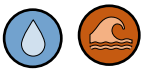
APPENDIX B: KEY PROJECT DESCRIPTIONS

Table B1. Summary of key projects from Achugao WMP

Site	Project Description	Planning Level $	Goals
As Agatan Stream & Wetland Restoration & Infrastructure Protection (AS-132)	Eliminate flows on Middle Rd. by redirecting through culvert under access drive; recreating a floodplain wetland to handle larger storms; providing treatment for runoff from impervious cover using green stormwater infrastructure; and improving habitat through invasive species removal and restoration of native riparian vegetation.	$250,000-$350,000	
Tanapag Beach Park (AS-137)	Community-led resiliency design to design living shoreline, stormwater management system, recreational usage, and educational moments for park users.	$170,000-$250,000	
Improving Stormwater Infrastructure at Tanapag Middle School (AS-153)	Reduce runoff volume at Tanapag Middle School by expanding capacity of onsite practices, installing additional practices, and fixing runoff bypass issues on Middle Rd. that are contributing to school flooding. Consider developing master drainage plans to meet coastal resiliency objectives for both schools in the watershed.	$75,000-$100,000	
Imperial Casha Site Stabilization (AS-502)	Address erosion and sedimentation from >10 acre clearing at stalled construction site. Involves replanting vegetated riparian buffers, hydroseeding exposed soils, and excavating existing sediment basins to restore capacity	$25-$50,000	
Lower Base Pollution Prevention (AS-128 & AS-168)	Remove accumulated sediment in concrete swales and drainage structures along road; install sediment forebays and swales in the road right-of-way; identify structural and non-structural practices and prepare stormwater pollution prevention plans for each property to reduce off site contributions of sediment and other pollutants.	$50,000-$150,000	
San Roque Green Streets (AN-300 & 301)	Utilize road median and right-of-way to incorporate street trees, stormwater management, and pedestrian/bike safety. There is also potential for additional stream and wetland restoration seaward of Middle Rd.	$400,000-$500,000	
Kensington Hotel Sustainable Green Infrastructure (AN-501 & 601)	Improve pollutant removal performance and aesthetics of hotel's stormwater infrastructure with wetland vegetation in the central pond system and parking lot improvements.	$250,000-$350,000	
Aqua Resort Overflow Parking (AN-307)	Implement sustainable hotel stormwater practices with drainage improvements at unpaved overflow parking using permeable pavers, swales, and bioretention facility.	$25,000-$100,000	
Upland Reforestation	Reforestation of areas at the upper ridges of Achugao, converting fire-vulnerable grasslands back into native forest.	$ 30,000	
Wildfire Outreach & Prevention	Island-wide environmental awareness campaign targeting one source of land-based sources of pollution (LBSP), wildfire and resulting erosion and sedimentation.	$ 30,000	
Watershed Warriors Program	Environmental education programming targeting 4th grade students at Gregorio T. Camacho Elementary School in San Roque village.	$ 15,000	
Mangrove Nursery	Establish *in situ* mangrove nursery to propagate existing and extirpated mangrove species for reforestation efforts along Saipan Lagoon.	$ 12,000	

AS-132 Stream/Wetland Restoration

Project Summary	
Subwatershed	As Agatan
BMP type	Constructed wetland
DA	13 acres (excludes stream contributing area)
IC	9 acres (70%)
Pollutant Removal	75% TSS
Ownership	Public/Private
Cost	$250,000- $350,000

Conditions

At a historic textile manufacturing plant off Middle Road, the As Agatan stream and associated wetlands were diverted when Middle Road was built and further altered by factory construction. The stream was straightened with a concrete embankment. It pops out onto the factory access road, ponding in at the intersection of Middle Rd. and flowing northward towards a large culvert where it formally crosses the road. As a result, stream base flow is continuously running along the Middle Rd. shoulder/gutter causing road damage and leading to flooding during rain events. Stream and buffer habitat have been impacted.

Concept

The goal of this project is to restore more natural stream conditions and enhance the floodplain to better handle rain events and improve wildlife habitat. It involves adding a culvert under the access road, recreating a floodplain wetland that can safely manage base flows, and treatment of stormwater runoff from the road and factory impervious cover using green stormwater infrastructure to remove trash and sediment and other pollutants. Buffer enhancement should include removal of invasive species and the planting of native riparian buffer vegetation to improve wildlife benefits. Excluding stream contributions, this retrofit would need to manage >9 impervious acres.

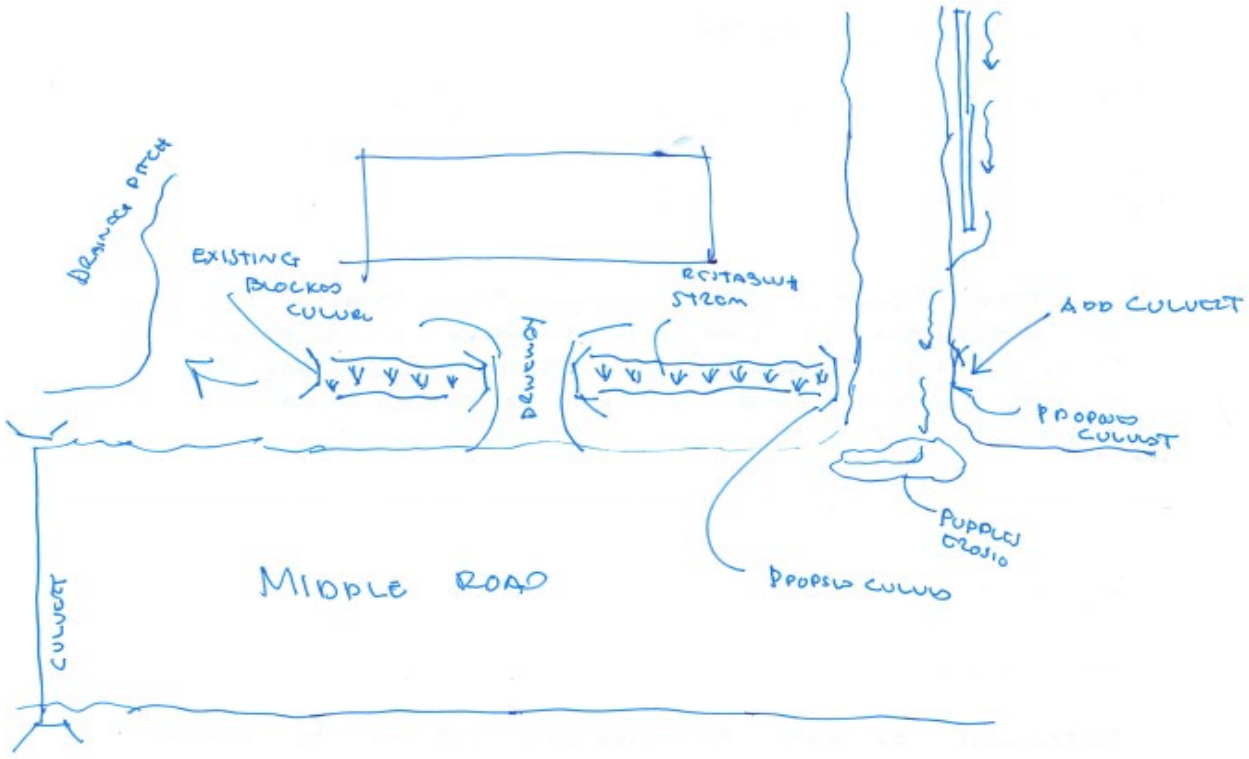
Other Considerations

Potential sewer line location, road and site ownership, and DPW buy-in are potential site challenges. Any project will need to accommodate stream flow by providing offline stormwater treatment. In addition, adjacent construction may influence the amount of runoff coming to this site.

Consistent flooding along Middle Rd. could be alleviated with a stream/wetland restoration project.

Area of impervious cover estimated to this retrofit location. Any project design would need to be offline to accommodate stream flow.

A field concept sketch and schematic concept are shown below. A planning level construction cost estimate is included in the table below. This estimate is equivalent to a rough estimate at <25% design and does not include engineering, permitting, contingency, or land purchasing.



Field Sketch

Conceptual Schematic

AN-132 STREAM RESTORATION			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Site Excavation	Cubic Yard	$30.00	$15,000.00
Rough Grading	Square Yard	$2.50	$18,750.00
Concrete Culvert & Headwalls	Each	$35,000.00	$140,000.00
Concrete Retaining Wall	Linear Feet	$250.00	$7,500.00
Fine Grading	Square Yard	$7.00	$52,500.00
Trash Rack	Each	$1,500.00	$3,000.00
Stream Restoration Plantings	Square Yard	$75.00	$22,500.00

ESTIMATED PROJECT COST	$260,000.00

San Roque Green Streets (AN 300-303)

Project Summary	
Subwatershed	San Roque
BMP type	Various (bioretention)
DA	30 acres
IC	9 acres (30%)
Pollutant Removal	50-75% TSS
Ownership	Public road ROW
Cost	$400,000-$500,000

Conditions

Middle Rd. in North Achugao offers a wide right-of-way (>25 ft) to design a streetscape that incorporates more shade trees, better manages stormwater, and offers safer pedestrian and bike lanes. Just south of the Kensington Hotel, the main flow path for the San Roque subwatershed crosses Middle Rd. near the Latte Stone Cafe. The natural and manmade drainage system includes a grassed roadside swale, two large culverts, concrete channels, and piped stream segments. The freshwater wetland seaward of Middle Rd. has opportunities for enhancement that are worthy of further investigation.

Concept

At several locations south of Kensington, opportunities were identified to install vegetated swales, street trees, or rain gardens within the grass road shoulders (or within a new landscaped median) to improve aesthetics, and water quality, particularly around commercial entrances. Figure 1 shows examples of Additional study of the stream system and wetland complex on the seaward side of the highway need to be further evaluated to identify feasibility of restoring natural flow paths and wetland habitats. Sediment from several unpaved roads and parking lots can be better managed by disconnecting them from Middle Rd. and providing road stabilization techniques.

Other Considerations

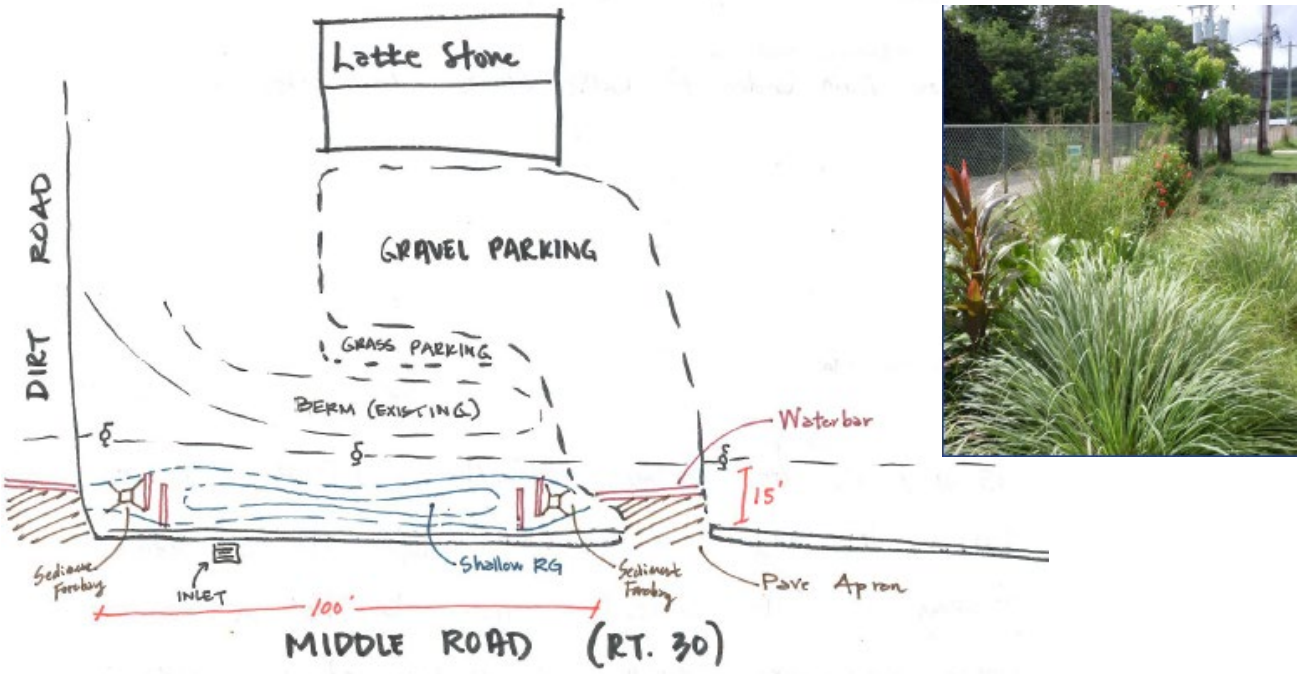
Overhead utilities on the northbound side of Middle Rd. may limit vegetation/tree selection based on height. Green street segments along

Green street opportunities along Middle Rd.

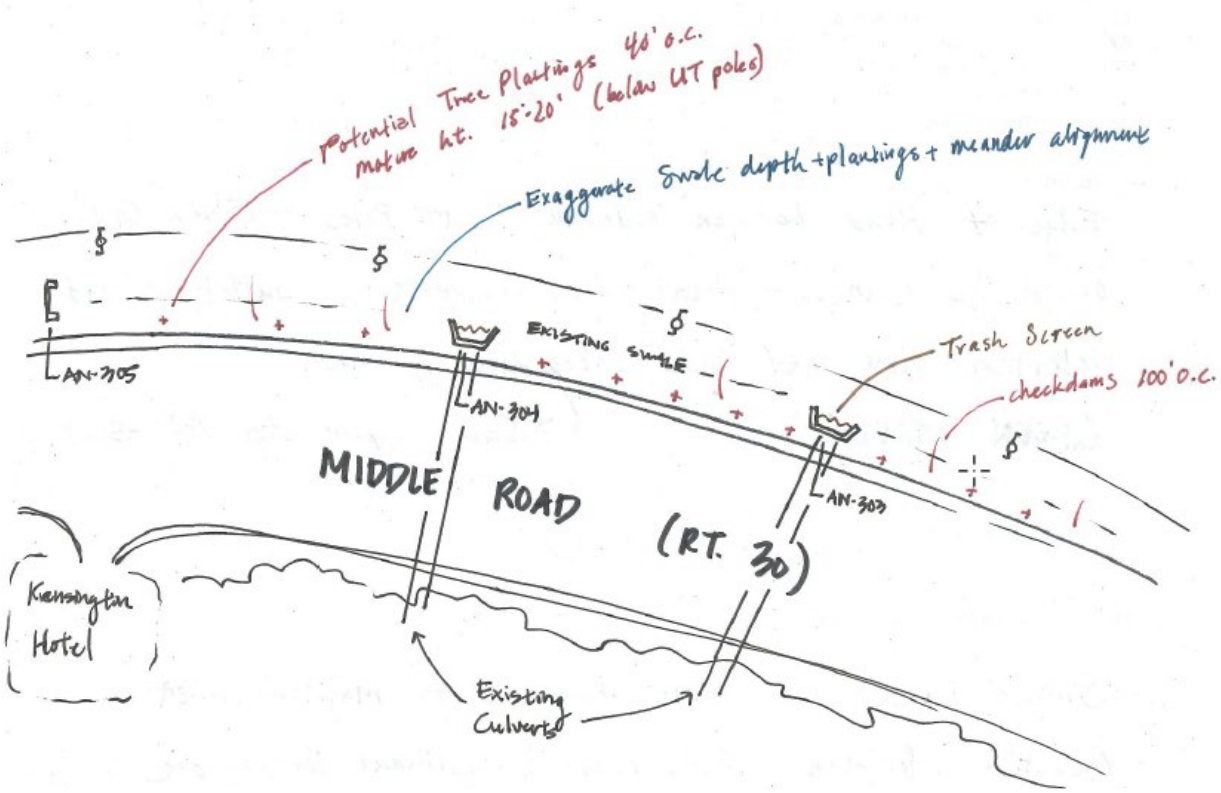
Middle Rd. may need to ultimately consider how they connect to resorts, park, Garapan, etc.

A field concept sketch and schematic concept are shown below. A planning level construction cost estimate is included in the table below. This estimate is equivalent to a rough estimate at <25% design and does not include engineering, permitting, contingency, or land purchasing.

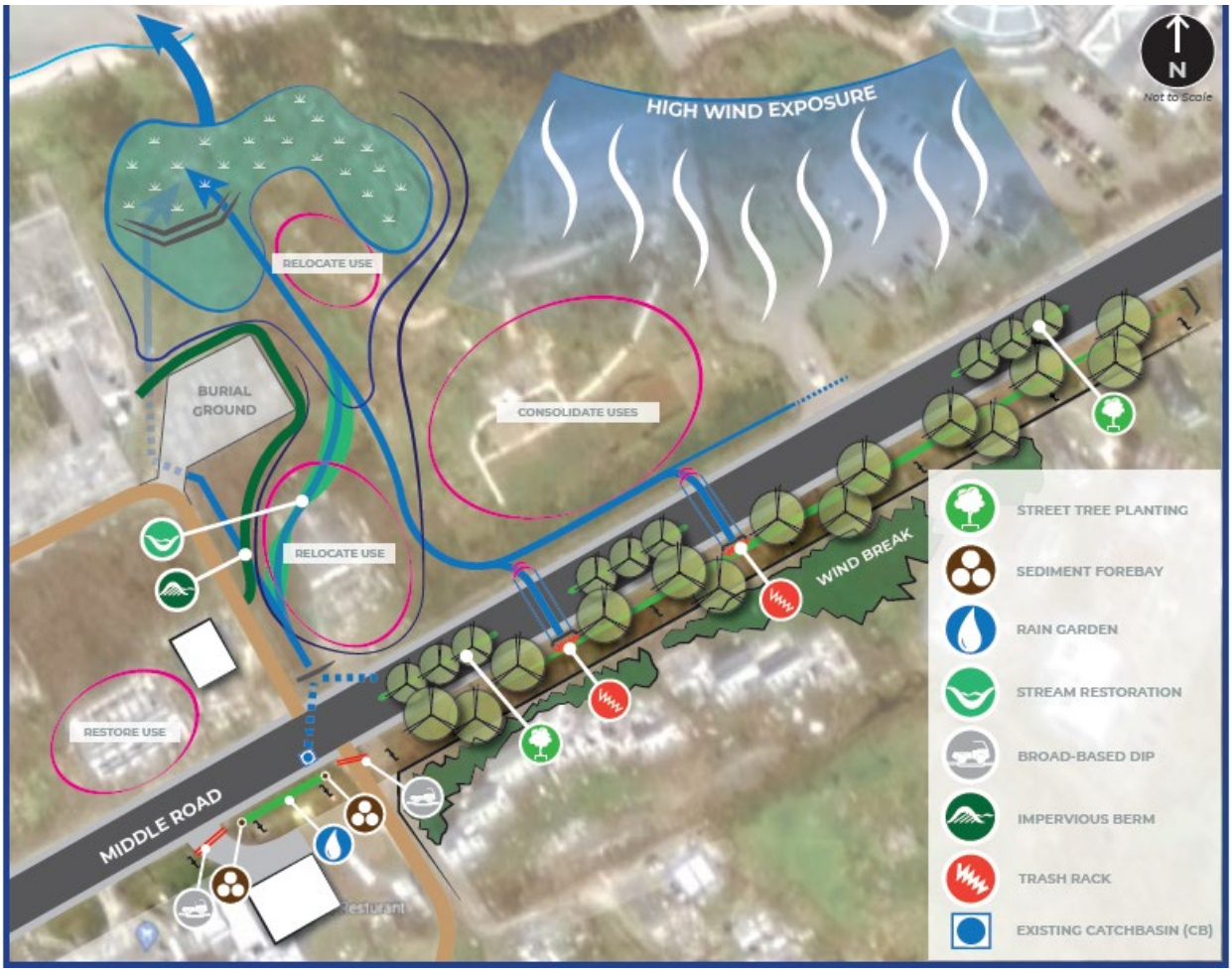
Figure 1. Examples on Saipan of street landscape medians that are not used to manage stormwater (top and middle) and a schematic showing one green street options with stormwater planters in the median and on road edge (bottom).



Field sketch of road ROW detention using a rain garden and precedent image (from San Vicente School)



Field sketch of road ROW detention and green streets.



Schematic of green streets concept for portion of Middle Rd. near Kensington that includes median and ROW tree planting. Schematic also illustrates preliminary concepts on downstream stream realignment and wetland enhancement.

AN-300 + AN-303 MIDDLE ROAD GREEN STREET			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Site Excavation	Cubic Yard	$30.00	$30,000.00
Sawcut & Pavement Removal	Square Feet	$12.00	$12,000.00
Rough Grading	Square Yard	$2.50	$37,500.00
Impervious Berm	Linear Feet	$50.00	$25,000.00
Sediment Forebay	Each	$1,500.00	$3,000.00
Broad-based Dip	Linear Feet	$30.00	$1,500.00
Vertical Concrete Curb	Linear Feet	$25.00	$25,000.00
Rain Garden	Square Feet	$35.00	$28,000.00
Fine Grading	Square Yard	$7.00	$105,000.00
Trash Rack	Each	$1,500.00	$3,000.00
Stream Restoration Plantings	Square Yard	$75.00	$112,500.00
Street Tree Planting	Each	$1,800.00	$41,400.00
		ESTIMATED PROJECT COST	$424,000.00

Kensington Sustainable Green Infrastructure (AN-501 and 601)

Project Summary	
Subwatershed	San Roque
BMP type	Floating treatment wetlands and various parking lot BMPs
DA	12 acres
IC	9 acres (80%)
Pollutant Removal	75-95% TSS
Ownership	Private- commercial
Cost	$250,000- $350,000

Conditions

The Kensington Resort has a series of ponds that collect drainage from the property and discharge to the lagoon at a concrete outfall on the beach. The parking lots drain through a series of concrete channels that convey stormwater runoff into a small wetland that either drains to the stream system to the south of the hotel or connects into the main pond system. At the lower pond's outlet structure, extensive algal mats and decaying organic matter buildup were observed that could lead to outlet clogging, odors, and additional water quality issues. Opportunities were identified to improve the overall pollutant removal performance (and aesthetics) of the existing drainage system and implement principals outlined in the CNMI Sustainable Hotel Guide.

Concepts

Retrofit the existing ponds by introducing vegetation to improve nutrient removal performance either with floating wetlands or by converting ponds to constructed wetlands.
A floating wetland system would consist of mini vegetated islands that would need to collectively cover ~5-10% of the pond surfaces. Once established, plants uptake and biofilm on the root mass contribute to the removal and processing of nutrients from the water. Floating wetlands allow for the restoration and creation of wetland habitat. The ponds at the Kensington are well protected from wave energy, providing ideal conditions to implement and monitor floating wetlands. Plant species and matrix selection will depend on aesthetics, salinity, water depth, material availability, and cost. Depending on the hydraulic, salinity, and other physical characteristics of the pond system, an alternative may be the creation of a freshwater or mangrove wetland system with variable microtopography to create diverse habitat regimes.

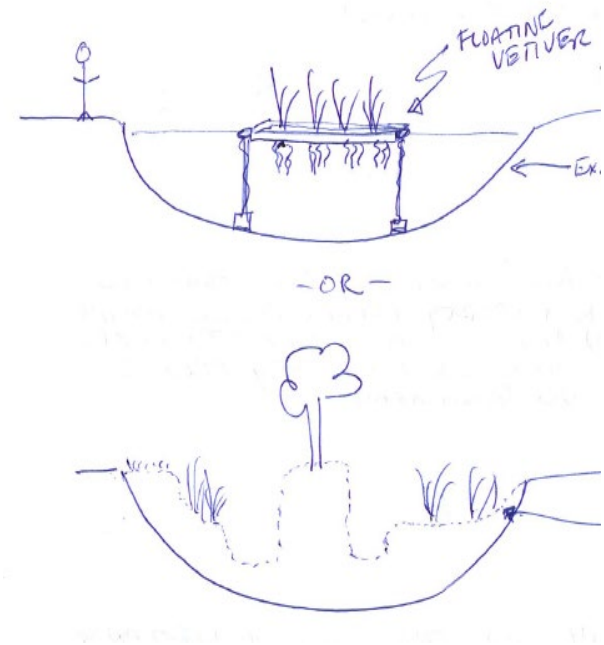
Drainage infrastructure at the Kensington Hotel.

Both parking lots have been identified as sites for pavement reduction and the integration of green infrastructure. For the parking lots, incorporating shade trees and reducing impervious cover will result in the generation of less stormwater runoff. Small scale rain gardens can be installed at low-points to capture and treat runoff prior to entering the natural wetland. Rain gardens will improve water quality and offer a sense of arrival for hotel guests. Low-maintenance vegetation with diverse flowers should be selected for the rain gardens.

Other Considerations

There are a lot of unknowns associated with the drainage system at the Kensington. A review of the site drainage plans and a site visit with the facilities manager is needed to better understand the drainage infrastructure at this site. In addition, the willingness of the hotel to advance sustainability initiatives is uncertain and the willingness to partner on stormwater retrofits and commit to long-term maintenance is unknown at this time.

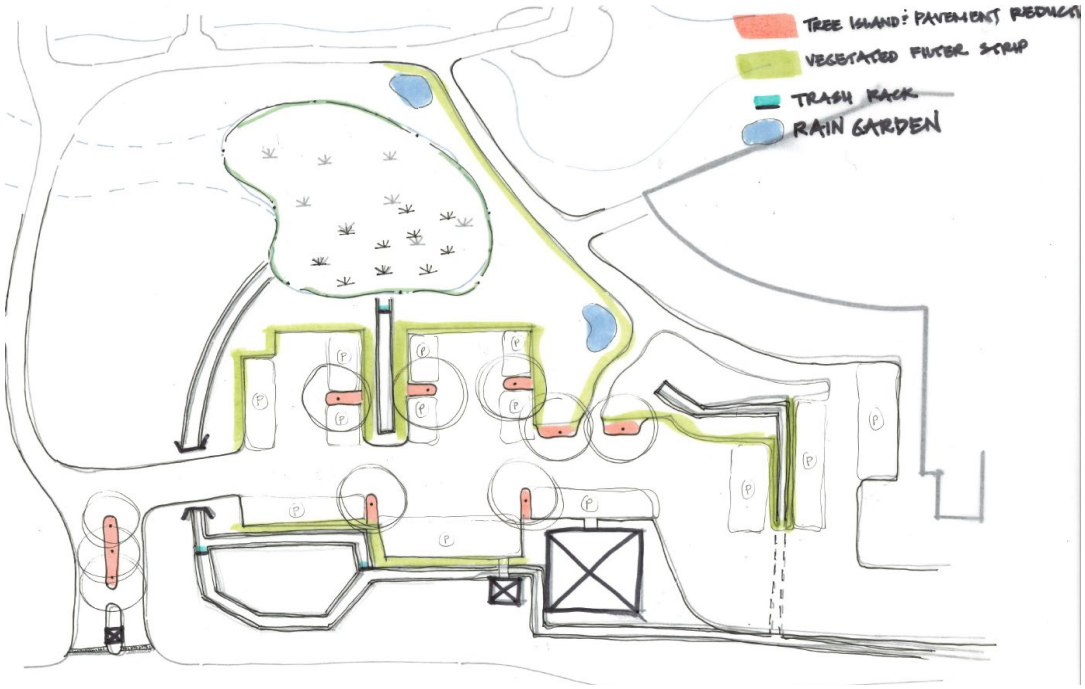
A field sketches and schematic concepts are shown below. A planning level construction cost estimate is included in the table below. This estimate is equivalent to a rough estimate at <25% design



Sketch of floating wetland cells and constructed wetland.

and does not include engineering, permitting, contingency, or land purchasing.

DCRM was planning to submit a grant application, but the hotel was not overly enthusiastic at the time.



Initial sketch of parking lot improvements at Kensington.

Preliminary schematics for parking lot stormwater improvements and floating treatment wetlands at Kensington Resort to improve water quality.

AN-601 KENSINGTON RESORT PARKING LOT IMPROVEMENTS			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Site Excavation	Cubic Yard	$30.00	$15,000.00
Sawcut & Pavement Removal	Square Feet	$12.00	$8,000.00
Rough Grading	Square Yard	$2.50	$12,500.00
Sediment Forebay	Each	$1,500.00	$6,000.00
Vegetated Conveyance Swale	Linear Feet	$12.00	$6,000.00
Vertical Concrete Curb	Linear Feet	$25.00	$5,000.00
Rain Garden	Square Feet	$25.00	$20,000.00
Fine Grading	Square Yard	$7.00	$35,000.00
Trash Rack	Each	$1,500.00	$4,500.00
Sand Filter	Square Yard	$18.00	$4,500.00
Parking Lot Tree Planting	Each	$1,800.00	$46,800.00
		ESTIMATED PROJECT COST	$164,000.00

AN-501 KENSINGTON RESORT FLOATING WETLANDS			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Biomatrix Mattress	Each	$5,000.00	$85,000.00
Wetland Plantings	Square Yard	$100.00	$10,000.00
Tie-downs & Duckbill Anchors	Allowance	$250.00	$5,000.00
Trash Rack	Each	$400.00	$500.00
		ESTIMATED PROJECT COST	$95,500.00

AQUA RESORT (AN-307)

Project Summary	
Subwatershed	San Roque
BMP type	Floating treatment wetlands and various parking lot BMPs
DA	2 acres
IC	2 acres (100%)
Pollutant Removal	85-95% TSS
Ownership	Private/ leased land
Cost	$25,000-$100,000

Conditions

The overflow parking area at Aqua Resort is unpaved and heavily compacted due to vehicular traffic. The overflow lot drains back towards storage containers and a catchbasin in the adjacent paved parking lot. The existing catch basin is clogged with sediment and debris.

Concept

There is an opportunity here to better manage stormwater from the parking lot (volume reduction and water quality) and provide for more formalized parking. At a minimum, the storage units should be relocated to the other end of the parking area at a higher elevation and a shallow bioretention or rain garden constructed at the low point. A sediment forebay should be incorporated into the bioretention. A sediment forebay is an isolated depression that collects sediment and trash before it enters the rain garden. Sediment forebays are designed with maintenance in mind to provide an accessible, small area to remove accumulated debris.

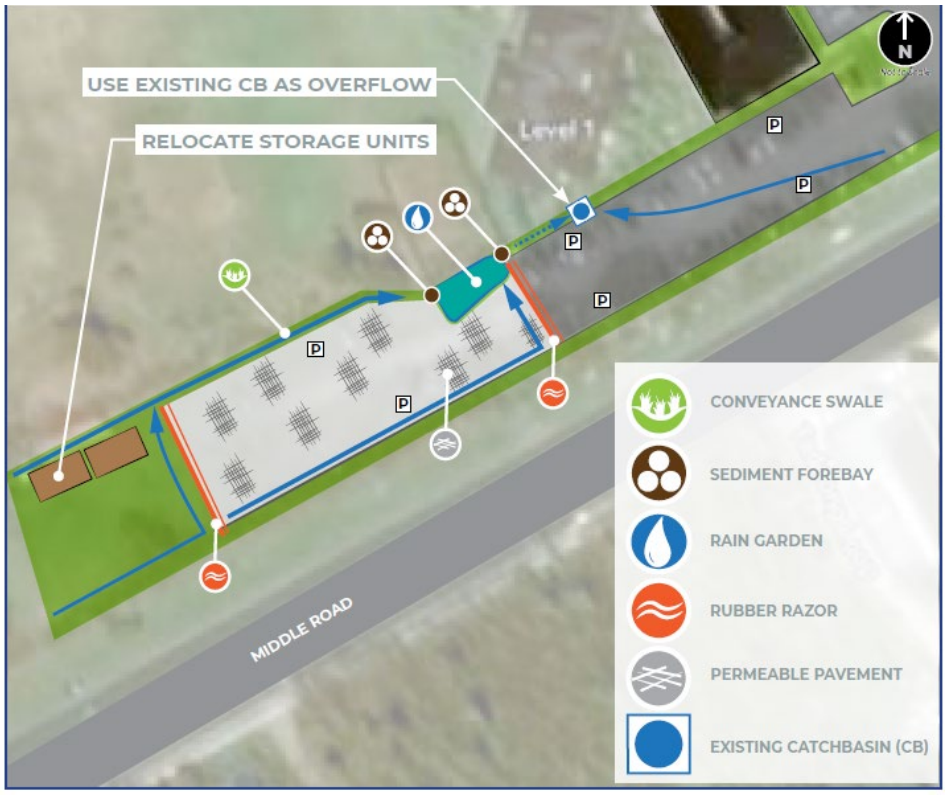
The overflow parking can be converted to a permeable surfacing with a perimeter swale to bypass offsite runoff or carry any overflows to the bioretention. Porous pavers, such as Ecoraster E40, Turfstone, or a brick designed/manufactured on island can be used to distribute the heavy load of vehicles and improve soil permeability while also working to retain the loose aggregate surface material and minimize erosion. Depending on design, speed bumps can divide the contributing drainage area and to help direct runoff.

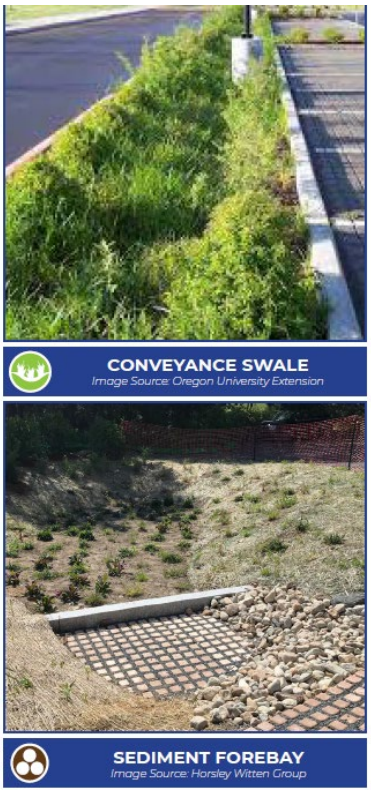
Unpaved overflow parking at the Aqua Resort.

Other Considerations

This is a private property (leased from DPL) and there may be little need or interest in partnering to upgrade the overflow lot. However, the Aqua Resort may be looking for ways to achieve some of the recommended practices outlined in the CNMI Hotel Sustainability Guide. While there are examples of permeable pavements on Saipan, this would be one of the first represented in the hotel industry.

A field sketches and schematic concepts are shown below. A planning level construction cost estimate is included in the table below. This estimate is equivalent to a rough estimate at <25% design and does not include engineering, permitting, contingency, or land purchasing.





Schematic design for parking lot stormwater management at Aqua Resorts.

AN-307 AQUA RESORT PARKING LOT IMPROVEMENTS			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Site Excavation	Cubic Yard	$30.00	$1,500.00
Sawcut & Pavement Removal	Square Feet	$12.00	$1,200.00
Rough Grading	Square Yard	$2.50	$2,500.00
Sediment Forebay	Each	$1,500.00	$3,000.00
Rubber Razor	Each	$750.00	$1,500.00
Vertical Concrete Curb	Linear Feet	$25.00	$1,000.00
Porous Concrete Pavement	Square Feet	$25.00	$25,000.00
Rain Garden	Square Feet	$25.00	$6,250.00
Fine Grading	Square Yard	$7.00	$7,000.00
Vegetated Conveyance Swale	Linear Feet	$12.00	$1,200.00
		ESTIMATED PROJECT COST	$51,000.00

Improving Stormwater Infrastructure at Public Schools (AS-153 & AN-313)

Project Summary	
Subwatershed	Dogas
BMP type	Inlet modifications, bioswales/bioretention
DA	1.2 acres
IC	1 acres (100%)
Pollutant Removal	75% TSS
Ownership	Public school and road ROW
Cost	$75,000-$100,000

Condition

Tanapag Middle school has a rain garden and participates in the Watershed Warriors program. The school sits at a lower elevation than the adjacent Middle Road. The 2'x2' metal inlet grate is located above the gutter line/curb on the road, easily clogs, and is frequently bypassed during rain events. When this happens, stormwater from the road is directed towards the middle school. Stormwater runoff from the schoolyard and parking lot is directed to an existing swale. The two surface inlets and outlet to/from this swale are clogged and need to be cleaned. Some drainage likely bypasses the swale and makes its way over to the park / basketball court across the street. The rain garden in the back often fills up and overflows back towards the main office.

A project was also identified for the Gregorio T. Camacho Elementary School. The elementary school has an infiltration basin and trench drain that then discharges to a basin (of sorts). The system is either underperforming or lacking maintenance as backups and overflows are reportedly common.

Concept

At Tanapag Middle School, the concept is to modify the existing road inlet to reduce bypass and repurpose underutilized space on the school property for stormwater management. We propose installing two bioretention landscape features: one in the corner of the grassed school yard and a linear feature in the parking lot. Both bioretention will need to be excavated and hydrologically connected via underground pipes. An outlet control structure will allow the bioretention systems to manage the water quality volume. While during more extreme storm events, the outlet control structure will divert floodwaters directly into the closed pipe storm drain on Middle Road and bypass the bioretention basins entirely. The outlet elevation of the existing rain garden needs to be lowered in relation to the concrete inlet swale to reduce the potential for backup. As a result, this project will improve public safety, decrease flood issues in the school parking lot and office building.

At Gregorio T. Camacho Elementary, the concept is to clean out the drainage infrastructure, remove invasive species and reconfigure the basin to offer more pleasing landscaping and improve function.

Tanapag Middle School participates in the Watershed Warrior Program and has a rain garden on-site (needs some attention).

There are also opportunities for educational signage and participation in watershed stewardship programs like the watershed warriors.

Other Considerations

There are a lot of projects that were identified at Tanapag Middle School (Figure 1). Soils and high water table seem to be an issue at the Middle school. Working in the Middle Rd. corridor to modify or tie into the drainage system could present a challenge.

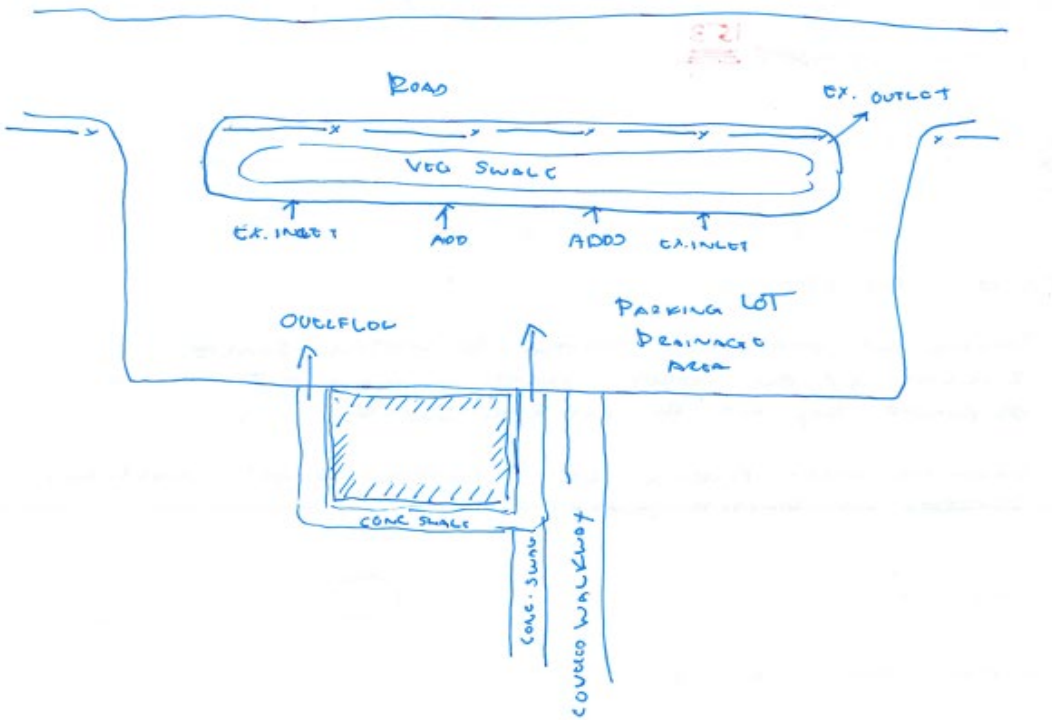
A field sketches and schematic concepts for Tanapag Middle and the Gregorio T. Camacho Elementary school are provided below.

DCRM received NOAA CRCP funding to support raingarden maintenance at Tanapag as well as to install two more raingardens in Achugao (or other priority watershed).

A planning level construction cost estimate for the Tanapag concept described above is included in the table below. This estimate is equivalent to a rough estimate at <25% design and does not include engineering, permitting, contingency, or other projects at the school, necessarily.

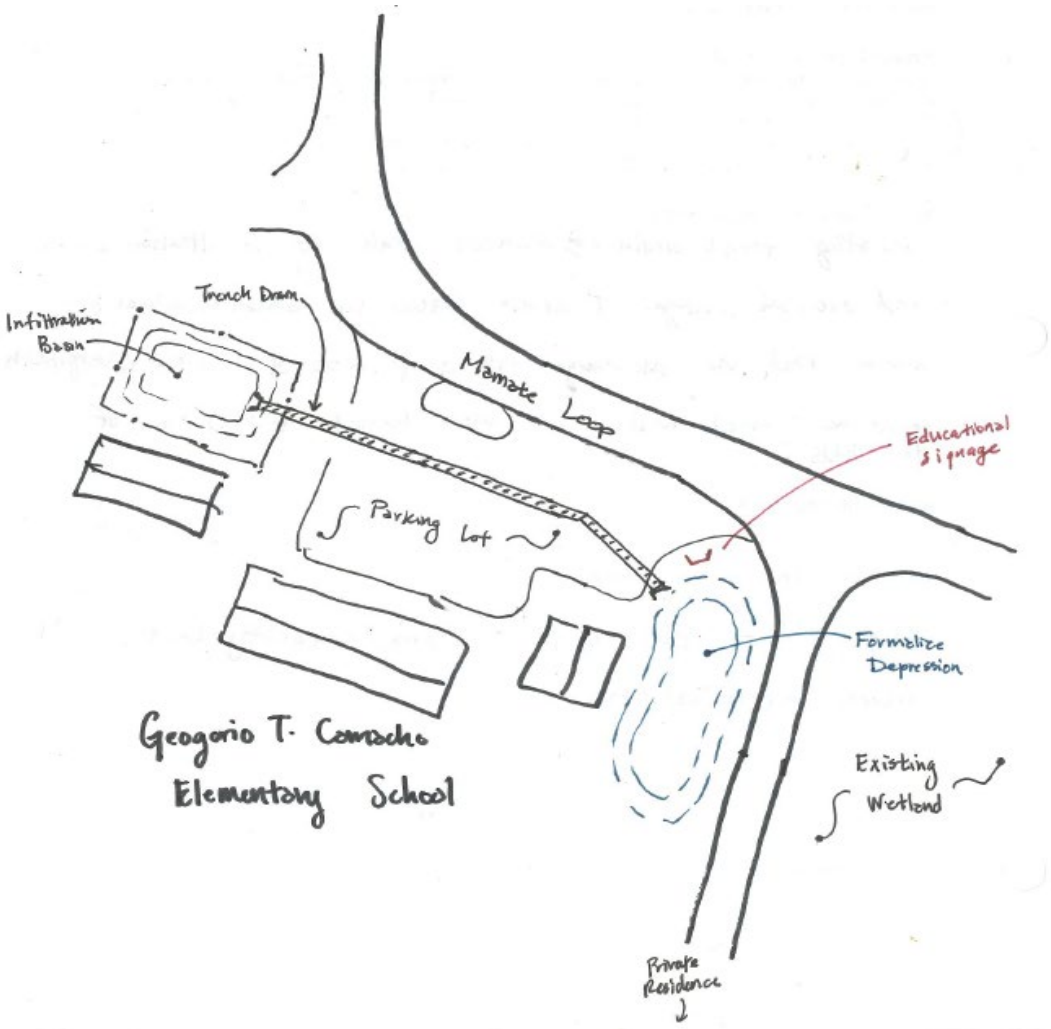
There are a lot of stormwater retrofit, coastal resiliency, and education at the Tanapag school that could be the focus of a school stormwater master plan.

AS-153 TANAPAG MIDDLE SCHOOL			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Site Excavation	Cubic Yard	$30.00	$22,500.00
12" Dia. Corrugated Drainline	Linear Feet	$10.00	$1,000.00
Rough Grading	Square Yard	$2.50	$2,000.00
Overflow Structure	Each	$2,000.00	$6,000.00
Sediment Forebay	Each	$1,500.00	$6,000.00
Vertical Concrete Curb	Linear Feet	$30.00	$3,750.00
Bioretention	Square Feet	$35.00	$28,000.00
Fine Grading	Square Yard	$7.00	$4,000.00
Flared End Pipe Section	Allowance	$500.00	$500.00
		ESTIMATED PROJECT COST	$74,000.00



Field sketch of swale enhancement at the Tanapag Middle School.

Schematic concept showing larger drainage improvements at the school and along Middle Road.



Potential enhancements at the Elementary school are shown in this field sketch.

TANAPAG BEACH PARK (AS-137)

Project Summary	
Subwatershed	Dogas
BMP type	Living shoreline, swales, permeable surfacing, native plantings
DA	6 acres
IC	4 acres (60%)
Pollutant Removal	85% TSS
Ownership	Public school and road ROW
Cost	$170,000-$250,000

Condition

The Tanapag Beach Park is a community treasure supporting numerous social activities, including playground, picnic shelter, volleyball court, boat ramp, and beach access. There is a combination of paved and unpaved roads within the park, which is mostly mowed turf grass. Today, Santa Remedio Drive drains towards the park, which lacks formal stormwater management to collect, treat, and discard any excess stormwater runoff. The park's shoreline is experiencing erosion and loss of vegetation and there is a lot of trash at the site. Vehicular circulation and parking are random.

Concept

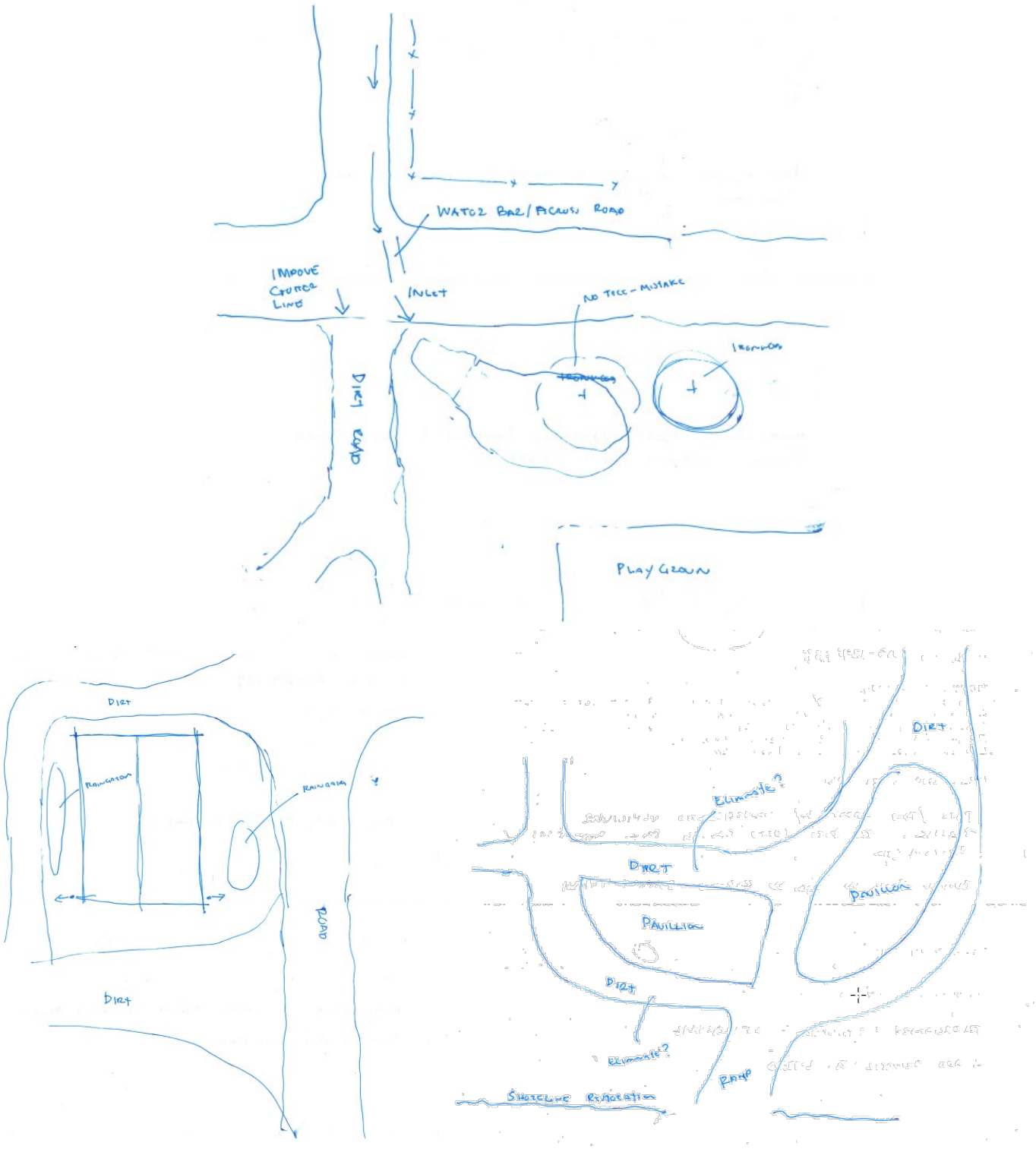
The goal is to work with the community to design a more resilient park using green infrastructure to manage stormwater drainage, protect the shoreline from erosion, and improve habitat and landscaping with strategically placed native plantings. A conceptual plan has been prepared to start the process including a grass swale network, rain garden features, permeable surfacing, educational signage, and a living shoreline. This project, however, will involve several rounds of community meetings and design alternatives to ensure recreational and environmental objectives are met.

Other Considerations

Coastal shoreline vulnerabilities (sea level, high groundwater, storm surge), diverse and sometimes competing recreational uses, vehicular circulation patterns, and assigning maintenance responsibility could be challenges.

Tanapag Beach Park is an important amenity for the community

A planning level construction cost estimate based on the preliminary schematic design is provided in the table below. This is a rough estimate at ~10% design and does not include community meetings, engineering, permitting, contingency, or other projects that may be proposed.



Field sketches of potential BMPs at Tanapag Park

Preliminary schematic design to start community design meetings.

AS-137 TANAPAG BEACH PARK			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Site Excavation	Cubic Yard	$30.00	$10,500.00
Dirt Road Restoration	Square Yard	$10.00	$2,500.00
Rough Grading	Square Yard	$2.50	$7,000.00
Vegetated Conveyance Swale	Linear Feet	$12.00	$6,000.00
Sediment Forebay	Each	$1,500.00	$6,000.00
Broad-based Dip	Linear Feet	$30.00	$1,500.00
Porous Concrete Pavement	Square Feet	$25.00	$50,000.00
Rain Garden	Square Feet	$25.00	$37,500.00
Fine Grading	Square Yard	$7.00	$6,000.00
Rubber Razor	Each	$750.00	$750.00
Wave Break (Shellfish Bags)	Allowance	$2,500.00	$2,500.00
Tie-downs & Duckbill Anchors	Allowance	$1,250.00	$5,000.00
Shoreline Restoration	Square Yard	$400.00	$36,000.00
		ESTIMATED PROJECT COST	$172,000.00

Controlling Erosion and Sedimentation at Abandoned Imperial Casha Construction Site (AS-502)

Project Summary	
Subwatershed	Dogas
BMP type	Riparian Buffer Revegetation, Hydroseeding, Sediment Basins
DA	15 acres
IC	N/A
Pollutant Removal	50-80% TSS
Ownership	Private (public lease?)
Cost	$30,000-$50,000

Conditions

Clearing of ~15 acres for this construction site was completed in 2018 and the abandoned site has remained exposed ever since. No construction has taken place (in the area landward of the stream) and no stabilization of unworked exposed soils has taken place (supposed to be within 14 days of exposure). While several sediment basins and a stabilized construction entrance were installed, it does not appear that these practices have been maintained.

The riparian buffer was impacted at several locations and stream walks revealed evidence of significant sediment accumulation in the stream bed. The status of the isolated wetland onsite is unknown, but presumably has been impacted. The operator of this site is in clear violation of the CNMI stormwater regulations, and their land development permits. This site drains to the Dogas stream and is the likely source of sediment plumes into the Tanapag Lagoon.

Concept

Proper erosion and sediment control needs to be implemented at this site, including maintenance of existing sediment basins, replanting and visible demarcation of riparian and wetland buffers, regrading of rills and gullies and hydroseeding of exposed soils. Some conveyance swales may need to be added to the site to direct surface runoff to basins. Sediment removed from basins could be used to fill erosional features and create diversion berms.

Left abandoned for >5 years, failure to stabilize cleared land does not met federal or territorial NPDES erosion control requirements for construction activities.

Other Considerations

The site is owned by a foreign developer who appears to have abandoned the site. It is uncertain of that territorial agencies have the legal authority or the political will to support an intervention at this site, despite the clear harm to aquatic ecosystems, water quality, and the Tanapag Community.

A planning level construction cost estimate based is provided in the table below. This is a rough estimate.

Over 15 acres cleared in 2018. Sediment plume is visible in google imagery (top)

AS-502 IMPERIAL CASHA			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Sediment Basin Cleanout Excavation	Cubic Yard	$30.00	$10,000.00
Hydroseeding	Acre	$3,500	$20,000.00
Fine Grading	Square Yard	$7.00	$10,000.00
Replanting Buffer	LS		$5,000
		ESTIMATED PROJECT COST	$45,000

Lower Base Pollution Prevention (AS-128 & AS-168)

Project Summary	
Subwatershed	As Agatan
BMP type	Maintenance, sediment forebays and swales, pollution prevention; slope stabilization
DA	15 acres
IC	14 (90%)
Pollutant Removal	75% TSS
Ownership	Public road right-of-way and private businesses
Cost	$50,000-$200,000

Condition

The industrial properties along the Lower Base coastal road (Santa Remedios Dr.) are generating a lot of sediment—primarily from unpaved parking and material storage areas. The concrete swale along road, inlets, and culverts are full of sediment. There is a culvert that has collapsed, and associated stream banks are eroded (may be an old WWII era tidal gate). The industrial properties in the area don't appear to control runoff from their site prior to discharge onto the road. There also does not appear to be consistent maintenance of public drainage structures by DPW or Mayor's office.

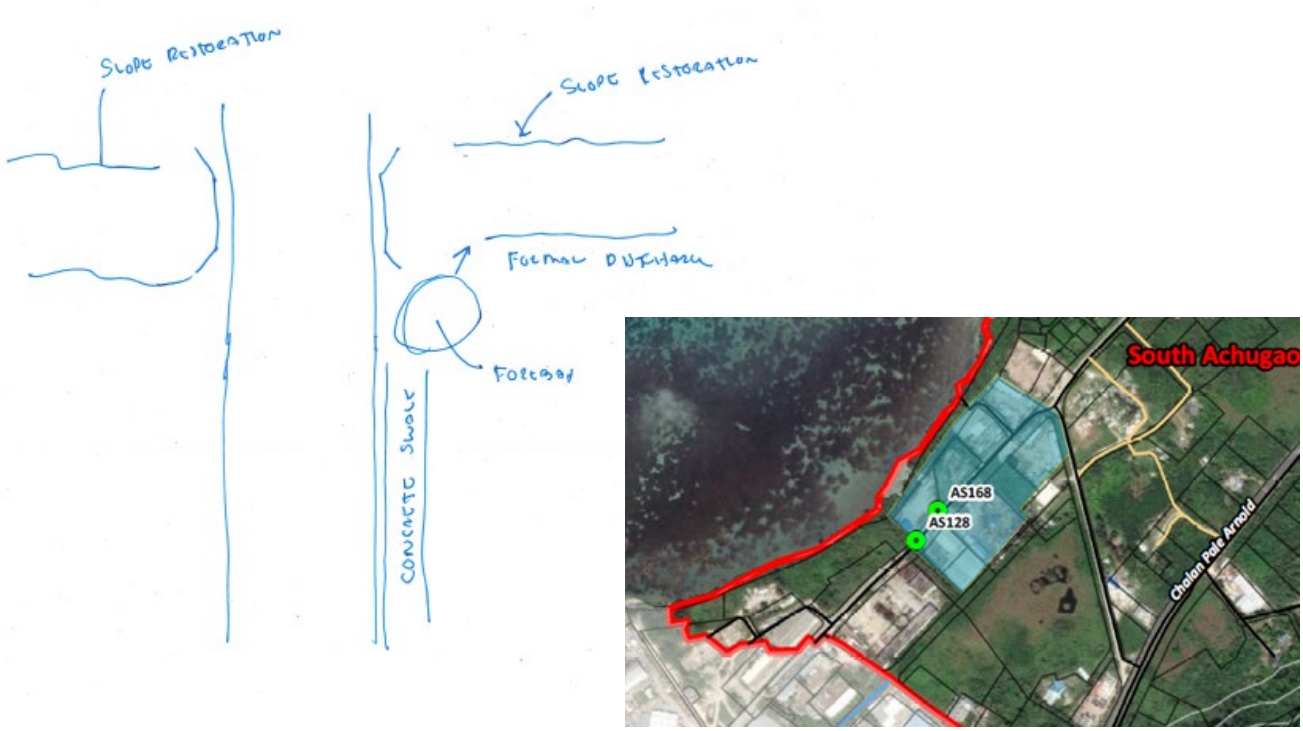
Concepts

There are several good locations where drainage structures can be cleaned or repaired. The main culvert should be replaced and stream side slopes stabilized. Sediment forebays, swales, or other BMPs can be added within the road right-of-way to improve sediment removal and water quality treatment. In addition to the work in publicly owned spaces, this project involves collaboration with each of the business owners in the area to identify pollution prevention opportunities on site and develop Stormwater Pollution Prevention Plans (SWPPPs) with concept designs to reduce sediment and other polluted runoff on individual properties. It would be up to the individual site owners to implement the projects at their facilities.

Sediment in concrete swale from adjacent industrial properties (top). Locations in the road ROW to trap sediment (middle). Collapsed culvert (bottom).

Other Considerations

Access to outfall challenging. Will need to better understand contributing drainage areas and stream flow for designing culvert replacement. Ownership, willingness, and site access will be critical to assessing industrial sites and to understand site operations and maintenance capacity.



Site sketch at culvert needing replacement.

AS-128 & AS-168 LOWER BASE POLLUTION PREVENTION			
ITEM	**UNIT**	**EST. UNIT COST**	**LUMP SUM**
Maintenance	Each	$500.00	$2,500.00
Sediment Forebay	Each	$1,500.00	$6,000.00
Vegetated Conveyance Swale	Linear Feet	$12.00	$6,000.00
Vertical Concrete Curb	Linear Feet	$25.00	$5,000.00
Slope Stabilization	Linear Feet	$25.00	$5,000.00
Rain Garden	Square Feet	$25.00	$20,000.00
Trash Rack	Each	$1,500.00	$6,000.00
Industrial Site Inventory	Each	$1,200.00	$7,200.00
SWPPP	Each	$5,500.00	$44,000.00
		ESTIMATED PROJECT COST	$101,700.00

A planning level construction cost estimate is equivalent to a rough estimate at <5% design and does not include engineering, permitting, contingency, or land purchasing.

UPLAND REFORESTATION

Project Summary	
Subwatershed	As Agatan & Dogas (S. Achugao)
BMP type	Native tree propagation and planting
DA	>6 acres
IC	N/A
Pollutant Removal	Expected increase in sediment reduction
Ownership	Public
Cost	$30,000

Condition

Upland erosion is one of the biggest contributors to impacts on water quality and nearshore (i.e., coral and seagrass) health in the watershed. The upland portion of this priority watershed has been historically deforested and is currently dominated by grasses; these grasses are less effective than forest cover in stabilizing soils and capturing runoff, and more likely to burn which in-turn further exasperates erosion issues. Between 2016-2019, over 450 acres were burned by wildfires. Conversion of low-habitat quality grasslands back to native forest would help control erosion. Reforestation will have additional benefits by reducing fire risk in the area, creating native species habitat and outreach opportunities. Data collected during this project will inform future watershed planning in CNMI and facilitate adaptive management through this project cycle.

Concept

Reforest priority areas starting at the upper ridges of Achugao, converting fire-vulnerable grasslands back into native forest. DCRM hired a coordinator and secured a 2020-2023 DOI CRCP Grant to identify priority areas for reforestation; purchase materials for native tree propagation; DFW and HPO permitting; and conduct out-planting, maintenance, and monitoring to reforest the Achugao watershed. Three areas totaling > 6 acres were identified along Wireless Ridge for initial implementation. DLNR-Forestry is taking the lead on the propagation of native tree species, which requires completion of Kagman nursey repairs and renovations.

Key locations for upland reforestation efforts (top); Kagman nursery repairs (bottom)

Other Considerations

Site selection and equipment purchases have been completed; however, the project is delayed due to due to typhoon damage at the nursery. Propagation of enough trees will require extensive nursery renovation and coordination with DLNR staff. There was also a government contracting delay with MINA who is providing support for the effort.

Wildfire Outreach and Prevention

Island-wide environmental awareness campaign targeting one source of land-based sources of pollution (LBSP): wildfire and resulting erosion and sedimentation.

Project Summary	
Subwatershed	Island-wide
BMP type	Native tree propagation and planting, signage, radio ads
DA	
IC	N/A
Pollutant Removal	
Ownership	Public
Cost	$30,000

Condition

Despite being a major source of LBSP in Saipan, fire has been given less direct attention than other environmental risks on the island (e.g., storm water, invasive species). Between 2016 and 2019, over 450 acres were burned in Achugao, sometimes repeatedly. Efforts on Rota to combat fires and the impact on habitat have seen great success, in large part thanks to outreach campaigns there (e.g., "Real Hunters Don't Burn").

Concept

This project includes collaboration between BECQ-DCRM, DFEMS, and DOI on fire prevention programing and the installation of "threat level" wildfire signage (seven on Saipan, including in Achugao). The purpose is to engage a wider public audience in watershed awareness through media campaigns focused on fire and resulting sedimentation and its impacts locally.

The messaging effort will emulate the work on Rota and adapt it to Saipan's media available and the unique sources of fires on-island. Forms of media will include newspaper and radio advertisements, roadside signage, and smaller informational materials (e.g. stickers, factsheets). Newspaper and radio advertisements will be targeted around the fire season (April – June)

Fire prevention awareness signage

and around fire-risk holidays/events: New Year's Eve, Chinese (Lunar) New Year, and 4th of July (locally "Liberation Day"). Roadside signage will target specific communities most prone to fires, and more specifically to their respective sources of fire as identified by DFEMS (e.g. hunters clearing land for deer grazing habitat in the uplands of Achugao); signs will be constructed and installed with concern for typhoons. Other outreach materials will be circulated at local festivities and events, school presentations, and numerous outreach events.

Success of the project equates to increased awareness among the populace, and a decrease in the occurrence and severity of fires in wild areas is anticipated. Such a result would improve public safety and watershed health, and in-turn the nearshore habitats which include coral reefs.

Other Considerations

Targeting diverse audiences will necessitate use of various media channels and translation across languages. Wildfire threat-level signage was installed on Wireless Ridge Rd.

MANGROVE RESTORATION

Project Summary	
Subwatershed	Achugao shoreline
BMP type	Mangrove restoration
DA	TBD
IC	N/A
Pollutant Removal	Unknown
Ownership	public
Cost	$12,000

Condition

Mangroves are vital ecosystems globally, providing numerous services including habitat for economically important fisheries species (e.g. *Caranx sexfasciatus*, *Lethrinus harak*) and threatened/endangered species (e.g. golden white-eye (*Cleptornis marchei*) and scalloped hammerhead (*Sphyrna lewini*]), carbon sequestration, sedimentation and solid waste catchment, ecotourism opportunities, disaster risk reduction, shoreline erosion control and even sea-level rise mitigation. Remaining mangroves in the CNMI persist in monospecific (*Brugeria gymnorrhiza*) fringe stands along the coastline of northern West Takpochao watershed and select estuarine stream locations in Achugao watershed. The CNMI has become committed towards initiating restoration activities in priority watershed which restore and enhance these and other wetland ecosystems.

Little monitoring or long-term data exists to determine the historical extent of mangroves on Saipan, although has undergone widespread disturbance via Spanish, German, Japanese, and American colonial development; wartime (WWII) activities, munitions and residential waste dumping, and contemporary activities (e.g. Peace Park construction). Archeological and paleoecological studies on Saipan have found evidence for more widespread and biodiverse mangrove forests (Butler 1995, Athens & Ward 2004), including now extinct species — *Rhizophora murconata*, *R. apiculata*, and *Lumnitzera littorea* — as south as Susupe and into norther Achugao; the decline of mangrove abundance in the areas under study correlate with sea-level changes (receding) around 2,500 years before present, however the compounding impacts since human settlement and intensifying development up to today cannot be ignored.

Concept

BECQ-DCRM received a 2021-2022 NOAA CRCP Grant to establish a mangrove nursery and import extirpated species of mangroves for eventual outplanting and restoration activities with support from CNMI and Guam Agriculture Offices, NPS, and DLNR. Sites in Achugao where mangrove planting could be targeted may include Global Saipan shoreline, Tanapag Beach Park, Kensington, etc.

Expanding on a current National Fish and Wildlife Foundation (NFWF) Coastal Community Resiliency grant, this program will work closely with project partners — including develop and construct an *in situ* mangrove nursery to propagate mangroves for out-planting on habitable mudflats at established mangrove sites, including the acquisition, propagation, and reintroduction of the aforementioned locally extinct mangrove species: *Rhizophora murconata*, *R. apiculata*, and *Lumnitzera littorea*.

Year 1 is focused on siting and permitting, and Year 2 will see construction of the nursery and import of extirpated mangroves.

This project has full support from CNMI's Bureau of Environmental & Coastal Quality (BECQ) and Department of Lands and Natural Resources (DLNR) Division of Agriculture, Guam Department of Agriculture, and the National Park Service (NPS). This project has been funded under NOAA's Coral Reef Conservation Program (CRCP) 2021–22 grant.

Other Considerations

Propagation of *Rhizophora murconata* and *R. apiculate* is similar to that of *Brugeria gymnorrhiza*, and not expected to face too many challenges on Saipan; however, propagation of *Lumnitzera littorea* has proven difficult on Guam and elsewhere, and may pose a challenge for this project. Pests may prove detrimental, as previous mangrove reforestation efforts on Saipan have seen depredation of young trees by rats and/or crabs. Out-planting is expected to be conducted under the next 2-year NOAA CRCP grant cycle, although such funds are not guaranteed.

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Butler, Brian M. (editor). 1995. Archeological Investigations in the Achugao and Matansa Areas of Saipan, Mariana Islands. Micronesian Archaeological Survey, Report No. 30. Division of Historic Preservation, Department of Community and Cultural Affairs. Saipan, MP.

Athens, J. Stephens and Jerome V. Ward. 2004. Holocene Paleoenviroment of Saipan: Analysis of a Core from Lake Susupe. International Archaeological Research Institute, Inc. Prepared for: Division of Historic Preservation, Department of Community and Cultural Affairs. Saipan, MP

Watershed Warriors Program

Project Summary	
Subwatershed	North Achugao (San Roque village)
BMP type	Stewardship and Education
DA	N/A
IC	N/A
Pollutant Removal	N/A
Ownership	BECQ-DCRM, PSS, DOI
Cost	$13,140.00

Condition

Land-based sources of pollution (LBSP) are a major threat to watershed health, from stream and drinking water to nearshore habitats like seagrass and coral reefs. The significance of this threat is reiterated from the national NOAA Coral Reef Conservation Program Strategic Plan to the local CNMI Coral Reef Management Priorities, and the CNMI Water Quality Assessment Integrated Report. While watershed issues are understood from a top-down perspective, and efforts are being made towards addressing LBSP (as seen in projects throughout this grant document), the public at-large must be included in the dialogue and informed on the seriousness of the issue in the CNMI. In particular, there is limited opportunity to include youth in natural resource and conservation discussions, and in particular the topic of LBSP has been neglected, and communities outside Garapan have had less opportunities in hands-on, experiential learning with DCRM staff. This project will provide a critical opportunity to engage Achugao youth, and by extension to their families and the community, in conservation activities.

Concept

The Watershed Warriors program is a set of lessons developed for 4th grade students to introduce them to aspects of the environment as it relates to watersheds. Students learn about the water cycle, watersheds, native plants and animals, maps, pollution, waste management, resources management and conservation. This program was developed in 2013 and piloted at Garapan Elementary School, but is formulated to be location-specific and adaptable across Saipan, Tinian, and Rota. For the Achugao watershed on Saipan, emphasis will be given to LBSP, in particular sedimentation and its causes locally. Curriculum will be largely hands-on and outdoor, including maintenance of the school's raingarden and field trips to nearby locations of interest within Achugao. Field trips will be scheduled based on communication with teachers and administrators, and adapted based on season, topics of interest, accessibility and location relative to the school. Additional assistance may be provided by high school and college groups to allow service learning opportunities for older students.

After a successful first year of Watershed Warriors at the GTC Elementary School, the program is expected to continue to grow

Other Considerations

Access to school may be difficult with COVID precautions, requiring adaption of proposed strategies.