

WASTEWATER SYSTEM SUMMARY

Introduction

This chapter presents an overview of Volume 3 - Wastewater System. There are nine chapters in the Volume providing an overview of the collection and treatment system facilities – both existing and planned.

A brief synopsis of each chapter is presented. Specific conclusions, recommendations and Capital Improvement Program (CIP) impacts are presented at the end of each of the respective chapters as appropriate.

Chapter 1 – Wastewater System Description

Chapter 1 presents an overview of the system and outlines Water Resource Master Plan (WRMP) activities to date that are pertinent to the plan. The system is characterized by two major categories of facilities - sewage treatment plants (STPs) and collection system facilities, which pipelines and pump stations.

STPs

Six of the seven STPs are profiled in the chapter. The seventh plant, Socio Pago is scheduled to be converted to a pump station site. Plant descriptions, staffing implications, and regulatory issues are presented for each plant.

Collection System

The collection system is comprised of collection pipelines and pump stations. An important aspect of the WRMP was to perform a condition assessment of the system and also upgrade the mapping and modeling of the system.

Wastewater Collection Pipelines

The total wastewater system comprises approximately 236 miles of pipeline and an estimated 1,800 manholes on lines larger than 10” diameter. An estimated 4,000 manholes are on lines smaller than 10 inches in diameter. A sampling of about 300 lines was inspected and condition rated.

Wastewater Pump Stations

There are 77 stations of varying types in the system - 20 are the submersible type and eight are ejector stations where the motive force is supplied by compressed air. Eighteen of the stations have emergency generators owned by Guam Waterworks Authority (GWA), and an additional 23 stations have generators owned by the Guam Power Authority (GPA).

Summary

Over 45 CIP projects have been identified for the GWA wastewater system to be completed over the next 20 to 30 years. The WRMP provides a road map for accomplishing this formidable task.

Chapter 2 – Wastewater Regulatory Issues

The principal regulations affecting GWA's wastewater utility are included in the federal Clean Water Act. This important body of regulations includes the rules treatment plant discharge requirements, wastewater biosolids, and other key wastewater system requirements. The wastewater system may also be affected by drinking water regulations. The federal Safe Drinking Water Act requires that ground water sources affected by surface activities (such as wastewater spills and septic tanks) receive treatment. Future regulations could also impact GWA's wastewater utility.

Major Issues

This chapter addresses details of several of the major regulatory issues covered in the WRMP, these are:

- Clean Water Act
 - National Pollutant Discharge Elimination System (NPDES)
 - Biosolids
 - Guam Water Quality Standards
 - Operator Certification Program
- GWUDI of Surface Water
- Potential Future Regulatory Requirements
 - SSOs and CMOM
 - Potential Secondary Treatment Requirements

Conclusions, recommendations, and CIP impacts are also presented.

Summary

The primary emphasis is the need for GWA to continue efforts identified in the WRMP to bring facilities into compliance with the Clean Water Act. The need to prepare for potential new regulations identified in the chapter is also a priority task for GWA.

Chapter 3 – Wastewater Facilities Condition Assessment

The chapter describes a process used in developing a condition assessment of equipment associated with the wastewater pump stations, ejector stations and the wastewater treatment plants. The assessment was performed by visiting each of the sites and visually inspecting the equipment.

Assessment Approach

Eight categories of equipment were surveyed using a 0 to 4 rating where “0” indicated “not applicable” to “4” which indicated “well maintained condition”. Volume 1, Chapter 12 – Electrical Assessment details the electrical system condition assessment and Volume 3, Chapter 4 – Wastewater Collection System addresses collection system condition assessment.

Six factors were considered in making the numerical judgments for the wastewater system, these included:

- Use
- Maintenance
- Power Quality
- Corrosive Environment
- Vandalism/Theft (observed or potential)
- Weather and Natural Disasters

Sewage Treatment Plants

Six of the seven sewage treatment plants were surveyed, the seventh, the Pago Socio STP site is scheduled to be converted to a new pump station and was not included. Those having a condition assessment visit were:

- Hagatna STP
- Agat-Santa Rita STP
- Baza Gardens STP
- Inarajan STP
- Northern District STP
- Umatac-Merizo STP

A summary of the details of the visits are profiled in the chapter and in-depth details are presented in a CD in Appendix 3A. As a general rule, rankings on the 0 to 4 scale fell consistently in the 1 to 3 range with minor exceptions.

Wastewater Pump Stations

Condition assessments were performed on over 70 pump stations. It was observed that the pumping equipment associated with the wastewater pumping stations was in better physical and functional condition than the equipment at the larger sewage treatment plants.

Summary

The better condition of pump station equipment was observed to be the result preventing a spill hence immediate replacement of the failed equipment. In the treatment plants, failure of a piece of equipment might result in reduced performance, but the flow still comes in and flows out. As with treatment plant findings, a summary of the in-depth details are presented in a CD in Appendix 3A. Conclusions, recommendations, and CIP impacts are also presented.

Chapter 4 – Wastewater Collection System

The Wastewater Collection System chapter presents details on a program to address the requirements of the EPA Notice of Violation (NOV) issued for frequent spills and poor condition of the existing system. Major elements of the program identifies and describes projects that will reduce Inflow and Infiltration (I/I) and provide adequate capacity for the current and expected future development conditions.

Major Chapter Topics

The chapter is a compilation of a number of collection system facets. Following are the major topics covered:

- Description of system components
- Completed work under existing programs
- Critical sewer assessment results
- Sewer component condition assessment
- Force main inspection findings
- Staff interview results
- Capacity assessment

Other System Related Programs

Although this chapter mainly addresses the physical characteristics of the collection system, the GIS program development and hydraulic modeling sections provide additional pertinent information. The GIS program is the topic of Volume 1, Chapter 9 as well as application discussions contained in this chapter. Hydraulic modeling is addressed in a number of sections in this chapter.

Summary

An assessment of the major elements of the collection system is presented in this chapter describing current condition and recommended upgrades to meet GWA's needs for the next 20 to 30 years. A number of specific recommendations are presented in the closing sections and projected CIP projects are also addressed.

Chapter 5 – Wastewater Treatment Facilities

This chapter summarizes the evaluation of the existing wastewater facilities' infrastructure and performance. The findings from the evaluation will serve as the basis for developing a long-term plan to meet the wastewater treatment needs of Guam.

An additional goal of the chapter is to identify major capital improvement requirements for the wastewater treatment facilities and estimate costs for these projects. This chapter establishes the necessary background and basis for the development of the wastewater treatment facility CIP recommendations presented in Volume 1, Chapter 15 and specific wastewater related projects are presented in Volume 3, Chapter 9 for each of the STP's.

Major Chapter Topics

The chapter develops an overview of facility characteristics for the seven STP's in the system. Specific facility descriptions are profiled with details in the following categories:

- Background information
- Wastewater characteristics and regulatory (NPDES Permit) compliance requirements
- Capacity assessment

- Recommendations and CIP planning

Regional Considerations

In addition to facility profiles, the chapter identifies several regional considerations including activities or goals for system improvement. Key items are:

- Need for reliable flow measurement
- Increased process control testing and application of test results
- Continued operation and maintenance personnel training
- Need for stress testing STP's to determine true unit process capacities
- Development of an island-wide biosolids management plan

System Improvements

Since the beginning of the WRMP effort, GWA has made substantial progress in repairs and in operations and maintenance of the wastewater treatment facilities. Examples of these are:

- GWA has awarded the Hagatna STP rehabilitation project
- Upgraded staff to improve operations
- Acquired sampling equipment
- Vastly improved their staff training program

System Recommendations

Several major recommendations are presented and identified for the 20 year CIP. These are:

- Replacement of both Santa-Rita and Baza Gardens STP's with new facilities
- Significant upgrades to both Northern District and Hagatna STP's
- Development of a centralized biosolids handling facility
- Continue plans to convert the Pago Socio site into a pump station facility

Summary

This chapter presents an overview of the GWA's wastewater treatment facilities including current conditions and necessary upgrades or replacements to bring those that require it, into regulatory compliance. Significant expenditures over the next 20 to 30 years are scheduled for the system, these are identified in this chapter and specific projects for each of the plants are detailed in Volume 3, Chapter 9.

Chapter 6 – Septic Systems & Unsewered Areas

This chapter covers the topic of septic systems that are currently in use throughout Guam for wastewater collection and disposal in the areas not sewerred. It is estimated that 41% of the island residents use these individual wastewater disposal systems (IWDS) as reflected in GWA's customer count list. A large portion of Guam residents have septic systems and these vary in quality and consistency of design and construction. Key topics on this subject are summarized below.

Regulatory Requirements

GEPA has the mandate for setting and enforcing regulations on IWDS. This requirement is summarized as "...any single-family residence or duplex located within 200 feet of public sewer availability shall connect to the public sewer system. If public sewer is not available, toilet facilities shall be constructed as a Type 2 facility, defined as a toilet flushed with water and connected to a septic tank and leaching system."

Ground Water Under the Direct Influence (GWUDI) of Surface Water

Wastewater pump station overflows that mimic significant rainfall in the area of some wells have affected water quality. This information as well as other data being gathered by GEPA and GWA will be used to determine if the Northern System might be considered GWUDI.

A GWUDI designation for the Northern System would require that groundwater used for drinking water comply with the Surface Water Treatment Rule. The greatest impact associated with this designation would be the cost to filter the groundwater and monitor water quality in the distribution system. As noted in the chapter, this topic is addressed in detail in Volume 2, Chapter 2, Sections 2.4 and 2.5 identifying areas most affected and alternatives for addressing the challenges.

Geographic Distribution of IWDS

The chapter notes that there are parts of Guam that are more sensitive to the affects of septic systems than other parts of the island. The Northern Region and the northern portion of the Central Region are located over an aquifer in an area of limestone formations that provides an environment for the septic-treated wastewater to filter down to the island's groundwater source.

Existing Conditions, Impacts on Water Quality of Aquifer

The chapter notes that Guam's groundwater quality is currently considered to be in good condition; however, there is concern that the presence of certain water pollutants will adversely affect the future supply. One such source of pollutants is insufficient residential wastewater treatment, causing unacceptable levels of bacteria and nitrates. The two leading potential sources of nitrogen in one basin are septic systems and runoff from a golf course (possibly from fertilizer usage).

Possible Mitigation Methods

Potential mitigation options to reduce potential groundwater contamination include extension of the sewer system to serve existing customers on septic tanks or implementation of constructed wetlands for individuals or groups of individuals. These options are expanded on in the chapter.

Institutional and administrative issues with mitigation are also explored and expanded in the chapter, noting that at least four different agencies have a stake in resolving problems of potential septic system influence on potable aquifers. There is a need for uniformity of regulation and monitoring in the areas of high incidence of septic tanks.

Summary

There is a high incidence of septic tank use on Guam, which is presenting a potential threat to the potable water quality through seepage into the aquifers. Several mitigation measures

are possible. The long range solution will depend on continued cooperation of a number of administrative and regulatory entities. The chapter concludes with recommendations and potential CIP expenditures associated with solutions to groundwater protection.

Chapter 7 – Water Reuse

The current potable water demand from residential, tourism, agricultural, and golf course irrigation uses are projected to substantially increase on Guam over the course of the planning horizon of this Master Plan through 2026. This chapter examines potential short term and long term opportunities to reuse treated wastewater as a means of reducing the demands on the potable water system on the island. Because Guam currently does not have established regulations governing recycled water reuse, Hawaii and California regulations are used as the basis for the recommendations provided in this chapter. Although no short-term wastewater reuse projects were identified, the chapter lays the groundwork for implementation of future applications when the regulatory framework is in place.

Common Types of Wastewater Reuse Applications

Several of the applications considered for the future consideration are:

- Groundwater recharge
- Industrial reuse
- Environmental reuse
- Restricted and unrestricted urban reuse
- Restricted and unrestricted recreational reuse
- Agricultural reuse
- Indirect potable reuse

Potential STP Vicinity Future Sites

Reuse opportunities for the future were examined for several of the STP sites and immediate vicinity. The reuse application options listed above were included in the consideration. Sites considered were:

- Agat-Santa Rita STP
- Hagatna STP
- Baza Gardens STP
- Umatac-Merizo STP
- Northern District STP

No opportunities were identified in the vicinity of the Inarajan or Pago Socio STP's. The most feasible options for reuse is for agriculture, golf courses or constructed wetlands. Groundwater recharge and unrestricted uses require a much higher level of treatment than is currently practiced by GWA facilities.

Stormwater Reuse

One of the tasks of the WRMP was to address the potential for capture and reuse of stormwater. Because of this public interest, further investigation into the feasibility of future

development should be considered. Ideally, a stormwater feasibility plan would focus not only on stormwater reuse, but also on floodwater prevention in urbanized areas. The conclusion was that urban areas would benefit from improvements made to existing storm drainage infrastructure. Development of surface water collection and storage for supplementing water for future demands should be pursued as technology becomes more advanced.

Summary

Although there appear to be limited reuse options at present, it was concluded that two major factors must occur before there are feasible opportunities. The first will be to formulate reuse regulations similar to those of the states of Hawaii and California. The second is the in-depth feasibility plans showing the benefits and taking advantage of advances in technology to deliver a safe product economically.

Chapter 8 – Biosolids Management

This chapter profiles both the potential biosolids regulation and beneficial uses on the island. It also capsulizes regulations from various United States locations as a potential resource for establishing biosolids regulations and identifies future possible uses of biosolids from specific GWA STP's. A centralized site for biosolids handling is also recommended.

Summary of Biosolids Reuse Regulations

A profile of potential uses of biosolids observed in various locations on the U.S. mainland is presented in this section. Pertinent regulations that govern these uses are also noted:

- **Land Application** – Land application of biosolids to condition or fertilize soil for crops or other vegetation is the most common beneficial use of biosolids in the U.S. Class A biosolids have far fewer restrictions than Class B biosolids.
- **Surface Disposal** – Surface disposal sites are defined as areas of land designated specifically for biosolids final disposal, and can include sites for beneficial use. Some examples of surface disposal sites include monofills, surface impoundments/lagoons, waste piles, dedicated disposal sites, and dedicated beneficial use sites.
- **Biosolids Incineration** – The EPA defines biosolids incineration as the firing of biosolids at high temperatures in an enclosed device such as an incinerator. A number of regulations must be met for use of incinerations including pollutant limits for hydrocarbons and seven metals.

Summary of Biosolids Treatment Processes

Some of the processes used for stabilizing organic material within the biosolids include anaerobic and aerobic digestion, composting, wet-air oxidation and vertical tube reactors. Other patented and emerging technologies are also either in pilot stage or limited full scale use as well.

Current Biosolids Practices on Guam

Of the seven STPs on Guam, five are currently generating and treating biosolids to various levels. These five STPs are:

- Hagatna STP
- Northern District STP
- Baza Gardens STP
- Agat-Santa Rita STP
- Inarajan STP

Construction contracts were negotiated in 2006 to begin upgrades to the biosolids handling facilities to improve current practices. These are for the Hagatna and Northern District STPs. Anaerobic and aerobic digestion are the two most frequently used stabilization processes used on the island. Some very limited composting occurs at the Northern District site, but it is not believed to be sufficient to meet even Class B biosolids regulations. Some stabilization may also occur in the lagoons at Umatac-Merizo and Inarajan, however no records are available for the condition of the solids that have been infrequently dredged and disposed of.

Biosolids Reuse and Disposal Options on Guam

Five reuse alternatives are presented below, reflecting the more feasible options in reusing or disposing of Guam's biosolids. The discussion of these alternatives in the chapter primarily focuses on potential reuse opportunities, with little emphasis on the associated treatment upgrades that would be required to meet the proposed regulations. The five options are:

- Use for daily landfill cover
- Dispose of in the landfill
- Incineration
- Liquid biosolids application to agricultural land
- Dewatered biosolids application to agricultural land

Summary

The chapter places a strong emphasis on the need for a biosolids handling and disposal plan for the island. It was noted that GEPA does not currently have biosolids regulations in place and provides background that should be considered when the regulations are formulated. Current practices for biosolids handling are profiled in the chapter as are potential future practices to bring GWA into compliance with EPA regulations.

Chapter 9 – Recommended CIP

Proposed CIP projects for a 20- to 30-year period are detailed in this chapter for the wastewater collection and treatment systems. Projects were identified during facility visits, review of available reports and studies, asset condition assessments, GIS development and hydraulic modeling. A summary table lists each of the projects and individual tables give specifics about each project.

CIP Ranking Method

As a means of verifying the priority of CIP projects, a system known as “pairwise comparison” process was used to rank the importance and hence at least partially, the scheduling of projects regardless of utility type (water, wastewater, etc.). The process involved making comparisons of six categories. These are:

- Life and Safety
- Regulatory Compliance
- System Reliability
- System Redundancy
- System Capacity
- Operation and Maintenance and Rehabilitation Recommendations

Project Tables

Over 45 separate project tables are listed, each providing specific information about the project description, estimated cost, type, etc. The results of the individual tables are compiled into a single table at the beginning of the chapter and also in Volume 1, Chapter 15.

Summary

A major objective of the WRMP was to prepare a 20-year CIP forecast for GWA's water and wastewater system. This chapter presents the major tasks supporting the projected wastewater needs. A similar chapter identifies water projects in Volume 2, Chapter 9.