COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS
Water Quality Assessment
305(b) Report

Division of Environmental Quality
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I. OVERVIEW

Section 305(b) of the Federal Water Pollution Control Act (Clean Water Act) requires States and Territories to monitor the quality of their surface and ground waters and prepare a report describing the status of their water quality. These reports (305(b) reports) are used by the Environmental Protection Agency (EPA), Congress, and the public to evaluate (1) whether US waters meet water quality standards, (2) the progress made in maintaining and restoring water quality, and (3) the extent of remaining problems. This is the first 305(b) report that the Commonwealth of the Northern Mariana Islands has prepared.

The Commonwealth of the Northern Mariana Islands (CNMI) is an archipelago of 15 islands in the Western Pacific Ocean (Figure 1). Almost the entire population of the Commonwealth lives on the southern three islands: Saipan, Tinian, and Rota. These three islands are primarily limestone (uplifted coral reefs) with minor deposits of exposed volcanic rock. Saipan is the largest and by far the most populous of the islands. The focus of this report is on Saipan, with minor references made to and data provided for the other islands. Future monitoring and reporting efforts will work to include the other islands.

The health and economic well-being of the people of the CNMI depend upon on good water quality. The island community is shaped by the water around and under it; when one thinks of a tropical island, inevitably pictures of clear blue water teeming with

Figure 1. The Mariana Islands.

image is difficult to maintain with a rapidly growing population and continued developmental pressures.

Good quality nearshore marine water is essential to support coral reefs. Coral animals require pollutant-free water that remains within a narrow range of various parameters for survival. The people of the CNMI in turn rely on the coral reef ecosystem for subsistence, recreation, storm protection, and tourism.

The islands of the Northern Marianas formed as the classic result of activity near a plate tectonic margin. In geological terms, the islands are relatively young when compared to land masses in the continental United States. The strata in the CNMI is composed entirely of limestone and volcanic formations. In isolated areas, the geology has created a situation where high level limestone fresh water aquifers overlie an impermeable volcanic layer which creates a good and relatively protected supply of drinking water. However, the majority of the fresh water is found in the basal aquifer with a fresh water lens sitting on top of sea water, separated as a result of differences in density of the fluids.

The location and distribution of the fresh water aquifers are of extreme importance in the CNMI. Approximately 99 percent of the drinking water comes from aquifers. The basal aquifer is susceptible to salt water intrusion if wells are over-pumped. The largest ground water problem in the CNMI is high chlorides resulting from over-pumping of this basal aquifer in an effort to keep up with the increasing population demand.

The chloride problem only exists on the island of Saipan, due to the large population, but new development initiated on Tinian and Rota may affect the basal aquifer if future well drilling is not monitored or managed properly.

The limestone aquifers are also highly porous and fractured and easily contaminated from various types of sources at the surface and subsurface. In addition to the increased presence of contaminants as development increases, there are concerns about historical contamination of groundwater from the 1940-60's from military activities. As water well drilling increases to keep up with population demand, the likelihood of identifying contaminated areas increases.

Wetlands can be found on the islands of Saipan, Tinian, Rota, and Pagan. The majority of the original wetlands in the Northern Mariana Islands remain, with the exception of those on Saipan. Saipan was heavily farmed during Japanese times (pre-World War II), which resulted in filling of wetland areas to make them suitable for farming. It is estimated that over 60 percent of the wetlands on Saipan were lost during this period. Increasing development continues to threaten wetlands on all of the islands. The wetlands provide habitat for endangered species and serve other functions such as surface water storage and pollutant uptake.

A. Water Quality of the CNMI.

If a comparison of water quality were made on a world-wide basis, CNMI waters would probably be close to the best. CNMI waters have only minor sources of industrial pollution: municipal waste water receives secondary treatment, and the government implements numerous programs to maintain and improve the quality of the water. However, because the quality of water is so critical to the well-being of the community and there is a limited supply of freshwater, even minor infractions are treated with the utmost concern.

The CNMI has two classes (AA and A) for marine water use and two classes (1 and 2) for fresh surface water use. All fresh surface waterbodies in the CNMI (wetlands, intermittent streams, and perennial streams) are Class 1 (Figures 2 and 3), meaning that these waters should remain in their natural state with an absolute minimum of pollution from any human-caused source. These waters are not used for drinking water or recreation and the quality of the water is not tested on a regular basis. These waterbodies may be monitored and reported on in the future, but will not be discussed further in this report.

Almost all of the coastal marine waters are Class AA, meaning that these waters should remain in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-related source or actions. The uses protected in these waters are the support and propagation of shellfish and other marine life, conservation of coral reefs

Figure 2. Class I Waters. Saipan, CNMI.

Figure 3. Class I Waters. Rota, CNMI.

and wilderness areas, oceanographic research, and aesthetic enjoyment and compatible recreation inclusive of whole body contact (e.g. swimming and snorkeling) and related activities. As will be discussed further in this report, with some exceptions, the goals set forth for Class AA waters are being met.

Table 1 lists Class A waters in the CNMI and Figure 4 shows the sizes and locations of Saipan Class A waters. Class A waters are protected for their recreational use and aesthetic enjoyment; other uses are allowed as long as they are compatible with the protection and propagation of fish, shellfish, and wildlife, and recreation in and on these waters of a limited body contact nature.

Table 1. Class A Waters, CNMI.

Waterbody	Reason for Class A designation
Puerto Rico Industrial, Saipan	Commercial port and municipal waste outfall
Agingan Point, Saipan	Municipal waste outfall
East Harbor, Rota	Commercial port
West Harbor, Rota	Commercial port
San Jose Harbor, Tinian	Commercial port

B. Causes and sources of water quality impairments.

Both point sources and nonpoint sources of pollutants are responsible for lowering the quality of the CNMI's water. Sewage outfalls, dredging, sedimentation from unpaved roads and development, and nutrients from golf courses and agriculture are the most significant stressors on the CNMI's marine water quality. Eutrophication and sedimentation are two of the biggest stresses

Figure 4. Class A Waters. Saipan, CNMI.

on coral reefs and are the two most significant causes of marine water quality impairment in the CNMI.

The CNMI’s groundwater is threatened by over-pumping. Due to the fragile nature of the basal aquifer, over-pumping of groundwater can result in saltwater intrusion. The thickness of the freshwater lens on top of the saltwater is related to several factors, including extent of recharge areas, geology, and proximity to the coastline. Saltwater intrusion is irreversible and causes permanent damage to the surrounding aquifer.

In addition to saltwater intrusion, other activities can impair the groundwater quality. There are large residential areas on the islands without sewer hookup. High concentrations of septic tanks can lead to excessive levels of nitrates in the drinking water supplies. In some areas, extremely fast percolation rates can result in bacteriological and nitrate contamination of water supplies from poorly designed septic systems.

The principal industry in the CNMI is tourism, but there has been a large increase in the garment industry over the last several years. Garment factories use various types of chemicals in the manufacturing process. There is also a large increase in the number of service industries due to the increase in population. Numerous automobile repair shops, gasoline stations, and power generators serve as potential sources of contaminants.

C. Programs to correct impairments.

The Division of Environmental Quality (DEQ) has implemented several programs to correct both point and nonpoint sources of pollution that cause water quality impairment and to protect water quality in general. DEQ has a comprehensive permitting program, recently established a new nonpoint source pollution section, conducted several CWA 319 demonstration projects, regularly monitors water quality using traditional parameters and biocriteria, and takes enforcement action against violators.

DEQ requires all water wells in the CNMI to obtain a permit prior to exploration and requires a permit renewal every year for continued operation. conductivity, hardness, nitrate as nitrogen, total dissolved solids, pH, and Fecal coliform.

It is the policy of DEQ to require decreasing the pumping rate for the operation of existing wells to minimize the potential for salt water intrusion, and encourage more well drilling to meet water production needs. The sampling results from the DEQ Well Operations Permits are reviewed semi-annually, and wells that have increased levels of chlorides are required to reduce the pumping rate. In some cases, wells operated by the local utility corporation that had extremely high chloride levels were closed down and replaced by several new wells with reduced pumping rates. It is an unofficial DEQ policy to limit all newly-drilled wells to a pumping rate of less than 45 gallons per minute unless there are unusual circumstances and evidence of a high quality yield from the aquifer.

Due to the increase of potential pollutants, the CNMI Division of Environmental Quality has increased the number and scope of regulatory programs to reduce the potential of nonpoint sources of pollution affecting groundwater. DEQ implements a fairly stringent permitting program for septic tanks. These permits for septic tank compare projected calculations of volume of wastewater for the permit with (1) the depth to groundwater and (2) soil percolation test results. Despite these precautionary methods, high concentrations of septic tanks in populated areas will eventually lead to elevated nitrate levels in the groundwater due to nutrient loading. Efforts are being made to procure funding to extend the existing sewer lines into highly populated residential areas. Concurrently, the DEQ environmental laboratory has expanded its ability to monitor nutrient levels, such as phosphate and nitrate.

Both underground storage tanks and aboveground storage tanks receive DEQ review and approval before installation. The storage of chemicals is controlled through permits, inventory, and inspections of facilities that store chemicals. Although DEQ programs are being developed with stringent standards, there is a need to manage our rapidly developing islands through other planning mechanisms such as zoning. The proposal of reinstating a zoning program is being reviewed by the current administration.

D. Monitoring programs, issues of special concern, and CNMI initiatives.

DEQ has developed an extensive monitoring program that includes monitoring Public Water Supply systems (PWS) and nearshore marine water for traditional water quality parameters. In addition, DEQ has developed a program using biocriteria methods to monitor the health of coral reefs. The coral reef monitoring program is vital in that it monitors the very resources that we are trying to protect through the water quality standards. Monitoring the coral reef itself will allow us to proactively detect problems early on and act before our resources are permanently degraded.

The Puerto Rico dump on Saipan is an issue of special concern to the CNMI. The area surrounding the dump has not been monitored for potential contaminants and we do not know the impact that the dump has had on the marine environment. However, as part of the dump closure plan, an independent firm will be contracted to evaluate the water quality surrounding the dump for metals and other chemicals associated with leachate. The final study will be submitted to the Environmental Protection Agency and subsequent remediation will take place.

In addition to the dump, there are several other locations throughout the CNMI that are potentially contaminated from World War II and post-World War II activities. The extent of contamination caused by World War II activities has not been fully investigated.

As part of the well operation permit, well operators are required to submit semi-annual water sample results on chlorides, hardness, nitrates, TDS, conductivity, pH, and Fecal coliform. At present, DEQ is developing a well database that will be eventually be incorporated into the newly developed Geographic Information System for the CNMI. It will then be possible to consider both historical and current trends in chloride increases in the groundwater due to over-pumping. It is hoped that with this information, DEQ will be able to develop a groundwater classification system to limit well drilling in certain areas of the island while identifying potential areas for future exploration.

II. BACKGROUND

The 15 islands of the CNMI account for a very small land mass as compared to the marine water resources (Table 2). The population of the islands is rapidly increasing and is projected to increase by 40 percent by 2000 (Table 3).

Table 2. Atlas of Commonwealth Resources.

Resource	Value
Surface area of CNMI[1]	457.1 sq km
Surface area of Saipan[1]	120.4 sq km
Surface area of Tinian[1]	101.5 sq km
Surface area of Rota[1]	85.0 sq km
Population[1] (total)	58,846
CNMI Residents	21,306
Alien workers	37,540
Tourists	1,978/day
Length of perennial and intermittent streams on Saipan[2]	95.5 km
Area of freshwater and tidal wetlands on Saipan[2]	2,808 sq km
Area of Saipan lagoon[2]	30,750 sq km
Length of Saipan coastline[2]	83.81 km
Area of bays (Lau Lau Bay, Saipan) [2]	10,662 sq km
Area of Saipan marina (Smiling Cove) [2]	0.1 sq km
Area of CNMI EEZ[3]	414,398 sq km (approximate)

Table 3. Population projections[1].

Year	Total
1996	60,960
1997	63,763
1998	66,559
1999	69,341
2000	72,101

[1] from the CNMI Department of Commerce Statistical Yearbook 1996 (based on 1995 census)
[2] from the CNMI Geographic Information System
[3] from the CNMI Department of Commerce

III. SURFACE WATER ASSESSMENT

Streams and wetlands are currently not monitored because they are not used for drinking water or recreation. This section discusses the assessment of marine water only.

A. Monitoring program

1. Monitoring design used by the CNMI

(a) Microbiological and chemical water quality monitoring

On a weekly basis, DEQ monitors 35 fixed stations along Saipan's most used West coast beaches for microbiological and chemical parameters (Table 4 and Figure 5). Six beaches on the Northeast coast and six beaches on the Southeast coast are monitored on only a quarterly basis because the quality of the water is consistently good and a smaller population uses these less developed areas. Eleven sites around Managaha Island are also monitored on a quarterly basis. Though the population recreating on this island is increasing, water quality is consistently good.

Each quarter, Tinian and Rota monitor four and fifteen beach "areas" respectively (Table 5). Again, the frequency is based on known water quality and the population of the island.

Table 4. Saipan microbiological and chemical monitoring sites (n = 62).

Name	Latitude	Longitude	Watershed ID #	Region ID#	Site ID#	Test Freq.
Wing Beach	N15 16.279	E145 47.517	2	1[1]	01	W
PauPau Beach	N15 15.295	E145 46.757	2	1	02	W
Nikko Hotel	N15 15..208	E145 46.643	4	1	03	W
San Roque School	N15 15.057	E145 46.376	4	1	04	W
Plumeria Hotel	N15 14.832	E145 46.028	4	1	05	W
Aqua Resort Hotel	N15 14.875	E145 46.001	4	1	06	W
Tanapag Meeting Hall	N15 14.554	E145 45.197	4	1	07	W
Central Repair Shop	N15 13.914	E145 44.412	4	1	08	W
Sea Plane Ramp	N15 13.818	E145 44.355	4	1	09	W
DPW Channel Bridge	N15 13.520	E145 44.249	6	1	10	W
Smiling Cove Marina	N15 13.018	E145 43.466	6	1	12	W
Micro Beach	N15 13.020	E145 42.998	6	1	14	W
Hyatt Hotel	N15 12.950	E145 42.945	6	1	15	W
Dai-Ichi Hotel	N15 12.854	E145 42.925	6	1	16	W
Dai-Ichi Drainage	N15 12.778	E145 42.951	6	1	17	W
Samoa Housing	N15 12.633	E145 42.938	6	1	18	W
Hafa-Adai Hotel	N15 12.555	E145 42.940	6	1	19	W
Hafa-Adai Drainage	N15 12.490	E145 42.955	6	1	20	W
Garapan Fishing Dock	N15 12.144	E145 42.980	6	1	21	W
Garapan Beach	N15 11.758	E145 43.030	6	1	22	W
Garapan Drainage	N15 11.974	E145 42.994	6	1	23	W
Chalan LauLau Beach	N15 10.883	E145 42.817	9	1	24	W
San Jose Beach	N15 10.143	E145 42.603	9	1	25	W
Civic Center Beach	N15 09.874	E145 42.491	9	1	26	W
Diamond Hotel	N15 09.551	E145 42.156	9	1	27	W
Grand Hotel	N15 09.397	E145 42.014	9	1	28	W
Community School	N15 09.214	E145 42.055	9	1	29	W
Sugar Dock	N15 09.081	E145 42.006	9	1	30	W
CK Dist #2 Drainage	N15 08.906	E145 42.012	9	1	31	W
CK Dist #4 Lally Beach	N15 08.716	E145 41.948	9	1	32	W
Chalan Piao Beach	N15 08.591	E145 41.591	9	1	33	W
Hopwood School	N15 08.429	E145 41.855	9	1	34	W
San Antonio Beach	N15 07.894	E145 41.565	9	1	35	W
PIC Beach	N15 07.643	E145 41.587	9	1	36	W
San Antonio Lift Station	N15 07.454	E145 41.623	9	1	37	W
Grotto Cave	NM	NM	3	2[2]	01	Q
Bird Island Beach	NM	NM	3	2	02	Q
Jeffrey's Beach	NM	NM	5	2	03	Q
Old Man By the Sea	NM	NM	5	2	04	Q
Marine Beach	NM	NM	7	2	05	Q
Tank Beach	NM	NM	7	2	06	Q
Managaha Beaches	NM	NM	NA	3[3]	01-11	Q
Forbidden Island	NM	NM	7	6[4]	09	Q
North Laulau Beach	NM	NM	8	6	10	Q
South Laulau Beach	NM	NM	8	6	11	Q
Obyan Beach	NM	NM	11	6	12	Q
Ladder Beach	NM	NM	11	6	13	Q
Unai Dangkulo Beach	NM	NM	11	6	14	Q
Obyan reef cut	NM	NM	11	6	01	Q
Obyan 30'	NM	NM	11	6	02	Q
Boy Scout reef cut	NM	NM	11	6	03	Q
Boy Scout 30'	NM	NM	11	6	04	Q
North Laulau reef cut	NM	NM	8	6	05	Q
North Laulau 30'	NM	NM	8	6	06	Q
South Laulau reef cut	NM	NM	8	6	07	Q
South Laulau 30'	NM	NM	8	6	08	Q

[1] West Saipan sites tested weekly - W.
[2] Northeast Saipan sites tested quarterly - Q.
[4] Managaha Island beaches sites tested quarterly.
[5] Southeast Saipan sites tested quarterly.

Figure 5. Monitoring Locations. Saipan, CNMI.

Table 5. Tinian and Rota microbiological and chemical monitoring sites.

Name	Region #	SITE ID#
Tinian		
Taga Beach	4	01
Jones Beach	4	02
Buoy #6	4	03
Harbor 1	4	04-16
Rota		
Manglona Beach	5	Y00
Coral Garden	5	01
Kokomo Beach Club	5	02
Mobil Storm Drain	5	03
East Harbor Dock	5	04
Tweksberry Beach	5	05
West Harbor Marina	5	06
Dist #2 Storm Drain	5	07
Dist #1 Storm Drain	5	08a
Pinatang Park	5	08b
Vet. Memorial Park	5	09
Teteto Beach	5	10
Guata Beach	5	11
Swimming Hole	5	12
Rota West Harbor	5	W01-W11

The biocriteria monitoring sites (described below) are monitored for microbiological and chemical parameters each time a survey is conducted at that site.

(b) ***CWA 401 Water Quality Certification monitoring***

The CNMI currently has four active projects that were approved as part of the Clean Water Act Section 401 Water Quality Certification program. These permits require that all of the CNMI water quality standards be met as stated in the anti-degradation policy. The standards are summarized in the Assessment Methodology and Water Quality Standards in Section B, below.

(c) Long Term Marine Monitoring Plan

DEQ has developed a Long Term Marine Monitoring Plan that uses biocriteria monitoring techniques to determine baseline conditions and evaluate long term changes in the health of the coral reef at eight fixed stations (four on Saipan and two each on Tinian and Rota) (see Figure 5). The methods used in the Long Term Marine Monitoring Plan will also be used at other sites to evaluate compliance with major siting permit conditions.

The Marine Monitoring Team, an interagency team consisting of members from the Division of Environmental Quality, Coastal Resources Management, Division of Fish and Wildlife, and Northern Marianas College, is responsible for conducting biocriteria monitoring.

2. Parameters and sampling frequency

The microbiological and chemical parameters monitored include: temperature (°C), salinity (‰), dissolved oxygen (% D.O.), pH, turbidity (NTU), and Fecal coliform (CFU/ 100ml). These parameters are monitored on a weekly or quarterly basis (see Tables 4 and 5). DEQ has just begun to test nutrient levels, nitrate and reactive phosphate (mg/L), on a monthly and quarterly basis.

The Marine Monitoring Team uses several different biocriteria monitoring techniques to monitor the health of the coral reef. A broadscale survey of each reef using the manta tow technique is conducted on an annual basis. Sedimentation rates using sediment traps to determine terrigenous sediment loads on the reef are measured on a monthly basis. The Marine Monitoring Team determines percent cover of coral and algae on a biannual basis using the Line intercept transect (LIT) and Point Intercept Quadrant (PIQ) techniques. A survey of butterflyfish, including territory sizes, is used as an indicator of coral health. The Butterflyfish survey is conducted biannually. At present, the Marine Monitoring Team does not conduct annual fish counts, but this is expected to begin in Fiscal Year 1999. Permanent quadrats to monitor percent cover of coral and algae will also be established in Fiscal Year 1999.

3. References for written protocols.

The DEQ Environmental Surveillance Laboratory Quality Assurance Manual includes Standard Operating Procedures (SOPs) for sampling, testing, reporting, and providing quality assurance for traditional water quality and biocriteria parameters.

4. Description of QA/QC program.

The Quality Assurance program is described in the Laboratory Quality Assurance Manual.

5. Data management.

Staff in the Laboratory section and members of the Marine Monitoring Team have been trained to input marine water quality and biocriteria monitoring data into an Excel-based spreadsheet. Data from the Line Intercept Transect (LIT) and broadscale (manta tow) biocriteria monitoring surveys are entered into a database on a program called ARMDES, created by the Australian Institute of Marine Sciences. All databases are updated monthly and verified before creating back-up copies of the data. The databases are incorporated into the Geographic Information System (GIS) and shared with other CNMI agencies.

6. Training received and given

The laboratory staff participate in workshops concerning both marine and freshwater protection and testing techniques on a regular basis. During Fiscal Year 1997, the laboratory staff received training over an array of concentrations including: microbiology plate reading, reactive phosphate analysis, hazardous materials decontamination, and sanitary surveys. The laboratory staff frequently conduct classes for students from the Northern Marianas College and area high schools.

Training for the Marine Monitoring Team is vital because the members are conducting technical biocriteria surveys, but opportunities for training are limited because the team is doing work that few others are. Most members of the Marine Monitoring Team received their Scientific Diver certification from the Northern Marianas College during Fiscal Year 1997. Coursework for this certification included: openwater SCUBA, advanced/dive rescue SCUBA, master SCUBA, marine biology, watershed ecology, seamanship and light salvage, small boat handling, and coral reef monitoring I and II. These courses were taught by other members of the Marine Monitoring Team and scientists from the University of Hawaii, University of Guam, and the National Oceanographic and Atmospheric Administration. Other training opportunities members of the Marine Monitoring Team have participated in during the last two fiscal years include: Qualitative Underwater Ecological Surveying Techniques from the University of Hawaii, Line Intercept Transect training from the Australian Institute of Marine Sciences (AIMS), coral diseases and video monitoring from the Global Coral Reef Alliance, and Point Quadrat surveying from the University of Guam. The team also continuously conducts in-house training sessions as refresher courses and to teach new members the monitoring techniques.

7. Volunteer monitoring

At the present time, volunteer monitoring is not taking place in the CNMI. This is an issue that the Division of Environmental Quality is exploring, but at the present time, efforts are focused on establishing an official monitoring program. With time, we will reach out to community groups, school groups, and the dive operators to initiate a volunteer monitoring program. A volunteer monitoring program might include school groups monitoring the quality of the water near their school's beach or SCUBA companies leading dives to collect fish behavior data for the Butterflyfish survey.

B. Assessment Methodology and Water Quality Standards

DEQ analyzes various data for determining "use support" status of the Class A and Class AA waterbodies described earlier. Depending on the designated use of the waterbody (i.e., wastewater treatment plant outfall, recreational swimming or SCUBA diving area) DEQ analyzes the data to determine if the quality of the water is supporting that use. The specific criteria and methodology are described below. Table 14 in Section III E lists the results of the use determination.

1. Methods to assess water quality data for use support

Water quality is assessed by comparing the parameters listed above to CNMI Water Quality Standards. Fecal coliform, turbidity, and orthophosphate are the primary parameters that DEQ evaluates to assess marine water quality data to determine if it is meeting their designated use.

(a) Inland Waters

As stated earlier, no inland waters (Class 1) are being monitored on a regular basis because these waters are not used for drinking water or recreation. Therefore, we have not developed a method to assess use support.

(b) Marine Waters

DEQ plans to use three criteria to assess use support of Class A and Class AA marine waters. Water quality data are only one aspect of the assessment methodology. Public health, aquatic life, and compliance with water quality standards are the three criteria that DEQ will evaluate. At the present time, DEQ is monitoring compliance with water quality standards and evaluating limited aquatic life in some locations. Public health issues and additional aquatic life monitoring (i.e., fish toxicity) need to be explored before DEQ can adequately determine if these waters are meeting their intended uses. Because these criteria have not yet been explored, DEQ has not set criteria for determining if the uses are being fully or partially supported or are threatened or not supporting.

(1) Class A

Certain waters of the CNMI are designated as "Class A" to allow for industrial activities. Activities taking place in Class A waters must not cause significant health problems, must not negatively affect aquatic life (especially that which is consumed by humans (i.e., fish, algae, and sea cucumbers)), and the waters must meet the CNMI Water Quality Standards. In meeting the Water Quality Standards, these waters must be capable of supporting recreational activities and aesthetic enjoyment, conform with the anti-degradation policy, and not violate the water quality criteria ten or more times during the year.

(2) Class AA

The methodology used to assess use support of Class AA waters is similar to that of Class A waters. Class AA waters must not cause significant health problems, must not negatively affect aquatic life (especially that which is consumed by humans (i.e., fish, algae, and sea cucumbers)), must not degrade coral reefs, and must meet the CNMI Water Quality Standards. In meeting the Water Quality Standards, these waters remain in their pristine state as nearly as possible, conform with the anti-degradation policy, and not violate the water quality criteria five or more times during the year.

2. Water Quality Standards

As required under the Clean Water Act, the CNMI Water Quality Standards were revised in 1997 through the triennial review process (Table 6). Changes were made to correct some typographical errors and other technical oversights made in previous amendments. One major change was the change of the designated use water body classification of a highly developed recreational area. The change was made for the area surrounding Managaha Island (see Figure 4) to be changed from a less stringent “A” classification to the proper “AA” designated use classification. The CNMI relies heavily on tourism for the local economy and has consequently developed fairly stringent water quality criteria for Class A waters.

The development of the CNMI Water Quality Standards were largely based upon the review of existing water quality standards for other tropical islands. Due to the potential impact and delicate aspects of the coral reef ecosystems and the lack of existing data, stringent nutrient standards were adopted for the CNMI. DEQ recently initiated the collection of nutrient level data as the environmental laboratory has just developed the ability to monitor nutrient levels. There is a concern whether or not the current readings of nutrients are reflective of natural

Table 6. CNMI Water quality standards.

PARAMETER	CLASS AA	CLASS A	CLASS 1	CLASS 2
Fecal Coliform (CFU/100 ml)	GM[1]< 200 < 400	GM[1]< 200 Never > 400	GM[1]< 200 Never > 400	GM[1]< 200 Never > 400
Enterococci (CFU/ 100 ml)	GM < 35	GM <125	GM < 33	GM < 90
pH	8.05 - 8.15	6.50 - 8.50	8.05 - 8.15	6.50 - 8.50
NO_3 - N (mg/L)	< 0.20	< 0.50		
Total Nitrogen (mg/L)	< 0.4	< 0.75	< 0.75	< 1.50
Orthophospha te PO_4 (mg/L)	< 0.025	< 0.05	< 0.10	< 0.10
Total Phos PO_4 (mg/L)	< 0.025	< 0.05	< 0.10	< 0.10
Ammonia (mg/L) (un-iodized)	< 0.02	< 0.02	< 0.02	< 0.02
Dissolved O_2 (%)	> 75	> 75	> 75	> 75
Total Filterable Suspended Solids (mg/L)[2]	5	40	5	40
Salinity (‰)[2]	10	20‰ or above 250 mg/L	10	20‰ or above 250 mg/L
Total Dissolved Solids (mg/L)		500 mg/L		500 mg/L
Temperature (°C)[2]	1.0	1.0	1.0	1.0
Turbidity (NTU)[2]	0.5	1.0	0.5	1.0
Radioactive Materials	Discharge prohibited	Discharge prohibited	Discharge prohibited	Discharge prohibited
Oil & Petroleum	ND[3]	ND[3]	ND[3]	ND[3]

[1] GM - Geometric mean in not less than five samples over a 30 day period.
[2] Shall not exceed ambient by more than the stated value.
[3] ND - Non-detectable.

or anthropogenic sources. To make such a determination might require monitoring nutrient levels in marine waters surrounding uninhabited islands of the CNMI over a sufficient period of time to establish natural ambient conditions in this area.

C. Water Quality Assessment Summary

1. Designated uses, causes, and sources of impairment

Designated uses, causes, and sources of impairment will be described below in the following categories: Class A - Agingan Point, Class A - Puerto Rico Industrial, Class AA - lagoon, and Class AA - eastern/southern side. As discussed earlier, inland waters have not been sampled and will not be discussed in this section.

(a) Class A - Agingan Point

Agingan Point is designated Class A because it is the site of the outfall for the Agingan Point Wastewater Treatment Plant (see Figure 4). These Class A waters encompass 2.5 square kilometers of coastal waters surrounding the Agingan Wastewater Treatment Plant, within a 1,000 foot radius of the outfall. The sewage receives secondary treatment and is then discharged offshore into strong currents. Few people recreate in this water because there is no shoreline access and the currents are quite strong. However, despite a sign posted by DEQ demonstrating in international sign language that fish from this site may pose a health hazard, many people continue to fish from this cliff site.

These waters consistently do not meet the Fecal coliform criteria of less than 400 CFU/100 mL, as set forth in the CNMI Water Quality Standards. During 1997, the waters were tested on a weekly basis for the months of October through December. The water exceeded CNMI water quality standards ceiling value of 400 CFU/100 ml twelve times and were found to exceed the NPDES effluent criteria each time (Table 7). The effluent discharges have never been found to meet the CNMI NPDES standards of <23 CFU/100 ml when tested by DEQ. Therefore, DEQ has asked that Commonwealth Utility Corporation (CUC) provide the NPDES Fecal coliform counts with their quarterly results, which are submitted to DEQ and EPA. The laboratory has also continued to randomly test the outfall effluent microbial quality on a random basis.

Table 7. Agingan Point Water Quality (1997 - 1998).

	Fecal coli. (CFU/ml)	Salinity (‰)	D.O. (%)	Temp (C)	Turb (NTU)	pH	Phos (mg/L)
n	13	8	6	6	12	11	1
Ave.	370	25	110	27.6	4.2	8.2	0.25
GM	280	22	109	27.5	1.9	8.2	0.25
Std. Dev	109.83	9.96	22.32	1.44	5.91	0.14	
CV%	29.7	38.9	20.2	5.22	140.7	1.75	
Max	400	33	150	29.4	20	8.4	
Min	4	3	91	25.1	0.18	7.9	

However, DEQ has not studied human health issues or aquatic life impacts with respect to Agingan Point. Therefore, DEQ is recommending that the local CUC restrict public access to this site so that fisherman will not gain access to this location or have on site security to keep individuals from fishing in these waters.

Another issue to consider when evaluating water quality data is the applicability of fecal coliform testing in tropical waters. Fecal coliform tends to survive for longer periods of time within tropical soils than in temperate soils. Therefore, DEQ will begin using Enterococci as a secondary microbiological indicator to better determine if marine water is indeed contaminated with human or animal waste rather than surviving Fecal coliform stirred up from soils during storms or aggressive wave action. The laboratory expects to begin parallel testing with Enterococci before the end of Fiscal Year 1998.

(b) Class A - Puerto Rico Industrial

The Puerto Rico Industrial area waters are designated Class A because they surround the commercial port and the Sadog Tasi sewage treatment plant outfall. These Class A waters encompass 7.5 square kilometers of coastal waters from Puntan Muchot to Saddok As Agatan except for waters up to 2,000 feet in all directions from the mean high water mark on the shore of

Managaha Island (Figure 6). The commercial port harbors container vessels, tankers, occasional cruise vessels, and the larger local tourist vessels. The sewage receives secondary treatment and is then discharged into the lagoon where the currents take it offshore to deeper waters. Other nearshore and in-water uses and activities include: the Puerto Rico dump, Smiling Cove marina, the CNMI's only National Park, a popular swimming beach, and the only two mangrove stands remaining in the CNMI (see Figure 6). Although this is primarily an industrial area, recreational boats and ships constantly ply these waters and certain beach areas are still popular for fishing and swimming.

The DEQ laboratory tests the water quality of four shoreline areas within the Class A-Puerto Rico Industrial area on a weekly basis (Table 8). DPW Channel Bridge did not meet the microbiological fecal coliform criteria of less than 400 CFU/100 mL, as set forth in the CNMI Water Quality Standards, more than ten times per year during 1997-1998 (Figures 7 and 8).

The DPW Channel Bridge sampling location is in a stormwater drainage that discharges into the mangrove stand. One of the

Figure 6. Puerto Rico Industrial, Class A; Nearshore and In-water Uses. Saipan, CNMI.

Table 8. Class A-Puerto Rico Industrial Microbiological Violations 97-98.

Lab I.D.	**Site**	**# Violations by Quarter**				**Total**
		1Q	**2Q**	**3Q**	**4Q**	**Violations**
8	Central Repair Shop	1	2	1	2	6
9	**Sea Plane Ramp**	2	0	0	3	5
10	**DPW Channel Bridge**	8	9	4	9	30**^
12	Smiling Cove Marina	2	2	2	10	16*

* 5 or more violations/year, **10 or more violations/year, ^Sewage treatment plant lift station to outfall.

characteristics of mangrove stands is pollutant uptake. DEQ has not performed any detailed analysis on human health issues or aquatic life impacts within this area. Few people swim in this area because of its poor visibility and proximity to the commercial port; however, some people do fish here.

As with the discussion of Agingan Point, where many people fish in the area but no health concerns relating to fish eaten from this site have been reported, DEQ is unable to declare this as an impaired waterbody, but evidence from water quality data does not support declaration that it is a fully supporting waterbody. The Puerto Rico industrial area has more potential sources of pollutants from industrial activities; the concerns of Agingan Point are primarily related to the sewage outfall.

Figure 7. Microbiological Violations; FY 97-98. Saipan, CNMI

Figure 8. Microbiological Violations; FY 97-98. West Takpochao Watershed; Saipan, CNMI.

A specific area of concern within the Class A-Puerto Rico Industrial area is the Puerto Rico dump. This site is not sampled by DEQ laboratory because access to collect samples is difficult (the dump is literally spilling into the lagoon) and because the DEQ laboratory does not have the capability to study the potential pollutants of concern that originate from the dump's leachate that may seep into surrounding marine waters.

The Puerto Rico dump is a known environmental problem that has received much attention from the local and federal government. The CNMI was issued an Administrative Order under the Clean Water Act by the EPA in September 1994 for discharging pollutants from the dump into the water. The origin of the dump in the Puerto Rico area dates back to the 1940's when the US Navy disposed of their post-World War II refuse at this site, including used military vehicles and likely various types of hazardous materials and unexploded ordnance. After military use of the open dump ceased, the site has been continuously used by first the Trust Territory government and later the Commonwealth government. Each of these factors: history, determining the extent of liability, and unknown contents, make the closure and clean-up of the Puerto Rico dump very difficult. In addition, setting aside an area for a new landfill on small islands is controversial and complex. Land-use planning in a land-poor community is difficult.

Many people fish nearby the dump, and Micro Beach (within the American Memorial Park) is a popular swimming, fishing, and windsurfing beach. Human health issues and aquatic life impacts have not been studied around the Puerto Rico dump, and, as stated earlier, compliance with water quality standards has not been evaluated either. However, because the Puerto Rico dump is in violation of the Clean Water Act and because leachate from the open dump obviously contains numerous contaminants, including metals, synthetic organic compounds, and other pollutants, the area surrounding Puerto Rico dump does not support its designated use. The closure of Puerto Rico dump and the return of these waters to enable them to support their designated use are two of the biggest environmental goals in the CNMI.

(c) Class AA - Saipan lagoon

The remainder of the lagoon, including waters off the barrier reef (up to 20 fathoms deep or 1,000 feet off-shore from the mean high water mark, whichever is the greater distance from the shoreline), is considered Class AA waters (see Figure 4). The lagoon receives an enormous amount of use on a daily basis, from commercial enterprises to family picinics on the beach (Figure 9).

Because it receives such heavy use and is a vital resource to the Commonwealth, DEQ monitors the quality of the water on a regular basis. Thirty-one sites are monitored weekly for traditional water quality parameters and two sites will be monitored on a regular basis for biocriteria parameters (see Figure 5). Biocriteria monitoring within the lagoon is expected to begin this fiscal year.

The majority of the lagoon is use supporting; however, several sites have been identified as problem areas that require further study and one site is not supporting its designated use.

Unsurprisingly, in 1997 and 1998, most microbiological violations occurred in areas with heavy stormwater run-off (in bold print within Table 9) and sewer overflows (see Figure 7). Many of these sites are within the highly developed Garapan district (West Takpochau watershed), which encompasses sites 14 through 23 (in red print within Table 9) (see Figure 8). Garapan was developed on a low-lying wetland. Therefore, frequently sewer overflows are in

Figure 9. Recreational and Commercial Marine Water Uses. Saipan, CNMI.

standing pools and act as a continual source of fecal coliform contamination.

Other frequent violations occur within Saipan's marinas or in waters surrounding docks. These include: Seaplane ramp, DPW channel Bridge, Smiling Cove Marina (see Table 8), Garapan Fishing Dock, and Sugar Dock (Table 9).

Rainy season, which runs from the fourth through the first quarter (July through November), may also be associated with increased fecal coliform violations, 41 and 33 percent of violations respectively. This is again due to increased run-off from land, and overflowing sewers as a result of the current sewage infrastructure being unable to handle the increased water volume during storm events.

Each of the following sites: Micro Beach, Dai-Ichi hotel, the drainage south of the Dai-Ichi hotel, Hafa Adai hotel, the drainage south of the Hafa Adai hotel, Garapan Fishing Dock, Sugar Dock, and CK District #2 drainage, did not meet the microbiological fecal coliform criteria for Class AA waters of less than 400 CFU/100 mL, as set forth in the CNMI Water Quality Standards, more than five

Table 9. Class A-Saipan Lagoon Microbiological Violations FY 97-98.

Lab I.D.	Site	# Violations by Quarter 1Q	2Q	3Q	4Q	Total Violations
1	Wing Beach	0	0	0	1	1
2	PauPau Beach	2	0	0	0	2
3	Nikko Hotel	0	0	0	1	1
4	San Roque School	3	1	0	1	5
5	Plumeria Hotel	0	0	0	0	0
6	Aqua Resort Hotel	1	0	0	0	1
7	Tanapag Meeting Hall	4	3	1	1	9
14	Micro Beach	5	2	1	3	11*
15	Hyatt Hotel	4	1	0	4	9
16	Dai-Ichi Hotel	4	3	1	10	18*
17	**Drainage S. Dai-Ichi Hotel**	**12**	**8**	**6**	**8**	**34****
18	Samoan Housing area	4	1	0	2	7
19	Hafa-Adai Hotel	4	2	0	4	10*
20	**Drainage S. Hafa-Adai Hotel**	**6**	**4**	**2**	**4**	**16***
21	Garapan Fishing Dock	4	3	1	5	13*
22	Garapan Beach	1	0	0	3	4
23	**Garapan Beach Drainage**	**1**	**1**	**0**	**1**	**3**
24	Chalan Laulau Beach	2	0	0	1	3
25	San Jose Beach	2	0	0	0	2
26	Civic Center Beach	1	1	0	2	4
27	Diamond Hotel	1	0	0	0	1
28	Grand Hotel	1	0	0	1	2
29	Community School Beach	0	0	0	1	1
30	**Sugar Dock**	**4**	**4**	**1**	**5**	**14***
31	**CK District #2 Drainage**	**6**	**2**	**0**	**4**	**12***
32	**CK District #4 Lally Beach**	**2**	**0**	**0**	**2**	**4**
33	Chalan Piao Beach	4	0	0	1	5
34	Hopwood School Beach	1	2	0	0	3
35	San Antonio Beach	1	0	0	0	1
36	Pacific Islands Club (PIC)	3	1	0	1	5
37	San Antonio Lift Station^	3	2	0	4	9
	Total Violations	86	41	13	70	210
	(% Violations from total)	**(41%)**	**(20%)**	**(6%)**	**(33%)**	
	Total Samples	722	555	454	592	2323

* 5 or more violations/year, **10 or more violations/year, ^Sewage treatment plant lift station to outfall.

times per year during 1997-1998. However, at this time, DEQ considers only one location, the drainage south of the Dai-Ichi Hotel, as not meeting the designated use criteria for Class AA waters, because, as discussed earlier, fecal coliform may not be the best indicator of water pollution in tropical areas.

Table 9 shows that the drainage south of the Dai-Ichi Hotel had 34 violations during 1997-1998, more than any other location, Class A or Class AA. In addition, several compounding issues surrounding the Dai-Ichi drainage lead DEQ to declare it as non-supporting of its designated use.

Two hotels are near the Dai-Ichi drainage, temporarily house large numbers of tourists throughout the year which take advantage of the sandy beaches. Also, many local people have been found fishing within the open Dai-Ichi drainage. Talapia, a non-native freshwater/brackish fish, lives in the drainage and sand perch (family Gerediae) often swim just offshore of the channel. People are often seen catching these fish, presumably for consumption on a regular basis. Two minor fish kills (fewer than 20 fish) were reported in 1997 and DEQ often receives reports of foul smells coming from the area. DEQ has not studied human health issues or aquatic life impacts surrounding the drainage south of the Dai-Ichi Hotel although, discussions are underway with the Division of Fish and Wildlife to monitor fish toxicity levels in this area. However, it is not likely that this project will commence any time soon.

The drainage south of the Dai-Ichi Hotel runs through the main tourist district of Garapan. Point and nonpoint sources of pollution are responsible for the poor water quality surrounding the drainage south of the Dai-Ichi Hotel. Urban runoff as a result of poorly designed stormwater drains, illegal dumping, discharge from the hotels' Reverse Osmosis systems, and overflows from the sewer lines (which are operating at or above capacity) are all known contributors to the problem within the drainage south of the Dai-Ichi Hotel.

As with the waters surrounding the Puerto Rico dump, the CNMI recognizes that the drainage south of the Dai-Ichi Hotel poses a water quality problem and has initiated several projects in an attempt to correct the problem. The Governor's Planning Office has developed a Master Plan for the Garapan tourist district and the Coastal Resources Management Office's 1997 Saipan Lagoon Use Management Plan both made recommendations to solve the urban runoff problem. The Commonwealth Utilities Corporation has made improvements to the sewer lines in this district and is working with the area business owners. DEQ has issued a request for proposal to address the runoff problem using constructed or enhanced wetlands under the 1998 nonpoint source pollution grants.

DEQ will continue to monitor this site and will employ best management practices to prevent and control the known contributors of point source and nonpoint source pollution to the drainage south of the Dai-Ichi hotel.

(d) Class AA - East and South sides

Very infrequently have microbiological violations been noted on the east and south sides of Saipan. Other water quality parameters (except for turbidity - to a limited extent) have not been analyzed for these sides of the island. When the data are analyzed, DEQ will pay specific attention to turbidity and nutrient levels, because these parameters are likely to have the greatest impact to coral reefs, an important resource on these sides of the island.

Only a small proportion of the population resides in these areas and commercial development is limited. However, there are other area of concerns on these sides of the island that prompted DEQ to develop the Long-Term Marine Monitoring Plan and employ biocriteria monitoring techniques to evaluate the quality of the water and its ability to support its designated use.

The south and southeast sides of the island are surrounded by fringing coral reefs. These reefs are frequented by commercial SCUBA diving operators, which supplement the tourist industry, the largest segment of the local economy, and residents who fish in these waters for sport and to feed their families (see Figure 9). Because the coral animals that make up the reef are extremely sensitive to even minor variations in water quality, specifically turbidity and nutrient levels, in addition to monitoring traditional water quality parameters, DEQ uses biocriteria monitoring techniques to look directly at the health of the coral reef.

Sediment-laden runoff was believed to be causing a decline in the coral reef ecosystem in Lau Lau Bay. To address this concern, DEQ conducted a study of the effects of nonpoint source pollution on the health of the coral reef. The main focus of this project was to develop techniques that could be used for long-term monitoring and to collect baseline data on the health of the Lau Lau Bay reef. The same techniques that were tested and refined in Lau Lau Bay are also being used in the south side of the island (Obyan and Boy

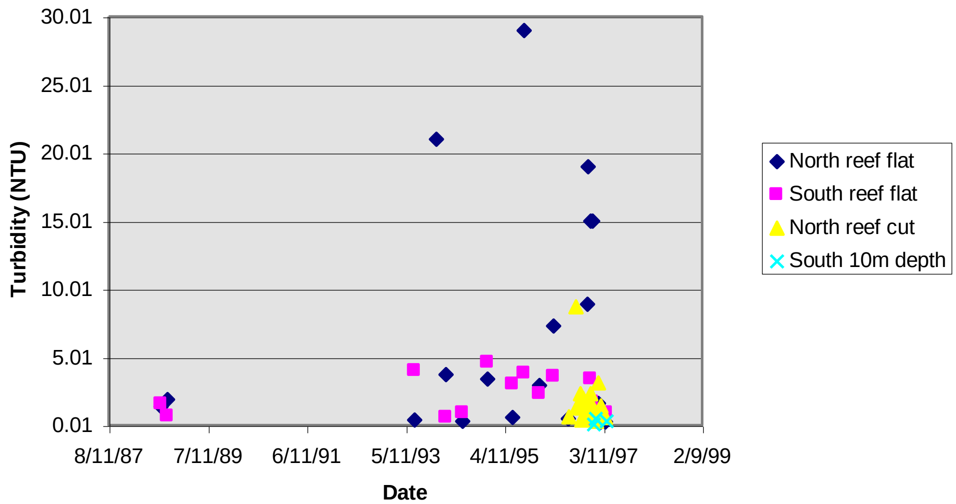
Scout Beaches). The data collected that will be discussed in this report include turbidity levels (Lau Lau Bay only), percent cover of coral and algae, and sedimentation rates.

(1) Turbidity

High turbidity levels were the greatest concern when the Lau Lau Bay Nonpoint study began. Appendix 1 contains the raw data for turbidity and Figure 10 shows trends. Figure 10 shows that turbidity levels are generally fairly low, with the exception of a few discrete outlying events.

Summary statistics have been conducted on these data after they were broken down into seasonal sampling dates. A One-way ANOVA shows that rainy season (July-December) turbidity levels are significantly higher than dry season (January-June) levels ($p=0.01$). However, even during the dry season, turbidity levels still do not meet the CNMI water quality standards of varying less than 0.5 NTU above ambient. Additional analysis needs to be done to correlate

Figure 10. Turbidity levels August 1988-April 1997.



sampling dates with rainfall to better indicate if the turbidity problem can be directly correlated with rain events.

(2) Percent cover of coral and algae

The Marine Monitoring Team determined the percent cover of coral and algae in Lau Lau Bay and the south side of the island using the Line Intercept Transect (LIT) technique. Table 10 shows the percent cover of coral and algae in the sampling locations in Lau Lau Bay and Table 11 shows the percent cover of coral and algae in the sampling locations on the south side of the island. Significant seasonal, site, or depth differences or changes have not been noted in either the percent cover of coral or algae. Continued data collection may show trends and differences may be noted as this side of the island is developed.

Table 10. Percent cover of coral and algae in Lau Lau Bay.

Location	Depth (meters)	Date	Percent cover coral	Percent cover algae
Lau Lau #1	5	8/30/96	34	40
Lau Lau #1	5	2/7/97	33	42
Lau Lau #1	5	8/22/97	50	36
Lau Lau #1	10	10/4/96	34	52
Lau Lau #1	10	2/24/97	28	47
Lau Lau #1	10	9/4/97	37	28
Lau Lau #2	5	4/7/97	37	49
Lau Lau #2	5	8/21/97	32	57
Lau Lau #2	10	1/15/97	34	52
Lau Lau #2	10	8/22/97	41	42

Table 11. Percent cover of coral and algae on the south side of Saipan.

Location	Depth (meters)	Date	Percent cover coral	Percent cover algae
Boy Scout	5	6/27/97	42	27
Boy Scout	10	6/20/97	29	25
Boy Scout	10	1/27/98	44	31
Obyan	5	7/3/97	52	26
Obyan	5	1/15/98	39	44
Obyan	10	6/19/97	24	16
Obyan	10	1/21/98	24	14

Although at the present time, the land areas adjacent to these coral reefs are undeveloped, CNMI permits have been issued for large scale golf course resorts in these areas. Due to the proximity of the proposed development near the Boy Scout/Obyan coral reef area, the Marine Monitoring

Team is actively collecting baseline data for this area. This will allow for proper monitoring of any changes to the coral reefs that can be correlated to the activities from the resort development.

(3) Sedimentation rates

Suspended sediment loads measured in Lau Lau Bay are listed in Table 12 and those measured on the south side of the island are listed in Table 13. Summary statistics for each sampling location are listed in Table 14. The mean sedimentation rate of all locations during the entire sampling period is 16.9 mg cm^{-2} day^{-1} and the median is 2.2 mg cm^{-2} day^{-1}.

The mean sedimentation rate is much higher than the median rate because several storm events significantly increased the rates during those collection periods. Because the storms are acute events, the increased rate associated with them is less worrisome than if the median rate were as high. Corals have adapted to withstand a certain amount of acute stress and environmental variation, such as that caused by typhoons.

Table 12. Sedimentation rates in Lau Lau Bay (mg cm^{-2} day^{-1}). The mean, standard deviation, and number of samples are given from a series of up to 12 traps at each station on each collection period. Shaded entries indicate that a typhoon passed near Saipan during the collection period.

Collection period	Site #1, 10m depth	Site #1, 5m depth	Site #2, 10m depth	Site #2, 5m depth
18 OCT 1996 - 15 NOV 1996	97.7±113.7 (n=9)			
14 NOV 1996 - 3 JAN 1997			3.7±1.0 (n=3)	
15 NOV 1996 - 20 DEC 1996	4.5±7.4 (n=8)			
20 NOV 1996 - 18 DEC 1996		2.0±0.6 (n=9)		
18 DEC 1996 - 17 JAN 1997		2.3±2.2 (n=12)		
20 DEC 1996 - 17 JAN 1997	14.9±14.7 (n=9)			
3 JAN 1997 - 10 MAR 1997			3.4±2.2 (n=11)	9.4±7.8 (n=6)
17 JAN 1997 - 12 FEB 1997		1.1±0.5 (n=12)		
17 JAN 1997 - 21 FEB 1997	1.2±1.1 (n=12)			
12 FEB 1997 - 25 MAR 1997		0.8±0.5 (n=8)		
21 FEB 1997 - 25 MAR 1997	1.3±0.9 (n=10)			
10 MAR 1997 - 7 APR 1997			1.6±0.2 (n=11)	3.6±0.8 (n=12)
25 MAR 1997 - 24 APR 1997	107.3±67.5 (n=9)	3.3±3.2 (n=5)		
7 APR 1997 - 20 MAY 1997			5.6±5.0 (n=11)	3.7±3.0 (n=3)
24 APR 1997 - 12 JUN 1997	0.8±0.5 (n=12)	0.4±0.1 (n=4)		
20 MAY 1997 - 12 JUN 1997			1.2±0.3 (n=12)	3.1±1.0 (n=4)
12 Jun 1997 - 30 Jul 1997	2.7±2.8 (n=9)	0.7±0.5 (n=10)	0.8±0.5 (n=4)	2.5±1.1 (n=4)
30 Jul 1997 - 11 Sep 1997	26.3±51.3 (n=4)	17.6±30.3 (n=3)	1.6±1.9 (n=4)	0.9 (n=1)
11 Sep 1997 - 21 Oct 1997	12.3±13.0 (n=4)		1.4±1.2 (n=3)	1.5±0.5 (n=3)
21 Oct 1997 - 26 Nov 1997	2.3 (n=1)			
26 Nov 1997 - 30 Dec 1997	59.5±68.6 (n=3)			

Table 13. Sedimentation rates on the south side of Saipan (mg cm^{-2} day^{-1}). The mean, standard deviation, and number of samples are given from a series of up to 5 traps at each station on each collection period. Shaded entries indicate that a typhoon passed near Saipan during the collection period.

Collection period	Obyan, 10m depth	Obyan, 5m depth	Boy Scout, 10m depth	Boy Scout, 5m depth
26 Jun 1997 - 15 Jul 1997	5.1±0.8 (n=5)	4.4±2.5 (n=5)	2.5±0.5 (n=5)	4.5±1.0 (n=5)
15 Jul 1997 - 7 Aug 1997	8.2±1.0 (n=4)	5.1±3.7 (n=4)	7.5±3.6 (n=4)	9.7±4.2 (n=4)
7 Aug 1997 - 17 Sep 1997	151.9±91.5 (n=4)	27.3±20.5 (n=4)	109.9±66.3 (n=4)	138.2±163.2 (n=2)
17 Sep 1997 - 22 Oct 1997	28.1±20.0 (n=4)	12.6±13.3 (n=3)	30.6±21.3 (n=3)	75.7 (n=1)
22 Oct 1997 - 26 Nov 1997	95.6 (n=1)			
26 Nov 1997 - 30 Dec 1997			97.4±89.0 (n=3)	

Table 14. Summary statistics for suspended sediment load measurements (mg cm^{-2} day^{-1}) on Saipan.

Location	Mean	Median	SD	CV%	N	Min	Max	Skew.	Kurt.
All	16.9	2.2	44.6	263.3	303	0.1	290.4	3.8	14.8
Lau Lau #1, 10m depth	28.1	1.6	60.0	213.8	84	0.1	290.4	2.7	7.1
Lau Lau #1, 5m depth	2.2	1.0	6.6	301.0	63	0.1	52.7	7.4	57.3
Lau Lau #2, 10m depth	2.6	1.7	2.9	109.7	59	0.3	19.4	3.7	19.1
Lau Lau #2, 5m depth	4.3	3.3	4.2	97.3	32	1.0	19.4	2.6	6.5
Obyan, 10m depth	48.6	9.0	72.3	148.9	18	4.2	229.5	1.7	1.7
Obyan, 5m depth	11.8	6.6	14.4	121.6	16	0.9	53.4	2.0	3.8
Boy Scout, 10m depth	45.6	9.0	62.5	137.1	19	1.8	177.8	1.3	0.1
Boy Scout, 5m depth	34.5	7.9	71.9	208.6	12	2.7	253.6	3.1	9.6

Pastorok and Bilyard (1985) developed a scale indicating the degree of impact on coral communities caused by increasing sedimentation rates. They conclude that a rate of 1-10 mg cm^{-2} day^{-1} will have a slight to moderate impact, 10-50 mg cm^{-2} day^{-1} will have a moderate to severe impact, and greater than 50 mg cm^{-2} day^{-1} will have a severe to catastrophic impact. Based on these numbers, the degree of impact to the coral reefs on Saipan from sedimentation appears to be moderate. In addition, compounding factors associated with sedimentation, including nutrification and an increase in turbidity, may increase the stresses to the reef.

2. Wetland protection activities

In previous years, the focus of CNMI and federal regulatory efforts to preserve wetlands were based on the endangered species habitat value of the wetlands. In the past year, an effort was initiated to develop a Hydrogeomorphic Model (HGM) that can be used to perform a rapid assessment of the value of a wetland for all functions, including hydrology (flood control, groundwater recharge), water quality (e.g. abiotic retention, biotic cycling, sediment retention), shoreline stabilization, and plant communities. The HGM model is a rapid assessment tool that will allow regulators to better assess the relative value of a wetland for each of its functions and allow for better assessment of the potential impact of a project and the appropriate mitigation. The developmental process will continue with field testing and final adoption of the HGM model in late 1998.

D. Public Health/Aquatic Life Concerns

1. Areas of special concern due to toxins in fish tissue

Due to the lack of fully supportive laboratories in the area that are capable of performing bioassays, we are unable to ascertain any levels of toxins in fish tissue. No health indicators exist that suggest fish poisoning is a problem in the CNMI, although an epidemiological study has not been conducted.

2. Pollution-caused fish kills/abnormalities

The few fish kills that have been reported over the last several years were small (fewer than 20 fish) and conclusions on causes were never determined.

3. Restrictions on surface drinking water supplies

The people of the CNMI are dependent on ground water for 99 percent of their drinking water supplies.

4. Incidents of waterborne disease during this reporting cycle

No incidents of waterborne diseases have been reported for the last four years.

5. Other aquatic life impacts of pollutants and stressors (e.g., reproductive interference, threatened or endangered species impacts)

No information on aquatic impacts of pollutants is available.

E. Water Quality Inventory

Table 15. Affected CNMI waterbodies.

Waterbody name	**Total size**	**Size impaired**	**Designated use**	**Degree of use support**	**Causes**	**Sources**	**Type of assessment**	**Comments**
Puerto Rico Industrial	7.5 km^2	<1 km^2	Class A	Non-supporting	Unknown chemicals in leachate	Dump	None	Need to conduct assessment
Saipan lagoon	30,750 km^2	<1 km^2 (Dai-Ichi drainage)	Class AA	Non-supporting	Fecal coliform	Urban runoff	Fixed-station micro-biological monitoring	

IV. GROUND WATER ASSESSMENT

Type of Aquifers

In general, there are two major aquifer types in the CNMI; the high level aquifers and the basal aquifers. High level aquifers occur where permeable limestone formations overlie impermeable volcanic formations. These aquifers are extremely valuable as they provide a good high quality yield of ground water that is not susceptible to saltwater intrusion. There are only a few limited geographical areas in the CNMI where high level aquifers can be located. There are continual exploration efforts to locate more high level aquifers at the present time. However, it is never envisioned that the limited number and capacity of the high level aquifers are capable of meeting the water needs of the population.

Basal aquifers can be located on almost all tropical islands with the fresh water lens overlies the salt water. The thickness of the freshwater lens in a basal aquifer is partly related to the local geology including porosity and permeability of the limestone formations and geologic structures such as fractures and faults. The total land area available for recharge and the distance to the shoreline also will factor in the thickness of the fresh water lens. Large flat areas provide a good collection area for fresh water. The CNMI receives approximately 80 inches of rain per year but in areas of high relief, the rain runs off into the sea without much percolation in ground water.

Uses of Ground Water

As the number of high level aquifers is limited, the majority of the island's groundwater is withdrawn from the basal aquifers. Since 99 percent of the water needs of the CNMI are derived from groundwater, careful monitoring of well drilling activities is needed to avoid salt water intrusion. Saltwater intrusion occurs when the coning influence of groundwater results in mixing of the salt water and fresh water. This mixing of saltwater creates permanent damage to the fresh water lens as the fragile density differential between salt water and fresh water is lost. If over-pumping occurs, the existing thin, pure layer of fresh water is contaminated with chlorides. As chlorides are increases in the water distribution lines, more corrosion occurs, and leaks develop. Even though it may be easier to pump and distribute lower quality water with high chlorides to meet public demand, the increase in leaks results in less water reaching the public.

On Saipan, there are several uses of ground water. As stated previously, almost of all the drinking water supplies are derived from ground water. The CNMI is heavily dependent on tourism for the local economy. Due to the high level of chlorides in the local water distribution lines, major hotels along the coast drill sea water wells and use reverse osmosis treatment for their private water supply. This is an expensive process with the final cost of drinking water is passed on to the tourists. It has been proposed that reverse osmosis of sea water be used as the local supply for drinking water but the economic impact of such treatment can not be supported by taxes.

Other uses of groundwater are for irrigation of golf courses and agriculture. The uses of ground water for agricultural uses is extremely limited but golf courses can require a large demand of ground water. To be assured that golf courses do not deplete the local ground water supplies, all golf courses are required to submit a groundwater management plans as part of the local permitting requirements. In addition to calculations of groundwater withdrawal rates and proposed number of wells with approved pumping rates, the golf courses are required to install lysimeters on the golf course. The lysimeters are used to monitor the application rate of pesticides and fertilizers to be assured that excess levels do not reach the ground water and affect drinking water supplies or marine habitat such as coral reefs.

To protect the basal aquifer from salt water intrusion requires limiting the exploration of new water wells to areas with the necessary of the thickness of the freshwater lens, controlling and limiting the pumping rate of existing wells, and close monitoring of the sample results of chlorides, conductivity, and total dissolved solids.

A. Numeric ground water standards

At the present time, the CNMI does not have numerical standards for ground water. There is a requirement in the CNMI Groundwater Management and Protection Act for the designation of Class I, II, and III aquifers. This has been difficult to do without any significant data sources on quality of aquifers. However, as the GIS system develops, this will allow for a better opportunity to designate aquifers.

Although no numerical standards are being proposed or examined to be used with the aquifer designations, it is expected that EPA Maximum Contaminant Levels (MCL) drinking water standards will be used for high value aquifers and marine water quality standards will be used to protect ground water in the nearshore environment.

B. Population using the aquifer

The problem of salt water intrusion of aquifers is limited to the island of Saipan. At the present time, the islands of Rota (population - 2,360) and Tinian (population - 3,200) have not had water demands that lead to over-pumping of the aquifers. Saipan with a population of approximately 15,000 in 1980 to an explosive 65,000 in 1995 has had a tremendous stress on the aquifers and ground water supply.

The majority of the population resides on the western side of the island. The four villages of Garapan, Chalan Kanoa, and Susupe are estimated to have concentrated sixty percent of the total island's population in a small ten percent of the available land mass on Saipan. The majority of the large municipal water supply wells are located in the southern part of the island. These municipal wells are pumping from the basal aquifer. There is a another smaller concentration of municipal wells located at higher elevations in the central part of the island. These wells are drawing water from the high level aquifers and are not susceptible to salt water intrusion.

Due the rapid development of Saipan in the 1980's and 1990's, full development of the island's infrastructure has still not been fully realized in 1998. There are large segments of the population who receive a limited supply of water from the local utility corporation. Often, this limited water supply is held on storage and is depleted before the next day. To obtain the necessary water supply prior to the full distribution of the local utility water supply, private water wells are drilled on Saipan. At the present time, there are approximately 170 public water wells on Saipan managed and operated by the local utility corporation. The United States Geological Survey is assisting the local utility by taking the lead in the exploratory efforts to locate new locations for municipal wells.

There are 174 private wells operating on Saipan. The majority of these private wells are located in shallow, low yield, and poor to moderate quality and are located in the villages of Garapan (34) Chalan Laulau (16) and Susupe (13) (Figure 11).

C. Summary results of ground water monitoring, by parameter

The CNMI Groundwater Protection and Management Act was enacted into law in 1988. The first set of Well Drilling regulations was adopted in 1992 and later amended in 1994. The well drilling requirements set standards for criteria for

Figure 11. Saipan Private Wells.

well drillers and licenses, well construction, siting (setback distances), and operational requirements for new wells. As part of operations, semi-annual monitoring is required for all wells.

At the present time, DEQ is developing a database of all private wells with information on operation date, location, and monitoring data. The database is its early infantile stages with much need for improvement on quality control of missing or inaccurate data. Appendix 2 is a listing of all the private water wells with location coordinates using the Saipan grid system with wells surveyed to within 0.001 meter accuracy. It is envisioned that the data will be integrated into the CNMI GIS system. DEQ will be able to use the fully developed GIS system to identify existing sources of contamination and potential problems for proposed new wells.

A general review of the sample data for the private wells shows that chlorides and conductivity gradually increase over time in many of the wells. In some wells, a reduction in the operating pressure has resulted in a decrease in conductivity and chlorides. (Note: Conductivity was believed to be a better indicator of increasing saltwater intrusion due to potential laboratory error associated with testing equipment for chlorides). It is the current unofficial policy to limit all new wells to under a pumping rate of 35 gallons per minute unless there are unusual circumstances with high quality aquifer and special needs.

As part of the CNMI's effort to increase water quality and water quantity distribution in the public water supply by the local utility, several old wells have been taken off line due to high chloride content and replaced with more wells operating at a lower pumping rate. This is a recommendation out of the Water Task Force that was formed in response to the Governor's Declaration of Emergency for Water Needs. In the last two years, 14 wells were taken off line and replaced with 35 wells operating at lower but sustainable pumping rates. The net increase is 750,000 additional gallons of water per day with higher quality being distributed to the general public.

As DEQ laboratory capabilities increase, DEQ will just requiring the testing of nitrates in private water wells used for drinking water. To be assured that the quality of ground water being used by the local utility corporation is not contaminated from old military activities, testing for metals, volatile organic compounds, and synthetic organic compounds was required as part of a source water assessment. No results from the private wells exceeded the EPA Maximum Contaminant Level (MCL) for drinking water. Some wells indicated a trace of tetrachlorethene and investigations by the Army Corps of Engineers are currently underway.

V. WATER POLLUTION CONTROL PROGRAMS

The Division of Environmental Quality (DEQ) and other CNMI government agencies implement several environmental programs to control point and nonpoint sources of pollution. Some of the programs are related to federal standards, whereas others are locally developed. The Division of Environmental Quality was created by the CNMI Environmental Protection Act of 1982 and its programs have evolved over time. The most recent program developed at DEQ is the Nonpoint Source/Marine Monitoring Team that was developed in response to the need to establish baseline data for the protection of our coral reefs.

Prior to the initiation of any large development in the CNMI, the developer must obtain a Coastal Resources Management (CRM) major siting permit. The CRM permitting process provides all of the appropriate government agencies an opportunity to inform the developer the various permitting requirements and general areas of concern for the proposed project. The CRM permitting process can be viewed as a quasi-zoning/planning environmental permit. The CRM permitting process is unique to the needs of the CNMI.

The Division of Environmental Quality implements a permitting program for Individual Wastewater Disposal Systems, which are required for septic tanks and package treatment plants. These permits provide minimum standards for construction and operation of domestic wastewater for rural areas not connected to sewer. The Commonwealth Utilities Corporation operates two sewage treatment plants that are permitted by EPA Region IX NPDES program.

Although the NPDES program has not been delegated to the CNMI, DEQ issues Section 401 Water Quality Certifications to any project that may affect water quality. Section 401 Water Quality Certifications are issued for all projects involving discharges, dredging, or any activity in wetlands. This CNMI permitting process is closely linked to the US Army Corps of Engineers 404 permitting program. The CNMI has developed Water Quality Standards which are used for the NPDES permitting program.

To control erosion run-off, DEQ has developed regulations and a permitting program for earthmoving and erosion control. Prior to any development, a plan is required in the permit to show how the developer will control all earthmoving activities to retain all run-off on site. This permitting program is currently being integrated with the building code permit process that is managed by the Department of Public Works.

The pesticide program, underground storage tank program, and aboveground storage tank program are all programs implemented in a preventative manner to control nonpoint and point sources of pollution to protect our surface and groundwater sources. The groundwater resources are also protected by a well drilling program that regulates the location and operation of all water wells in the CNMI. Within the regulations, set back distances are included to be used as wellhead protection areas.

Special CNMI concerns are related to the effect of increasing development on the coral reef ecosystem. The strategy that has been developed is to use the Marine Monitoring Team to establish baseline data on the health of the coral reefs. Focus on monitoring is made in areas of planned future developments. In addition, all new developments are required to submit a Marine Monitoring Plan, as required in the CRM permit.

The strategy for the protection of aquifers to develop a three-tiered zoning of aquifers in the CNMI. The aquifer zoning process is currently underway. It is envisioned that after the three zones are developed, specific well drilling and well operational restrictions will be applied to each of those areas. This will minimize the affect of over pumping of the aquifer which leads to salt water intrusion.

Additional training in monitoring techniques and assessment will always be needed in the CNMI. It is possible that the one area needing improvement is the ability to perform bioassays and issue fish consumption advisories. There are no local laboratories capable of performing such analyses and no information exists on the potential problem of contaminants in the fish. This is a concern in areas such as the waterbody in front of the Puerto Rico Dump where many subsistence fishermen still fish. In the future, DEQ may request assistance and guidance from the EPA in this area.

Appendix 1. Turbidity data for Lau Lau Bay.

	Sample date	Time collect.	Turbidity (NTU)
North Lau Lau Beach reef flat	8/17/88		1.38
	9/29/88		1.89
	7/15/93	2:35	0.4
	12/16/93	2:12	21
	2/24/94	10:50	3.7
	6/22/94	10:36	0.31
	12/15/94	10:53	3.4
	6/8/95	11:58	0.55
	8/30/95	11:40	29
	12/14/95	10:04	2.9
	3/27/96	1:30	7.3
	7/5/96	12:15	0.49
	11/21/96	3:02	8.9
	11/26/96	11:50	19
	12/5/96	2:00	0.7
	12/11/96	10:18	15
	12/18/96	1:55	1.3
	12/27/96	2:07	15
	1/3/97	12:55	1.4
	1/17/97	11:52	0.61
	1/24/97	1:43	0.55
	1/29/97	3:35	0.43
	2/5/97	12:20	1.6
	2/7/97	1:45	0.57
	2/12/97	9:45	1
	2/21/97	3:48	0.23
	2/24/97	1:15	0.40
	3/5/97	10:28	0.73
	3/26/97	1:47	0.25
	8/22/97		0.58
	11/6/97	8:50	0.90
	12/30/97	4:45	0.50
	2/10/98	11:30	0.20
South Lau Lau Beach reef flat	9/29/88		0.69
	7/15/93	2:48	4
	2/24/94	10:33	0.59
	6/22/94	10:20	0.89
	12/15/94	11:04	4.6
	6/8/95	12:09	3
	8/30/95	11:26	3.8

	Sample date	Time collect.	Turbidity (NTU)
North Lau Lau Beach cut	12/14/95	9:55	2.3
	3/27/96	21:36	3.6
	11/21/96	11:47	1.6
	11/26/96	11:45	1.1
	12/5/96	2:00	1.03
	12/11/96	10:10	3.4
	12/27/96	1:56	1.7
	1/3/97	12:20	0.34
	1/14/97	1:57	
	1/17/97	10:50	0.66
	3/5/97	10:48	0.76
	4/7/97	3:00	0.9
	5/20/97	10:00	0.62
	8/21/97		0.52
	11/6/97	9:15	0.5
	12/9/97	11:05	0.6
	12/30/97	4:10	0.27
	7/12/96	3:45	0.62
	8/30/96	4:30	8.7
	9/6/96	4:50	1.3
	9/20/96	3:30	1.3
	10/2/96	4:25	2.3
	10/4/96	4:20	1.3
	10/9/96	3:30	0.38
	10/18/96	4:30	2
	10/25/96	1:50	0.73
	11/15/96	12:00	1.3
	11/22/96	12:14	0.73
	11/26/96	11:50	1.2
	12/11/96	10:20	2.3
	12/12/96	9:35	0.69
	12/18/96	2:00	1.5
	1/3/97	12:55	1.2
	1/17/97	11:49	0.74
	1/24/97	1:42	0.28
	1/29/97	3:32	0.54
	2/5/97	12:14	3.1
	2/7/97	1:42	0.62
	2/12/97	9:47	1.1
	2/21/97	3:48	1.4
	2/24/97	1:15	0.7
	3/5/97	10:30	0.58

	Sample date	Time collect.	Turbidity (NTU)
So. Lau Lau Beach 30' sed. traps	3/26/97	1:47	0.56
	8/22/97		0.58
	9/4/97	10:48	0.66
	12/30/97	4:43	0.51
	1/3/97	10:30	0.08
	1/17/97	10:48	0.49
	4/7/97	11:20	0.28
	5/22/97	10:20	0.35
	8/21/97		0.41

Appendix 2. Saipan Private Well Locations.

WELL NAME	LOCATION	WELL ID	x coordinate	y coordinate
Plumeria #1	Achugao	AC1	N58,854.80	E56,197.68
Plumeria #2	Achugao	AC2	N58,864.58	E56,289.07
Aqua # 1	Achugao	AC3	N58,788.707	E56,148.768
Aqua #2	Achugao	AC4	N58,799.928	E56,169.466
M.G.M. Corporation	As Lito	AL1	N47946.7493	E52147.5067
Saipan Industrial Company	As Lito	AL2	N48059.092	E51275.287
Saipan Koresco Hotel	As Lito	AL3		
TAC International	Chalan Laulau	CL1	N51,888.508	E50,985.743
Korea Town Restaurant	Chalan Laulau	CL10	N50,184.099	E50,494.877
Pang Jin Sang Sa #1	Chalan Laulau	CL11	N51,970.148	E50,812.937
J & S Corporation	Chalan Laulau	CL12	N51868.73	E50948.32
R.S.A. Development	Chalan Laulau	CL12		
International Corp.	Chalan Laulau	CL15		
Geotesting Building	Chalan Laulau	CL2	N51,871.082	E50,822.675
United Construction Corporation	Chalan Laulau	CL3	N51,913.814	E50,712.125
Saipan Sanko Transportation	Chalan Laulau	CL4	N51,319.252	E51,003.743
Pang Jin Sang Sa #2	Chalan Laulau	CL5	N51,996.834	E50,793.834
B&R corporation	Chalan Laulau	CL6	N51,226.954	E50,554.971
McDonald's Restaurant	Chalan Laulau	CL7	N166,788.353	E167,270.73
Saipan Resort Club (SRC)	Chalan Laulau	CL8	N51492.414	E50949.498
Garden Motel	Chalan Laulau	CL9	N51,726.512	E50,976.496
Mariana Fashions, Inc.	Chalan Piao	CP1	N46,894.852	E49,010.364
Hyatt Staff Housing	China Town	CT1	N53,762.915	E51,751.552
Pelley Enterprises	China Town	CT2	N53,442.852	E51,953.501
Woo Young Corp. (apartment)	China Town	CT3	N54,253.4	E51,519.78
C-Kiya Circle "C" Apartment	Chalan Kiya	CY1	N49680.0406	E50996.9302
Luis Camacho Res. Apartment	Chalan Kiya	CY2	N50173.315	E51354.773
Saipan Country Club Well # 1	Chalan Kiya	CY3	N50,770.165	E51,100.222
Salt Water Fish Pond	Chalan Kiya	CY4	N49660.6061	E50971.1931
San-Ai Deep Well	Chalan Kiya	CY5	N50028.183	E51385.829
MGM Employee Barracks	Chalan Kiya	CY6	N49030.98144	E50909.0736
Mac Homes	Chalan Kiya	CY7	N49812.453	E51478.535
Chalan Kiya Farms	Chalan Kiya	CY8	N49840.5508	E50747.0257
Saipan Country Club Well # 2	Chalan Kiya	CY9	N50,087.846	E51,083.515
Abed Younis	Dandan	DD1	N47605.475	E52,621.201
Christian Service Center	Dandan	DD2	N148,874.6583	E167,900.70
Hawaiian Rock Quarry	Dandan	DD3	N44,397.896	E54,399.742
Black Micro Corp. Camp	Dandan	DD4	N48,888.058	E51,772.611
Riviera Resort Club #2	Fina Sisu	FS1	N48437.8738	E50930.2492
Fina Sisu Well	Fina Sisu	FS2	N47626.480	E50614.099
Riviera Resort Club	Fina Sisu	FS3		
Dai-Ichi North wing	Garapan	GP1	N55335.187	E50,782.625
Kae Pong Apartment	Garapan	GP10	N178,284.645	E167,210.37

WELL NAME	LOCATION	WELL ID	x coordinate	y coordinate
Ceasar Sauna	Garapan	GP11	N54,160.980	E50,817.452
Duty Free Shopper housing unit	Garapan	GP11		
Hyatt new (1995) well #1	Garapan	GP13	N55469.883	E50877.929
Hyatt new (1995) well #2	Garapan	GP14	N55484.1226	E50892.3503
Glory Corporation	Garapan	GP15	N55,077.1688	E50,862.012
Saipan Aluminum	Garapan	GP16	N54,169.9487	E50,903.085
Summer Holiday	Garapan	GP16	N54,153.545	E50,834.528
Saipan Ocean View Hotel Ext.	Garapan	GP17	N54,501.097	E50,881.003
Duty Free Shoppers Ltd.	Garapan	GP18	N54,883.155	E50,976.527
Gold Barron # 6	Garapan	GP19	N54,661.6399	E51,199.830
Kimpachi Barracks Well	Garapan	GP19		
Japan Enterprises	Garapan	GP2	N55,290.66	E50,944.60
Holiday Inn	Garapan	GP20	N54,757.359	E50,979.666
Kimpachi Restaurant	Garapan	GP20	N55,338.59	E50,869.28
Horiguchi Building	Garapan	GP23		
Mike's Jewelry	Garapan	GP26	N55,263.0028	E51,004.781
Macro Energy	Garapan	GP3	N55,162.199	E50,803.034
Dai-Ichi Hotel Staff Housing So.	Garapan	GP31		
Mariana Relay Station	Garapan	GP33		
Cabrera Center	Garapan	GP4	N52,721.282	E50,746.669
Ito Suisan II/MaytenthBldg. I	Garapan	GP6	N55,213.58	E50,948.80
Paradise Hotel	Garapan	GP6		
Gold Beach Hotel	Garapan	GP7		
Saipan Ocean View Hotel	Garapan	GP7	N54,523.152	E50,820.451
Dai-Ichi Hotel Staff Housing No.	Garapan	GP9	N55,403.958	E51019.296
Highway Market	Gualo Rai	GR1	N53477.47	E51040.97
ABA Corporation	Gualo Rai	GR10		
Pansay Inc.	Gualo Rai	GR2	N176539.360	E167447.891
REM	Gualo Rai	GR3	N52160.5283	E50866.4793
Gualo Rai Court Apartments	Gualo Rai	GR4	N52779.19	E51122.64
TII Building	Gualo Rai	GR5	N52400.111	E51644.304
Johnny Fong (Residential)	Gualo Rai	GR6	N52730.701	51101.366
Pacific Orient Star Apartment	Gualo Rai	GR8		
Gualo Rai Deep Well	Gualo Rai	GR7	N51946.0138	E52013.9850
Mirage (SPN) Co., Ltd.	Gualo Rai	GR9		
Lao Lao Bay Well # 10	Kagman	KG1	N49451.617	E57672.314
Lao Lao Bay Well # 4	Kagman	KG2	N50,079.800	E57,054.295
Lao Lao Bay Well # 5	Kagman	KG3	N50,092.101	E57,197.631
Lao Lao Bay Well # 6	Kagman	KG4	N49,826.621	E57,223.650
Lao Lao Bay Well # 8	Kagman	KG5	N49,617.328	E57,607.162
Lao Lao Bay Well # 15	Kagman	KG6	N49,144.688	E57,908.800
Lao Lao Bay Well # 16	Kagman	KG7	N49052.628	E57863.688
Lao Lao Bay Well # 11	Kagman	KG8	N49379.846	E57668.816
Lao Lao Bay Well # 9	Kagman	KG9	N49,537.618	E57,645.421
Lao Lao Bay Well # 13	Kagman	KG10	N49,225.929	E57,889.274

WELL NAME	LOCATION	WELL ID	x coordinate	y coordinate
Lao Lao Bay Well # 14	Kagman	KG11	N49,509.500	E57,196.500
Lao Lao Bay Well # 12	Kagman	KG12	N49,313.431	E57,680.561
Lao Lao Bay Well # 1	Kagman	KG13	N50043.002	E56,585.340
Lao Lao Bay Well # 3	Kagman	KG14	N50061.786	E56,885.113
Pacific Castle	Koblerville	KO1	N44,274.023	E50,020.967
Coral Ocean Point Well # 1	Koblerville	KO2	N49,237.869	E57,901.106
JM Farm	Koblerville	KO2		
Coral Ocean Point Well # 4	Koblerville	KO3	N49,384.539	E57,686.978
Coral Ocean Point Well # B	Koblerville	KO4	N51,155.405	E57695.222
Coral Ocean Point Well # 2	Koblerville	KO5	N49,522.293	E57,211.216
Coral Ocean Point Well # 3	Koblerville	KO6	N49,464.1554	E57,686.899
Coral Ocean Point Well # A	Koblerville	KO7	N50770.165	E51100.222
Coral Ocean Point Well RO # 1	Koblerville	KO9	N60,287.666	E58,543.088
Saipan Ice Inc.	Lower Base	LB1	N56,911.937	E54,0456.63
American Knitters #1	Lower Base	LB2	N51,151.1245	E53,769.310
Viking Internation #2	Lower Base	LB3	N56,949.9051	E53,821.496
American Knitters #2	Lower Base	LB4	N57,069.8869	E53,925.768
Global Manufacturing	Lower Base	LB5		
Trans-Asia Garment Forte Corp.	Lower Base	LB6		
Global Manufacturing	Lower Base	LB7		
G M I Factory	Lower Base	LB8	N57,069.8869	E523,925.76
Marianas Country Club Well # 1	Marpi	MP1	N60534.93	E59146.074
Marianas Country Club Well # 3	Marpi	MP2	N60287.666	E58543.088
Marpi Farm	Marpi	MP3		
Marianas Country Club Well #4	Marpi	MP4	N61040.059	E59416.813
MCC/Swimming Pool	Marpi	MP5	N60,888.292	E58,800.858
Seishin Farms	Marpi	MP6		
Navy Hill Residence (Mike Imai)	Navy Hill	NV1	N54,654.154	E51,681.862
Ito Suisan/Hill Top Futaba	Navy Hill	NV2	N54,742.338	E51,792.558
Evergreen Condo	Navy Hill	NV3	N51,726.962	E51,826.780
Haas & Haynie (explorat. well)	Obyan	OB1		
Botanical Garden	Papago	PP1	N50,575.05	E54,198.75
Tropical Laundry Well # 2	Puerto Rico	PR2		
UMDA # 5	Puerto Rico	PR1	N55,982.0726	E52,965.814
Pac Isl Club Sea Water well #1	San Antonio	SA1	N45,660.3817	E48,315.360
Pac Isl Club Sea Water well #2	San Antonio	SA2	N45,634.8016	E48,301.685
Neo Fashion, Inc.	San Antonio	SA3	N46,287.368	E48,862.506
Uno Moda Inc.	San Antonio	SA4	N46,210.204	E49,012.472
Sablan Construction Building	San Antonio	SA5	N46,342.645	E48,756.236
H.K. Laundry	San Antonio	SA6	N46,369.305	E48,781.221
UIU Commercial Building	San Jose	SO1	N50,312.7624	E50,265.563
Modern Stationary	San Jose	SO2	N50,371.081	E50,0096.92
Kim's General Corporation	San Jose	SO3	N49,907.0541	50,092.19
New Orient Enterprises	San Jose	SO4	N49,890.135	E50,130.512
Airport Standby Hotel	San Jose	SO5	N50,035.229	E50,169.167

WELL NAME	LOCATION	WELL ID	x coordinate	y coordinate
Diamond Hotel #1	Susupe	SP1	N49,175.992	E49,351.891
Arirang Apartments	Susupe	SP10	N48,511.023	E49,547.754
Onwell MFG. Ltd. II	Susupe	SP11		
Angel Market	Susupe	SP12		
Saipan Grand Hotel	Susupe	SP13		
Marianas Cleaners	Susupe	SP2	N48,902.739	E49,247.252
Diamond Hotel #2	Susupe	SP3	N49,046.710	E49,171.288
Diamond Hotel/Shallow well #1	Susupe	SP4	N49,207.152	E49,373.022
Onwell MFG. (SPN) Inc.	Susupe	SP5	N48,847.968	E49,817.389
Diamond Hotel #3	Susupe	SP6	N49204.135	E49,376.376
Sun Inn Motel	Susupe	SP7	N49,525.901	E49,906.714
CTS Building	Susupe	SP8	N49813.28	E49979.53
Sai-Hon Development	Susupe	SP9	N160,372.332	E161,581.85
Saipan Grand Hotel #1	San Vicente	SV1	N48,973.1733	E49,048.134
Saipan Grand Hotel #2	San Vicente	SV2	N48,911.2634	E48,994.127
Hilltop Condominium	San Vicente	SV3		
Eurotex SPN Inc.	San Vicente	SV4	N48,798.595	E53,387.337
Larry Hillblom Apartment	San Vicente	SV5	N47,973.950	E53,403.518
Saipan Carson Corp.	San Vicente	SV6	N49,118.722	E52,799.254
Kingfisher well # 10	Talofofo	TL1	N712304.18	E32381.009
Kingfisher well # 11	Talofofo	TL2	N71113.201	E33101.756
Kingfisher well # 2	Talofofo	TL3	N71437.506	E32373.393
Kingfisher well # 6	Talofofo	TL4	N71361.765	E32405.277
Kingfisher well # 9	Talofofo	TL5	N71384.488	E32362.784
Sam Marianas	Tanapag	TP1		