

American Samoa Environmental Protection Agency

American Samoa

Watershed Management and Protection Program

FY19 Annual Report



Photo: AS-EPA enforcement officers conducting an island-wide inspection of piggeries with residents in Ofu, Manu'a.

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Introduction

American Samoa received full approval of the American Samoa Coastal Nonpoint Pollution Control Program (also known as Watershed Management and Protection Program) on July 24, 2003. The program includes a monitoring strategy designed to track water quality and nonpoint source (NPS) management measures simultaneously to allow the Territory to evaluate the performance of the management measures, and to assess the success of the measures in achieving water quality objectives. This report describes the American Samoa Coastal Nonpoint Pollution Control Program monitoring strategy and provides available information on improvement in water quality, implementation milestones, and reductions in NPS pollutant loadings for FY19.

American Samoa Coastal Nonpoint Source (6217/319) Monitoring Strategy

The monitoring goal is to assess over time the success of NPS management measures in reducing pollution loads and improving water quality.

The monitoring objectives are:

1. To determine trends in water quality by tracking changes in designated use support for the watersheds of American Samoa
2. To evaluate the effectiveness of Best Management Practices (BMPs) for restoring impaired use

American Samoa utilizes four monitoring methods to achieve our monitoring goal: Baseline Monitoring (water quality and land use), Trend Monitoring (designated use support determinations and watershed trend assessments), Effectiveness Monitoring (for selected management measures), and Implementation Monitoring (management practice tracking techniques).

To achieve our monitoring objectives with the limited monitoring resources available, we assess trends in designated use support for the watersheds of American Samoa. Designated use support determinations are developed as part of the USEPA Clean Water Act, Section 305(b) process.

The 305(b) process requires the Territory to evaluate whether designated uses assigned to waterbodies are supported. The determinations are based on ambient water chemistry, biological assessments, habitat assessments, fish tissue contaminant levels and sediment chemistry. Where designated uses are impaired, the Territory identifies the pollutants causing water quality impairments, and the sources of those pollutants. Specific criteria used to determine attainment of these individual designated uses are in accordance with Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act (USEPA 2005) and 2006 Integrated Report Guidance (IRG), supplemented by EPA's 2008, 2010, 2012, 2014, and 2016 memorandums.

American Samoa has determined that threatened or impaired designated uses in the Territory are due to point and non-point sources. There are six identified point sources in the Territory. Five of the NPDES permittees discharge into Pago Pago Harbor. Recent analysis of NPDES monitoring data has demonstrated non-compliance by several permittees. Point sources are therefore likely to contribute to water quality impairment in watersheds influenced by point source discharges. For watersheds beyond the influence of point sources, watersheds identified as threatened or impaired are considered areas where NPS management measures have not improved water quality in the coastal zone. Threatened and impaired watersheds are targeted for enhanced management measures and water quality monitoring.

The total surface area of American Samoa is very small, only 76.1 sq. miles. This small surface area is divided into 42 major watersheds, with an average size of approximately 1.5 sq. miles per watershed (Table 1). Water quality monitoring, along with coral / fish / benthic monitoring covers 32 out of the 41 watersheds, and also covers 99% of the population of American Samoa. Accordingly, tracking on a watershed scale is fully adequate to meet our monitoring objectives and goal. In 2015, census data from the 2010 census was used to update the Watershed Classification for American Samoa.

To measure overall program effectiveness, baseline data collected during baseline monitoring, along with data collected in the trend monitoring effort, is used for designated use support trend analysis. BMP implementation information is collected during effectiveness monitoring and implementation monitoring. A database is used to track trends in designated use support, along with BMP implementation information, on a watershed-by-watershed basis.

The FY19 319 Annual BMP Summary database and database key are included in this report (Appendix A). In addition to the BMP information, we have included the latest (2018) Integrated Water Quality Monitoring and Assessment Report (305b) Use Support Summary (Appendix B). While we do not yet have sufficient data to completely evaluate the utility of our Watershed Management and Protection Program and its potential benefits to water quality and designated use support, preliminary evaluations demonstrate the efficacy of our BMPs in improving local water quality (see Water Quality Improvements section below).

Water Quality Improvements

In 2010, AS-EPA removed the pollutant enterococcus for Watersheds 14, 18, 19, 28, and 34 (Waterbody Type Ocean Shoreline) from the 2008 303(d) list because the data used for previous listing was superseded by more recent credible and scientifically defensible data showing that the surface waters now meet the applicable numeric water quality standard. Sa'ilele Beach (Watershed 14), Alao Beach (Watershed 18), Auasi Wharf (Watershed 19), Maliau Mai Beach and Maliau Mai Swimming Hole (Watershed 28) were sampled weekly (approximately 100 samples) and Aunu'u Wharf (Watershed 34) was sampled monthly (24 samples) over FY08 and FY09. All beaches met both the single sample and geometric mean criteria for fully supporting recreational use.

AS-EPA removed Watersheds 14, 18, 19, and 34 (Waterbody Type Ocean Shoreline) from the 2008 303(d) list and placed them in CALM Category 2 for the 2010 Integrated Report because all pollutants for the waterbodies were removed from the list.

It has been shown that there is a significant relationship between rainfall and enterococcus counts on American Samoa's beaches (see *Localized beach contamination in American Samoa: Results from two years of weekly monitoring*, DiDonato and Pselio, Marine Pollution Bulletin 52, 2006). The correlation of beach contamination and rainfall can serve as a useful indicator of the efficacy of AS-EPA Watershed Management and Protection efforts. The decrease in enterococcus levels as reported above occurred in spite of above average rainfall for American Samoa; rainfall for FY08 was 113% of normal, and was 105% of normal for FY09 (see Pacific ENSO Application Climate Center, NOAA, 2010).

In 2014 AS-EPA removed the pollutant enterococcus for Matuu Watershed 26 (Waterbody Type Ocean Shoreline) from the 2010 303(d) list because the data used for previous listing is superseded by more recent credible and scientifically defensible data showing that the waters now meet the enterococcus numeric water quality standards for single sample and geometric mean criteria. The watershed is now fully supporting for recreational use. In addition, a 2013 TMDL for bacteria in beaches and streams (see Trend Monitoring page 6) found that at both beaches in Matuu watershed bacteria concentrations typically fall below the enterococcus WQS single sample maximum. However, the watershed remains on the 303 (d) list due to a Partially Supporting use support determination for ALUS.

No waterbodies were removed from the 303(d) list in 2016 and 2018. The pollutant enterococcus for ocean shorelines in Watersheds 14 (Sailele), 32 (Nua-Seetaga), and 33 (Amanave) was removed from the 303(d) list in 2016 because a TMDL was completed.

Removal of the pollutant enterococcus from the 303(d) list for the beaches of these watersheds is a success story for the AS-EPA Watershed Management and Protection Program, especially the Piggery Compliance Program. Over the past 10 years, AS-EPA has reduced the number of pigs kept in illegal piggeries by over 70% (from 8,373 to ~1,770) resulting in a significant reduction of pig waste washed down streams and onto the beaches of American Samoa.

Another water quality improvement success story is demonstrated in a 2016 report titled *American Samoa Watersheds Health report: terrestrial sedimentation in Faga'alu and nutrient loading in Tutuila watersheds* (Greg McCormick, San Diego State University). Conclusions from the report are provided below:

“Island-wide water quality has improved over the last 10 years with overall decrease in nutrient discharge (concentrations of nitrate and phosphate) and lower nutrient thresholds of majority of the 45 watersheds tested according to local EPA water quality standards. Seasonal (dry vs wet) effects of nutrient concentrations show overall decrease in nitrate in 44 out of 45 watersheds. Additionally, there was a decrease in phosphate concentrations in 32 out of 45 watersheds in the dry season. During the wet season, there is decreased nitrate concentrations in 39 out of 45 watersheds; while phosphate decreased in 31 out of 45 sampled watersheds. Spatial patterns of disturbance ratios show elevated levels in the east side for nitrate and the central region for phosphate concentrations. Population density and % of disturbed land show the highest are most significant variables important in driving nutrient concentrations in the watersheds around Tutuila.”

Load Reductions

In FY19, AS-EPA collected all available quantitative load reduction data (Table 2). Data is limited as resources for modeling efforts are not available at this time.

Program Implementation Milestones

BASELINE MONITORING

- Reef Flat National Coastal Assessment Project:** The USEPA National Aquatic Resource Surveys (NARS) are a long-term monitoring effort to enable status and trend assessments of aquatic ecosystems across the U.S. NARS include National Coastal Assessments (NCA) and Wadeable Stream Assessments. The NARS statistical (or probability) sampling design provides the framework for unbiased, representative monitoring for condition of an aquatic resource with a known confidence level. Monitoring with this approach through time allows statistical detection of change (and subsequently trends) in condition. The NARS approach, when implemented over time, provides quantifiable estimates of the environmental benefits derived from the Agency's protection and restoration strategies.

NARS have developed and tested ecological indicators as integrators of stressors and estimators of aquatic condition. An ecological indicator describes the condition of the ecosystem, and reflects an ecosystem's biological, chemical, or physical attributes. NARS primarily uses biological indicators to integrate all the different stressors acting on an ecosystem. USEPA partners with EPA Regions, States, and Territories to aggregate local data into broader regional assessments.

In 2015, US EPA partnered with American Samoa EPA, CNMI BECQ, and Guam EPA to implement a Reef Flat survey effort in these Territories as part of the 2015 National Coastal Condition Assessment (NCA). For American Samoa, 50 sampling locations on reef flats of Tutuila and Aunu'u Islands were surveyed within a probabilistic sampling framework. Ecological indicators were measured at all selected sampling sites. Indicators included *in situ* water column measurements (temperature, pH, dissolved oxygen, salinity, PAR), water chemistry (chlorophyll *a*, total nitrogen, dissolved inorganic nitrogen, total phosphorus, dissolved inorganic phosphorus), microbiology (enterococci), and a bioassessment (characterization of the major floral and faunal composition). This 2015 condition assessment represents the second quantitative evaluation of condition for American Samoa reef flat waters (NCA 2015 and 2010).

In FY16, the survey data for American Samoa reef flats was compiled into a technically-sound environmental condition report *US EPA National Coastal Assessment 2015 American Samoa Reef Flats Project Report*. The Executive Summary from the report is provided below.

“Reef flat condition was characterized using three independent assessment indices including a Water Quality Index (WQI) based on NCA cut-points for tropical islands, a WQI based on American Samoa Water Quality Standards (ASWQS) and a Benthic Integrity Index (BII) developed by Peter Houk, PhD. The assessments provided a “snapshot” of reef flat water quality conditions in American Samoa for 2015.

Water quality condition for American Samoa reef flats is rated **FAIR** overall. This rating is consistent with the FAIR rating for each of the three independent indices, and comparable to the NCA 2010 rating of FAIR.

Elevated DIP at all except one site, and elevated DIN at 25 sites, contributed significantly to the **FAIR** rating for the NCA-derived WQI. The utility of DIP and DIN as an estimator of potential eutrophication in American Samoa reef flat waters is questionable; concentrations of DIP and DIN did not correspond with exceedance of NCA Chl *a* criteria.

The ASWQS-derived WQI rating of **FAIR** was influenced by exceedances for TN at 27 sites and Chl *a* at 26 sites. Indications are a significant nutrient input, most likely through non-point source contaminants from human and animal wastes in watershed uplands.

The BII rating of **FAIR** was influenced primarily by the poor floral and faunal composition at 27 sites. Prior to comparing the condition of benthic substrate assemblages across the reef flats, soft and hard-bottom habitats were separated to account for inherent natural variability. This stratification facilitated the development of gradients in reef flat substrate condition that best indicate the potential influence of watersheds and land-based pollution. The 2015 results did not provide evidence for consistent, geographic partitioning of reef flat integrity scores. Rather, hard-bottom reefs with lowest condition were: 1) closest to stream discharge points, 2) associated with the large and/or populated watersheds, and 3) associated with relative lower wave exposure (i.e., not subjected to high southeast exposure).

Relatively high phosphorus levels in reef flat waters may represent natural conditions (i.e., natural weathering of volcanic rock). Total Phosphorus levels in stream waters in pristine watersheds where there are no anthropogenic sources often exceed the ASWQS. This is a clear indication that the natural weathering of the geologic base is the probable source. That DIP was the majority of the total phosphorus pool in 2015 (as in 2010) also suggests a geologic source of phosphorus. Determination of an acceptable level for DIP as a water quality indicator for American Samoa marine waters requires further investigation.

Contrary to DIP, the concentrations of DIN made up only a small portion of the total nitrogen pool in 2015 (as in 2010). Organic forms of nitrogen therefore

dominate the total nitrogen pool. Freshwater inputs likely carry organic forms of nitrogen to the reef flat waters. Inadequately treated human and animal wastes that are discharged directly to streams, or indirectly to groundwater via surface infiltration, cesspools, and leaking septic tanks are the most likely source of nitrogen inputs to reef flat waters. Increased inputs of nitrogen from anthropogenic sources, in the presence of naturally high DIP levels, could influence primary productivity in the reef flat water column, and increase the potential for an eventual shift from hard corals to turf and macroalgae on the reef flats (Lapointe et al., 2004). This potential is demonstrated by the abundance of green algae observed on Aunuu reef flats in the vicinity of a documented raw sewage discharge.

The principal environmental influence for each independent index rating of **FAIR** appears to be the watershed drainages that carry pollutants from upland activity to reef flat waters.

The influence of drainage discharges on reef flat water quality appears to be mitigated by reef flat flushing from wave and tidal actions. Clearly, the degree of flushing on a reef flat has mitigating effect on pollutant inputs from upland activities. Reef flats in watersheds that have better flushing did not exhibit the extent of water quality degradation observed for more sheltered waters. Greater flushing of reef flats from wave and tidal actions on exposed coasts compared to more sheltered locations probably has a significant influence on observed water quality degradation in American Samoa.

Although the reef flat waters were rated **FAIR** overall for both 2015 and 2010, the NCA results for this 5-year interval are only weakly comparable for American Samoa reef flat conditions. Marked differences in weather conditions prevailed during the respective survey events. Weather for the survey period of June-July 2010 was relatively calm and dry compared to the same period in 2015. During 2015 surveys, the weather was persistently squally with episodic rain and consistent trade winds of 15-25 knots during each day of field work. This weather had the overall impact of pushing actual sampling sites closer towards shore than was specified for the NCA-designated “x-spot”. NCA results for indicator components of the water quality indices for 2015 and 2010 likely represent baselines for the reef flat for “rougher-and-wetter” vs “calmer-and-drier” conditions, respectively.

Overall, this reef flat condition assessment shows that upland land use practices in American Samoa should remain the focus of the Territory regulatory agencies, particularly AS-EPA, ASCMP, and the PNRS Board. Enhanced regulatory controls on waste discharges from villages will improve water quality on American Samoa reef flats and will help sustain this valuable resource for current and future generations.”

National Coastal Assessments provide AS-EPA with cost-effective monitoring methodologies that simultaneously serve both levels of decision making; local information

needs and federal reporting requirements. Cost-savings can then be used to address priority issues identified through the assessment process.

Future participation in NCAs (done every 5 years) will provide trend data to gauge protection needs and effectiveness. Data can also be utilized for a Pacific regional assessment. The next NCA will be conducted in 2020.

- Ridge to Reef Ecosystem Health in American Samoa:** American Samoa EPA in collaboration with partners from the Coral Reef Advisory Group, Department of Marine and Wildlife, National Marine Sanctuaries of American Samoa, and the University of Guam led a study to examine Ridge to Reef connectivity and ecosystem health status in the Territory. This project was funded under US EPA's Wetland Program Development Grant (WPDG) in the amount of \$291,944. The project is the first of its kind in terms of spatial and temporal scope to be conducted in American Samoa to systematically examine the trends in water quality and coral reef condition. This Ridge to Reef assessment provides a decision-making framework to assess and manage local stressors that threaten coral reef resilience through an ecosystem health index using water quality and coral reef monitoring protocols that can be used to assess the current status of streams and coral reefs, pinpoint specific sources of degradation, and provide spatially-explicit threat models highlighting areas where these stressors are found. This integrated approach leverages existing interagency collaboration in support of coral reef conservation and pulls existing resources and efforts together to better understand and manage priority conservation and management areas and address locally-relevant priorities. Through EPA WPDG assistance, AS-EPA and partners are able to conduct a whole-of-island systematic approach to determining the specific stressors that significantly drive coral reef condition. This project emphasizes local capacity building and providing village-based reef health report cards that will enable tracking of the success of local management actions and interventions and allow for temporal and spatial comparisons among watersheds and villages on Tutuila.

For Fiscal Year 2017, the following project activities were conducted:

- Two biological surveys for 28 sites completed with ~70 underwater hours, 4,368 benthic photos, 4,480 measurements of turf algae, 921 sea urchin and 44 giant clam counts, and 57,873 counts of 228 species of coral reef fishes
- 12 months (September 2016 to September 2017) of stream and reef flat water samples collected from 73 sites across 26 watersheds on Tutuila
- 1,800 water samples collected and successfully analyzed for Dissolved Inorganic Nitrogen Analysis

Results show stream Dissolved Inorganic Nitrogen (Nitrate-Nitrite-Ammonia) (DIN) average concentrations are largely attributed to human populations across watershed classes with minimal influence from watershed size (total watershed area), wave exposure and reef flat width. There is a significant relationship between DIN and population per area that is evident only in extensive watersheds, while in intermediate and pristine watersheds DIN concentrations are low. Final project results will be available December 2017.

The outcomes of this project will not only provide the most comprehensive baseline to assess current ecosystem condition in the Territory but can also inform locally-relevant management priorities. These project outcomes will help communities make goal-oriented management decisions using the best-available scientific information on ecological condition, promote data transparency, and enhance collaborative opportunities with partners and the regulated community.

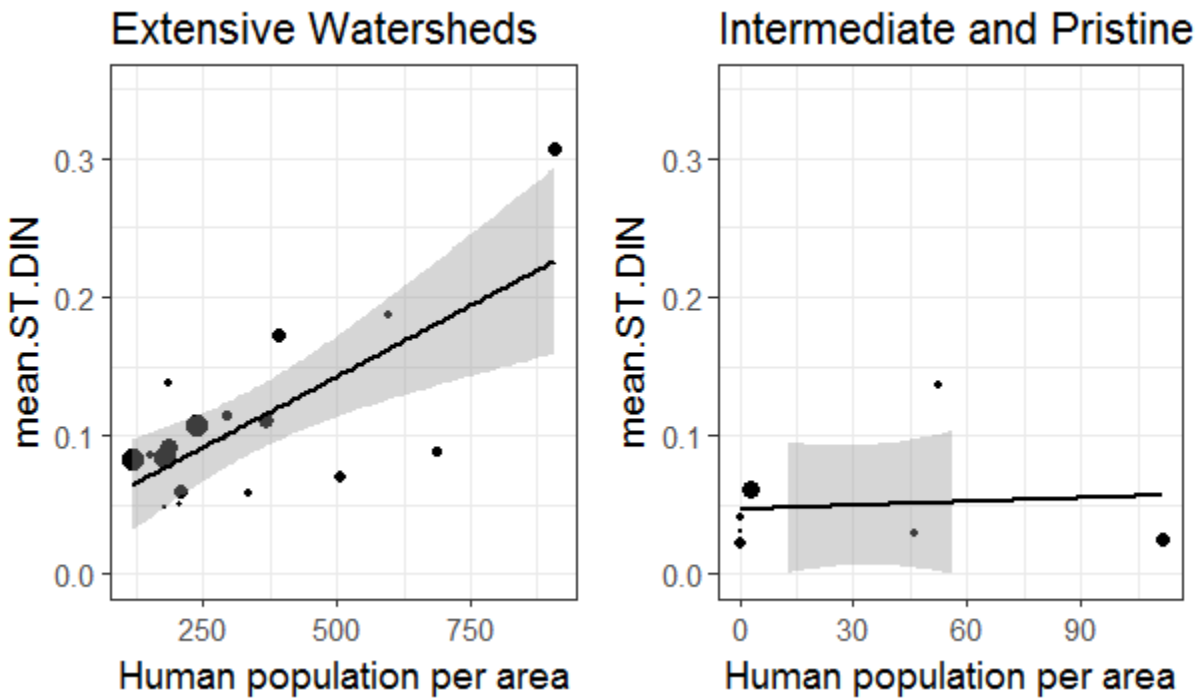


Figure 1. Mean stream DIN concentrations across extensive and pristine watersheds showing the significant relationship between population per area and DIN

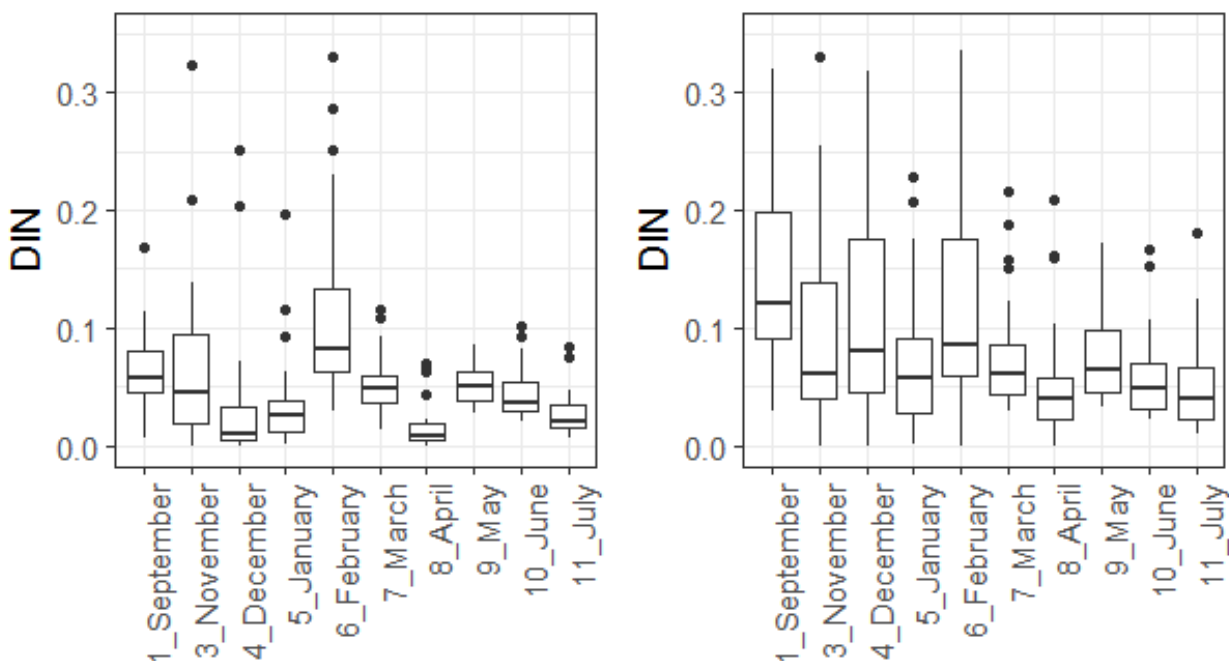


Figure 2. DIN concentrations Reef Flat (left panel) and Stream (right panel) over 10-months of sampling across 26 watersheds around Tutuila

In Fiscal Year 2018, coral reef assemblages were evaluated across three distinct reef types with respect to water quality, watershed characteristics, wave energy, and proximity to fishing access.

Results show that coral assemblage condition was best predicted by DIN concentrations in two reef types, south and wave-sheltered reefs, whereas only natural factors such as wave energy predicted coral assemblages on the north side of the island where fewer humans live. Fishing access, measured as boat and driving distances to main population centers in Tafuna, Pago Pago and Fagasa, and wave energy best predicted fish assemblage condition in all reef types. Fishing access was also influential to presence of calcifying benthic substrates in all reef types, but human population density provided a secondary driver for south and wave-sheltered reefs. In sum, both bottom-up and top-down processes were both highly influential to coral-reef resources, with elevated nutrient concentrations having the greatest influences on coral assemblage metrics such as species richness and heterogeneity, while fishing access had the greatest influences on fish and calcifying benthic assemblages.

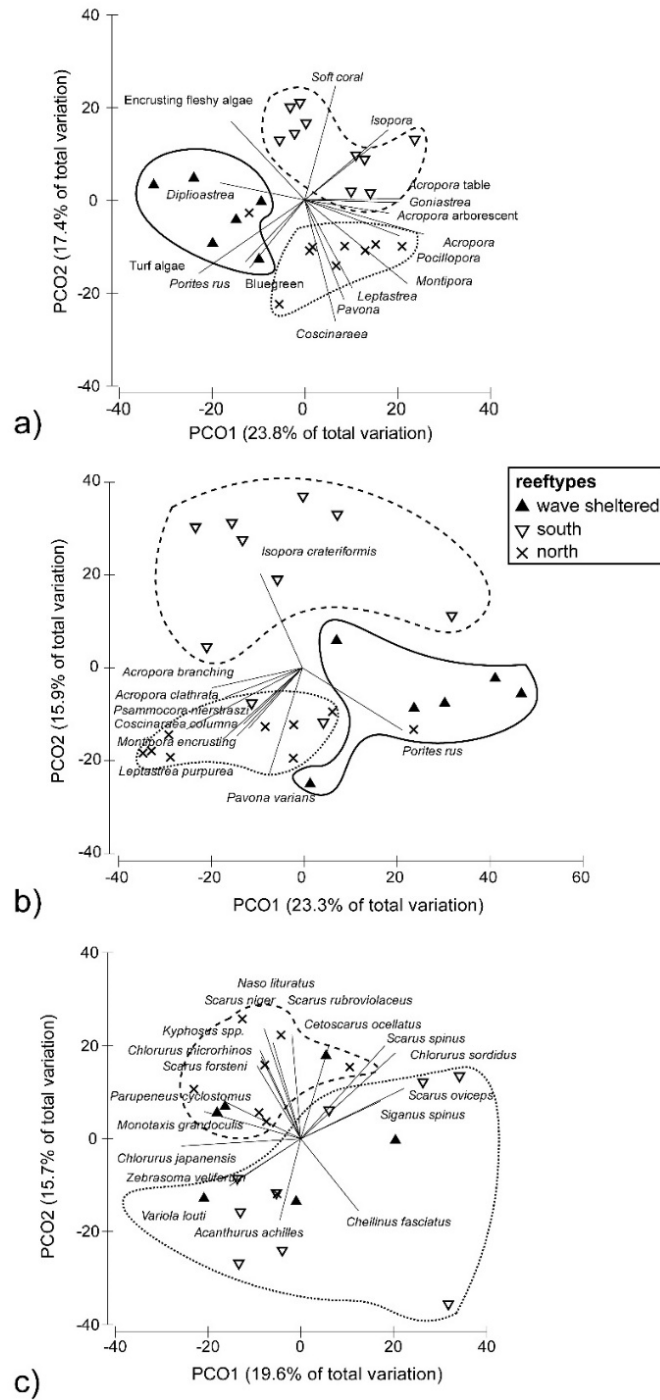


Figure 2. Principle component ordination plots of benthic (a), coral (b), and fish (c) assemblages. Circles represent significant differences in biological assemblages that existed within each reef type. Vectors indicate taxa that were the strongest contributors to reef type differences, with vector length proportional to correlation strength with the primary PCO axes.

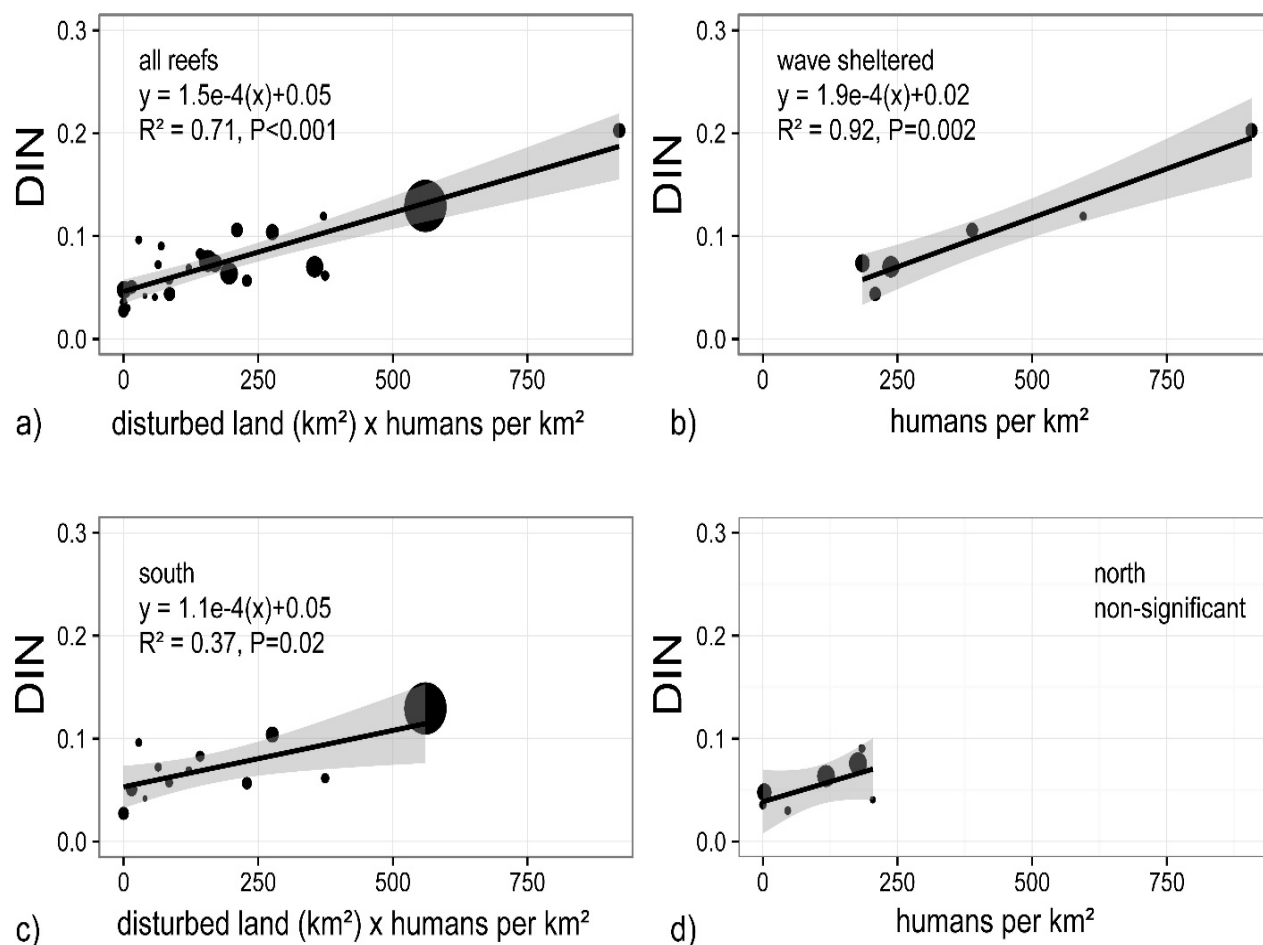


Figure 4. Relationships between mean annual dissolved inorganic nitrogen (DIN) concentrations and human populations and disturbed land. Best-fit models for all reefs together as well as south reefs only represented an interaction between disturbed land and humans. DIN values associated with wave sheltered reefs were best predicted by human populations only, while north reefs had non-significant best fits with humans. Circles indicate watershed size.

TREND MONITORING

- Total Maximum Daily Loads (TMDLs):** In FY14, AS-EPA and USEPA completed *American Samoa Bacteria TMDLs for Beaches and Streams* for 29 watersheds listed as impaired for *Enterococcus*. The TMDLs were approved by US EPA Region 9 in September 2015. The overview from the report is provided below:

Several watersheds in American Samoa are listed as impaired for *Enterococcus*, an indicator bacteria, on the Clean Water Act (CWA) Section 303(d) list. Total Maximum Daily Loads (TMDLs) are required to be developed for all 303(d)-listed impairments. The purpose of a TMDL is to attain water quality standards (WQS),

thereby supporting designated uses of the waterbody. A TMDL is defined as the sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background, such that the capacity of the waterbody to assimilate pollutant loading (i.e., the loading capacity) is not exceeded (40 CFR §130.2).

American Samoa Environmental Protection Agency (AS-EPA) uses the watershed as the primary unit of assessment. According to the 2012 Territory of American Samoa Integrated Water Quality Monitoring and Assessment Report (2012 Integrated Report or IR), 36 of 41 watersheds in American Samoa were assessed and a total of 29 watersheds were not supporting designated uses due to bacteria impairments in stream and/or ocean shoreline reaches (i.e., beaches). AS-EPA prioritized bacteria impairments as a high priority for TMDL development in the 2012 Integrated Report. The TMDLs presented in this report address the bacteria impairments for the 21 streams and 21 beaches that were identified on the 2012 303(d) list.

Watersheds Addressed by the Bacteria TMDLs for American Samoa

Watershed No.	Watershed Name	Stream Impairment	Beach Impairment
1	Poloa	●	
2	Fagalii	●	
3	Maloata	●	●
4	Fagamalo	●	
5	Aoloau Sisifo	●	
7	Aasu	●	
8	Fagasa	●	●
9	Fagatuitui	●	
10	Vatia	●	●
11	Afono		●
12	Masefau	●	●
13	Masuasi	●	●
14	Sailele		●
15	Aoa		●
16	Onenoa		●
18	Alao	●	
19	Auasi	●	
20	Amouli		●
21	Fagaitua	●	●
22	Alega	●	●
23	Laulii-Aumi	●	●
24	Pago Pago	●	●
25	Fagaalu	●	●

Watershed No.	Watershed Name	Stream Impairment	Beach Impairment
26	Matuu	●	●
27	Nuuuli Pala	●	●
30	Leone	●	●
31	Afao-Asili		●
32	Nua-Seetaga		●
33	Amanave		●

These TMDLs used a hydrology-based framework, combining monitoring data with flow and precipitation information. This provided an expanded analysis of existing data, which allowed patterns to be examined based on estimates of flows conditions (e.g., wet versus dry). Classifying conditions under which water quality problems occur supports a meaningful transition to implementation efforts.

This TMDL report begins with a description of the setting and water quality impairments in American Samoa (Section 2). The applicable WQS and the numeric targets are discussed in Section 3.2. A review of water quality data and the identification of potential sources are summarized in Section 4 and Section 5, respectively. Technical approaches are identified in Section 6, while application of the selected approach and the relationship between pollutant sources and receiving water conditions is described in the Linkage Analysis (Section 7). TMDL allocations, including the identified margin of safety (MOS), are provided in Section 8. Additional analyses and information to support implementation is presented in the individual water quality assessments for streams and beaches within impaired watersheds in Appendix A.

- **AS-EPA Nearshore Marine Water Quality Monitoring Program:** The program continued to test for non-point source pollutants. This program includes and implements Core and Supplemental Water Quality Indicators, Quality Assurance, Data Management, Data Analysis/Assessment, and Reporting Elements as part of the monitoring design. In FY19, the program continued to monitor local recreational beach areas. Forty (40) of the most frequently visited beaches, as well as some remote beaches, were monitored on a weekly basis, while six (6) less frequented beaches were monitored on a monthly basis.

In 2011 AS-EPA evaluated all available water quality data for TN, TP, and Chlorophyll a in Open Coastal and Embayment waterbodies collected between 2001 and 2010. The data was compared to the new 2013 Water Quality Standards for American Samoa. Findings indicated that the Open Coastal and Embayment water quality is good, with data meeting the standards (calculated log-normal distribution line for data falls below standard line).

- **AS-EPA Stream Water Quality Monitoring Program:** The program was developed to address the need to monitor for effects of potential non-point source pollution on American Samoa stream ecosystems. In the first four years (FY04-FY07), the monitoring plan used a modified probabilistic design, whereby streams were selected at random and monitored for one year. Ambient physical, chemical, and habitat variables were measured at monthly

intervals for eight (8) Tutuila streams each year. In the fifth year (FY09), AS-EPA began monitoring nine (9) randomly selected streams on a monthly basis. Data were used for 305(b) designated use assessments.

In FY10, data from the four-year monitoring period was pooled and a report was completed by Dr. Guy DiDonato. The report presented a comprehensive assessment of the data, and determined whether there were statistical differences between watershed classes for the measured parameters, and whether future monitoring should be carried out under the modified probabilistic design. Findings of the report are summarized below:

Over the four survey years, 30 different streams were sampled, while two streams were sampled twice. Over that time the program did a reasonable job sampling the population of watersheds within each class and collecting data relatively free of place-based bias. With respect to the effect of watershed classes on stream variables, these data show several important findings. First, there was significant variability seen in the data at many scales: among stations within a stream, within a stream across time, among streams in a watershed class, and among watershed classes. Second, after summarizing the data, the watershed orderings for most of the variables followed the *a priori* predictions. Third, there was often a statistical difference between the watershed classes. Of the 10 variables examined for effects on mean stream responses, 7 showed a significant watershed class effect. Of the 10 examined for effects on within-stream variability, 7 were significant and 1 was close to significant. Fourth, the least impacted watersheds and the most impacted watersheds were often at opposite ends of the spectrum and were statistically different from each other. Despite the great variability in the data, which was to a certain extent a result of the probabilistic sampling approach, a watershed class signal more often than not emerged from the noise.

In 2011, AS-EPA evaluated all available water quality data for TN and TP in streams collected between 2001 and 2010. The data was compared to the revised 2013 Water Quality Standards for American Samoa. Findings indicated that the water quality is good in the pristine watershed streams, with all data meeting the standards for TN and TP. However, water quality in streams overall (including all categories of watersheds) may be considered poor due to anthropogenic inputs because the data did not meet the TN standard (calculated log-normal distribution line for data does not fall below standard line). Overall stream data also did not meet the TP standard. However, there is indicative evidence that the majority of TP in streams is due to the natural weathering of the geologic base (volcanic basalt), and is not due to anthropogenic inputs.

Stream monitoring was limited to microbiological parameters in FY12 and FY13 due to equipment malfunctions and lack of technical staff. AS-EPA re-implemented stream monitoring for bacterial and physical parameters in FY14 and intends to add chemical parameters (nutrients) in FY20.

- **AS-EPA Coral Reef Monitoring Program:** The goals of the American Samoa Environmental Protection Agency (AS-EPA) coral-reef monitoring program are to

conduct long-term monitoring activities to characterize the present condition and temporal dynamics of coral-reef assemblages adjacent to several village-based watersheds around Tutuila. This effort started in 2003 when six watershed-based monitoring sites were first established, and has expanded over the years to include 15 sites with temporal trends developed. The latest round of monitoring by Dr. Peter Houk (UOG Marine Lab) took place in 2013. The Executive Summary of his report *Watershed based coral reef monitoring across Tutuila, American Samoa: Summary of decadal trends and 2013 assessment* is provided below.

Introduction

The goals of the American Samoa Environmental Protection Agency (AS-EPA) coral-reef monitoring program are to conduct long-term monitoring activities to characterize the present condition and temporal dynamics of coral-reef assemblages adjacent to several village-based watersheds around Tutuila. This effort started in 2003 when six watershed-based monitoring sites were first established, and has expanded over the years to include 15 sites with temporal trends developed.

The design, spatial scale, and methodology of this monitoring program were selected to match management programs that are focused at the village level, and account for inherent natural variation that exists on Tutuila's reefs. On Tutuila, coral-reef assemblages on the northern shoreline are distinguishable from the south (*furthered within*). While both have well-developed reefs, they differ in taxonomic composition, as the many of the most common benthic substrates, corals, and fish differ in abundance based upon geography. This is likely an artifact of natural settings, geology of the underlying watershed bedrock, or some combination of both. While this topic is of interest for further study, the existing monitoring effort deals with the inherent variation by stratifying survey designs. Representative sites have been established within each reef type (north and south), along gradients of watershed size, land use, and human population density. Sites associated with uninhabited watersheds are used to provide an ecological endpoint from comparatively undisturbed watersheds, Fagatuitui (Tafeu) in the north and Fagatele-Larson in the south.

At each monitoring site we used standardized, transect-based protocols to gather data pertaining to the benthic substrates, coral, and fish assemblages with appropriate statistical confidence to detect change through time. Through monitoring, trends in coral-reef status indicators are being detected at time scales appropriate to assess management (1 – 5 years). The present report highlights decadal trends since the inception of monitoring in 2003, which encapsulates a time where a major disturbance (cyclone Heta in 2004) impacted Tutuila's reefs, and recovery occurred. We analyzed metrics of coral-reef recovery and present reef condition with respect to proxies of watershed pollution, grazing potential of herbivorous fishes, and wave exposure. Prior studies have shown that these

variables represent the localized stressors and natural regimes of greatest significance to the condition of corals and benthic substrates.

Decadal Trends

The most significant change to Tutuila's reefs since AS-EPA monitoring began has been the sharp decline (~15%) in coral cover following cyclone Heta, and subsequent recovery over the past decade. The decadal trends hypothesize a nearly full recovery of coral growth since the damage from cyclone Heta in 2004, however, these trends must be understood alongside the baseline that our monitoring efforts are founded upon. Previous studies suggested that island wide coral cover estimates may have been higher in the past (as high as 62% in 1982), substantially higher than the 2003 baseline we have noted. Thus, while we documented successful recovery, the overall trends were disproportionately driven by a few of the monitoring sites that had the greatest coral loss and growth potential (such as Fagaitua, Fagatele-Larson, Fagatuitui (Tafeu), and Aoa), while sites with less coral remained more static or had a slow, steady decline through time (such as Fagaalu, Laulii, Fagasa, and Masefau). Therefore, successful recovery indicated that sites classified by high and low condition indices remained that way since 2003 when monitoring began. In support of these findings, EPA-based aquatic life use support rankings (i.e., the classification system used to assess reef condition) found that most (10 of 15 sites) of the aquatic life use support rankings did not change through time.

Causes of impairment to Tutuila's reefs

More detailed insight into the causes of impairment to Tutuila's coral reefs was generated through examinations of the rate of recovery at each site using regression models and correlation analyses. Following the 2008 monitoring event, early stages of recovery from cyclone Heta were already noted based upon two ecological indicators, benthic substrate ratios and coral evenness. Benthic substrate ratios describe the ratio of calcifying versus non-calcifying substrate on the reef, and provide an overall indication of reef growth capacity. Coral evenness describes the extent to which the total coral coverage at each site was distributed across many species. These initial results suggested that recovery rates were dependent upon both water quality and herbivore biomass, both in conjunction with wave exposure. Interestingly, the relative influence of water quality and herbivore biomass was equal for reefs along the southern shoreline, while herbivore biomass had a disproportionate influence for the reefs along Tutuila's northern shoreline.

The present monitoring effort used enhanced datasets to expand upon these findings. Regression models highlighted a similar magnitude of influence from pollution proxies and mean herbivore size for the reefs along Tutuila's southern shoreline, yet proxies to land-based pollution were components of more of the significant models examined. Similar to past reports, wave exposure was a

required component for all models. For reefs along Tutuila's north shoreline, fewer sites were investigated and only exploratory correlation analyses were performed. Correlations also indicated that both herbivore size and proxies to pollution were associated with the recovery process and current reef condition. Examinations with coral evenness were strongest with mean herbivore size, while benthic substrates had greatest associations with pollution proxies and wave exposure. Notably, the influence of wave exposure differed between the north and south. In the south wave exposure had a negative relationship with recovery indices, while in the north the relationship was positive. This was attributed to the predominant weather patterns and wind directions around Tutuila (*furthered within*).

ALUS rankings

The present condition assessment determined that 8 of the monitoring sites were considered either full or partially supportive for aquatic life use support, while 7 were considered not supportive. Sites that have consistently been described with non-supportive ALUS rankings since the inception of monitoring include Fagaalu, Fagasa, Laulii, Alofau, Aoa. While their rankings are similar, the perceived causes behind the rankings differ based upon the decadal trend data. Alofau and Fagaalu had the lowest mean herbivore sizes, moderate to high proxies to land-based pollution, and relatively low wave exposure. In contrast, Fagasa and Aoa had highest proxies to land-based pollution, with moderate to low herbivore sizes and wave exposure. Last, Laulii had equal influence from high wave exposure, moderate to low herbivore sizes, and high proxies to land-based pollution.

Among the four sites with partially supportive ALUS rankings, three have remained in this category since monitoring began (Fagaitua, Leone, and Vaitogi), while Matuu has improved from a 2008 non-supportive ranking based upon trend data suggesting wave exposure is the most limiting environmental parameter for improved benthic substrate ratios, and a general improvement in the coral assemblage.

In addition to Fagatele and Fagatuitui (Tafeu) that have been ranked as fully supportive since monitoring efforts began, both Masausi and Alega now also considered to be fully supportive based upon recovery trends that depicted wave exposure as the limiting factor for non-significant improvements to the benthic and coral assemblages noted.

Conclusions and future directions

The present study summarized decadal disturbance and recovery trends across Tutuila initiated by cyclone Heta in 2004. Over the past decade we report that coral cover appears to have rebounded to pre-disturbance levels, but we caution that pre-disturbance levels were based upon a snapshot of the reefs in 2003,

and do not take into account changes that have occurred over longer periods of time (i.e., several decades). So, while overall recovery trends were encouraging, sites in good ecological condition (i.e., fully and partially supportive ALUS) were drivers of the trends. In contrast, sites with poor condition rankings remained more static. While high proxies to land-based pollution and small mean herbivore sizes both limited the recovery process, recovery along the south shore of Tutuila appeared to have more consistent ties with pollution proxies. One hypothesized driver of these findings is that the nature of freshwater input from the watershed to the nearshore reefs differs between the north and south shores, but spatial and temporal salinity profiles would be needed to further this hypothesis.

Continued efforts to better understand the influence of localized stressor upon Tutuila's nearshore reefs and to assess management regimes are long-term goals for AS-EPA's monitoring effort. Reports in the past indicated that pig densities per km², alone or in combination with other pollution proxies, had significant ties with the ecological metrics used here. Over the years since the AS-EPA piggery program has started, pig densities have become less influential predictors of reef condition, and the present analyses found no significant ties evident with pig densities. Clearly linkages such as these are speculative, but these findings can support further study directed at understanding the contribution of piggery waste to overall watershed pollution levels, and perhaps be useful in generating funding to perform such a study. Similarly, the Fagaalu watershed and nearby sewage treatment plant are the current (or proposed) topic for more descriptive study that can benefit from long-term ecological datasets. Cumulatively, the ALUS rankings generated here are currently being used to establish a watershed priority list that assists with maximizing the effectiveness of limited management budgets, and fulfills federal grant requirements.

The future goal of the AS-EPA coral monitoring effort is to conduct surveys on a bi-annual basis, tracking changes over time and drawing linkages with human disturbances. The existing program would benefit from increasing the number of sites visited along both the north and south shore to improve the (statistical) foundation for assessing the trends presented, or focusing the existing resources on either the south or north shore.

- **AS-EPA Village Public Water System Monitoring:** AS-EPA continued to test twice a year for pathogen indicators in nine Village Public Water Systems that remain under US-EPA Administrative Order. The results (all water samples tested positive for *E. coli*) were posted in village common areas and submitted to each mayor. AS-EPA also installed permanent signs in each village to educate residents on the health effects of drinking contaminated water and the importance of boiling before consumption.

ASPA completed the expansion of the water distribution system to service the last unserved villages of Fagamalo, Malota and Fagali'i on the far west end of Tutuila. The new water system consists of a new groundwater well to supply the system, two bolted steel water storage tanks for storage and fire flow, a booster station to supply water to the Fagamalo

tank, and approximately 4.7 miles of PVC pipeline connecting the system from Poloa to Fagamalo village. This project was funded by DOI and USEPA. Extending the potable water system to these three villages accomplished ASPA's goal of providing water to all villages of American Samoa.

The villages of Afono, Masausi, and Vatia are each connected to ASPA's satellite distribution system water. However, the small percentage of homes which are thought to be connected to the potable ASPA supply piping does not allow the long-standing administrative orders (AOs) to be lifted. The AOs are still in place for Afono, Amouli, Fagamalo, Fagalii, Masausi, Onenoa, Poloa (upper and lower), and Vatia.

- American Samoa Power Authority (ASPA) Water Quality Monitoring:** ASPA continued to monitor raw and finished groundwater from operating wells for Primary Drinking Water Contaminants. ASPA is also conducting ongoing well Groundwater Under the Direct Influence of Surface Water (GUDI) studies to determine if existing wells are under the direct influence of surface water. Currently, a GUDI study has been completed on 42 wells, and no new GUDI wells have been detected in the system other than the 9 wells that have already been determined GUDI. This is the cause of the current Boil Water Notice in areas of the ASPA water system. ASPA already shutdown 2 of the 9 GUDI Wells and is working diligently to drill replacement wells so the Boil Water Notice can be lifted. ASPA completed the drilling of eight new wells to assist in replacing GUDI wells in the system. All eight drilled wells yielded good water. Three of the eight wells with an estimated production of 700 gpm will service the BWN area. This will allow ASPA to replace at least three GUDI wells once these three wells are connected to the system by end of 2017.

ASPA secured funding from US-EPA to begin replacement of approximately 20,000 linear feet of old Asbestos Cement (AC) pipes with new waterlines. The AC pipes are deteriorating and leaking at the joints causing high water losses and potential contamination in the water system. ASPA completed 5,000 linear feet of AC pipe replacement in the Leone area last year. More AC pipe replacement projects are in design and will be out for construction next year.

The high level of Non-Revenue Water (NRW) remains a top priority for ASPA. ASPA continued leak detection work with two in-house leak detection team to help reduce NRW in the central water system. An average of 150 leaks are detected/reported and repaired each month with an estimated loss of about 0.5 million gallons per day (MGD). This effort has resulted in noticeable improvements in the system pressure and flow. ASPA completed installation of 32 Variable Frequency Drives (VFDs) at critical wells and booster stations to assist in the proper management of pressure in the system. The VFDs have assisted in lowering energy usage and reduce the amount of water going to leaks. ASPA was able to reduce the NRW from 60% last year to 57% at the end of FY16.

Well Exploration Project (Drilling) (USEPA Funded)

This Project includes exploratory well drilling to find new non-GUDI water sources to replace GUDI wells and high salinity wells (8 Wells Total).

To date, five out of eight new wells have been successfully drilled. The angled well in Pago Pago village is 100% complete and is on hold due to challenges getting a pump down the angled hole. Both Laulii and Aua wells have been drilled and are now being pump tested. Alega, Tula and Aoa villages will be drilled next. The new well driller is doing a good job training the crew and fixing the old rig in order to get these wells drilled and continue the well drilling program.

Tramway Tank Phase II (USEPA Funded)

This Project includes the installation of a new water storage tank to serve upper Utulei/Fagatogo area and the rehabilitation of the existing Tramway Tank. The Project will result in better pressure for Upper residence and extend life of existing one-million-gallon tank Tramway.

The project construction is 50% complete.

Pago Pago to Fagasa Pass Service Area Project (Upper Pago Pago Water Improvement Project) (USEPA Funded)

This Project includes the installation of waterlines and a water storage tank to serve the Upper Pago Vaipito Microfiltration Plant and Fagasa water system.

This Project has been awarded to Happy Trucking and is 100% complete. Water is now available to all high elevation residents along the main road from Pago to Fagasa.

Replacement of Upper Amouli Tank (USEPA Funded)

This Project will replace the old leaking Amouli water storage tank near the Sopoagas residence. This Project is anticipated to improve water losses and improve the longevity of water storage on the east side.

The project was awarded to Tony's Construction and construction is 100% complete. The tank is now in operation.

New Wells Project - Nuuuli (Well 24) (USEPA Funded)

This Project includes the installation of waterlines to connect newly drilled Well 24 in Nuuuli (Tauese area) to main water system. This will result in better pressure in this Nuuuli area.

Project construction has been awarded to Happy Trucking and will start once materials arrive.

Vaitogi AC Pipe Replacement (USEPA Funded)

This Project will replace the old AC pipe in Vaitogi from Ilili intersection to Vaitogi village.

The project construction was awarded to CTC and construction is 80% complete.

Well Exploration Project (Connections W4, 5, 6 plus 5 more) (USEPA Funded)

This Project involves the installation of waterlines to connect newly drilled Wells to System. (Wells 4, 5, and 6)

Well 5 has been eliminated from this list as it did not yield sufficient water. Well 4 is on-hold due to issues with land owner stopping ASPA from doing work on his property. Well 6 design is 50% complete.

New Wells Project - Malaeloa (Well 15) (USEPA Funded)

This Project will install waterlines to connect new Well 15 and Well 70 to the Leone water storage tank.

The Project design is complete and submitted to procurement for solicitation.

Aoa Water System Improvements (USEPA Funded)

This Project includes the drilling of a new well to replace existing GUDI wells in Aoa. The Project will help to lift the Boil Water Notice and provide clean potable water to the Aoa residence.

The Project is included in the drilling project and will be drilled in early 2020 due to issues with the drilling program and drill rig.

Manu'a Water System Sanitary Survey (USEPA Funded)

This Project includes the drilling of new wells in Ofu and Fitiuta, replacement of water storage tanks in Fitiuta and Olosega, and the installation of waterline connections.

This project as awarded to Happy Trucking and is 30% complete.

Central Water System – Mapusaga Fou to Mesepa Waterline (DOI Funded)

This Project will upgrade the existing HDPE & AC Pipes in areas where NRW is high to reduce losses. This Project will cover areas in the Central Water System like Pavaiai and Mapusaga.

The Project was awarded to CTC and is 100% complete.

AC Pipe Replacement Project – Pavaiai to Tafeta (NMTC Funded)

This Project includes the replacing of the existing AC pipe in this area.

This Project is funded by the New Market Tax Credit funding and construction is 20% complete.

Water Meter Replacement Project (USEPA Funded)

This Project replaces all old meters with new smart meters.

To date 6500 meters out of 9500 meters have been replaced. This project is ongoing until all old meters are replaced with new more efficient smart meters.

- **American Samoa Power Authority (ASPA) and University of Hawaii (UH) Hydrological Monitoring Project:** ASPA and UH have been working collaboratively to install a hydrological monitoring network that consists of stream gauging sites, weather stations, and rain gauges distributed throughout Tutuila Island. ASPA also monitors groundwater levels and pumping water levels at operational wells. Weather station data collected from four sites (Poloa, Aasu, Mt Alava and Vaipito) are made available on ASPA's website under Public Notices for interested agencies and organizations. The stream gauge data (stream water levels and discharge) are collected from five sites (Maloata, Leone, Vaipito, Fagaalu, and Afono) on Tutuila Island and data collected including weather station data are sent to the University of Hawaii to be used by graduate students for modeling watershed areas, groundwater distribution and discharge, movement of groundwater contaminants and water budget modeling.

Some of the stream gauging sites have been installed in previous locations used by United States Geological Survey (USGS) with the aim of data continuity. However, there is still a large gap in the data available and a critical need for wider network coverage. ASPA has secured funding from USEPA to widen the network coverage for hydrological data, and is working together with UH to implement and install more hydrological stations not only for Tutuila Island but also Aunu'u and Manua Islands. This project shows the need to adapt to climate change and its observed impacts on American Samoa's water resources. Over the years, groundwater levels have receded and chloride levels are increasing in some of the production wells closer to the coast. There is a critical need to site more water sources, drill more wells, and shut down wells that have incurred saline up coning. This hydrological monitoring network provides ASPA with information to assess sustainability of water resources on Island and make informed and well guided decisions on siting new water sources.

- **National Park of American Samoa Core Monitoring Program:** The Park has established a core monitoring program for marine waters on the north side of Tutuila Island. This program monitors fish, corals and substrate cover. All 30 sampling sites were randomly selected along the 30-m isobath and are sampled annually. Marine water and freshwater quality measurements began in 2009, and terrestrial ecosystem components are being phased into the program. Annual stream biota monitoring began in 2010 in several

streams on Tutuila and Ta'u. Vegetation and land bird mapping began in 2011 and will be monitored at 5-year intervals. In 2015 the Park released a summary report for water quality. The abstract of the report titled *Water Quality in Streams of National Park of American Samoa* (National Resource Data Series NPS/NPSA/NRDS – 2015/753) is provided below:

This Natural Resource Data Series Report (NRDS) presents data collected from Amalau Stream, Fagatuitui Stream, and Leafu Stream on the island of Tutuila, and Laufuti Stream on the island of Tau, National Park of American Samoa, in American Samoa. This is a summary or “data report” as described in the Water Quality Vital Signs Monitoring Protocol for the Pacific Island Network Version 1.0, Natural Resource Report NPS/PACN/NRR-2011/418. This report is restricted to data presentation and limited description. The data presented in this report will be analyzed for the establishment of expected parameter value ranges and long-term trends in future reports published in the NPS Natural Resource Report (NRR) series. Lower concentrations of dissolved nutrients observed in Laufuti pools as compared to downstream flowing portions of Laufuti stream were consistent with hydrological conditions. Differences between parameter values measured in Amalau Stream forest and village sites were subtle. TDN measurements appear higher in downstream Leafu Stream village sites compared to upstream forest sites. Turbidity slightly exceeded the published water quality limit once in Fagatuitui Stream in 2010, but sampling was limited to times of low flow due to safety concerns.

- **Non-Point Source Related Research Projects:** Numerous non-point source research projects have been conducted in American Samoa. In FY19, three research projects were completed. Partial abstracts/conclusions are provided below, complete documents can be obtained from AS-EPA.
 - 1) *Assessing Water Quality and the Likely Sources of Nutrient Loads in American Samoa Watersheds* (G. McCormick, 2015): The concentrations of nitrate and phosphate decreased in the streams of Tutuila between 2005 and 2015, with the only increase seen at the stream near the market in Fagatogo (Watershed #24). Nutrient levels were highly correlated with population density and disturbed land.
 - 2) *Expanding Monitoring and Modeling of Land-based Sources of Pollution to Priority Coral Reefs in American Samoa, Final Report* (T. Biggs, A. Messina, G. McCormick, M. Curtis, J. Newton, 2016): Turbidity and suspended sediment concentrations were clearly impacted by humans at Faga'alu (Watershed #25) while at Nu'uuli (Watershed #27) there is no significant impact of human activity on turbidity (turbidity was the same up and downstream from the village during storm flow, and was slightly higher at the downstream village site during baseflow. Nutrient concentrations at Nu'uuli are similar to the forested background, but are higher at Faga'alu for nitrate. Phosphate concentrations are typically lower downstream of both villages, though this could be due to sorption of phosphate onto suspended sediments in

the stream rather than to lower concentrations of total phosphorus. Following mitigation activities at the quarry in Faga'alu, turbidity, SSC, and suspended sediment yield downstream of the village are still slightly elevated above the forest background. Several peer-reviewed publications and reports were produced from this work.

- 3) *American Samoa Watersheds Health Report: terrestrial sedimentation in Faga'alu and nutrient loading in Tutuila watersheds* (G. McCormick, 2015): Island-wide water quality has improved over the last 10 years with overall decrease in nutrient discharge (concentrations of nitrate and phosphate) and lower nutrient thresholds of majority of the 45 watersheds tested according to local EPA water quality standards. Seasonal (dry vs wet) effects of nutrient concentrations show overall decrease in nitrate in 44 out of 45 watersheds. Additionally, there was a decrease in phosphate concentrations in 32 out of 45 watersheds in the dry season. During the wet season, there is decreased nitrate concentrations in 39 out of 45 watersheds; while phosphate decreased in 31 out of 45 sampled watersheds. Spatial patterns of disturbance ratios show elevated levels in the east side for nitrate and the central region for phosphate concentrations. Population density and % of disturbed land show the highest are most significant variables important in driving nutrient concentrations in the watersheds around Tutuila.
- 4) *Baseline Assessment of Faga'alu Watershed: A Ridge to Reef Assessment in Support of Sediment Reduction Activities and Future Evaluation of their Success* (S. H. Rice, A. Messina, T. Biggs, B. Vargas-Angel, and D. Whitall 2016. NOAA Technical Memorandum CRCP 23): Sediment loading from Faga'alu has been tripled by the unmitigated runoff from the quarry prior to the intervention. There is significant spatial variability in sediment stress on corals as a result of water circulation patterns over the reef, with the highest impacts near the stream mouth and on the northern reef. Sediment mitigation at the quarry should dramatically reduce sediment loading from the stream and sediment stress on the reef. Mean prevalence of coral disease were low overall. The historic landfill located on the premises of the current Matafao Elementary School site is potentially a source of contaminants, especially arsenic. Potential for sediment toxicity in the bay is relatively low. Possibly toxic levels were measured for at least one site for silver, arsenic, chromium, copper, zinc, nickel, chlordane and PCB but only two analytes (nickel and zinc) exceeded levels where probable toxicity was likely. Of the analytes that are elevated, most appear to have strong watershed sources and are likely entering the bay via the stream. An exception to this is arsenic, which appears to have some other source, possibly the legacy Department of Defense landfill on the north shore.
- 5) *Pollution in Surface Sediments in Faga'alu Bay, Tutuila, American Samoa* (Whitall, D. and S. Holst 2015. NOAA Technical Memorandum NOS/NCCOS 201): Pollution in the surface sediments of the Bay and in the watershed, streams is generally low, although there are a few contaminants for which levels appear

to be elevated above levels of concern including: arsenic, chromium, nickel, silver, zinc, chlordane, DDT and PCBs. In some cases (e.g., nickel, silver and zinc) these elevated levels may be due to natural erosion of bedrock, although this erosion may be accelerated by mining activities at the quarry. In other cases (arsenic, PCBs, DDT), there is some evidence that the legacy landfill beneath the elementary school may be a potential source of pollution through groundwater leaching.

- 6) *Land-Based sources of marine pollution: Pesticides PAHs and phthalates in coastal stream water, and heavy metals in coastal stream sediments in American Samoa* (B. A. Polidoro, M. T. Comerros-Raynal, T. Cahill, C. Clement, 2016): All sampled stream sediments contained high concentrations of diethyl phthalate and of organophosphate pesticides, above chronic toxicity values for fish and other aquatic organisms. Parathion, which has been banned by the US Environmental Protection Agency since 2006, was detected in several stream sites.
- 7) *Source Partitioning of Anthropogenic Groundwater Nitrogen in a Mixed-Use Landscape, Tutuila, American Samoa* (C. Shuler, 2016): In this study, land-use and hydrological data are integrated with water quality analysis in a N-loading and transport modeling framework for the purpose of quantifying and partitioning the water quality impacts from human land use in the Tafuna-Leone Plain. Results indicate that On-Site Disposal Systems contribute significantly more TN to the aquifer than piggeries or agriculture.
- 8) *A Baseline Chemical Contaminants Study in the Marine Sediments of the Nu'uuli Pala Lagoon Special Management Area (SMA), American Samoa* (A. Mason, D. Whittal, 2017): In July 2017, scientists from NOAA's NCCOS conducted a baseline assessment of chemical contaminants in the Nu'uuli Pala Lagoon. The results from the one-time sediment sampling effort will quantify the magnitude and spatial extent of pollution within the lagoon from the collected sediment samples. Additionally, the magnitude of pollution will be put into ecological and regional context using sediment quality guidelines and existing National Status and Trends data from other locations in the region/nation. Twelve sites were selected using a stratified random sampling design. Three target sample sites informed by local stakeholders will also be sampled. At each site, targeted or random, surface sediments will be collected. In the case of hard pack sediment or sand at deeper sampling sites (>2m), SCUBA divers may be used to collect the sample. The samples will be analyzed for a suite of over 230 chemical contaminants including 59 polycyclic aromatic hydrocarbons (PAHs), 37 aliphatic hydrocarbons, 31 organochlorine pesticides, 83 polychlorinated biphenyls (PCBs), and 16 trace and heavy metals. In addition to these chemical contaminants, indicators of human and animal waste such as fecal coliforms and *Clostridium perfringens*, along with possibly one-time water samples for caffeine/sucralose analysis will be included. These analyses will allow for the quantification of impacts to the lagoon from human and animal waste inputs

from the watershed. Potential Contaminants of Emerging Concern (CECs) that may be analyzed as well include Current Use Pesticides (CUPs) and brominated flame retardants. The information generated from this study will provide local resource managers with information on the type and extent of chemical contamination within the Nu'uuli Pala Lagoon SMA and allow them to make informed decisions on where to focus remediation activities if needed. Results from this study will be included in a technical publication, as well as outreach materials used to communicate the findings of this study to the public.

- 9) *Olosega Nutrient Discharge Source Investigation* (M. Comeros, C. Shuler, 2017): This investigation sought to identify sources of groundwater into the inshore coastal waters of Olosega lagoon. Our sampling yielded only one coastal spring discharging fresh water into the located at the easternmost end of the village. Since there are no perennial streams observed in the sampling area, water (after evapo-transpiration and lost to storm run-off) must discharge somewhere at the coast or offshore. A prevalence of hardened sand deposits (beach rock) was observed on the coastline fronting the village, with little to no groundwater escaping above. This may indicate that groundwater is temporarily confined under the beach rock and is discharging through the nearshore reef flat or possibly beyond the reef crest. The contributions of groundwater, locations and temporal patterns will need to be further investigated in order to improve our understanding of nutrient influences on persistent algal blooms and reef health in the Olosega lagoon. Additionally, the relative contribution of nutrient enrichment to the degraded state of the reef in Olosega (Garrison et al. 2007) with other disturbances and environmental factors need to be understood so that appropriate management actions are implemented. Impacts of elevated nutrients to adjacent coral reef ecosystems are well understood for the most part on American Samoa, however definitive assessment of groundwater's role in nutrient transport and subsequently algae growth needed to be conducted given the substantial and often underestimated nutrient contributions of groundwater to coral reefs.
- 10) *Nutrient Dynamics and Benthic Algae Cover in Vatia Bay, Tutuila, American Samoa* (D. Whittal, B. Vargas-Angel, A. Mason, G. Piniak, M. Curtis, 2017): NOAA scientists from NOS-NCCOS and NMFS-CRED are working with local partners (American Samoa Department of Marine and Wildlife Resources, American Samoa Community College and American Samoa Environmental Protection Agency) to conduct nutrient and biological monitoring to assess the relationship between potential nutrient pollution and benthic algal communities. Since May 2015, surface water and bottom water nutrients (nitrate/nitrite, ammonium, urea, total nitrogen, orthophosphate, total phosphorus, silica) are collected on a monthly basis at 16 sites. Salinity is also quantified in the field. Nutrient samples were collected under baseflow and stormflow conditions, using a YSI nutrient probe, as well as grab samples for lab analysis. Benthic communities were assessed with photo quadrats. The monitoring program will characterize key water quality parameters to allow

coastal managers to assess the potential impact of nutrients and other stressors on coral reef ecosystems, as well as to detect change over time.

Conclusions so far:

- Evidence of habitat degradation with the most evident signs of LBSP impacts observable along eastern and western inner bay, ~5 – 10 m.
- Nutrient concentrations are elevated compared to a reference site, but appear to be relatively well mixed within the Bay
- Combination of silicate and salinity data suggests that submarine groundwater discharge is not a big contributor to the nutrient budget
- Preliminary tracer data confirms that human waste is reaching the Bay. Sucralose is correlated with urea.

11) *Groundwater Development Potential and Exploratory Drilling Recommendations for Tutuila, American Samoa. Phase I: Well Data and Provisional Conceptual Hydrogeologic Model* (Shuler et al. 2017):

As part of US EPA's Making a Visible Difference Program, the University of Hawaii's Water Resources Research Center is leading a study on Groundwater and Hydrologic Monitoring and Assessment in American Samoa. This study will provide a comprehensive and up-to-date reassessment of the existing conceptual hydrogeological model for Tutuila that can be used to inform exploration drilling targets that target new groundwater resources and for the sustainable development of new water supplies on Tutuila.

12) *Improving Watershed and Island Scale Resilience through a Quantitative Priority-setting Management Framework* (M.T. Comerros-Raynal et al. 2019):

1. Integrated watershed and coral reef management is an important tool in prioritizing and protecting resources that millions of people depend upon for livelihood, cultural, and aesthetic uses. Ridge-to-Reef approaches are increasingly applied to conservation planning and prioritization to improve reef resilience, revitalize customary management efforts, and in setting relevant thresholds to achieve management goals.
2. Despite the widespread adoption and application of ridge-to-reef management approaches, our understanding of the different sources and pathways of dissolved inorganic nitrogen (DIN) to coastal waters, and the spatial and temporal patterns of dissolved nutrients and follow-on effects of nitrogen pollution on coral reef ecosystem condition remain limited. Additionally, studies that quantitatively predict the levels of DIN and the conditions where they are most likely to have negative impact on coral reef resources is rare and, in many cases, absent in the literature. This knowledge gap hinders ridge-to-reef management because management measures cannot be made that can inform managers of what types and specific levels of terrestrial run-off are most likely to have negative impacts on nearshore coral reef habitats.

3. We address the ridge-to-reef management gap in American Samoa by first developing a model to determine natural and anthropogenic factors driving DIN, and using the model results to classify watersheds as pristine, moderate, or extensive according to Ridge to Reef: improving watershed and island-scale resilience PAGE 4 human influences. We used the percentage of exceedance of DIN concentration in each watershed as a standardized means to define DIN criteria for local water quality standards updates into the future. Secondly, we developed a quantitative DIN loading model for the island of Tutuila that integrated extensive water sampling data with water flux estimates from an open-source water budget model and publicly available streamflow data. To examine coral reef ecosystem condition and drivers of reef health, we developed a protocol to examine the influence of nitrogen pollution to nearshore coral reef habitats through stable isotope analysis of macroalgae and coral specimens. We also sampled 14 streams and reef flats to examine the spatial and temporal patterns of nutrients. Finally, we developed training packets and compelling, targeted outreach materials to share the best-available scientific information on land-based pollution impacts on coral reef health.
4. Synthesis and applications. Our project builds on our previous Ridge to Reef study (WPDG 2015 Award) by adding to the knowledge framework and applying the results to help direct management and policy decisions in American Samoa. Furthermore, our project leverages existing efforts by various local and federal government agencies to formalize links of land use to resilience indicators on adjacent coral reefs. Importantly, this project forges strong scientific collaboration and engagement with important actors in the protection and prioritization of environmental resources in the Territory that are critical for livelihood, cultural, and aesthetic uses. Finally, this project advances Ridge-to-Reef management in the Territory by building a strong scientific foundation to better understand the tight connections between upstream activities and the condition of downstream coral reef ecosystems.

13) Island Wide Nutrient Modeling and Quantification of Coastal Freshwater Discharge for Tutuila, American Samoa (C. Shuler, 2019)

Excessive nutrient discharge to tropical island coastlines has the potential to cause effects such as algal blooms and eutrophication. To address these issues, environmental regulatory agencies often set water quality standards for discharging surface waters. However, these standards generally only consider surface water nutrient concentrations, which do not account for groundwater discharge, variability in flow, or dilution effects. The calculation of nutrient loads by multiplying concentrations of nutrients or other constituents in discharging waters by volumetric rates of water discharge, can provide better predictions of water quality conditions that influence nearshore biota. Nutrient loading can, therefore, be a more accurate indicator of terrestrial impact compared to discharging surface waters. The primary objective of this report is to document the development of an island-wide dissolved inorganic nitrogen

(DIN) loading model for the island of Tutuila, in the Territory of American Samoa. The DIN loading model integrates results from an open-source water budget model, multi-month water sampling data, and publicly available streamflow data.

14) *Applying a ridge-to-reef framework to support watershed, water quality, and community-based fisheries management in American Samoa* (M.T. Comerós-Raynal, 2019).

Water quality and fisheries exploitation are localized, chronic stressors that impact coral reef condition and resilience. Yet, quantifying the relative contribution of individual stressors and evaluating the degree of human impact to any particular reef are difficult due to the inherent variation in biological assemblages that exists across and within island scales. We developed a framework to first account for island-scale variation in biological assemblages, and then evaluate the condition of 26 reefs adjacent to watersheds in Tutuila, American Samoa. Water quality data collected over 1 year were first linked with watershed characteristics such as land use and human population. Dissolved inorganic nitrogen (DIN) concentrations were best predicted by total human population and disturbed land for watersheds with over 200 humans km⁻², providing a predictive threshold for DIN enrichment attributed to human populations. Coral reef assemblages were next partitioned into three distinct reeetypes to account for inherent variation in biological assemblages and isolate upon local stressors. Regression models suggested that watershed characteristics linked with DIN and fishing access best predicted ecological condition scores, but their influences differed. Relationships were weakest between coral assemblages and watershed-based proxies of DIN, and strongest between fish assemblages and distances to boat harbors and wave energy (i.e., accessibility). While we did not explicitly address the potential recursivity between fish and coral assemblages, there was a weak overall correlation between these ecological condition scores. Instead, the more complex, recursive nature between reef fish and habitats was discussed with respect to bottom-up and top-down processes, and several ongoing studies that can better help address this topic into the future were identified. The framework used here showed the spatial variation of stressor influence, and the specific assemblage attributes influenced by natural and anthropogenic drivers which aims to guide a local ridge-to-reef management strategy.

EFFECTIVENESS MONITORING

- **Matu'u Watershed project:** Small-scale piggeries (1 to 20 pigs) with improperly constructed waste management systems caused Afuelo Stream in Matu'u watershed to be contaminated with high levels of bacteria and exposed the public to the disease leptospirosis. Regular stream water monitoring, public education and outreach, facility inspections, and enforcement of environmental and public health regulations helped reduce the leptospirosis risk and led to impressive declines in average *E. coli* concentrations, with preliminary data indicating the stream is now meeting water quality standards. Continued piggery enforcement actions have resulted in the closures of all illegal piggeries in Matu'u.

The last remaining piggery is a legal dry litter piggery that uses composting for waste management and is in compliance with AS-EPA and public health regulations. Stream water quality effectiveness monitoring continues on a monthly basis. Water quality analyses are ongoing for bacteria.

In 2014 AS-EPA removed the pollutant enterococcus for Matuu Watershed #26 (Waterbody Type Ocean Shoreline) from the 2010 303(d) list because the data used for previous listing was superseded by more recent credible and scientifically defensible data showing that the waters now meet the enterococcus numeric water quality standards for single sample and geometric mean criteria. The watershed is now Fully Supporting for recreational use. In addition, a 2013 TMDL for bacteria in beaches and streams (see Trend Monitoring page 6) found that at both beaches in Matuu watershed bacteria concentrations typically fall below the enterococcus WQS single sample maximum. Early work on this project was posted on the USEPA 319 Success Story web page.

- Confined Animal Facilities Waste Management:** In late FY07, a near shore water monitoring program was developed to enable AS-EPA to evaluate the effectiveness of environmental compliance and enforcement actions. Twenty-eight streams that are directly impacted by untreated wastes from illegal piggeries were geo-located during a piggery survey as part of the AS-EPA Piggery Compliance Program (PCP). Fifty-six sample sites along these 28 streams (one upstream and one downstream site per stream) were selected for monitoring purposes. Water samples were collected and analyzed for enterococcus starting 4th quarter, FY07. Sample results and other monitoring data from four consecutive quarters represents baseline data and will be compared with future sampling results to evaluate the effectiveness of enforcement work done over time for the PCP.

In FY20, AS-EPA plans to evaluate the data collected to date and expand monitoring parameters to include nutrient analyses. These data, along with the baseline microbiology results, will be used to calculate load reductions and assess Non-Point Source Best Management Practices. AS-EPA has purchased a nutrient analyzer and in-house nutrient analysis will begin following equipment maintenance in FY20.

IMPLEMENTATION MONITORING

AGRICULTURE

- Erosion and Sediment Control:** NRCS continued to record progress of management measures instituted for particular clients on a village/watershed basis. During FY19, NRCS was involved in erosion control and sediment reduction projects to include the installation of 16 acres (696,960 sq. ft. of vegetative barriers). This resulted in a total estimated load reduction of 48 tons into American Samoa waters in FY19. No residue and tillage management activities were reported for FY19. The load reduction per watershed was not reported by NRCS this fiscal year.

ASCC/LGP's Forest Stewardship Program continued to provide trees that were planted throughout watersheds in the Territory.

- Pesticide Management:** In FY19, AS-EPA continued to enforce American Samoa's pesticide regulations on the importation, distribution, storage, sale, usage, and disposal of pesticides. Activities include inspections of farms and monitoring activities to ensure consistency with FIFRA and other federal regulations. The program's activities safeguard the health of workers who apply insecticides, fungicides, and rodenticides; protect occupants of treated buildings and homes; and protect consumers of locally grown produce. The program's monitoring activities prevent misuse or over-application of products.

AS-EPA Pesticide Enforcement Actions in FY19:

VILLAGES	WATERSHED#	#INSPECTIONS	#VIOLATIONS	# PESTICIDE APPLICATORS
Maloata	3	0	0	1
Aoloau Sisifo	5	1	1	0
Vatia	10	0	0	1
Afono	11	0	0	1
Amouli	20	0	0	1
Lauli'i-Aumi	23	0	0	2
Pago Pago	24	11	0	5
Fagaalu	25	0	0	1
Matu'u	26	0	1	0
Nu'uuli Pala	27	4	2	10
Tafuna Plain	28	20	8	23
Leone	30	8	1	6
Amanave	33	0	0	1
Aunu'u Sisifo	34	0	0	1
TOTAL		44	13	53

AS-EPA Pesticide Enforcement Inspection Types in FY19:

Inspection Types	FY19 Inspection Commitment	Actual Conducted	Enforcement Actions	
			Warnings	Stop Sale /Seizure
Agricultural Use	20	18	8	1
Agricultural for Cause	Open	3	0	0
Non-Agricultural	20	20	0	0
Non-Agricultural for Cause	Open	2	0	0
Market Inspections	20	21	4	3
RUP Dealer Inspection	1	1	1	0
Certified Applicator Records	1	0	0	0
TOTAL:	62	65	13	4

Other AS-EPA Pesticide Branch accomplishments include:

- **Pesticide Applicator Training (PAT):** Administered **seven** PAT exams and issued **53** certifications
- **Treated Lumber Importations:** A total of **179** Certification of Treatment for Lumber & Plywood was sent in for review and Pre-Approval letters were also issued in order for A.S. Customs to release them from Port.
- **Confined Animal Facilities Waste Management:** In FY19, AS-EPA continued with the implementation of the Piggery Compliance Program (PCP). Since the beginning of the program in 2006, AS-EPA has decreased the number of pigs kept in illegal piggeries by over 70% (from 8,373 to ~1,770), which has resulted in the cumulative nutrient load reductions of **277,931 pounds of Nitrogen** and **112,788 pounds of Phosphorus** to waterbodies of the Territory. The program continues to contribute to the reduction in bacterial loading into the streams and onto the beaches.

Piggery Compliance Program (PCP) activities are described below:

PCP Background Information

The PCP is multi-phased, incorporating environmental education, compliance assistance, and enforcement. The objectives of Phase I were to educate the public on the leptospirosis disease and on the laws governing piggeries, and to geo-locate pig facilities and assess piggery waste management systems. In Phase I, AS-EPA provided education to over 1,000 community members and their families, and identified 1,017 illegal piggeries (8,373 pigs) operating in American Samoa. The goal of Phase II is to bring all piggeries into compliance with local environmental and health regulations.

AS-EPA began Phase II in FY07 and work has been carried out through FY19. At each compliance visit to a piggery, inspectors re-educate and give verbal warnings to owners of non-compliant piggeries. A second education and technical consultation visit is conducted 15 days later, and another verbal warning is given for non-compliance. At the third visit, owners who have not achieved compliance are issued 30-day LOWs. After the 30-day warning period, enforcement officers issue citations to owners who do not demonstrate satisfactory progress by bringing their piggery into compliance. Examples of satisfactory progress include gradually or completely removing pigs from piggery, closing piggery, applying for an LUP, or providing AS-EPA with proposed designs for new or improved piggeries. Owners receiving citations are required to appear in District Court, and typically are ordered to comply with LUP requirements, or remove pigs and close piggery, or pay fines. AS-EPA also conducts village outreaches to disseminate information about risks of leptospirosis, and impacts to water quality from piggery wastes to a larger audience.

In addition to inspection and enforcement, technical assistance for design and construction of piggeries is offered with improved sustainable piggery designs that address the problems with nutrient management, and are affordable and manageable for the local farmers. Four options are approved for local farmers – a portable pigpen, a dry litter system and two wash down systems for farmers who can renovate their existing piggeries. All options minimize

waste from polluting groundwater and streams, as well as odor problems from pig waste. These designs promote environmentally-friendly habits and teach good animal husbandry.

In 2009, demonstration piggeries were completed at the ASCC/LGP. All four AS-EPA-approved piggery designs are now on display (wash down system, portable, dry litter and Ihaka system) at the ASCC/LGP compound. This was a collaborative effort between CRAG, SWCD, ASCC/LGP and AS-EPA. Anyone who is interested in reconstructing old piggeries is referred to the demonstration projects to view first-hand what the designs look like post-construction, and to learn about the associated operation and maintenance requirements of each design prior to making a decision on the type of piggery they desire.

Initial operations of the different designs showed that the dry litter system is the most environmentally and financially beneficial design, and is preferred by nearly all the local farmers. The main advantage of the dry litter system is its use of wood chips as a bedding material that provides the carbon source for the composting process with the end result yielding a value-added product, compost that can be sold. Once the demonstration project was in place, the local USDA-NRCS office was able to qualify existing piggery owners for EQUIP funded dry litter piggeries. Most farmers build AS-EPA's standard 4-6 pen dry litter design, while others needing larger pens use 10-pen dry litter systems (example pictured below).



AS-EPA conducts dry-litter management workshops to continue to educate pig farmers about the importance of maintaining a dry litter system and how to remain compliant with local and federal regulations. In addition, AS-EPA conducts Pre-Construction meetings with new applicants for Dry Litter Piggeries. The Pre-Construction meeting includes a 30-minute presentation on the design drawings, constructing the new pig pen from the footing, foundation, slab, posts and roofing. During this meeting we emphasize how and why this new technology is so important to the environment, the importance of maintenance, and consequences of poor maintenance.

To help ensure the success of the PCP, AS-EPA, Natural Resource Conservation Services (USDA–NRCS), and the Community College Land Grant initiated an interagency group early in 2011. This inter agency’s mission is to join forces to better serve the farmers community in their ongoing efforts and to have better communication between the federal and local agency on piggery issues. The group is called the Interagency Piggery Management Group (IPMG) and it has improved communication, permit process, review and inspections of piggery cases. Additionally, the IPMG conducts outreach efforts to primarily focus on the importance of having a dry litter system and the benefits it provides. The group meets every month to discuss problematic cases and find solutions to remedy problems farmers stumble upon through the process. In FY13 the group expanded to 6 members that include AS-EPA, ASCC Community and Natural Resources, AS Department of Health, AS Department of Agriculture, US Department of Agriculture, and US NRCS.

AS-EPA and ASCC Land Grant have shared local knowledge concerning Dry Litter technology operations with other Pacific Islands to encourage the use of the technology in their respective jurisdiction. The success of this effort was demonstrated in 2012 when the U.S. Ambassador to the Federated States of Micronesia participated in a ground-breaking ceremony for a new U.S. funded dry litter piggery demonstration project at the College of Micronesia National Campus in Pohnpei. Several dry litter projects were subsequently constructed in Pohnpei.

AS-EPA PCP FY19 Activities

In FY19, 37 Letters of Warnings and 26 citations were issued, 22 piggeries were closed, and 226 follow-up inspections were conducted (Table below). Enforcement and compliance in FY19 resulted in annual load reductions of 2,665 pounds of Nitrogen and 1,902 pounds of Phosphorus to waterbodies of the Territory (Table 2).

WATERSHED NAME	WATERSHED#	# FOLLOW-UP INSPECTIONS	#CITATIONS	#LETTERS OF WARNING	#VERBAL WARNINGS	#PIGGERIES CLOSED	#PIGS REMOVED
AOLOAU SASAE	6	1	0	0	1	0	0
FAGASA	8	13	0	0	13	5	0
VATIA	10	0	0	0	0	0	14
AFONO	11	7	0	0	7	2	2
MASEFAU	12	0	0	0	0	0	0
AOA	15	3	1	1	3	1	3
TULA	17	9	2	0	9	3	36
FAGAALU	25	1	0	0	1	0	0
MATUU	26	7	0	0	7	0	0
NUUULI PALA	27	35	10	11	3	2	4
TAFUNA PLAIN	28	78	0	17	58	6	9

FAGAELE-LARSON	29	0	0	0	0	0	7
LEONE	30	48	10	6	33	2	35
AFAO-ASILI	31	4	0	0	4	1	3
AMANAVE	33	7	3	0	6	0	3
AUNUU SISIFO (WEST)	34	4	0	1	1	0	1
AUNUU SASAE (EAST)	35	9	0	1	3	0	1
TOTAL		226	26	37	149	22	118

NRCS EQIP Program FY17 Activities

In FY17, NRCS completed 2 new Modified Dry Litter Piggery Waste Management Systems that resulted in estimated load reductions of 695 lbs/year of nitrogen and 164 lbs/year of phosphorus.

In FY18 and FY19, no new Modified Dry Litter Piggery Waste Management Systems were completed under the NRCS EQIP Program.

PCP FY19 Challenges

In FY19, the number of approved LUPs for piggeries decreased substantially compared to previous years. AS-EPA and NRCS agreed to slow down the piggery LUP approval process due to increased issues with existing piggeries. Problems include poor maintenance of the dry litter system, utilization of water to clean instead of composting the waste, and putting holes in the pen so farmers can use water to clean up. In addition, the grant funding for NRCS was only able to assist a few farmers compared to past years due to limited funds available through the funding cycle.

While the Dry Litter System is a big hit on island and the Territory's most attractive design for the farmers, glitches continue to surface while operating this system. The leading cause of problems is the inadequate amount of available wood chips due to the low number of wood chippers on island, and the increased demand for chips due to the increase in the number of dry litter piggeries.

The American Samoa Land Grant owns, houses, and operates a commercial wood chipper. Land Grant also offers their services to chip farmer's wood for their piggery by mobilizing a small-scale chipper. The Coral Reef Advisory Group owns a few small-scale machines that are also placed at Land Grant along with a few coconut shredders. Additionally, the AS Department of Agriculture and the Soil and Water Conservation District own commercial wood chippers. Unfortunately, due to the lack of repair experts on island, these chippers are often out of commission for long periods of time and sometimes all chippers are non-functional at the same time.

In addition, the cost of wood chips has increased tremendously throughout the years and has elevated to unattractive prices. Farmers complain about the increased cost for woodchips and come into non-compliance as they turn to using a water hose to clean and clear waste from the pig pens. This changes the whole concept of "dry litter system" due

to water usage and changes a legal system into an illegally operated piggery that warrants legal actions.

AS-EPA and NRCS are working diligently to address these challenges.

- **Pesticide and Fertilizer Management:** In FY17, the AS Department of Agriculture conducted numerous inspections at farms and uncovered many violations by some local farmers (use of toxic foreign labeled pesticides, use of pesticides with no US EPA registration numbers, overuse and abuse of fertilizer, and use of illegal fertilizer with foreign labels). The Governor ordered a temporary ban for the sale of locally grown vegetables except local taro, green bananas, ripe bananas, and hydroponically grown vegetables. The Governor also directed DOA, AS-EPA and other agencies to inventory chemical on farms, assess compliance with local laws, ascertain how chemicals and fertilizers are used, and to propose new legislation to improve local ability to monitor, control, and enforce against illegal uses.

URBAN AREAS

- **On-Site Disposal Systems (Inspections):** ASPA continued to conduct monthly inspections for adequate OSDS as a prerequisite for connecting water and electricity throughout FY19. Many of the villages on Tutuila that do not have access to the central sewage system have been inspected.
- **On-Site Disposal Systems (Facility Planning for Pago Pago Harbor):** In 2007 AS-EPA completed a study for wastewater management for Pago Pago Harbor villages that are not served by the municipal sewer system entitled *Small Community Wastewater Facilities Plan for Villages of Leloaloa, Aua, and Onesosopo*. The Villages of Leloaloa, Aua, and Onesosopo are located along the northern shoreline of Pago Pago Harbor. Currently there is no centralized wastewater infrastructure for Aua or for its smaller neighboring villages of Leloaloa and Onesosopo. Efforts at workable on-site wastewater management in these villages are impeded by population density, topography, soils characteristics, and complex land tenure among residents. High population density is the principal factor that exacerbates the difficulties of effective on-site wastewater management in this area where there is little buildable land, soils have high permeability, and land ownership is sometimes in dispute.

Water quality monitoring for Aua streams and near-shore waters shows that there is chronic bacterial contamination in the Aua embayment of Pago Pago Harbor. Contamination is primarily the result of non-point source pollution, although one point-source was identified in an investigation by AS-EPA. Residents of Aua and the two neighboring villages of Leloaloa and Onesosopo routinely consume fish and shellfish from the Aua embayment, and also use these waters extensively for recreational activities. Given the risks to public health, and the lack of practicable on-site wastewater treatment for the Aua embayment area, it is important to mitigate non-point source wastewater impacts through one or more alternative treatment systems that incorporate centralized or regional facilities.

Planning and developing small community wastewater infrastructure to alleviate identified non-point source and point source pollution in the Aua embayment area were the focus of the Small Community Wastewater Facilities Plan. The report presented engineering and environmental considerations for the selection of the best alternative for wastewater management for these villages. The study was completed by an off-island engineering and planning consultant, under the direction of Peter Peshut, AS-EPA Technical Programs Manager. The purpose of this project was to provide AS-EPA and the American Samoa Power Authority (ASPA) with reliable data for selection of the best wastewater management option for these villages. Seven alternatives were evaluated; several options looked at using the existing Utulei Wastewater Treatment Plant, other options considered construction of new treatment facilities within the villages. Representative Paopaoailua J. Fiaui (District 11), Senator Liufau T. Sonoma (District 11), and Ponausuia (Aua Village Council), met with AS-EPA Director Fanuatele Dr. Toafa Vaiaga'e and ASPA officials to discuss the findings of the report. A consensus was reached among the parties, and the selected alternative is to connect the three villages to the existing Utulei wastewater treatment plant, via a new pipeline that will be constructed in the existing Highway 001 corridor. Upgrades to the Utulei treatment plant will also be included. The final Facilities Plan included preliminary design of the selected alternative, which expedited the process of final design. USEPA committed funding for final design and construction. In March 2009 Lyons Associates Inc was awarded the contract for the design work.

Construction of the first phase, Utulei Waste Water Treatment Plant began in 2011, with other phases of the project started in 2012. The project is scheduled to be completed in 2017 at a cost of \$24 million. Approximately 360 houses including school buildings and churches will be connected to the ASPA sewer system once construction is completed. This project will increase the protection of the groundwater that affects the entire island and alleviate the potential of an epidemic disease outbreak in these villages from overflowing sewage on the ground, streams, lagoon, and nearby beach area on the shoreline.

Wastewater upgrade work also includes modification of the diffuser configurations for both Utulei and Tafuna sewer outfalls to increase initial wastewater dilution (\$215,000), manhole and old leaky pipe rehabilitation to reduce surface water inflow (\$917,000), and installation of UV disinfection at both treatment plants (\$7.7 million).

- **East Side Village Project** (USEPA Funded): Packages 2, 3 and 4 of the East Side Village Project were completed in FY 2017. This includes the repair and upgrade of Malaloa Lift Station as well as the installation of new force mains to handle future flows. The design and bidding processes are complete for Package 5, Phase I was awarded to Fletcher and construction is 85% complete. This Phase includes the installation of gravity mains and lift stations from Atuu to Aua. Phase 2 design is 100% complete and will be put out to bid in November 2019.

- **Onsite Septic System Project (USEPA Funded):** ASPA has installed over ten septic systems in 2019. Each of these systems was approved by the AS and US-USEPA and is located near a water resource. This Project protects the aquifers and surface waters from nutrient loading and fecal contamination.
- **Inflow and Infiltration Project (USEPA Funded):** This Project included the repair of manholes and gravity sewer lines to eliminate sources of inflow and infiltration into the wastewater collection system. To date, Phase 1 & Phase 2 for Manholes is 100% complete. Phase 1 of AC Pipeline is 100% complete. Phase 2 of AC Pipeline has 34,412 L.F. (6.5 mi) inspected this year.
- **On-Site Disposal Systems (Facility Planning for Leone):** ASPA intends to bring a centralized sewer system to Leone at an estimated cost of \$18 million. A schedule for design for this work has not yet been set.
- **On-Site Disposal Systems (Replacement by sewer hookups):** ASPA continued with its US-EPA funded wastewater infrastructure construction program for extension of the municipal sewer system within the Tafuna Plains. Completed construction of the sanitary sewer allowed decommissioning of septic tanks/cesspools.
- **On-Site Disposal Systems (Cesspool Inventory):** AS-EPA continued the cesspool inventory to include the villages of Aoa, Vatia, and Aunu'u. As a result of the cesspool inventory in FY15, ASPA created the "Healthy Living Program" in which their remaining septic tanks were solely dedicated to protecting water quality by replacing cesspools that were in proximity to drinking water wells. In FY16 ASPA continued to evaluate homes with the potential to impact water resources in American Samoa. The sites which are determined to have the potential to impact these resources receive a free septic system which is designed for the site-specific conditions. A total of 235 have been installed since 2011. In addition to the residential systems ASPA has also eliminated the illegal discharge from the Leone High School. The school is now served with several small septic and grey water systems.

ASPA installed 11 septic systems in FY19. Each of these systems were approved by AS-EPA and US-EPA and are located near a water resource. This project will protect aquifers and surface waters from nutrient loading and fecal contamination.

- **New Development (Land Use Permits):** DOC continued to administer the Project Notification and Review System (PNRS) as a regulatory component of the Coastal Management Program. The PNRS board issues Land Use Permits (LUPs) that require implementation of appropriate erosion control measures on construction projects where there is a potential for detrimental impacts. AS-EPA continues to be a major participant in the PNRS weekly site visits and semi-monthly board meetings to ensure that residents understand AS-EPA regulations and that projects are in compliance. In FY05 DOC implemented the use of an ArcIMS website where potential PNRS projects are assessed for susceptibility to flooding and landslide hazards. Projects are then designed using best

management practices to protect the applicant and the area's natural resources. In 2006 DOC began enforcing the legal requirement for LUPs for piggeries.

During FY10 DOC started issuing citations for noncompliance with LUP regulations. Unfortunately, in April 2010 the Court determined that it lacks jurisdiction to hear the citations, and dismissed the citations without prejudice.

In FY19, 871 permits were issued (see table below). The number of permits for piggeries have decreased substantially over the past 4 years from 98 in FY14 to 6 in FY19.

AS-EPA continued to aggressively promote that the onus of responsibility to meet land-use permit conditions on the community and the individual landowner.

PNRS Report FY 2019	
Project	Approved
New Construction	183
Utilities	382
Repair	101
Extension	59
Renewal	30
Federal Consistency	21
Demolition	24
Piggery	6
Paving/ Parking lot	23
Road	15
Other	27
Total	871

- **New Development (Section 401 Water Quality Certification permits):** The American Samoa (AS-EPA) continued permitting activities under Section 401 of the Clean Water Act to regulate projects with potential impacts to waterways, coastlines, wetlands, or drainage pathways. In FY18, AS-EPA processed 1 Section 401 Water Quality Certification application. Best Management Practices (BMPs) and erosion control plans were evaluated to control runoff to territorial surface waters.
 1. Section 401 Water Quality Certification – Pacific Energy South West Pacific, Ltd. – American Samoa Terminal
 2. Section 401 Water Quality Certification – ASPA Utulei Sewage Treatment Plant, NPDES Permit No. AS00020001
 3. Section 401 Water Quality Certification – Starkist Samoa Tuna Cannery, NPDES Permit No. AS00000019

- **Watershed Management (Education – AS-EPA):** EA&E’s media and mass communication coverage undertakes a big mission in supporting perspectives of environmental awareness. The influence of the media and mass communication is regarded as a powerful force in widening and creating public opinions, awareness, attitude and behavior through several kinds of programs here at AS-EPA about environmental issues. Therefore, EA&E division’s endless efforts of campaigns for the community’s awareness of our comprehensive messages and reminders to the public about current AS-EPA programs in prompt progression. Following is the overview of the media and mass communication coverage in FY19:
 - Conducted 110 radio live interviews/talk shows appearances with significant announcements and reminders to the community of our on-going environmental programs and public participation of environmental inquiries and assistance.
 - Conducted 30 television interviews together with 30-minute talk show programs on various environmental matters through joint efforts with partner agencies.
 - Submitted 1,725 newspaper advertisements and press releases on various environmental issues, promotion and awareness. Broadcasted 2,880 radio advertisements through local radio stations (KSBS FM-92.1 & Southseas Broadcasting v103/FM-103.1) to promote environmental awareness.

The Keep American Samoa Beautiful (KASB) program is still an on-going effort to address the constant presence of litter along the roadsides, inside of streams, on coastal areas and public places such as bus stops, recreational parks and so forth. The on-going goals and objectives of KASB is to create public awareness of environmental problems caused by littering, encourage behavioral change and instill a sense of pride and ownership within our community, while improving the appearance of roadsides, streams and coastal areas and public places. This year was the sixth year of the KASB anti-litter campaign. The table below reflects the KASB Adopters and their areas of adoption.

KASB Adopters	Clean-ups	Village	Watershed
New Apostolic Church Youth	14	Pago Pago	24
All Peoples Pentecostal Church Youth	6	Pago Pago	24
Assembly of God Church Youth - Alofau	10	Alofau	21
Ieova Nese Church Youth	18	Utulei	24
Apo Family	10	Utulei	24
MASI Organization w/ Miss Am. Samoa	10	Onenoa Utulei	16/24
Grafalen’s Landscaping ...	6	Tafuna	28
Kanana Fou High School – JROTC	06	Tafuna	28
Seven Days Adventist Church Youth	12	Leone	30
Leone Empowerment Team	12	Leone	30
Cancer Coalition in Fagaalu, Utulei, and Fagatogo	1	Fagaalu Utulei Fagatogo	25/24
Total Clean-ups	105		

One of the very successful accomplishments of the Education Division for this fiscal year was the collaborative efforts amongst agencies in implementing outreach programs to schools, organizations, and island-wide events. The number of educational materials that were distributed in FY19 are outlined in Appendix A – BMP Summary. Brochure topics are listed below and available at AS-EPA:

- Leptospirosis Disease & Symptoms and Protect Your Family
- Watersheds of American Samoa
- Safe Drinking Water
- Hazardous Materials
- Open Burning
- AS-EPA Lube Cube Program
- Piggery Compliance and Enforcement
- Cess-pool vs Septic Tank
- Pesticide
- Best Management Practices for Construction Sites
- Best Management Practices for Stormwater Control

The Education Division also conducts ongoing tours of the AS-EPA Green Building. It is the first LEED Platinum certified and Green Building in American Samoa and in the South Pacific. AS-EPA achieved the highest level of LEED certification for implementing practical and measurable strategies and solutions at achieving high performance in sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. Therefore, the AS-EPA Green Building is a constant reminder to the community to reduce the overall impact to the environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation.

In FY19, AS-EPA conducted 20 Green Building Tours

- **Watershed Management (Education – DMWR):** Four rain gardens were installed on Tutuila in 2016 in order to reduce the volume of stormwater and its pollutants reaching nearshore waters. One ~150 sq. ft. rain garden was installed by level 6-8 students at Lauuli'i Elementary in the Lauuli'i-Aumi watershed after in-class lessons on watersheds and climate change were presented by CRAG staff. The other three of these BMPs were installed in the Nu'uuli Pala priority watershed. CRAG collaborated with the Le Tausagi summer camp to teach its 30 elementary-age campers about stormwater, its impacts, and its solutions. A ~600 sq. ft. demonstration rain garden was installed in July during this summer camp. Students at Manulele Elementary were given a lesson on American Samoa's watersheds and its stormwater issues before a ~480 sq. ft. rain garden was installed on the campus by roughly 50 level 7 students. ASCC's Land Grant students and staff received a two-hour seminar on watersheds, stormwater, and raingardens. This was shortly followed by a collaborative design and installation of a stormwater ditch retrofit in the form of a ~1300 sqft rain garden.

The collaboration with ASCC helped to build the capacity of the college to educate others about and proliferate stormwater best management practices.

Each of these locations will receive educational signage in the next year. All of these community participants were given informative rack cards on rain gardens and stormwater, as well as a rain garden installation guide. Outreach and BMP installations will continue in priority and non-priority watersheds throughout the territory in 2017. Work in priority watersheds is funded by a NFWF grant; non-priority watershed work is supported by DOI funds.



Rain garden installation at Manulele Elementary School

In FY18, two school outreach events were conducted to increase awareness of stormwater management, rain garden installation and maintenance, and how these concepts tie into coral reef ecosystems. Both groups were briefed on how to design their own rain gardens and identify areas where rain gardens would be best suitable. Installation guides and rack cards were handed out at both events. Two youth groups (Maoputasi Coalition and Leone HS Green Club) were given tools to continue rain garden installation around the island. These groups have been involved in rain garden installation and have taken interest working closely with CRAG to install more rain gardens around their communities. MOUs were signed by both groups with a follow up report due every six months. CRAG hopes to continue working with community groups to increase capacity of rain garden installation around the island.

The ASCC Science Club and Natural Marine Resource class installed a rain garden on November 20th, 2018. This new rain garden has a footprint of 320sq.ft and drains an area of ~2,000sq.ft. It is one of the two rain gardens in the main quad of the campus that help drain pooling rain water that floods the area. This rain garden makes the seventh rain garden installed in the local priority watershed of Nu'uuli. Tools and equipment were provided and funded by DOI and NFWF-CRCP. Land Grant donated plants and assisted with installation. Maintenance of existing rain gardens have been a priority during FY18. A CRAG staff and intern have been assisting in replacing mulch and plants at some rain gardens that have not

been maintained. Educational signs have also been installed to recognize eight rain gardens and increase awareness of rain garden importance.

As of FY18, fifteen rain gardens have been installed around the island within seven watersheds. Ten are located in the priority watershed of Vatia, Faga’alu, and Nu’uuli. Due to limited funds and engineering expertise, none of the rain gardens have been designed to gauge rain water drainage or monitor pollutants being filtered. Tools and equipment for rain garden installations are housed at the Department of Marine and Wildlife Resources under the Coral Reef Advisory Group (Crag).

Photo: ASCC Marine Science students and Crag intern (far right) standing next a rain garden they installed on campus. PC: Meagan Curtis 2018



- **Watershed Management (Education – ASCC-ACNR):** The American Samoa Community College Division of Agriculture, Community and Natural Resources (ASCC-ACNR) contributes to reducing non-point source pollution of the territory’s watersheds by helping develop and promote best practices in forest stewardship and agricultural production.

Taro:

The taro leaf blight of the 1990s and the black leaf streak disease of bananas negatively impacted the production of taro and banana in American Samoa. The Agriculture Extension, Researchers, and Tissue Culture Specialist continue to multiply the resistant and best taste varieties of traditional staples of American Samoa. In FY2019, the Agriculture Extension distributed 1,212 improved taro setts and banana planting materials to farmers. With the continued multiplication and distribution of improved varieties, farmers and producers now have a great diversity of disease-resistant products.

Pig Waste Management:

There is still a need to address the pig waste management problem, and to introduce biodiversity in the local pig gene pool to prevent inbreeding. The Programs continued to use the ASEPA funded piggery to demonstrate the four recommended waste management

systems to farmers, students and the general public. The ASCC-CNR piggery serves as a demonstration site for 48 farmers, 8 tours of 390 students and public visitors.

Pesticides:

The continued usage of illegal pesticides in American Samoa is still an issue. Importation and entry of pesticides into American Samoa are also challenging. Another issue is the improper way of handling pesticides before, during, and after usage. During FY 2019, ASCC-ACNR conducted 5 Pesticide Applicator workshops. Due to language barrier, one of the trainings was specifically for the Chinese farmers. Extension professionals trained and certified 65 participants. The EPA Pesticide officer was present to certify the participants. The certification allowed the participants to buy pesticides from the local Department of Agriculture and non-government vendors. As a result of the 5 pesticides workshops, farmers and users/applicators increased awareness of the Integrated Pest Management strategies and biological programs.

Food and Farm safety:

In FY2019, questions have been posted on the quality of the produce sold to the public, especially the school lunch program. The Department of Health have cited or shut down farming business due to poor sanitation or illegal usage of pesticide. Local Produce have been rejected by the School Lunch Program because of poor quality due to lack of knowledge in better farming practices to ensure good quality produce. The Ag. Extension have conducted 5 Farm Safety Workshop and 5 Pesticide Training with Farmers, Schools and Partners. The FCS program conducted 105 food safety workshops. More than 5,000 participants acquired knowledge on Food and Farm Safety through tours, workshops, activities, and training.

Forestry:

The ASCC-ACNR Forestry Program conducted 38 outreach presentations to more than 1,100 participants. The ASCC-ACNR Forestry Program celebrated its 24th Annual Arbor Week with outreach and tree planting activities to 3 schools with a total of 128 students and 10 teachers. A total of 31 trees were planted in 2019.

With the leadership of Forestry Program Manager Denis Sene, the ASCC-ACNR Extension Forestry program successfully completed their first USDA Forest Service Landscape Restoration Project. In partnership with the village youth, community leaders, and local agencies, 2.43 tons of debris was removed from the streams in Nuuli, Leone, Pago Pago and Lauli village.

- **Watershed Management (Education – National Marine Sanctuary of American Samoa):** The Sanctuary conducted “Sanctuary Summer Science in the Village” for students in 4 villages in FY17. Sessions provide hands-on activities and experiments about coral ecology, climate change, threats to reefs, and how important it is for students to be great stewards and protectors of the oceans.

In FY18, the Sanctuary held a marine clean-up for the village of Aunu'u in May with six additional clean-ups completed by a local women's group in the village.

- Watershed Management (Special Management Areas):** In 2007 AS-EPA completed a proposal to designate Malaeimi Valley as a Special Management Area (SMA). Significant water resources in Malaeimi Valley recharge the Tafuna-Leone Plain aquifer, which supplies a significant portion of potable water to the Island of Tutuila. The proposal was approved by the PNRS board and was forwarded to the Governor for adoption on April 30, 2007. The Governor has not yet adopted the proposal. In FY10 the aquifer under Malaeimi Valley was found to be contaminated with *E. coli* bacteria, which resulted in Boil Water Notices for the ASPA public water system. This contamination problem renewed interest in moving forward with the SMA proposal.
- Watershed Management (Community Based Fisheries Management Program):** The American Samoa Department of Marine and Wildlife Resources (DMWR) continued to further its Community Based Fisheries Management Program in villages on Tutuila with 10 villages (Fagamalo, Poloa, Amanave, Matu'u & Faganeanea, Fagasa, Alega, Amaua & Auto, Alofau, Sa'ilele and Aoa). These communities have established and co-managed their Village Marine Protected Areas (VMPA) with DMWR. Additionally, the village of Faga'alu officially signed the agreement on August 9, 2015 to join the CFMP program and further work has continued in 2016 to work with the Faga'alu village chiefs to finalize the process. The village of Vatia is currently not part of the program due to conflicts between village council members.

Coral Reef Monitoring Surveys are conducted in the Village MPAs with the involvement of the Management and Enforcement Committee to increase awareness and witness the changes since the implementation of the Village Marine Protected Areas. Monitoring survey protocols have been integrated with other fisheries programs to alleviate the delay and successful implementation of monitoring surveys.

Outreach activities are conducted in the CFMP villages, which youth groups are targeted. These outreach activities are conducted in regards to marine resource management issues that needed to be address in their villages and/or group such as; importance of coral reefs, piggery, sedimentation and run offs, Crown of Thorns, pollution, and fishery by-law. These where CFMP will work together and consult with partners which includes; DOC, EPA, NPS, NRCS, ASPA to present and aware the communities on issues that they are facing reading their resources.

Monthly community visits are conducted in all participating village communities in the Community-based Fisheries Management Program to get an update from community members regarding their Village Marine Protected Areas; such as opening and closing of VMPA's, problems that village communities are witnessing in their MPA's, and also CFMP staff will collect information on what kind of species that are caught by communities within the open areas of the village. In addition, it also allows the opportunity to inform community members of proposed program activities for their villages and has progressed to an interpersonal relationship between the communities and program staff. These visits were conducted with village community representatives such as village mayors, pastors and other individuals and many other environmental issues are discussed

including the whole watershed. Any issues that DMWR cannot deal with are passed onto the relevant ASG agency.

- **Watershed Management (DMWR DOI Grant):** In FY17, DMWR received a DOI grant of \$94,906. The grant will be utilized for several projects including:
 - Coordinate efforts to combat overfishing, climate change, land-based pollution, and population pressure in the priority watersheds (Faga’alu, Vatia, and Nu’uuli).
 - Continue development of rain gardens and other BMPs to manage stormwater runoff.
 - Provide GIS mapping training and certification to better inform management of priorities across watersheds.
- **Watershed Management (DMWR Marine Debris Project):** The DMWR Marine Debris Project has continued in FY2016 through one-off grant funding from the NFWF (National Fish and Wildlife Foundation) for the ‘*American Samoa Marine Debris Prevention Program - MDPP*’. The project aims to decrease the amount of trash that ends up in the ocean while also removing trash that is already there to improve water quality to support coral reef health.

The MDPP has been conducted by three local agencies—the Department of Marine and Wildlife Resources’ (DMWR) Marine Debris Program, the Department of Commerce’s Coastal Zone Management Program (CZM) and AS-EPA, with support from the Coral Reef Advisory Group (CRAG). Each department focuses on trash reduction and removal in their specific program areas; AS-EPA on streams and coastal roadways, CZM on mangrove and wetland areas and DMWR on beaches and debris in the water. Universal data sheets have been designed to ensure consistent data collection that is input into a MDPP database. Data will be used to identify sources of trash and to inform educational programs on the negative effects debris has on coral reef and coastal ecosystems. The data will be used to determine effectiveness over time, and to be used to guide other management outcomes in the future (e.g. policy, regulations, and expanded intervention areas).

Currently the project involves 10 groups, with focus on the Pago Pago Harbor and Nu’uuli Watershed areas, however continuing work is needed to initiate the program with another 10 groups in these areas. Continued outreach and education activities with schools and community groups is being undertaken to ensure the key messages about reducing marine debris and protecting the environment.

- **Watershed Management (AS-EPA Marine Debris Project):** Marine Debris is an emerging and significant issue in American Samoa. It has important effects in our ability to protect human health and the environment, and timely actions to address this major threat are needed, particularly in the face of other significant threats such as adverse impacts from climate change that can exacerbate its effects, complicate recovery, and reduce our resilience to bounce back from these impacts. To prepare for, and address this threat, AS-EPA recently launched a Marine Debris Program (MDP) with the goals of building capacity in mitigating and minimizing sources of marine litter.

The objectives of the MDP are to ensure a sustained marine debris program in the Territory, conduct scientific research and monitoring, initiate targeted source reduction projects, and to regularly and systematically engage with the community, and federal, regional and local partners.

Since its inception in 2015, the Program has met some significant milestones. Firstly, at the 2015 SPREP annual meeting in Apia, Director, Fa'amao O. Asalele Jr. presented on marine debris initiatives by the Agency. This provided a platform for discussion of overlapping lessons and opportunities for collaboration with local, regional, and international partners. In May 2016, a Marine Debris Action Plan workshop was convened by AS-EPA and USEPA Region 9 to provide background of the known and projected impacts of marine litter, share knowledge of existing initiatives to address this issue in the Territory at the federal and regional levels, and to discuss opportunities to develop action items to implement potential solutions and management actions. This workshop aimed to strengthen existing collaborative efforts at the local, federal, and regional levels and build & foster new activities and partnerships to address the problems of marine debris in and around American Samoa and the Samoan Archipelago. A key outcome of the action plan workshop was the identification of six priority projects that follow SMART (Specific, Measurable, Achievable, Realistic, and Time-related) objectives: 1) moving waste and recyclables off-island; 2) ramping up education and outreach to improve environmental literacy; 3) generating a village-based Materials Recovery Facility (MRF) 4) passing legislation on banning Styrofoam; 5) removal of the grounded longliner vessel, Seahawk, off of Coconut Point, and; 6) establishing a dedicated clean-up team for Pago Pago harbor. Additionally, there was keen interest in getting projects off the ground and in collaborating amongst the different agencies to realize these project goals. As such, a Marine Debris Coalition was formed with AS-EPA leading the charge and all participating agencies as part of the Steering Committee. The three-day Marine Debris Action Plan workshop reinforced the shared goals to protect and manage the resources in American Samoa.

- Watershed Management (AS-EPA, ASU, DMWR Marine Debris Project):** AS-EPA partnered with Arizona State University (ASU) and the Department of Marine and Wildlife Resources (DMWR) to conduct a screening-level ecological risk assessment for microplastics in seafood in American Samoa. This project is led by Dr. Beth Polidoro from Arizona State University and enabled by NOAA's Marine Debris Grant awarded to ASU. This project is aligned with the 2016-2018 Strategic Objectives of AS-EPA's Marine Debris Program which prioritizes microplastics monitoring, research and risk assessment. The objective of this two-year project is to use an ecological risk framework to: 1) quantify the type and concentration of microplastics in water, sediment, and bivalves in three coastal study sites on Tutuila, 2) determine the type and concentration of hydrophobic organic contaminants in microplastics, water, sediments and bivalves at each study site, and 3) estimate toxicological impacts of microplastics and organic contaminants on locally consumed bivalves and fishes, in order to characterize ecological risk to marine ecosystems and health risk to human populations in American Samoa. This two-year project will provide the first known in-situ field study on the relationship between microplastics and organic contaminants present in the near-shore marine environment and the type and

quantity of microplastics and organic contaminants present in-situ, in locally consumed seafood. Results will fill a critical knowledge gap in quantifying bivalve uptake of microplastics and organic contaminants under complex, and often non-equilibrium conditions in the field. Results will inform ongoing environmental regulation, educational outreach, and marine conservation efforts in American Samoa.

In FY18, ASU in collaboration with ASEPA finished sampling marine waters, sediment, and bivalves in Nu'uuli Pala Lagoon, Pago Pago Harbor, and Lau'i'i. More than 600 samples were collected and are now being analyzed for microplastics and contaminants. Samples were also collected from 100 marine fishes from local seafood markets and are also being analyzed for microplastics and both metal and organic contaminants.

As part of this project, seven American Samoa Community College (ascc) students participated in an 8-week marine Debris internship supported by ASEPA and led by ASU PhD student Tiffany Lewis and Professor Beth Polidoro during June – July 2018. Students learned field and lab techniques to qualify the presence and impacts of plastic and other types of pollution.

- Watershed Management (Alamea Eradication Project):** A Crown of Thorns starfish outbreak has been a territory-wide issue since late 2012 and has become a high priority for the DMWR coral reef monitoring program. Control efforts have included conducting COTS removal using SCUBA and snorkeling, and working with the National Park Service (NPS) of American Samoa by conducting rapid snorkel tow assessments to identify areas with COTS outbreaks. The DMWR monitoring team also conducted DropCam surveys between 50-150 ft and on offshore banks and pinnacles along the SW and NW coast of Tutuila with the aim of locating large COTS populations. Over 25,000 of the starfish have been killed since 2013.

Program staff have attended the inter-agency COTS working group and a priority list of sites has also been developed which identifies sites which should be checked on a regular basis for COTS outbreaks, with the aim of ensuring that the high biodiversity coral reef communities are protected in the event of a Territory-wide COTS outbreak. A USFWS grant was submitted to request funds for a COTS control program run by DMWR, and staff are continuing to work on the NEPA approvals prior to initiating the project. Further efforts have been undertaken to raise the profile of the COTS issue with the Governor and the ASG leaders through the production of a Statement of Concern and various media outreach efforts. Education and Outreach efforts have been conducted on the issue, which include topics related to land-based sources of pollution which are believed to cause COTS outbreaks elsewhere around the world.

Unfortunately, a coral bleaching event occurred in January 2015 as a result of warmer water temperatures. When corals bleach the skeleton turns white and it looks just like the scars left by Alamea, making it difficult for scientists to find the starfish. Once the waters cooled down and the bleaching stopped scientists noticed a new outbreak on the north side of Tutuila. In particular, a heavy outbreak was identified just outside Fagasa where NPS divers killed 952 Alamea in one day. Almost 2,000 Alamea were killed in only six days

near Fagasa. The NPS is currently working on outbreaks in Fagasa, Fagamalo, and Vatia with 315 *Alamea* killed in FY16.

As of 2017, the NPSA marine crew eliminated 26,258 *alamea*. These kills were from the north side of the Tutuila island including park waters, and in Ofu park unit. This number does not include the NPSA kills on the south side of Tutuila earlier in 2013 and kills from DMWR and the Sanctuary.

In FY18, there was continued monitoring around the territory of Crown-of-Thorns starfish. No eradication needed as the populations have been under control. CRAG has been working with AIMS (Australian Institute of Marine Science) to provide genetic samples, but this has been slow because of the fortunate lack of specimens from the island's waters.

- **Watershed Management (Endangered Species Act):** In FY16 the U.S. Fish and Wildlife Service listed five animal species in American Samoa as federally endangered under the Endangered Species Act (ESA). The listing included the Pacific sheath-tailed bat, mao, the friendly ground-dove, and two land snails. This is the first time ESA protections have been applied to species in the territory. Listing these species will help focus additional resources, conservation efforts and attention on addressing primary threats to the species including habitat degradation and loss.
- **Watershed Management (National Park Service of American Samoa):** A campaign initiated in 2001 to eradicate the invasive tamaligi tree (*Falcatariamoluccana*) from park land and American Samoa continues. The tamaligi tree, which grows fast and has weak roots, out-competes native rainforest trees. The program was expanded in FY 10 to include the invasive red seed tree Lupa (*Adentherapavonia*). Lupa competes with native flora, which provides food and shelter for native bird and animal life. When these invasive trees replace native vegetation on the steep slopes of American Samoa, soil erosion tends to increase, especially during the rainy hurricane season as these large trees are more vulnerable to tipping over by strong winds. In addition, removing these trees reduces nitrates input to freshwater streams that negatively impact aquatic ecosystems, coral reefs, and water supply. NPSA worked cooperatively with the villages of Fagasa, Pago Pago, and Vatia, and the American Samoa Special Service Commission to control the tamaligi population on-island. By the end of FY12, the partnership removed all invasive tamaligi trees within the park (more than 6,000 trees), saving 1,800 acres of the forest. Park crew have replanted 6 acres of forest with 7,000 native tree saplings, such as ifilele and asi.

In FY19, NPSA implemented the following best management practices and projects to help eliminate pollution in the environment:

- Over 8,000 pounds of aluminum, cans, and plastic redirected from the landfill by recycling at ASPA and GHC Reid
- Work with EPA to establish an electronic waste recycling partnership through the Moana Taka Partnership with SWIRE/SPREP
- 10 dumpsters full of cardboard redirected from the landfill by composting and using the soil in a community garden.

- Lead over 25 local area cleanups utilizing all employees for 30-60 minutes to clean the area by Pago Harbor boat ramp.
 - Established a “Styrofoam Free Workplace” by banning take out Styrofoam containers in the office. Employees wishing to eat from Styrofoam must do so outside of NPS property.
 - Purchased “Styrofoam Free Workplace” bumper stickers for all NPSA vehicles
 - Continue a “No idling” policy. If the vehicle is expected to be idling for more than 30 seconds, turn it off.
 - Continue to support a “Green Team”, comprised of members of each program, to take the lead on environmental initiatives.
 - Hosted an employee field trip to the Futiga landfill to see where our garbage ends up
 - Purchased re-usable mugs for all employees
 - Assist American Samoa Community College, ACNR, and Pago churches with cleanup at Pago streams. Collected ~ 600lb of plastic, car tires, and another household trash
 - Currently renovating our NPSA Park greenhouse
 - Conducted 6 illegal dump cleanups in Poloa, Sailele, Pago, Utulei-Tramway, Masausi, and Amouli from 2018 to 2019. Over 3 tons of municipal solid waste and 100 yards of scrap metal removed in total.
 - Launched two presentations with EPA on the negative impacts of Styrofoam at a local church and TAOA (Territorial Administration on Aging) with over 100 people in attendance
 - Assisted the Le Tausagi group to cleanup Aua for CoastWeeks. 450 pounds of predominately plastic waste removed.
 - Assisted DOC with CoastWeeks by providing a presentation in Nuuuuli village on wetlands, and planned a cleanup.
- **Watershed Management (Priority Watershed Projects and Monitoring):** The continued monitoring of turbidity in Faga’alu stream and the collection and processing of devices that monitor sediment deposition throughout the bay continued December 2016. These efforts were supported by AS-EPA and CRAG and funded by NFWF grant awarded to SDSU. The goal of the project was to quantify the effectiveness of the BMPs and ensure they continue to function as intended. Results show the BMPs have been successful in reducing sediment loads when compared to similar sized storm events prior to their installation. A final report for work completed under the NFWF grant will be released at the end of February 2017. Dr. Alex Messina completed his PhD and his dissertation contains the methods and results of three studies in Faga’alu. In the coming year scientific journal articles will be published regarding Dr. Messina’s work.

The nutrient dynamic study in Vatia led by Dr. David Whitall of NOAA’s NCCOS has continued through CRCP funding. The study commenced in May 2015. Jurisdictional managers had expressed concerns that nutrients from the village of Vatia are having an

adverse effect on the coral reef ecosystem in the bay. Excess nutrient loads can cause increases in algal growth and can have deleterious effects on corals, such as benthic algae outcompeting and overgrowing corals. The project quantifies the nutrient dynamics of the bay and concurrently measures benthic algal proliferation/blooms in order to assess the link between nutrient pollution and coral reef ecosystem health. This is accomplished with monthly water quality sampling (nitrate/nitrite, ammonium, urea, total nitrogen, orthophosphorus, total phosphorus). In addition to the standard suite of nutrients, samples were also taken for caffeine and sucralose in June 2016. Results for the first 6 months of sampling have been reported and are available from Dave Whitall (Email: Dave.Whitall@noaa.gov). Results from the caffeine surveys have also come back. This project also entails the establishment of a benthic structure and demographic baseline for the bay and the establishment of long-term monitoring stations (using photo quadrats) to track changes both in the coral and algal communities. To assist with this, Dr. Bernardo Varagas-Angel and his NOAA CRED Benthic team members conducted benthic monitoring surveys in November 2015 in Faga'alu, Vatia and Fagamalo, including the installation of permanent transects in Vatia Bay. DMWR has continued to monitor these transects every two months to document changes in algal growth in the shallow inner and middle bay area.

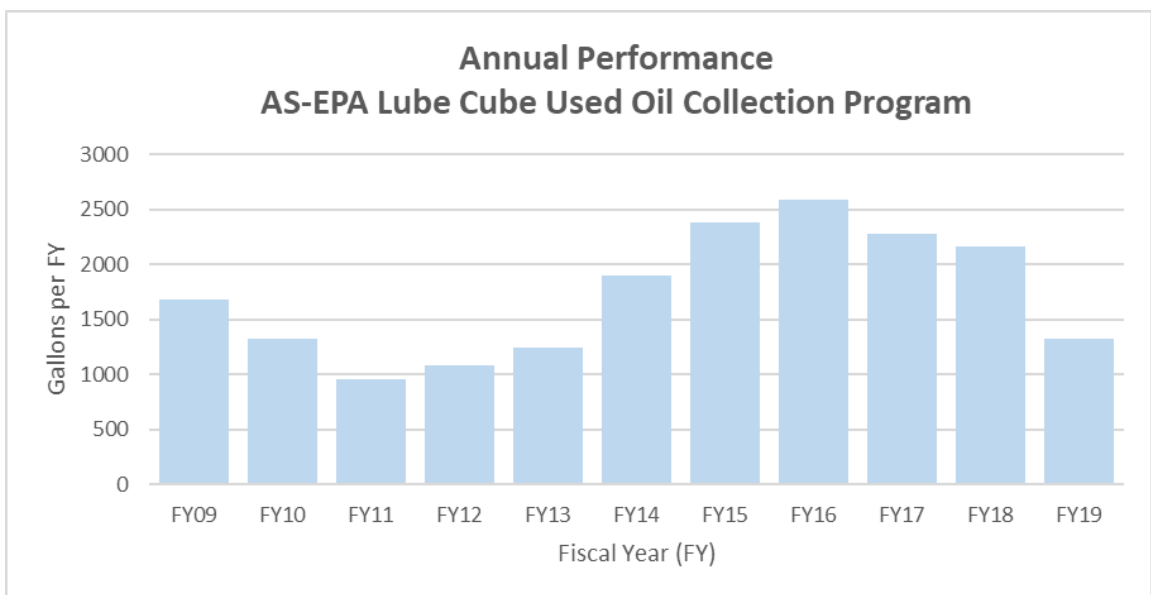
- Pollution Prevention (Commercial NPS sources):** Pacific Energy Southwest Pacific Ltd and ASPA Power Plants conducted Spill Prevention Control and Countermeasures (SPCC) related inspections of their Aboveground Storage Tanks (AST) and associated piping based on guidelines that are within their SPCC Plans (whether daily, weekly, monthly, immediately after a heavy rain event). Inspections ensure no risk of NPS or point source pollution from oil or fuel. Pacific Energy Southwest Pacific Ltd operates and maintains the "Tank farm" for fuel storage in American Samoa, as well as the Fuel Dock (Port), and aviation fuel storage at Tafuna International Airport. American Samoa Power Authority (ASPA) is the public utility that generates power for island consumption. ASPA has two Power Plants, one in Tafuna and one in Satala. The new Satala plant was dedicated in May 2017 and is now in operation. This new plant replaces the old one that was destroyed in the 2009 tsunami.
- Pollution Prevention (Starkist Samoa):** In FY17, the cannery Starkist Samoa was fined \$6.3 million dollars by the U.S. Department of Justice after AS-EPA investigations revealed a discharge pipeline break at the facility which was spilling unpermitted wastewater into the inner Pago Pago harbor. Other violations found included improper storage of ammonia, butane, and chlorine gas. In addition to the fine Starkist is required to make upgrades to reduce pollution and improve safety, donate no less than \$88,000 worth of specified emergency response equipment to the AS Fire Services Bureau, improve the facility's ammonia refrigeration system and discontinue the use of chlorine gas and butane, and implement a new system for notifying the public in real time in the event of a release.
- Pollution Prevention (Used oil recycling):** AS-EPA continues to implement the used oil collection program utilizing oil collection receptacles ("Lube Cubes") installed at gas service stations on Tutuila. The public is invited to discard all their used motor oil at these

service stations, and then the American Samoa Power Authority collects, cleans, and delivers the oil to Starkist Cannery to be burnt in their boilers. AS-EPA monitors the oil levels at all these stations and tests the oil with Chlor-D-Tect Q 4000 test kits.

The public's initial reception of this program was tepid, and only 47 gallons were collected during the first year (FY02) of the effort. A campaign designed to increase the general public awareness of this program occurred in FY03. This public awareness campaign ("You dump it, you drink it!") focused awareness on the threat of improperly discarded used motor oil on the Territory's groundwater supply. The campaign was successful, and led to the collection of over 450 gallons in FY03 to 655 gallons of used oil collected in FY07.

In May 2008, nine waste oil collection signs were installed at nine different service stations that have Lube Cubes. These signs were placed in conspicuous locations at the stations. To supplement collection efforts, AS-EPA ran media ads promoting the signs and the Lube Cube Program as part of the "You dump it, you drink it!" public awareness campaign. As a measure of the success of these recent efforts, 1440 gallons of oil was collected in FY08. In FY09 total waste oil collection continued to increase to a total of 1680 gallons, half of which came from three gas stations in the Tafuna watershed.

In the September 2009 Tsunami the lube cube at Pago Way Service Station in Pago Pago was swept away, and was never recovered, leaving eight lube cubes currently in use. As a result, the FY10 total waste oil collected in the lube cubes decreased slightly to 1,320 gallons. The decrease may have been due to a downturn in the local economy as a result of the closure of one of the large tuna canneries. In FY12, the gallons of collected lube cube used oil began to increase gradually to its highest level in FY16 of 2,583 gallons. Since FY16, lube cube collection has shown a slight decrease to 1,320 gallons in FY19.



- **Pollution Prevention (Hazmat Assessment Inspections):**

In FY19, AS-EPA conducted 111 inspections and responded to 5 oil spills.

- **Pollution Prevention (Litter Control):**

In FY17, AS-EPA greatly enhanced enforcement capability by finalizing District Court Citation authority, so that AS-EPA can issue citations for littering under the KASB Act. The Solid Waste Compliance Program was developed with the objective to protect human health and the environment by enforcing compliance for proper solid waste disposal. To meet the objective, AS-EPA effectively regulates and enforces compliance through a concerted program of inspections, warnings, citations, follow-ups, and community outreach. The Compliance Program is divided into two components: (1) Compliance, and (2) Public Education. For FY19, the AS-EPA Solid Waste Enforcement Officers conducted 368 inspections that resulted in the issuance of 130 Letters of Warning (LOW), 14 citations for Solid Waste, and 36 citations for Littering.

Watershed	Inspections	LOW Issued	Solid Waste Citations	Litter Citations	KASB Adopters
1	2	2	0	0	0
2	1	0	0	0	0
8	3	0	0	0	0
10	1	0	0	0	0
11	2	0	0	0	0
12	2	0	0	0	0
15	2	0	0	0	0
21	2	1	0	0	2
23	1	0	0	0	0
24	53	17	1	29	8
25	6	3	0	0	0
26	4	2	0	0	0
27	37	11	3	7	0
28	208	83	10	0	3
30	38	9	0	0	1
32	6	2	0	0	0
TOTAL	368	130	14	36	15

Outreach programs were also conducted on radio and television platforms to inform the public of solid waste regulations and report on the progress of the KASB Program. In FY19, nine groups from the public and non-profit sectors conducted a total of 88 cleanups in their designated areas.

The KASB program also continues to encourage the recycling of plastics and aluminum cans. In FY18, GHC Reid exceeded their usual count of 350,000 pounds of compacted aluminum cans for recycling and shipped three containers to the United States. More cans continue to be collected under their partnership with the AS-EPA KASB Program.

- **Pollution Prevention (Anti-Littering Campaign: Island Wide Clean-Up Committee):** In January 2015 the Governor issued an executive Order to develop and implement a strategic clean-up plan for the Territory through the Island Wide Clean-Up Committee (IWCC). The IWCC is chaired by the AS-EPA Director and co-chaired by the ASPA CEO. The IWCC organizes clean-ups on a regular basis by assigning various groups to designated zones. Groups consist of local and federal government departments as well as private sector companies, villages, and families. Clean-ups are held every second Friday of the month. Current efforts are being made to separate and weigh trash in order to improve data collection.
- **Pollution Prevention (ASPA Pala Lagoon Project):** ASPA's efforts to clean the Pala Lagoon area have resulted in the removal of one-hundred and two (102) tons of trash during FY 2017. Two staff members, Sanele Mulitalo and Enele Ta'atasi, have been assigned to the Litter Control Program. As of the date of this report, ASPA staff have not received ticket booklets to begin enforcement efforts.
- **Pollution Prevention (Amendment of local litter laws under the Keep American Samoa Beautiful Act):** In FY17, the KASB Act was amended to strengthen enforcement authority. The bill authorized additional agencies besides AS-EPA to issue litter citations including Samoan Affairs, ASPA, DOH, DMWR, P&R, and DPS. The bill also outlined fines or litter clean up hours to be imposed on violators by the District Court and requires a \$10 per conviction "litter enforcement costs offset fee".
- **Pollution Prevention (Task Force to combat illegal dumping):** In FY17, the American Samoa National Park Service and villages around the park formed a task force to combat illegal dumping. Task force members include village Pulenu'u, park representatives, and local agencies including ASPA, AS-EPA, DOC, and Samoan affairs. The task force will meet regularly to formulate action plans to address the issue and plan clean-ups. In FY18, the task force reported 2560 lbs. of debris collected from illegal dumping.
- **Pollution Prevention (Fautasi Coastal Challenge):** In FY18, DOC organized fautasi (longboat) villages in a Fautasi Coastal Challenge, a set of 5 challenges that highlight rich cultural traditions, coastal resources, and dependence on people, air, land, and sea for economic and cultural security. Challenges include: 1) Adoption of a coastal watershed

area to eliminate trash and marine debris, 2) Installation of marine debris catchment nets in streams, 3) Monitoring and Enforcement to ensure appropriate land use and building permits are in place and report areas of trash and wetland filling, 4) Outreach and Awareness to build coastal stewardship, and 5) Fautasi Ecotourism.

- **Pollution Prevention (Oil Spill Prevention):** Pacific Breeze Fisheries LLC was convicted and sentenced at the federal court in Washington D.C. for discharging oil into the waters off American Samoa without the use of required pollution prevention equipment. The company agreed to pay a \$1.6 million fine, in addition to a community service payment of \$400,000 for use in the National Marine Sanctuary of American Samoa. The company also agreed to implement an extensive environmental compliance plan if it resumes operations.
- **Pollution Prevention (Plastic Shopping Bag Ban):** In FY14 AS-EPA conducted “Plastic Shopping Bag” enforcement inspections, resulting in the issuance of warning notices to four business establishments who were found utilizing illegal plastic shopping bags. Follow up inspections have shown complete compliance.
- **Pollution Prevention (Stray dog eradication):** In FY14 the Governor created the Animal Care and Control Task Force by executive order. The task force established a full time animal clinic with veterinary services at the DOA. The veterinary services issue licenses for all spayed or neutered dogs, maintain a computer database of licensed dogs and their owners, and implement a public awareness campaign.

On March 31 2014 the Governor issued an Executive Order that suspended importation of cats and dogs that are not spayed or neutered.

Kristen Jensen took over as territorial veterinarian in September 2015. At that time, the DOA Director Mel Purcell discontinued the village clinic program and DOA were no longer visiting villages to trap dogs. DOA did still continue trapping dogs from public spaces such as parks, government property, and schools, and also continued actively spaying and neutering at the veterinary clinic.

In October DOA conducted a village campaign with two non-profit groups Alofa Mo Meaola and Animal balance. 150 dogs were spayed, neutered, vaccinated and dewormed during the village clinic effort.

In FY16, 395 dogs were trapped. Of these, 130 were euthanized. 182 were spayed, neutered, dewormed, vaccinated (including for leptospirosis), and adopted to families. The remaining 83 were spayed, neutered, dewormed, vaccinated and re-released where they were trapped (trap/neuter/release). DOA sterilized a total of 911 dogs in FY16. This should help tremendously to keep the dog population controlled on the island.

Although there was no report of stray dog or cat eradication in FY17 and FY18, DOA was able to provide the following for FY19:

- **58 dog trappings** – Result of requests for removal, Department of Public Safety bite cases, stray dogs found on Government property and on the road side
- **25 feral (wild or unwanted cats) trappings**
- **Pollution Prevention (Executive Orders/Legislation for Climate Change Mitigation):** In FY 2012, the Governor issued Executive Order 03-2012 that prohibits the importation of soaps or detergents containing phosphates, prohibits the use of incandescent light bulbs in government facilities, prohibits importation of vehicles more than 10 years old, and orders all ASG departments to implement a recycling program. ASG intends to replace all of the territory's street lights with LED lamps by 2017. In FY15 AS-EPA responded to 1 request from Customs regarding compliance assistance in accordance with EO 03-2012, which prohibits the importation of soaps or detergents that are not phosphate free. AS-EPA inspected the detergent(s) and found that the label indicated the presence of phosphate. As a result, the detergent was returned at the importer's expense and minimized an increase in nutrient levels into the environment.
- **Pollution Prevention (AS-EPA Adopt a Stream Program):** In FY13, as part of the KASB Program, AS-EPA organized individuals, families, businesses, government departments/agencies and other community organizations who want to beautify the islands, protect coral reefs, and keep the environment clean, to adopt a stream and associated roadside area for the throughout the year. The ultimate goal of the program was to increase public awareness of environmental impacts caused by littering. AS-EPA provided trash bags and gloves for all participants and marked designated areas with "recognition signs" naming the group responsible for adopting the area. Trash was sorted into the following categories: shoreline and recreational, ocean waterway, smoking, dumping, and medical. The data is entered into a database to help focus public education efforts.

HYDROMODIFICATION

- **Restoration of Wetlands and Riparian areas:** AS-EPA's Riparian Restoration projects remain on hold pending reevaluation of effectiveness. Previous projects showed significant progress but were damaged during flooding events. Flooding occurs frequently in American Samoa due to its location within the South Pacific Convergence Zone, making successful riparian restoration difficult.

WETLANDS

- **Wetlands Protection (Restoration of Leone Village Coastal Wetlands Project):** The Restoration of Leone Village Coastal Wetlands project is funded by the US Fish & Wildlife Service's Coastal Wetlands Conservation Grant Program (FY2013). Project implementation was initiated in January 2014 and has been extended until September 2017. The key objective of the project is to implement community-based restoration of coral reefs and mangroves in Leone village, American Samoa. The project proposes to restore 18.3 acres of coastal wetland habitat with the aim of addressing the degradation and loss of coastal wetland and coral reef habitat in Leone Village, in particular to address damage resulting from the 2009 Samoan Islands Tsunami event. Project staff are based in the

village and are tasked to work with the village community to implement project activities which include debris removal in the mangrove wetland area and coastal and coral reef areas, construction of a mangrove nursery and development and implementation of a mangrove restoration action plan, and construction of an underwater coral nursery and development and implementation of a coral restoration action plan.

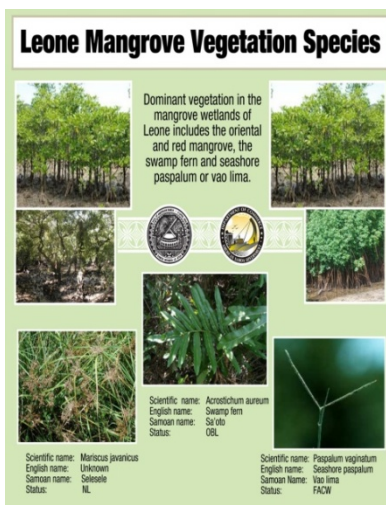
Progress has been made with regards to the Leone project staff of three (Project Coordinator, Coral & Mangrove Technician and Coral Reef Officer) situated in the Leone village and working closely with the main DMWR management and technical staff, attending workshops, sharing information with the village council, working with various women and youth groups and various local government agencies who are partners in the interest of protecting the environment and implementing the goals/objectives of this unique project. The project staff worked closely with ASPA and ASEPA to review the no adverse impact for its debris removal approach and was granted permission to proceed under Section 7 Consultation of NEPA and having completed its Section 106 with American Samoa Historic Preservation Office. The six (6) critical areas identified by the Leone project staff with non-point source pollution includes the three (3) streams in Leone—Aualii, Leafu and Fuafua. For two years, the staff walked the entire village and the six critical areas for debris removal are as follows: *(1) Togatupu Area; (2) Inner Puna Mai II; (3) Inner Puna Mai I; (4) Puna Mai; (5) Pritchard's Bakery to the end of Fuafua Stream Entering Leone Bay; and, (6) Fuafua Stream from Border of Malaeloa-Leone to Pritchard Bakery Bridge.*

The DMWR-Leone staff also worked closely with the Department of Commerce (DOC) Coastal Zone Management Program to create outreach and awareness signs for the wetland and participated in marine sanctuary workshops for the youth in the village. Site visits were conducted with the various local elementary schools to showcase the importance of protecting the watershed and about non-point source of pollution. The non-point source pollution in the Leone village is occurring due to residents connecting pipes from their kitchen sink, shower, washing machine, piggery into the streams; use of excess fertilizers, herbicide and pesticide by farmers; leaking septic tanks and cesspools; car batteries; and dumping oil and other chemicals in the streams.

The Leone project staff were also showcasing its due diligence and documentation to Kathy Hollar from the US FWS Pacific Region Chief and E. Flinn Curren, Coordinator, who visited American Samoa in May 2016. The debris removal phase will be launched in the beginning of 2017.



NPS-Piggery runoff into Leone Mangrove



NPS-Sink/Shower runoff

In the past year, planning has continued for debris removal and mangrove seedling propagation in Leone for the wetland restoration program. This is in collaboration with Land Grant and 6 village groups

- **Wetlands Protection (NPSA front from DOI):** In FY17, NPSA received a grant of \$400,000 to restore wetland areas in Nu'uuli along with other projects.

Federal Support

Federal support for the Watershed Management and Protection Program is received from USEPA, NOAA, the National Park of American Samoa, and NRCS. Federal support activities are documented above. All other supporting agencies are local.

Table 1. Information and classification for watersheds of American Samoa (updated January 2016)

Watershed	Number	Area (mi ²)	Population ¹	Pop Density ¹	Longitude	Latitude	Classification ²
Poloa	1	0.42	193	460	170° 50' 05.21" W	14° 19' 02.57" S	intermediate
Fagalii	2	0.80	247	309	170° 49' 34.48" W	14° 18' 24.30" S	intermediate
Maloata	3	1.08	8	7	170° 48' 59.11" W	14° 18' 14.45" S	pristine
Fagamalo	4	1.30	47	36	170° 48' 26.06" W	14° 17' 36.76" S	pristine
Aoloau Sisifo	5	0.62	0	0	170° 47' 27.50" W	14° 17' 25.16" S	pristine
Aoloau Sasae	6	2.05	nd	--	170° 46' 26.61" W	14° 17' 35.02" S	pristine
Asu	7	3.27	1109	339	170° 45' 10.66" W	14° 17' 46.61" S	intermediate
Fagasa	8	1.35	831	616	170° 43' 18.75" W	14° 17' 13.56" S	intermediate
Fagatuitui	9	2.00	0	0	170° 42' 06.27" W	14° 15' 15.27" S	pristine
Vatia	10	1.89	640	339	170° 39' 54.64" W	14° 14' 50.92" S	intermediate
Afono	11	1.29	524	406	170° 38' 53.76" W	14° 15' 22.23" S	intermediate
Masefau	12	1.42	425	299	170° 37' 52.29" W	14° 15' 23.39" S	intermediate
Masausi	13	0.60	164	273	170° 36' 28.22" W	14° 15' 21.65" S	intermediate
Sailele	14	0.26	75	288	170° 35' 48.79" W	14° 15' 23.39" S	intermediate
Aoa	15	0.85	855	1006	170° 35' 14.58" W	14° 15' 41.95" S	extensive
Onenoa	16	0.30	150	500	170° 34' 48.48" W	14° 14' 58.46" S	intermediate
Tula	17	0.60	405	675	170° 33' 41.80" W	14° 14' 44.54" S	intermediate
Alao	18	0.52	495	952	170° 33' 48.76" W	14° 15' 47.17" S	extensive
Auasi	19	0.40	161	403	170° 34' 22.97" W	14° 16' 17.32" S	intermediate
Amouli	20	0.80	920	1150	170° 35' 16.32" W	14° 16' 38.19" S	extensive
Fagaitua	21	1.88	1629	866	170° 36' 47.93" W	14° 16' 05.14" S	extensive
Alega	22	0.51	98	192	170° 38' 14.33" W	14° 16' 48.05" S	intermediate
Laulii-Aumi	23	0.70	1078	1540	170° 39' 01.88" W	14° 17' 18.20" S	extensive
Pago Pago	24	4.00	9276	2319	170° 41' 58.11" W	14° 16' 20.29" S	extensive
Fagaalu	25	0.96	910	948	170° 40' 58.92" W	14° 17' 28.92" S	extensive
Matuu	26	1.00	662	662	170° 41' 20.33" W	14° 18' 07.33" S	intermediate
Nuuuli Pala	27	6.70	6707	1001	170° 42' 38.40" W	14° 18' 58.97" S	extensive
Tafuna Plain	28	5.50	18170	3304	170° 43' 26.26" W	14° 20' 51.99" S	extensive
Fagatele-Larson	29	1.23	0	0	170° 45' 34.39" W	14° 22' 25.49" S	pristine
Leone	30	5.67	6836	1206	170° 47' 11.99" W	14° 20' 56.08" S	extensive
Afao-Asili	31	1.07	406	379	170° 47' 57.98" W	14° 20' 02.84" S	intermediate
Nua-Seetaga	32	1.20	652	543	170° 48' 58.35" W	14° 19' 53.87" S	intermediate
Amanave	33	0.40	250	625	170° 50' 03.81" W	14° 19' 30.26" S	intermediate
Aunuu Sisifo	34	0.38	436	1147	170° 33' 38.94" W	14° 16' 58.98" S	extensive
Aunuu Sasae	35	0.22	0	0	170° 32' 47.75" W	14° 17' 04.82" S	pristine
Ofu Saute	36	1.78	176	99	169° 40' 09.18" W	14° 11' 08.81" S	pristine
Ofu Matu	37	1.06	0	0	169° 39' 28.09" W	14° 09' 56.41" S	pristine
Olosega Sisifo	38	0.80	177	221	169° 37' 54.65" W	14° 10' 08.65" S	intermediate
Olosega Sasae	39	1.20	0	0	169° 36' 33.94" W	14° 10' 21.85" S	pristine
Tau Matu	40	14.20	790	56	169° 28' 18.79" W	14° 12' 55.30" S	pristine
Tau Saute	41	3.3	0	0	169° 27' 35.81" W	14° 14' 57.18" S	pristine

¹population data are taken from the US 2010 Census

²disturbance classification based on population density: pristine $\leq 100 \text{ mi}^{-2}$, intermediate $> 100 \text{ mi}^{-2}$, $\leq 750 \text{ mi}^{-2}$, extensive $> 750 \text{ mi}^{-2}$

Table 2. AS-EPA Closed Piggeries - Annual New Load Reductions of Nutrients to Waterbodies – FY19

Watershed			Pollutant Source	BMPs Used	Load Reduction Nitrogen lbs/yr	Load Reduction Phosphorus lbs/yr
#	Name	Location				
10	Vatia	170° 39' 54.64" W 14° 14' 50.92" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (0)	429.38	163.38
11	Afono	170° 38' 53.76" W 14° 15' 22.23" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (18)	61.34	23.34
15	Aoa	170° 35' 14.58" W 14° 15' 41.95" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (12)	92.01	35.01
17	Tula	170° 33' 41.80" W 14° 14' 44.54" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (59)	1104.12	420.12
27	Nuuuli Pala	170° 42' 38.40" W 14° 18' 58.97" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (65)	122.68	46.68
28	Tafuna Plain	169° 37' 54.65" W 14° 10' 08.65" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (168)	276.03	105.3
29	Fagatele- Larson	170° 45' 34.39" W 14° 22' 25.49" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (7)	214.69	81.69
30	Leone	170° 47' 11.99" W 14° 20' 56.08" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (134)	1073.45	408.45
31	Afao-Asili	170° 47' 57.98" W 14° 20' 02.84" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (12)	92.01	35.01
33	Amanave	170° 50' 03.81" W 14° 19' 30.26" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (19)	1471.68	559.68
34	Aunuu Sisifo	170° 33' 38.94" W 14° 16' 58.98" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (7)	30.67	11.67
35	Aunuu Sasae	170° 32' 47.75" W 14° 17' 04.82" S	CAFO (Piggeries)	Facility inspections, enforcement of regulations, removal of pigs (14)	30.67	11.67
TOTALS					2665.28	1,902

APPENDIX A

Annual BMP Summary Key

Annual BMP Summary

2018 Integrated Report Appendix B 305(b) Use Support /CALM Category Summary

Appendix A FY 2019 Summary Key of Type of BMP's Reported per Watershed	
Source Category	
Agriculture	
Erosion and Sediment Control (NPS)	Number of trees planted
Erosion and Sediment Control (NRCS)	Soil load reduction (tons)
CAFO Waste Management (ASEPA, NRCS, LGP)	Number of piggeries cited or LOW/verbal warning/closed/composting facility built
CAFO Waste Management- Follow-up (ASEPA)	Number of Follow-up inspections
Pesticides Management - Inspections (ASEPA)	Number of inspections/violations
- Operator Certifications (ASEPA & LGP)	Number of people certified in pesticide application
Urban Areas	
Development Management (ASEPA, ASCMP)	Number of LUP's issued (major/minor projects/ stop orders)
Dev. Mgt. - Inspections of Major Permits (ASEPA)	Number of inspections
New Sewer Hookups (ASPA)	Number of new sewer hookups with demolished septic tanks
Watershed Management - Education (ASEPA)	Number of brochures / booklets distributed
New OSDS Management (ASPA)	Number of new OSDS installed
Existing OSDS Management (ASEPA, P.Health)	Number of citations/ warnings issued
Pollution Prevention Commercial (B.P., ASPA)	Number of inspections/ problems corrected
Fuel Storage Tank Inspections, Spill Response (AS-EPA)	Number of inspections/oil spill responses/auto shop inspections
Used Oil Collection (ASEPA)	Number of gallons of used oil collected
Chemical Collections and Disposal (AS-EPA)	Number of collections and disposal
Stray Dogs -Trapping records (DOA)	Number of dogs euthanized
Litter Control - Prevention (ASEPA)	Number of inspections/LOW/accumulation citations/litter citations
Litter Control - Keep Am Samoa Beautiful (KASB) (ASEPA)	Number of adopter groups
Hydromodification	
Riparian Restoration (ASEPA, ASCMP)	Number of projects completed
Wetlands	
Wetlands Restoration (ASEPA, ASCMP)	Number of projects completed

[illegible]

[illegible]

[illegible]

VII 2018 Appendix B Table B1. 305b Use Support / CALM Assessment Category Summary (FY16 and FY17 data only)

WATERSHED		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	
Development Category		in	in	pr	pr	pr	pr	in	in	pr	in	in	in	in	in	ex	in	in	ex	in	ex	ex	in	ex	ex	ex	in	ex	ex	pr	ex	in	in	in	ex	pr	pr	pr	in	pr	pr	pr	
Waterbody Type		Designated Use																																									
Streams																																											
Aquatic Life		N ^f		F	F				N ^f		N ^f	F	F	N ^f		N ^f						N ^f	N ^f	N ^f	F	N ^f	N ^f	F	N ^f			N ^f	F	F	N ^p								
Swimming				N ^p	N ^p				N ^p		N ^p	N ^p	N ^p										N ^p	N ^p	N ^p	N ^p	N ^p	N ^p				N ^p	N ^p										
Drinking Water **																																											
CALM Assessment Category		5	3	4a	4a	3	3	3	5	3	5	5	4a	5		5	3	3	3	3	5	5	5	4a	5	5	4a	5			5	4a	2	5									3
Ocean Shoreline																																											
Aquatic Life		N ^p		F	F				N ^f		N ^p	N ^f	N ^f	N ^f		N ^p					N ^f	N ^p	N ^f	N ^f	N ^f	N ^p	N ^p	N ^p	N ^f	F	N ^p	N ^f	N ^f	N ^f									
Swimming									N ^p		N ^p	N ^p	N ^p	N ^p	F	N ^p	N ^p	F	N ^f	N ^f	N ^f	N ^p	N ^p	N ^p	N ^p	N ^p	N ^f	N ^p	F		N ^p	N ^p	F	F	F		F		F		F		
Fish Consumption																																											
CALM Assessment Category		5	3	2	2	3	3	3	5	3	5	5	5	5	2	5	4a	2	5	5	5	5	5	5	5	5	5	5	5	2	5	5	5	5	2	3	2	3	2	3	2	3	
Wetlands																																											
Aquatic Life																																											
Agriculture																																											
Cult./Ceremonial																																											
Recreation																																											
CALM Assessment Category											3		3			3		3	3			3			3			3			3				3	3	3		3		3		

Note: In watersheds where samples were taken at more than one site, the lowest level of use support was used for the summary.

Legend

Shaded areas indicate watersheds that do not have the waterbody type for evaluating designated use, or, the designated use does not apply for the waterbody in that watershed.

Designated Use Support Level
F - Fully Supporting (good)
N ^f - Not Supporting (fair)
N ^p - Not Supporting (poor)

Development Category
pr - pristine
in - intermediate
ex - extensive

CALM Assessment Category
1 - All Designated Uses (DUs) met
2 - Some DUs met; insufficient data to evaluate remaining DUs
3 - Insufficient data to evaluate any DUs
4a - Water is impaired; TMDL completed
5 - Water is impaired; TMDL needed

Note: Watershed 24 (Pago Pago) placed in Category 4a for Fish Consumption (TMDL completed in 2007) but remains in Category 5 for Swimming

Note: All Waterbodies (Streams) have only ASWQS Class 2 designated uses