securing the drive shafts for the chain-and-flight system had failed, causing the drive shafts to separate. The clarifier had been out of service for approximately two years at the time of the inspection. The repair cost was estimated at $300,000 to $400,000. Bids for the repair had been received, but no monies had been set aside for the work to begin.

Digesters

Settled sludge and surface skimmings from the primary clarifiers are pumped to four covered aerobic digesters. Each digester has a volume of 174,493 gallons. All four digesters were operating at the time of the inspection.

Gravity Thickener/Centrifuges

A single gravity thickener receives settled digester solids, untreated septage waste, and sludge from the Northern District STP (unstabilized), Baza Gardens STP (stabilized), and Agat-Santa Rita STP (stabilized). It has a volume of 48,470 gallons and was operational at the time of the inspection. Supernatant from the thickener is returned to the primary clarifiers. Dewatered solids are pumped to two Centrysis centrifuges. Polymer is injected into the feed line to aid dewatering. Dewatered solids are trucked to a landfill for disposal.

The unstabilized solids from Northern STP and the septage waste may contribute substantial concentrations of BOD, particularly soluble BOD, to the plant effluent. Self monitoring reports for Hagatna indicate repeated violations of the NPDES permit effluent limit concentration for BOD. It would be more appropriate for the septage waste and unstabilized solids to be discharged to the plant digesters so BOD can be reduced.

Final Discharge

Effluent from the primary clarifiers discharges through a common channel over a common weir. No disinfection was being provided at the time of the inspection. Samples are collected at the discharge weir. A Hach Sigma 900 automatic sampler was installed and in operation at the time of the inspection. Flow monitoring is not provided at the effluent discharge.

Hydraulic Loading

The average flow rate for the period January 2011 through March 2012 was 5.67 MGD. With all three primary clarifiers in service, the surface loading rate is 463.2 gal/ft^2-day, which is less than half the design surface loading rate of 980 gal/ft^2-day. With one clarifier out of service, the surface loading rate would be 695 gal/ft^2-day.

The peak flow loading rate, at 21 MGD, would be 1,716 gal/ft^2-day. The highest flow rate recorded during this period was 9.94 MGD. At this rate, the surface loading rate would be 812 gal/ft^2-day; with only two clarifiers in service, the rate would be 1218 gal/ft^2-day. Thus, even with one clarifier out of service, the plant was able to remain within the hydraulic loading parameters.

Risk Assessment

1. Overall condition: The influent head works were operating properly, and appeared to be in good repair. The two operating clarifiers have the capacity to handle the historical incoming flows. The major issue of concern is the extended amount of time (more than two years at the time of the inspection) it has taken to repair the out-of-service primary clarifier.

2. Parallel treatment/backup: The Hagatna STP was constructed as a three-train system. Two trains in service have the capacity to handle the historical flows and loadings to the plant. Failure of a single train should not result in overloading of the functional trains or failure to meet permit limits under normal conditions. This assumes that loading to the plant are consistent with the recorded and reported values. Hagatna STP has reported repeated violations of the BOD and TSS limits. This may be due to exceptionally high ratios of soluble BOD to Total BOD in the incoming wastewater and to poor settleability of the incoming solids. Also, the BOD contributed by septage waste and unstabilized solids being added to the gravity thickener as described above may contribute to the problem.

3. Failure consequences: Because of the three-train configuration, failure of a single main component, as has happened with one of the primary clarifiers, should not result in either overloading of the plant or failure to meet permit limits. Again, this depends on the proper operation of the plant and loadings being consistent with the historical loadings.

Concerns

A. Appendix STP-P NPDES Permit No. GU0020087, Part II A.1., Proper Operation and Maintenance, "*The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit.*" The primary clarifier has been out of service for more than two years. With one clarifier out of service, the plant is more susceptible to hydraulic overloading in high flow conditions, leading to potential effluent limit violations. Hagatna STP has reported effluent limit violations for BOD and TSS.

B. Appendix STP-N, NPDES Permit No. GU0020141, Part II A.1., Proper Operation and Maintenance, "*The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit.*" According to the PMP for the Hagatna STP, solids from the Northern District STP, Baza Gardens STP, and Agat-Santa Rita STP, as well as septage are discharged by septage haulers is discharged to a thickener, along with the stabilized solids from the digesters at Hagatna. The digesters at Northern District STP are not functioning; therefore the solids received from the Northern District STP have not been stabilized. In addition, the septage received by the thickener has not been treated. Unstabilized solids and septage in the thickener can produce high concentration of BOS and generally do not settle as well. Soluble BOD and unsettled solids may be returned to the primary clarifiers, where they may add to the organic and solids loading of the clarifiers, potentially leading to effluent limit violations. As noted above, Hagatna has reported violations for BOD and TSS even though the plant is generally not hydraulically overloaded.

Agat-Santa Rita STP

The Agat-Santa Rita STP (Agat) is a contact stabilization activated sludge plant, designed to provide secondary treatment. The plant is a single-train system, with no backup facilities. According to the WRMP, the plant was constructed in 1972, which means it is approaching the end of its normal service life (normally 25-30 years). Agat has not undergone major upgrade or modification since it was placed in operation. The plant is designed to treat an average flow rate of 0.75 MGD, with a peak flow rate of 2.2 MGD.

Influent Waste Water Characteristics

Plant process control data for the months from January 2011 through April 2012 was reviewed to assess waste water characteristics to the plant. The average monthly flow rates varied from a low of 0.89 MGD in May 2011 to a high of 2.45 MGD in August 2011. The highest reported peak flow day was 3.1 MGD in September 2011. Samples were analyzed for BOD but not COD. Only 7 of the 16 months of MORs reviewed reported influent BOD and TSS. The monthly average BOD ranged from a low of 44 mg/L in July 2011 to a high of 74 mg/ in April 2011. The highest single day BOD reported was 90 mg/L in April 2011. The monthly average suspended solids concentration ranged from a low of 52 mg/L in August 2011 to a high of 74 mg/L in April 2011. Typical values for sanitary wastewater are 150-200 mg/L for BOD and 200-300 mg/L for TSS. The low influent concentrations reported at Agat are indicative of high amounts of infiltration and inflow into the collection system. This is further supported by the high flow rate the plant regularly receives.

Head Works

Influent to the plant is screened for debris with a manually raked bar screen. The bar screen is located in a confined space below the surrounding grade. Screened waste water is pumped to the contact tank for secondary treatment. There is no grit removal system at the plant.

According to D. Fletcher, the influent line discharging to the bar screen is hydraulically overloaded during high flow conditions. To alleviate this overloading, a trailer-mounted diesel pump with a capacity of 400 gallons per minute (gpm) has been installed at a manhole immediately upstream of the bar screens. The pump discharges through a flexible hose directly into the contact tank.

Contact Stabilization

The contact stabilization system uses four separate tanks (contact tank, reaeration tank, clarifier, and digester). The contact tank receives all incoming wastewater and serves to mix the influent with activated sludge from the reaeration tank. The mixed liquor formed in the contact tank is pumped into the clarifier for solids settling. Settled solids are pumped from the clarifier into the reaeration tank for reintroduction to the contact tank. Excess solids in the clarifier are pumped to the digester for stabilization. Stabilized solids in the digester are pumped to two drying beds during the dry season; during the rainy season, the solids are hauled by tanker truck to the Hagatna STP for dewatering and disposal.

The contact tank has a capacity of 106,971 gallons. At the design average flow rate, the hydraulic residence time is 3.4 hours; at the design peak flow rate, the hydraulic residence time is 1.16 hours. Mixing and aeration is provided by electrically driven blowers and coarse bubble diffusers set near the interior wall of the tank.

The reaeration tank has a volume of 213,194 gallons. As in the contact tank, mixing and aeration are provided by coarse bubble diffusers arranged against the wall that separates the tank from the clarifier. The reaeration tank receives return activated sludge (RAS) from the clarifier by a three-way valved line and variable speed pump. By adjusting the position of the valve, operators can divert a portion of the RAS from the clarifier to the digester, allowing control of the solids inventory.

Activated sludge in the reaeration tank is fed into the contact tank through a 1-square-foot port in the wall that separates the reaeration tank from the contact tank. Flow from the reaeration tank to the contact tank is driven by differential head between the two tanks, created by the difference in the rate at which RAS is pumped into the reaeration tank and the rate at which influent wastewater is pumped into the contact tank. This arrangement compromises the effectiveness of the treatment system if the influent flow rate exceeds the RAS flow rate. Under those conditions, the flow from the reaeration tank to the stabilization tank could stop, or even reverse, preventing the movement of stabilized solids from the reaeration tank into the contact tank. This situation is made worse when the portable pump set up to relieve flooding at the bar screens is activated, as it discharges into the contact basin as well.

Mixing and aeration in the contact tank and the reaeration tank are uneven. The coarse bubble diffusers are not as efficient in transferring oxygen as fine bubble diffusers would be. The location of the coarse bubble diffusers, adjacent to the interior wall of the tank, means there is uneven distribution of air through the tanks, and mixing is limited. D. Fletcher stated that the plant experiences buildup of solids along the outside edges of the tanks due to the poor mixing. In addition, the lack of aeration where influent wastewater enters the contact tank inhibits treatment throughout much of the tank. A fine bubble diffuser distribution system has been procured for the plant, but installation would require taking the plant off-line and bypassing secondary treatment. Another consequence of the coarse bubble aeration is that water is splashed over the wall that separates the contact tank and reaeration tank from the clarifier, and into the discharge weir, short-circuiting treatment.

Process control samples for mixed liquor suspended solids (MLSS) are collected from the stabilization tank. The MLSS concentrations reported in the monthly operating reports ranged from a high of 3038 milligrams per liter (mg/L) to a low of 260 mg/L. The average over the period January 2011 through March 2012 was 1,776.6 mg/L. The target MLSS concentration, according to the PMP for the Agat STP, is 2,000–3,000 mg/L. The PMP does not specify if the target MLSS concentration is for the stabilization tank or the contact tank. The recommended ranges for the stabilization tank are 6,000–10,000 mg/L and 1,000-3,000 mg/L for the contact tank (Metcalf and Eddy). If the solids concentration is too low, the treatment effectiveness of the system is compromised as there are too few microorganisms present to the treat the volume of wastewater.

Digester/Solids Handling

Waste solids are stabilized in an aerobic digester. The digester has a capacity of 184,020 gallons. Mixing and aeration are provided with coarse bubble diffusers arrayed along the inner wall of the digester. Decanted supernatant is returned to the contact tank. Solids are removed from the digester with a portable pump. During the dry season, the solids are dewatered on two drying beds. During wet periods, the solids are loaded to a tanker truck and dewatered at the Hagatna STP.

Outfall

Disinfection is not applied to the effluent. All flow is measured using an inline magmeter installed on the line from the influent pumps to the contact tanks. The treated effluent is combined with effluent from the Nimitz Naval Base Apra Harbor wastewater treatment plant, before being discharged through a common outfall.

Hydraulic Loading

The average flow rate for the period January 2011 through March 2012 for the Agat plant was 1.591 MGD, which is twice the design flow rate of 0.75 MGD. At this average loading rate, the hydraulic residence time for the contact tank is 1.61 hours. Metcalf and Eddy recommend a hydraulic detention time for the contact basin as 0.5–1 hour, so, even at the elevated flow rate, the hydraulic detention time for the contact tank is greater than the recommended minimum.

The clarifier has a surface area of 1,256 square feet. At the average flow rate of 1.591 MGD, the surface overflow rate is 1,266 gal/ft^2-day, which is far in excess of the design surface loading rate of 597 gal/ft^2-day. Metcalf and Eddy recommend an average surface loading rate of 400-700 gal/ft^2-day. This increased surface loading rate may result in washing solids out of the clarifier, leading to possible permit limit exceedance of both Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS). The self monitoring reports for Agat STP show periodic exceedance of the BOD and TSS effluent concentration limits, and frequent violations of the percent removal requirements for the same parameters. This is likely a consequence of the low strength of the wastewater and the excessive hydraulic loading of the plant.

Bypasses and Wet Weather Events

NEIC reviewed the monthly operating reports for the period January 2011 through March 2012. These reports contained notations regarding two types of bypass events resulting from various causes. One type is bypassing of the influent bar screens by pumping from a manhole upstream of the plant and into the contact tank. The second type occurs when flow is pumped from the manhole upstream of the plant directly to the Ga'an pump station, co-located at the plant, which combines effluent from Agat and the Nimitz Naval Base and discharges to the ocean. With the second type of bypass, diverted flows receive no treatment prior to discharge to the ocean. High levels of flow to the plant can also result in overloading the clarifier, resulting in the washout of solids. Bypassing the bar screen can cause problems in the plant by increasing the amount of inert solids such as sand and gravel that are deposited in the contact tank and the clarifier. It also allows rags and large debris into the tanks, possibly resulting in pump fouling. A further issue is that pumping directly into the contact tank may reduce the flow from the stabilization tank into the contact tank. This would result in lower concentrations of MLSS at a time when higher concentrations are needed to treat the increased flow. Table 2 presents reported bypasses and wet weather-related upsets at the Agat-Santa Rita STP derived from the review of the monthly reports.

Table 3. REPORTED BYPASSES AND WET WEATHER-RELATED UPSETS AT AGAT-SANTA RITA STP
Guam Waterworks Authority
Guam, United States Territory

January 2011	Overloading of clarifer resulted in solids washout for three days.
February 2011	On February 1, the plant bypassed the bar screens and pumped directly to the contact tank using a trailer-mounted pump, due to high flows to the plant.
April 2011	Bypassed flow around treatment directly to Ga'an pump station using trash pump for 15 minutes on April 1.
July 2011	On July 18, heavy rain caused short circuiting and solids washout. Ga'an pump station had only two pumps operating and was unable to keep up with the incoming flow from the plant. Short-circuiting again on July 28 and wet pit flooded.
August 2011	On August 7, 8, and 15, heavy rain caused short circuiting and solids washout.
September 2011	Heavy rain during the first week of the month resulted in short circuiting of treatment.
October 2011	Heavy rain during the first week resulted in short circuiting and solids washout.

Risk Assessment

1. Overall condition: The influent head works were hydraulically overloaded on a regular basis, requiring use of relief pumps to bypass the bar screens and influent pumps. Operator's monthly reports indicate frequent power failures, pump failures, and electronic failures, requiring repair and bypassing. The aeration system is inefficient and allows short-circuiting of treatment. The plant is hydraulically overloaded on an almost continuous basis. The age of the mechanical components elevates the risk of major

failures and makes it more difficult to secure replacement parts as these are not readily in stock. The plant self monitoring data indicates frequent permit effluent violations.

2. Parallel treatment/backup: The Agat-Santa Rita STP was constructed as a single-train system. Failure of a major component, such as the clarifier drive gear box, any of the lift pumps within the activated sludge system, or the main distribution for aeration would effectively shut down the plant.

3. Failure consequences: Because of the single-train configuration, failure of a single main component would result in either overloading of the plant or failure to meet permit limits.

Findings

1. Appendix STP-J, NPDES Permit No. GU0020222, Part IX 14(4), Prohibition of by-pass, "*(1) Bypass is prohibited, and the Regional Administrator may take enforcement action against the permittee for bypass, unless: (a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage; (b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance; and (c) The permittee submitted notices as required under paragraph c. of this section.*" The plant reported bypassing treatment directly to the Ga'an pump station for 15 minutes on 4/1/2011. The plant used a trailer-mounted pump to bypass the bar screens on at least one occasion on February 1, 2011.

2. Appendix STP-J, NPDES Permit No. GU0020222, Part IX 6.6., PROPER OPERATION AND MAINTENANCE [40 CFR 122.41(e)], "*The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit.*" The plant reported solids washout on at least 8 days during the period January 2011 through October 2011. There is no disinfection system being operated at the plant, even though the permit specifies limits for e. coli and fecal coliform. Agat-Santa Rita has reported effluent limit violations for both e.coli and fecal coliform.

3. Appendix STP-J, NPDES Permit No. GU0020222, Part II.A.1.b. "*Effluent samples shall be taken after any in-plant return flows and the last treatment process and prior to mixing with the receiving waters, where representative samples to the Toguan River can be obtained.*" Flow monitoring data was being collected using a magmeter installed between the head works building and the contact tanks. This is not the specified location

for collecting effluent samples, and does not represent flows pumped through the trash pump or the effects of wasting solids into the digester.

Concerns

Appendix STP-J, NPDES Permit No. GU0020222, Part IX 6.6., PROPER OPERATION AND MAINTENANCE [40 CFR 122.41(e)], *"The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit."*

A. The aeration system does not provide even mixing and aeration throughout the contact basin, stabilization basin, or the digester. Inadequate mixing means the solids are not available in sufficient concentration throughout the basins to provide adequate treatment. Insufficient aeration limits the ability of the system to oxidize BOD and ammonia.

B. The hydraulics of the contact basin and stabilization basin may impede the mixing of stabilized solids from the stabilization basin into the contact basin. This is especially the case when the trash pump is being used to bypass the bar screens. If the flow rate from the influent pumps and the trash pump exceed the pumping capacity of the RAS pump into the stabilization tank, the flow from the stabilization tank into the contact tank may stop.

C. The short traverse across the contact basin may cause short-circuiting of the treatment system. The configuration of the tank and the location of the influent discharge into the tank and the discharge from the tank may allow some of the flow coming into the tank to discharge to the clarifier with insufficient hydraulic residence time.

D. The excessive aeration at the interior of the contact tank was causing water to splash across the wall that separates the contact basin from the clarifier and into the effluent weir. This effectively short circuits the clarifier and may allow excessive solids to discharge from the plant.

E. The plant regularly operated in excess of its maximum hydraulic design capacity. Review of MORs shows the plant regularly exceeds it design monthly average flow capacity and its maximum single day flow capacity. Excessive hydraulic loading can cause numerous problems, including reduce time for treatment, and increases the potential for solids washout.

Baza Gardens STP

The Baza Gardens STP is an activated sludge secondary treatment plant. The plant has been in service since 1975, and is near the end of its design service life of 30 years). The walls of the aeration basin and clarifier were visibly deteriorated. The concrete on the outside of the basin was well worn, while the steel wall that separates the clarifier from the other tanks had rusted through in several locations. Like the Agat-Santa Rita STP, it is a single-train system, with no backup or built-in bypass capability. The plant configuration differs from the Agat-Santa Rita plant in that it is an extended aeration design, instead of a contact stabilization plant.

Influent Waste Water Characteristics

Plant process control data for the months from January 2011 through April 2012 was reviewed to assess waste water characteristics to the plant. The average monthly flow rates varied from a low of 0.07 MGD in March 2012 to a high of 0.39 MGD in April 2011. The highest reported peak flow day was 2.66 MGD in April 2011. Samples were analyzed for BOD, but not COD, at Baza Gardens STP; 10 of the 16 months of monthly operating report reviewed reported influent BOD and TSS. The monthly average BOD ranged from a low of 61 mg/L in October 2011 to a high of 1.11 mg/L in April 2011. The highest single day BOD reported was 143 mg/L in April 2011. The monthly average suspended solids concentration ranged from a low of 104 mg/L in April 2011 to a high of 305 mg/L in August 2011.

Head Works

The influent head works consists of a manually raked bar screen followed by an aerated grit chamber. At the time of the inspection, the aeration system was shut off because the diffusers were plugged. Influent flow rate was being monitored with an ISCO Model 2150 area velocity meter set in the influent discharge pipe upstream of the bar screens, and connected to a programmable data logger. The data logger is downloaded every two weeks and the data used to construct a flow chart. The calibration of the meter is checked when data is downloaded from the logger by measuring the depth of flow in the pipe and comparing it to the reading measured by the area velocity meter. The data collected by the data logger was used for reporting in the Monthly Operating Reports and DMRs for the facility. Wastewater from the aerated grit chamber passed through a comminuter before it discharged to the aeration tank.

Extended Aeration System

The plant is configured in a circle; the aeration basin and digester are on the perimeter and the clarifier occupies the center. The basins are set in the ground so the rim of their outer walls is near level with the surrounding grade. A steel wall separates the clarifier from the aeration tank and the digester. A steel wall also separates the digester and aeration tank. The exterior wall is concrete.

The aeration basin has a volume of 457,417 gallons. Mixing and aeration are provided along its length with a coarse bubble diffusion system distributed along the interior wall of the basin. Influent wastewater from the head works enters at one end of the tank and discharges at the other end to the clarifier. At the design average flow rate of 0.6 MGD, the hydraulic residence time in the aeration basin is 18.3 hours. According to the PMP for the plant, the target MLSS concentration is 2,000–3,000 mg/L.

As with the Agat–Santa Rita STP, the configuration of the aeration system reduces the efficiency of the activated sludge process. Mixing and aeration are uneven throughout the basin, and solids tend to build up along the outside perimeter wall. In appearance, the mixed liquor appears thin, with insufficient solids concentration. Sludge worms are clearly visible on the surface of the aeration tank and the clarifier. According the D. Fletcher, the MLSS concentration tends to be 400–600 mg/L, well below the target range. The process control sheets for the period April 18–24, 2012, indicated an MLSS concentration of 480 mg/L for the aeration basin. The typical concentration of MLSS in an extended aeration system is in the range of 3,000 – 5,000 mg/L. The presence is visible sludge worms may be an indicator of an older sludge, which is less active and less effective at oxidizing BOD and ammonia.

The permit for Baza Gardens STP specifies limits for the nutrients nitrate and orthophosphate for meeting water quality standards. The most common method for treating nitrate is through a biochemical process called denitrification. Orthophosphate can also be controlled biochemically, although physical chemical processes may also be used. Biochemical treatment for nitrate and orthophosphate requires careful control of the location and rate at which Return Activated Sludge (RAS) is introduced in the aeration basin. Aeration must also be modified to create the low dissolved oxygen conditions both processes require. Baza Gardens STP is not configured or equipped to meet these conditions and would not be expected to provide effective removal for either nitrate or orthophosphate without major modification.

Clarifier

A straight pipe connects the aeration tank to the center of the circular clarifier, which has a volume of 106,500 gallons and a surface area of 1,017 square feet. The sludge sweeps are attached to a rotating boom that pivots around the center column and pushes settled sludge to a sump near the base of the column. A surface skimmer rotates with the boom and pushes floating material into a scum box near the discharge baffle. The sweeps and skimmer arm are driven by an electric motor through a gear box. At the time of the inspection, the gear box emitted an unusual amount of noise, possibly indicating problems with the gears. The skimmer arm appeared to hang at certain points in its rotation. The depth of the sludge blanket on the day of the inspection was 2.8 feet, within the 1–3-foot-depth specified by the PMP.

Digester

The digester, which occupied a section of the outer ring of the plant, had a volume of 117,286 gallons. Mixing and aeration were provided by coarse bubble diffusers set along the interior wall that separates the digester from the clarifier. According to the PMP, the target MLSS concentration for the digester is 6,000–9,000 mg/L. The process control records for April 26, 2012, indicated the MLSS concentration in the digester was 280 mg/L, possibly because a poorly mixed sample was collected near the surface, where the mixed liquor was visibly thin. The same day's sample results for the sludge pumped from the bottom of the digester for disposal (labeled WAS in the record) showed a concentration of 20,408 mg/L.

Sludge Handling

The stabilized solids from the digester is pumped to a tanker truck and hauled to the Hagatna STP for dewatering. There are no dewatering facilities at the Baza Gardens facility.

Effluent Discharge and Monitoring

The plant has no operational disinfection system. Effluent discharges through a V-notch weir. The notch appears to be greater than 90 degrees, possibly 120 degrees. Effluent composite and grab samples are collected immediately upstream of the V-notch weir. A Hach Sigma 900 automatic sampler with refrigerated sample storage was installed at the sampling point.

The permit requires flow rates to be reported at the effluent monitoring point. However, data for the plant was being reported from the temporary flow meter installation at the head works described above.

Hydraulic Loading

The average flow rate for the Baza STP for the period January 2011 through March 2012 was 0.177 MGD, which is well below the design average flow rate of 0.60 MGD. At the recorded average flow rate, the surface loading rate for the clarifier is approximately 174 gal/ft^2-day, well below the 590 gal/ft^2-day standard in the PMP for the plant. The highest recorded peak flow for the plant was 0.651 MGD, only slightly above the maximum average flow rate.

Risk Assessment

1. Overall condition: The tank walls were corroded through in several locations, and the concrete was spalling on exposed surfaces. The gear box for the clarifier drive was grinding, and the clarifier skimmer arm appeared to hang at several points in its rotation. The aeration system is inefficient and allows short-circuiting of treatment. The age of the mechanical components elevates the risk of major failures and makes it more difficult to secure replacement parts as these are not readily in stock. The concentration of the MLSS in the aeration tank and the digester is well below the target range specified in the

PMP. The current permit establishes nutrient limits for nitrate and orthophosphate that the plant in its current configuration cannot effectively treat. No disinfection and continuous violation of coliform and e coli effluent limits.

2. Parallel treatment/backup: Baza Gardens STP was constructed as a single train system. Failure of a major component, such as the clarifier drive gear box, any of the lift pumps within the activated sludge system, or the main distribution for aeration, would effectively shut down the plant.

3. Failure Consequences: Because of the single-train configuration, failure of a single main component results in either overloading of the plant or failure to meet permit limits.

Findings

1. Appendix STP-H, NPDES Permit No. GU0020095, Part II.A.1.c., *"Effluent samples shall be taken after any plant return flows and the last treatment process and prior to discharge to the exfiltration trench and mixing with the receiving waters,..."* The plant flow rate reported on MORs and DMRs was being collected at the influent to the plant, not at the discharge as specified in the permit. Because of this the reported flow data may not be representative of the actual effluent.

Concerns

Appendix STP-H, NPDES Permit No. GU0020095, Part IX 6., PROPER OPERATION AND MAINTENANCE [40 CFR 122.41(e)], *The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit."*

A. The May 2011 monthly operating report indicated a 3-inch hole in the wall between the digester and aerator. As of the inspection on April 2012, the hole had not been repaired. This condition may allow short circuiting of the clarifier.

B. The aeration system does not provide sufficient mixing throughout the basin. Operators indicated that solids were settling along the perimeter of the aeration tank and the digester instead of being evenly mixed throughout the tank. Inadequate mixing of solids in the aeration tank may lead to inadequate treatment. The plant has reported permit effluent limit violations for percent removal of BOD, and violations of the effluent concentration limits for nitrogen, nitrate, phosphorus, and e.coli.

C. The current configuration of the plant does not allow for denitrification to remove nitrate or for removal of phosphorus. The design configuration of the plant is optimized for removal of BOD and oxidation of ammonia to nitrate. However, the internal recycle systems are not set up to remove the nitrate or phosphorus. Since there are no chemical precipitation systems to provide that treatment, the plant will have difficulty meeting the effluent limit requirements for those parameters.

D. There is no system for disinfection of the effluent, although the permit specifies an e.coli and fecal coliform limit. As noted above, the plant has reported failing effluent limits for both parameters.

Umatac-Merizo STP

The Umatac-Merizo STP was put into service in 1981. The WRMP describes it as an aerated facultative lagoon, with a land application disposal system. It serves the Umatac and Merizo village areas, with a service population of approximately 4,000. Although the plant is intended to operate as a zero discharge treatment system, it can and does discharge to the Toguan River under NPDES Permit No. GU0020273.

Influent Head Works

At the time of the inspection, no influent bar screen or grit removal system was in operation at the plant. A 10-inch pipe discharges into a 6-inch Parshall flume. The Parshall flume has an ultrasonic probe installed, but that system was not functional at the time of the inspection. AN ISCO 2150 flow measurement system was installed in the 10-inch pipe. This temporary system, installed by the plant's engineering department, consists of an area velocity meter connected to a data logger. Data is downloaded to a laptop computer; there is no display at the installation, and operators have no means of measuring the flow with the instruments at hand. Flow data for the facility is reported from this installation. There is no staff gauge installed in the Parshall flume, and access would require confined space entry procedure be followed.

Facultative Lagoon

The facultative lagoon is contained within earthen embankments, but has a concrete lining. It is approximately 360 feet long and 186 feet wide. Wastewater discharges into the lagoon near the center of the embankment and discharges from the center of the opposite side. A submerged baffle is installed approximately 20 feet in front of the discharge weir. Two floating mixers of approximately 15 horsepower (hp) each are installed in the lagoon. One is positioned near the influent discharge pipe; the second is positioned about 2/3 of the length of the lagoon from the influent and slightly offset to the right, as viewed from the effluent weir. Discharge from the lagoon flows by gravity to effluent pump Station 19.

The lagoon does not have an overflow spillway, but it is equipped with an overflow pipe for high-level conditions to avoid overtopping. The overflow pipe discharges into a second, smaller basin that functions as an overflow basin. This basin was dry at the time of the inspection. If the water level in the overflow basin is too great, the basin discharges into two 12-

inch corrugated plastic pipes that discharge into a catch basin, then through two 36-inch pipes located beneath the service road and then into the Toguan River. This discharge is not covered by the NPDES Permit.

Recirculation Pond and Wetland Treatment System

Effluent Pump Station 19 discharges to a wet well at the top of the Wetland Treatment System (WTS). From the wet well, water can be distributed to different points of the WTS. The WTS is divided into two sections, which are terraced in a manner to allow the water to flow in a serpentine path downhill. At the base of the WTS, any water that has not infiltrated into the ground is collected in a concrete channel and discharged into the recirculation pond. Pump Station 20 is located adjacent to the recirculation pond and lifts water back to the wet well at the top of the WTS. According to the Umatac PMP (Appendix STP-M), the operational procedure for the WTS is to alternate discharging water to each side of the WTS, rather than discharging to both sides continuously. At the time of the inspection, only one side of the WTS was being used. The water being applied was not being fully absorbed in the WTS, and the runoff was draining back into the recirculation pond. The Umatac PMP labels such a condition as an Alarm condition, which requires notification of the condition to the Superintendent of Operations.

If flows sufficiently exceed the rate at which the WTS can absorb, the excess water discharges from the recirculation pond over a spillway and down a series of concrete steps into a concrete channel leading to the Toguan River. The Umatac PMP labels such a condition as Process Incident and requires reporting to the Operations Manager and corrective action.

The top of the spillway is the monitoring point for Discharge Point 001, which discharges to the Toguan River. The spillway is not equipped with a primary or secondary device to measure flow. According to Dave Fletcher, discharges from Outfall 001 are not measured at this location. An ongoing discharge from the spillway into the channel was observed during the inspection. No disinfection is applied to discharges from the pond.

Hydraulic Loading

The average influent low rate for the period January 2011 through March 2012 was 0.407 MGD. The maximum permitted monthly average flow rate was 0.391 MGD. Neither the most recent permit nor the PMP for the Umatac-Merizo STP specify a maximum single day flow rate. The highest recorded single day flow rate was 1.22 MGD, during August 2011.

The Umatac PMP does not specify a loading rate for either the facultative lagoon or the WTS. The only performance parameters regarding hydraulic loading are discharge from the WTS to the recirculation pond, discharge from the recirculation pond to the spillway, and overflow from the facultative lagoon to the bypass.

Bypasses and Wet Weather Events

NEIC reviewed the Monthly Operating Reports (MOR) for the period January 2011 through March 2012. These reports contained notations regarding bypass events due to various causes. The bypasses occurred when the water level in the facultative lagoon rose to a level sufficient to allow a discharge through the overflow line and into the overflow basin next to it. The MORs did not specify whether the by-passes reached the Toguan River, or were contained in the overflow pond. By-passes which reached the river would be unpermitted discharges. Table 3 presents reported bypasses and wet weather-related upsets at the Umatac-Merizo STP derived from the review of the MORs.

Table 4. REPORTED BYPASSES AND WET WEATHER-RELATED UPSETS AT UMATAC-MERIZO STP
Guam Waterworks Authority
Guam, United States Territory

January 2011	On January 10, the facultative lagoon overflowed through the lagoon bypass line.
February 2011	On February 2-7, the lagoon overflowed through the bypass line.
July 2011	On July 28–31, the facultative lagoon overflowed due to pump failure at pump station 19.
August 2011	On August 1–4, the facultative lagoon overflowed through the bypass due to a failure at pump station 19. On August 8–12, the lagoon overflowed through the bypass due to excessive flow.
September 2011	On September 1, 12, and 18, the facultative lagoon overflowed for unspecified reasons.
October 2011	On October 26 and 30, the facultative lagoon was reported as bypassing for unspecified reasons.
November 2011	The facultative lagoon was reported as bypassing from an unspecified start date until November 12. The reason for the bypass was not given.

Risk Assessment

1. Overall condition: The aerators in the facultative pond were functioning. Review of the monthly operating reports indicates the plant has periodic shut-downs of the internal pump stations. The reports also indicate that the internal pump stations are not capable of keeping up with the flows the plant historically receives; this leads to discharges through the facultative lagoon bypass. The WTS was not completely absorbing the water being applied, even though it was the dry season. The monthly operating reports indicate frequent discharges from the recirculation pond to the NPDES authorized discharge point 001. GWA reports frequent violations of effluent limits at discharge point 001 including fecal coliform, e.coli, ortho Phosphate and BOD and TSS percent removal.

2. Parallel treatment/backup: The Umatac-Merizo STP was constructed as a single-train system. Failure of a major component, such as the internal pump stations, would result in an eventual bypass.

3. Failure consequences: Because of the single-train configuration, failure of a single main component could result in either overloading of the plant or failing to meet permit limits. Discharge through the facultative lagoon bypass is an unpermitted discharge.

Findings

1. Appendix STP-L, NPDES Permit No. GU0020273, Part II.A.1.c., "*Effluent samples shall be taken after any in-plant return flows and the last treatment process and prior to mixing with the receiving waters, where representative samples to the Toguan River can be obtained.*" NPDES discharge point 001 is described in the facility fact sheet as being the top of the spillway from the recirculation pond. According to Dave Fletcher, effluent flow rate data is not collected at this point, although samples for the other parameters are.

2. Appendix STP-L, NPDES Permit No. GU0020273, Part II.A.1.a., "*Samples and measurements taken as required in this permit shall be representative of the volume and nature of the monitored discharge.*" There is no mechanism for accurately measuring effluent flow rate when the recirculation pond discharges at NPDES discharge point 001. The top of the spillway is a broad concrete channel, which discharges down a series of steps to a concrete lined channel. Conventional flow measurement practice would require a weir or flume of some type to be installed at this location to accurately measure the discharge flow rate from this location.

3. Appendix STP-L, NPDES Permit No. GU0020273, Part IX 14 (4), Prohibition of by-pass, "*(1) Bypass is prohibited, and the Director may take enforcement action against the permittee for bypass, unless: (a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage; (b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance; and (c) The permittee submitted notices as required under paragraph c. of this section.*" GWA bypassed the Wetland Treatment System on at least 27 days between January 2011 and March 2012 and made unpermitted discharges of the bypassed wastewater from the facultative pond overflow basin to the Toguan River. The WTS serves to provide additional treatment to the discharge from the facultative lagoon, including absorption of BOD, solids, phosphorus and nitrogen. The facility has reported violations of the permit effluent limits for all of these parameters.

Concerns

Appendix STP-L, NPDES Permit No. GU0020273, Part IX 6., PROPER OPERATION AND MAINTENANCE [40 CFR 122.41(e)], *"The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit."*

A. During the inspection of the facility, the WTS was unable to absorb enough water to avoid discharging through Discharge Point 001. According to the Umatac PMP, discharge over the spillway is considered a Process Incident, which mandates corrective action.

B. There is no system for disinfection of the effluent, although the permit specifies an e.coli and fecal coliform limit. As noted above, the plant has reported failing effluent limits for both parameters.

Inarajan STP

The Inarajan STP was put in service in 1989. The plant has a treatment capacity of 0.191 MGD and is designed to operate as a zero discharge facility.

Aerated Lagoons

As constructed, the Inarajan STP had four lagoons (cells). Each lagoon was equipped with a floating aerator for mixing and aeration. Although each cell was approximately equal in size, the size of installed aerator in each one varied. Cell 1, which was the first to receive influent, was equipped with a 10-hp aerator. Cell 2 was originally equipped with a 10-hp aerator; however, this aerator was not in place and the cell was being bypassed at the time of the inspection. Cell 3 and Cell 4 were originally equipped with 3-hp aerators; the aerators had been removed at the time of the inspection. Only Cell 3 was receiving flow (from cell 1).

Percolation Basins

Discharge from the cells passes through a weir box for flow measurement. A V-notch weir is the primary flow measurement device. Discharge from the weir box passes through a dosing chamber where chemical treatment previously occurred. No disinfection was in service at the time of the inspection. From the dosing chamber, flow is split among three equally sized percolation basins. Only one basin was in use at the time of the inspection. Because of the sandy nature of the soil in this area, percolation was rapid and there was no indication of a surface discharge from the percolation basins.

Hydraulic Loading

The average flow rate for Inarajan STP for the period January 2011 through March 2012 was 0.077 MGD, which is well below the design limit of 0.191 MGD. The maximum one-day recorded flow rate during this period was 0.378 MGD, during August 2011.

Risk Assessment

1. Overall condition: Of the four cells in the treatment system, only one had a functioning aerator. One cell was being bypassed completely. Extensive duckweed was growing on the surface of two of the cells. The dosing chamber and the internal flow monitoring point were off-line.

2. Parallel treatment/backup: The Inarajan STP was constructed to allow water to be diverted between the four treatment cells as necessary. Therefore, removal of one or more cells from service would not drastically compromise the treatment system.

3. Failure consequences: Because of the multi-cell configuration and the ability of the percolation pond to absorb the effluent, failure of a single main component should not result in overloading of the plant.

Concerns

A. The Inarajan STP is to receive leachate from a sanitary landfill being constructed nearby. The current treatment system may be inadequate to treat leachate containing high organic concentrations or metals. There is not a normal surface discharge from the plant. However, the nature of the local soils may allow a hydraulic connection to the ocean.

Pago-Socio STP

The Pago-Socio STP is a small aerated package plant that was privately constructed, then deeded to GWA for operation. It includes a small aerated treatment basin covered with a concrete cover. The effluent from the basin discharges to a percolation field. There are no on-site solids handling capability. Solids were periodically being pumped from the clarifier and taken off-site for disposal.

The plant did not appear to be receiving regular maintenance. The aeration system was not operating. The only access to the plant had been blocked by a retaining wall constructed across the gate. The percolation area had been taken over as a planting area by a local gardener, numerous pots, plants, and gardening tools were on the ground, and a large tent had been erected over the area.

Risk Assessment

1. Overall condition: The overall condition of the facility was moderate to poor. The aeration system did not appear to be functional. The facility did not appear to be receiving regular maintenance or upkeep. The percolation filed was covered with potting materials

2. Parallel treatment/backup: The Pago-Socio STP, is a single-train system discharging to a percolation field. Although failure of the aeration system would reduce the level of treatment, there appeared to be low risk of a surface(?) discharge from the plant due to the limited number of service connections

3. Failure consequences: Unless the percolation field were overloaded or compromised, there appeared to be a low risk of a discharge to surface waters. Visual inspection of the plant did not indicate a surface discharge from the percolation field.

Concerns

A. The only entrance to the plant was blocked. The percolation field was covered with privately owned potting material. The plant did not appear to be receiving active maintenance.