Memorandum

Date: February 13, 2010

To: Evangeline Luan, Guam Coastal Management Program;
Kathy Chaston, NOAA Pacific Services Center

From: Anne Kitchell, Horsley Witten Group,
Kelly Collins and David Hirschman, Center for Watershed Protection

Re: Summary from August 31-September 4, 2009 Guam Better Site Design Workshop and Piti-Asan Watershed Field Assessment

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This memorandum summarizes discussions and recommendations generated during a one-day training workshop by the Center for Watershed Protection (CWP) and Horsley Witten Group (HW) on better site design and stormwater management supported by the Guam Coastal Management Program (GCMP), Guam Environmental Protection Division (GEPA), and National Oceanic and Atmospheric Administration (NOAA) Coral Program. Workshop participants primarily included representatives from the development community, engineering consultants, military, and agency staff. After the workshop, CWP and HW met separately with GEPA on the status of post-construction stormwater regulatory updates initiated after a 2008 training conducted by CWP; recommendations from that meeting are included here. CWP and HW also spent two days in the field with agency staff from GCMP and GEPA, non-profit representatives, and students from the University of Guam (UOG) evaluating existing conditions and restoration priorities in the Piti-Asan watershed. Findings and a watershed management framework are presented in this memorandum.

The memorandum is organized into four sections:

Section 1.0 Better Site Design/Low Impact Development Workshop
Section 2.0 Stormwater Management Regulation Update
Section 3.0 Piti-Asan Watershed Findings and Recommendations
Section 4.0 Progress and Status on Items from 2008 CWP Workshop

Workshop evaluations, BMP design adaptation summaries, and concept descriptions for some of the priority watershed projects are included as attachments to this memorandum.

All workshop materials including slideshows, handouts, maps, participant's list, and additional resources can be downloaded directly at:
http://www.cwp.org/Our_Work/Training/temp_wrkshp/index.htm

1.0 Better Site Design/Low Impact Development Workshop

The CWP training in 2008 led to a recommendation for GCMP to provide specific training to the development community (i.e., developers, engineers, military) on better site design (BSD) techniques to minimize impacts of new construction on Guam's surface and groundwater resources by applying the standards of the 2006 Guam/CNMI Stormwater Manual. BSD or Low Impact Development (LID) techniques minimize impervious cover, mimic on-site natural hydrology, and reduce impacts to natural areas during new construction and redevelopment projects. This topic was considered critical given the pending base expansions and associated new construction anticipated over the course of the next decade.

The purpose of the workshop was to introduce effective watershed planning, stormwater management, and site design techniques that could be used island wide on Guam, and also to solicit feedback and ideas for four island-specific BMP designs. The one-day workshop covered four areas: (1) applying BSD/LID techniques on Guam; (2) updating erosion control and stormwater regulations; (3) envisioning island stormwater practices; and (4) managing stormwater for transportation projects. There were over 70 attendees.

The workshop began with a welcome by Tony Lamorena, the Director of Guam's Bureau of Statistics and Plans, followed by an overview of the impacts of stormwater on coral reefs by Kathy Chaston from NOAA. CWP and HW then discussed many site planning and innovative stormwater management practices that could be implemented on development sites to reduce the negative impacts of stormwater runoff. Participants were then divided into small groups to examine three local site plans: the Talo Verde subdivision, Santos Memorial Park, and Tumon Bay Shopping Center and Condominiums. The objective of the exercise was for the teams to envision general approaches whereby BSD/LID techniques could be incorporated into these real-world sites (Figure 1).


Figure 1. Attendees worked in small groups to redesign an existing site plan using BSD/LID techniques. Groups were asked to report out to the full group.

In the afternoon, GEPA presented information on new erosion control and stormwater regulations being developed for Guam. CWP then presented ideas for four innovative island specific stormwater practices, which included multi-cell ponding basins, island bioretention, permeable parking, and rainwater harvesting. Workshop participants discussed the designs and provided comments on island design considerations, materials, and additional features of the practice designs (Figure 2). A summary of participant comments on these practices are included as an attachment. CWP and HW are in the process of developing details and specifications for these practices based on this feedback.

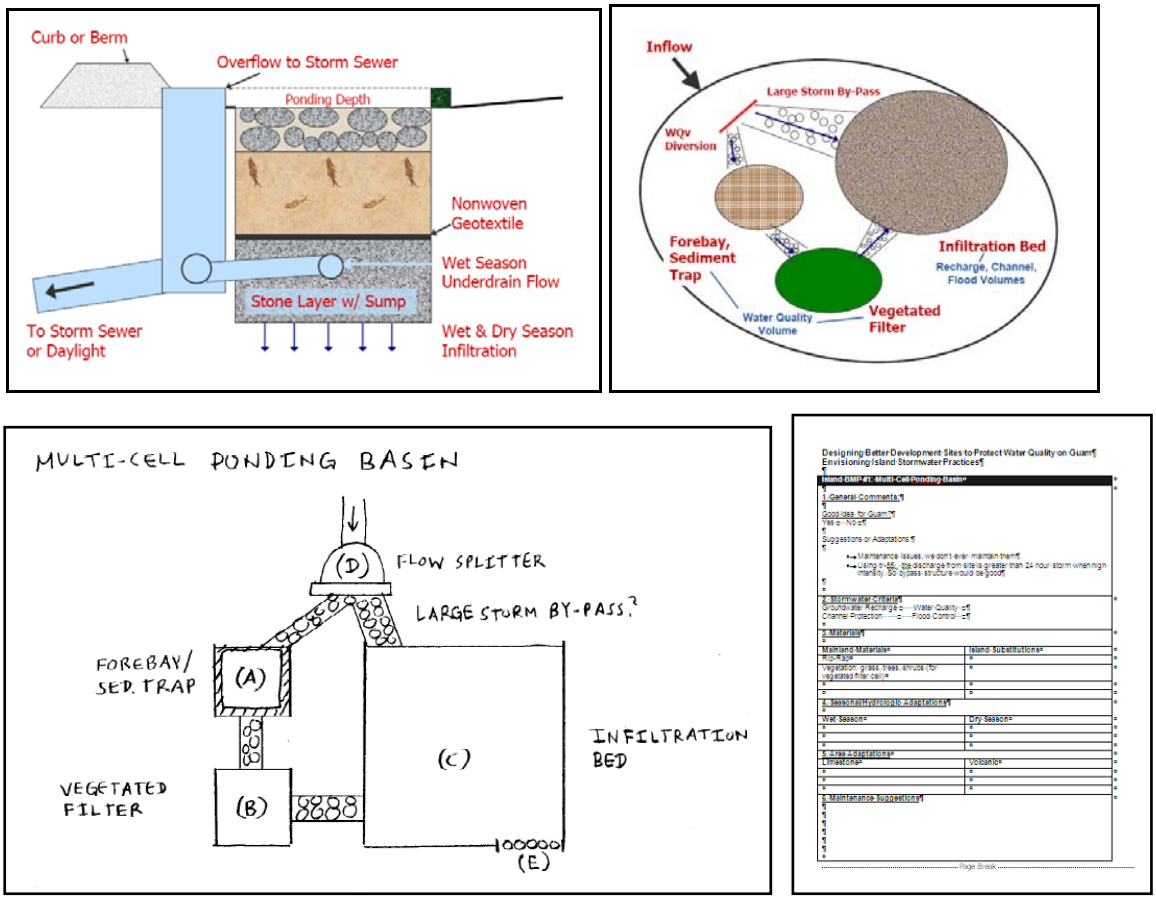

Figure 2. Four specific stormwater practice designs including island bioretention and multi-cell ponding basins were presented. Participants were asked to discuss/complete worksheets to solicit feedback on available materials, hydrologic and seasonal adaptations, maintenance, and other recommended features.

Leslie Lahndt, of Parsons Transportation Group, reported briefly on efforts to develop transportation stormwater best management practices (BMPs) for Guam. At the end of the afternoon, workshop participants returned to small groups to finish the site redesign exercise and present their BSD/LID design adaptations (Table 1). The main point of the group exercise was not so much to redesign these three sites (which have already been approved and partially built), but to show that BSD/LID can be incorporated in the real world and can, it is hoped, be incorporated into future sites on Guam.

Table 1. Site Redesign Activity Summary	
Talo Verde Subdivision	• Capture and treat stormwater runoff on each residential lot using rain gardens • Add vegetation to park in the middle of the neighborhood • Add landscaped bioretention in the center of cul-de-sacs to reduce impervious cover and treat stormwater
Tumon Bay Shopping Center and Condominiums	• Use a multi-cell ponding basin to treat site runoff • Use bioretention and permeable pavement to treat parking lot runoff • Reduce the parking lot size by using more structured parking or compact stalls • Reconfigure building design to reduce site impervious cover footprint and increase open space
Santos Memorial Park	• Harvest rainwater from building structures and re-use water for landscape irrigation • Use permeable pavement walkways and parking stalls • Increase tree canopy by planting additional trees

The Tumon Bay site used in the exercise was located across the street from the workshop, and currently under construction. Participants were able to actively observe sediment laden runoff discharging from the site during a rainstorm on to the street. Perimeter ESC controls (i.e., silt fences, stabilized construction entrances) were not installed at the construction entrance observed. Once the rain stopped, a site worker used a hose to wash the sediment on the street into the nearest storm drain inlet; which reportedly discharges into a publicly-owned underground infiltration practice across the street (Figure 3).

Figure 3. Teaching point across the street from the workshop at Tumon Towers construction site where lack of proper ESC practices at site entrance resulted in off-site sedimentation.

Key recommendations to further advance BSD/LID and promote improved stormwater treatment that were generated from workshop include:

- Once the BMP specifications are finalized, GCMP should consider providing another series of training for engineers and plan reviewers specifically addressing the design, construction, and maintenance of these practices. Part of the training could include visits to a variety of existing facilities (i.e., the "island bioretention" across street from GEPA).

- It is critical to install demonstration practices as soon as possible to show how these facilities work and to gain experience in the construction and maintenance process (Figure 4). Grant funding should be solicited as soon as possible to identify appropriate retrofit locations (i.e., public property). Several potential locations for demonstration projects were identified in the Piti and Asan Watersheds (see Section 3.0).
- The 2006 Guam/CNMI Stormwater Design Manual needs to be posted on the GEPA webpage. Consider developing a webpage specifically for stormwater treatment, with links to individual design schematics, permits, inspection checklists, etc.
- Guam DPW is in the process of developing a supplement to the Stormwater Manual specific to road transportation projects. Without inter-agency coordination, there is the potential for conflicts to arise between DPW's new stormwater criteria for road projects and the Guam stormwater manual. GEPA and DPW should work together to integrate these criteria early in the process to avoid a reduction in water quality treatment requirements.
- Maintenance of existing facilities should be evaluated by GEPA or GCMP to assure these practices are managing stormwater as designed and to ensure longevity of the facility. This evaluation may help assess gaps in overall maintenance, and should be combined with a GIS inventory to track existing practices.
- GEPA and GCMP should continue to communicate with the Department of Navy regarding stormwater management for new development. Improved treatment prior to direct infiltration of stormwater into the northern aquifer is critical to prevent contamination of drinking water supplies.
- Consider conducting a stormwater retrofit inventory and pollution source assessment for the Tumon Bay area.
- Investigate incentives to further encourage use of Better Site Design and LID, particularly while the stormwater manual remains voluntary.

Figure 4. An example of a BMP that could be used as a demonstration for design, construction, and maintenance of an innovative BMP is located at Core Tech, which is across the street from GEPA. This coral stone infiltration practice is located in the landscape island of this commercial parking lot. Curb cuts allow stormwater to flow into the coral stone filter. An adjacent construction site lacking proper ESC practices has discharged sediment off-site, causing additional maintenance and potential clogging of this private facility.

2.0 Stormwater Management Regulation Update

CWP and HW met with GEPA staff on September 2, 2009 to specifically discuss progress on GEPA's update to the stormwater management regulations. Subsequent to the 2008 training workshop, CWP conducted a review of the existing regulations and drafted recommended changes to incorporate construction and post-construction stormwater standards from the 2006 Guam/CNMI Stormwater Manual. Since then, GEPA has been evaluating these recommendations internally and developing a final draft of regulatory language. Draft regulations for legal review were forwarded from GEPA to the Attorney General on February 2, 2010. In addition, DPW has contracted with Parson Group to develop a set of stormwater management criteria specific to road projects.

Recommended actions from this meeting include:

- Up to this point, the standards of the 2006 Guam/CNMI stormwater manual have not been officially adopted. While mandatory for public projects, the stormwater management criteria are voluntary for the private sector, and possibly the military. There is concern that continued delay in adoption and codification of these standards jeopardizes protection of drinking water and surface water resources from polluted stormwater runoff, particularly as development occurs as a consequence of the BRAC. Since the workshop, it is a very positive outcome that the regulations have been forwarded for legal review. The regulatory adoption process will require all involved to stay informed and make sure the regulations are adopted in a timely manner.
- Without inter-agency coordination, there is the potential for conflicts to arise between DPW's new stormwater criteria for road projects and the stormwater manual. GEPA and DPW should work together to integrate these criteria early in the process to avoid a reduction in water quality treatment requirements.
- Based on observations in the field and from our experience in other jurisdictions, we strongly recommend pursuing inclusion of a Post-Construction Performance Bond. Performance bonds are required for other aspects of the construction process on Guam, so it would not be overly burdensome to apply this financial surety to erosion control or post-construction stormwater facilities. Such a bond would provide the financial resources for GEPA to maintain and repair structural practices if the developer fails to do so. There is an administrative cost associated with such a program. During the Piti-Asan watershed assessment, we observed an abandoned construction site with failing erosion and sediment control practices. This site continues to export sediment and could be stabilized by GEPA if such a bond had been required.
- To provide better access to the 2006 Guam/CNMI Stormwater Manual, its supplements, and forthcoming CAD design schematics, we recommend GEPA host a dedicated website for stormwater management to include quick links to stormwater regulations, manuals, permits, and design details.

These recommendations are supported by the new 2012 Natural Resources Protection Strategy for Guam:

> ***Wetlands and Watersheds Goal 1.*** *Implement CNMI and Guam Stormwater Management Manual as an enforceable regulation. Integrate Stormwater Management Manual with the Guam Soil Erosion and Sedimentation Control Regulations or promulgate separate stormwater management regulations that require the manual's implementation.*
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> ***Wetlands and Watersheds Goal 2****: Develop design guidelines for development and integrate stormwater and site design standards. At a minimum, use the Better Site Design and Structural BMPs from Volume II of the CNMI and Guam Stormwater Management Manual as a basis for developing user-friendly publications and Web-based guidance for developers and home-builders. As an interim measure to stormwater regulations, request the Governor to issue an Executive Order to the Guam Land Use Commission, Department of Public Works, and Guam Environmental Protection Agency to require appropriate stormwater design BMPs and other measures from the manual as conditions of land use permit approvals.*

At this time, CWP/HW also discussed completing the Ugum watershed plan to meet sediment load reduction requirements. Badland restoration is the primary restoration activity in this undeveloped watershed, and most of the work to date has been conducted by the University of Guam, Forestry, and USDA/NRCS. We recommend GEPA facilitate a strategic planning meeting of the interested parties in order to gain a full understanding of all agency and university efforts, and to agree upon priorities and responsibilities for implementation. GEPA should compile existing information into a simple report clearly outlining a scheduled implementation strategy and associated monitoring plan. Progress should be tracked and reported annually.

3.0. Piti-Asan Watershed Findings and Recommendations

The Piti-Asan watershed is located on the northwestern coast of central Guam (Figure 5). It is mostly undeveloped (i.e., scrub forest, savanna, wetlands, and badlands) in the area between the shoreline residential and commercial areas along Marine Corps Drive (Route 1) and the military and civilian residential areas along the upper ridgeline. The Piti subwatershed (~1.8 sq miles) is drained by three main rivers: the Masso, Taguag, and the Matgue. Noteable features include the Piti Village, the Rios Elementary School, Masso Reservior (Navy impoundment), Piti Bomb Holes Marine Preserve, Piti Guns National Historic Park (NHP), and Pedro Santos Memorial Park. The Asan Village, War in the Pacific NHP, and the Nimitz Hill memorial are located in the Asan subwatershed (~4.5 square miles), which is drained by the Asan River and an unnamed tributary.

The Piti-Asan watershed was identified by GCMP as a priority for management. It is the site of nearshore monitoring efforts related to the Piti Bomb Holes Preserve, has been the focus of badland/reservoir restoration activities by DANR and NPS, and is undergoing conservation area planning (CAP) and Local Action Strategy development led by the The Nature Conservancy (TNC) and GCMP. A two-day reconnaissance of the watershed was conducted in late August 2009 by CWP, HW, NOAA, GCMP, GEPA, WERI, and other interested parties to: (1) identify sources of pollutants and locations of watershed impairments; (2) meet with local residents; (3) evaluate restoration and pollution prevention opportunities; and (4) provide informal training to agency staff on assessment protocols.

It is our understanding that GCMP is developing a comprehensive watershed plan for the Piti-Asan. The information presented in this section is intended to provide a basic framework to

assist in this effort. The preliminary goals, management strategies, and restoration priorities outlined here are based on observations from our field assessment and conversations with staff and local residents. Refinement of these findings by GCMP is anticipated as the watershed planning process further evolves.

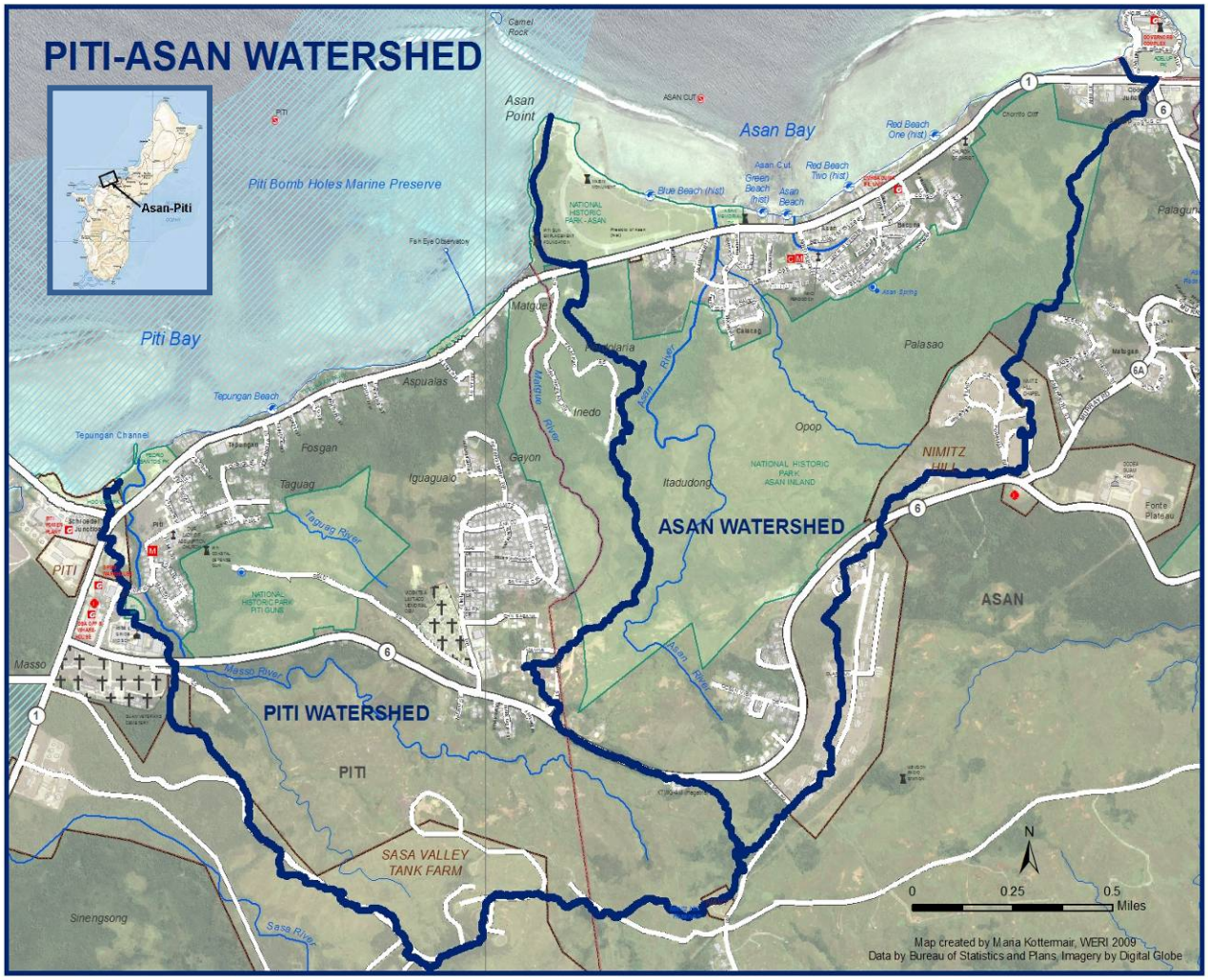

Figure 5. Map of the Piti/Asan Watershed (WERI 2009)

3.1 Management Goals and Key Strategies

There is much work currently being done in the Piti-Asan, and a comprehensive watershed plan could be used to provide a big-picture framework to coordinate and implement these agency and non-agency efforts. We recommend establishing overarching management goals for the Piti-Asan that integrate objectives from multiple resource conservation and restoration planning efforts, and that reflect a variety of perspectives. The watershed plan will have a greater chance of being implemented if it incorporates and synthesize all the ongoing efforts and stakeholders.

Table 2 summarizes several of the relevant goals and objectives from a number of interrelated planning efforts. We recommend reviewing the 2012 Natural Resources Strategy for the Guam Buildup, as well as the badland/forest management goals of the NPS and DANR as final watershed goals are being developed.

Table 2. Summary of Relevant Watershed Goals and Objectives from Other Efforts

TNC Conservation Area Planning (CAP, draft)	• Implement a 2-year outreach campaign to promote watershed stewardship among residents • Increase native canopy cover to 80% of the total cover by 2018 • Decrease occurrence of invasive plant species by 50% by 2018

GCMP Local Action Strategy (LSA)	• Improve health of coral reef ecosystems by reducing amount of sediment and pollution from development, fires, and agriculture.
	  • Monitor water quality and implement EPA EMAP (objectives h,j)
	  • Develop and implement a comprehensive plan to identify pollution sources and restore impaired water quality (obj. k)
	  • Reduction of sedimentation and restoration of badlands (obj. l)
	  • Educate the community (obj. m)
	  • Conduct watershed restoration training and staff development in erosion control measures for reducing sedimentation (obj. o)
	• Reduce impact of military buildup on water resources by:
	  • Implement CNMI/Guam stormwater management manual as an enforceable regulation
	  • Develop watershed management plans for several critical watersheds

NPS. Minton. 2005. Fire, Erosion and Sedimentation in Asan-Piti Watershed. pg 3	• Quantify coastal sedimentation and estimate the potential "zone of impact" on the reef from the discharged sediments in the target watersheds. • Investigate the efficacy of using anti-erosion plants such as vetiver grass (*Vetiveria zizanioides*) to reduce soil erosion and improve soil quality. • Develop Best Management Practices (BMPs) to reduce upland erosion and coastal sedimentation.
Piti Community Association Meeting*	• Improve enforcement of ESC during construction • Prevent arson • Provide educational program on development regulations • Incorporate performance bonds for stormwater practices • Provide residents with opportunities for native vegetation planting and trash cleanups • Administer a complaint hotline for citizens to report waters pollution
DANR (personal communication)	• Restore capacity of Masso Reservoir and protect endangered species • Reduce erosion from badlands
Guam Visitors Bureau (GVB)	• Plant a million native trees
* Evening meeting of watershed residents organized by Peggy Denney. We reviewed information on the watershed assessment and residents provided feedback on their priorities.	

From a review of these initiatives, and based on our understanding of watershed conditions, we propose the following goals as a preliminary "strawman" for the Piti-Asan watershed management plan:

Goal #1. Protect and improve the health of major rivers and the Piti Bomb Hole Marine Preserve by reducing sediment and other pollutant loadings from badlands, channel erosion, and urban stormwater runoff.

Goal #2. Promote watershed stewardship, historic preservation, and interagency coordination by developing a comprehensive management approach for the Piti-Asan watershed that can serve as a model for other watersheds on Guam.

To meet these goals, we recommend the following management strategies for the Piti-Asan (in order of priority) and described in more detail below:

1. **Reduce erosion from badlands through replanting and fire prevention activities. Continue and enhance existing efforts for revegetation, reforestation, and education and outreach.**
2. **Protect water quality by requiring new development projects to apply BSD and meet criteria of 2006 Guam/CNMI Stormwater Manual. As part of this effort, incorporate the four new Island BMP Specifications by reference into the Manual.**
3. **Minimize sediment loading from construction sites through enforcement and application of ESC techniques.**
4. **Pursue priority stream, shoreline, and reservoir restoration projects.**
5. **Retrofit publicly-owned areas to improve stormwater quality treatment, solve flooding problems, and demonstrate innovative practices.**
6. **Improve watershed awareness and stewardship through storm drain stenciling, watershed signage, residential rain garden programs, radio announcements, etc.**
7. **Establish a commercial and municipal pollution prevention program.**
8. **Assign a watershed coordinator to oversee implementation, track and report restoration progress, and integrate monitoring efforts of WERI, Park Service, and other federal/territorial agencies.**

1. Reduce erosion from badlands through replanting and fire prevention activities. Badland erosion is considered one of the most significant sources of sediment in the Piti-Asan, and in other watersheds on Guam (i.e., Ugum). DANR, Fish and Wildlife, Forestry & Soil Resources Division, the military, and the Park Service all have initiatives underway to replant, fence out ungulates, and prevent arson. To reduce sedimentation in the Masso Reservior, for example, eight acres of badlands are being stablized with 6-inch Acacia saplings (nitrogen fixing, soil enrichment), then a year later with native vegetation/understory including Pago (fast growing, broadleaf) and Pandanus (slow growing) in conjunction with reservoir dredging (Figure 6).

GVB also has a million native trees initiative which could be linked with large scale replanting efforts. As part of this effort, the Navy has set up plots to study the effectiveness of Vetiver and erosion control blankets at preventing soil loss on slopes. Other engineering techniques to stabilize exposed slopes using terracing, erosion control matting, and vegetation have also been used in Guam (Figure 7).

Figure 6. Hillside above Masso Reservoir has been the location of extensive badland replanting efforts to stabilize slopes and prevent erosion. Photo on left shows Acacia planted 1-2 years ago to help enrich soils in preparation for subsequent planting.

Figure 7. Restoration of eroding hillside above Nimitz Estates residential neighborhood showcases another approach to stabilizing exposed slopes.

2. Protect water quality by requiring new development projects to apply BSD and meet criteria of 2006 Guam/CNMI Stormwater Manual. Restoration efforts seem less meaningful if measures to prevent additional water quality degradation from new development are not taken. Indeed, this is critical given pending base expansion activities. GEPA, DPW, CGMP, and other agencies should work cooperatively to adopt the stormwater standards for construction and post-construction activities as detailed in the stormwater manual, at a minimum. The four new Island BMP Specifications being developed by CWP and HW should be incorporated by reference into the Manual. The codification of the standards into the regulations and permitting process should and must be followed up with relevant review, inspection, and enforcement policies.

3. Minimize sediment loading from construction sites through enforcement and application of ESC techniques. Soils exposed during the construction process can be highly susceptible to erosion. Therefore, efforts should be taken to reduce the amount of clearing and grading to the minimum necessary, and to install and maintain the appropriate erosion and sediment control practices. This is an island-wide issue, but has specific application in the Piti-Asan where a large construction site (the JHT construction site on Nimitz Hill) was found in violation of ESC requirements in February-March 2008. A follow-up evaluation of this site in August-September 2009 revealed that even though the site is no longer active, it remains a source of sediment due to the same ESC practice failures which were in violation the previous year (Figure 8). Collection of a performance bond is one tool that would help provide GEPA with the financial and regulatory means to repair/install appropriate ESC practices in the case of an absentee and/or negligent developer.

Figure 8. Exposed soils, eroded slopes, and failing perimeter silt fences that were observed in 2008 (photos on left) were also observed in 2009 (photos on right).

4. Pursue priority stream, shoreline, and reservoir restoration projects. A number of streambank stabilization and reservoir restoration activities are occurring along the Masso River in the Piti subwatershed. Eroded streams can contribute sediment to nearshore reefs and can threaten private property and public infrastructure. Lack of vegetation with stabilizing root systems and canopy cover adjacent to streams can exasperate channel erosion problems, reduce stream shading/temperature control, impact instream habitat, and encourage invasives (Figure 9). There are a number of anadromous species (i.e., gobies, shrimp) that require adequate stream habitat and water quality conditions to migrate upstream. There is a general preference for "soft" vegetated stream and shoreline stabilization practices that mimic natural habitat conditions, rather than rock, concrete, or gabion baskets where feasible (Figure 10). The Masso Reservoir dredging project and proposed upstream impoundments (two on-line weirs) will trap sediment and provide habitat for endangered waterfowl; however monitoring indicates turbidity increases somewhere between the reservoir and the Masso River bridge, likely from stream bank erosion.

Figure 9. Vegetated stream corridor of Pandanus, Pago, and other native species along the Masso River (photo on left) as compared to the lower reaches of the Asan River (photo on the right) where no canopy cover exists, stream banks stabilized with rock, and in-stream habitat conditions are poor.

Figure 10. Bank erosion near Masso River Bridge contributes to stream turbidity (photo on left). This site is being stabilized primarily with gabion baskets, though additional banks and buffer plantings are encouraged. Bank collapse and shoreline erosion at Santos Memorial Park (photo on right).

5. Retrofit publicly-owned areas to improve stormwater quality treatment, solve flooding problems, and demonstrate innovative practices. There are a handful of existing stormwater management facilities (i.e., ponding basins) in the Piti-Asan watershed. However, most of the existing development appears to discharge directly to the stream network via ditches and storm drain pipes without treatment. A number of opportunities at public facilities and in residential areas were identified that would serve as highly visible demonstration projects for the use of bioretention facilities, swales, rain gardens, and or multi-celled ponding basins (Figures 11-12). Attached to this memo are more detailed descriptions of retrofit concepts at priority sites.

Figure 11. A rain garden similar to the one shown here (photo on left) capturing runoff from a maintenance yard parking lot on Saipan could be installed on the side of the Asan Village Mayor's office (photo on right) as a demonstration project to manage rooftop runoff.

Figure 12. A good example of a BMP design at an light industrial site that includes a pretreatment swale to a wetland/bioretention area. The owners of this facility should keep up with the proper maintenance of this facility.

While not required, retrofitting existing development to capture and treat this runoff prior to discharge can not only help improve water quality, and can also improve drainage conditions, such as flooding problems and sediment export at the Rios Middle School (Figure 13).

Figure 13. Roof runoff, in addition to exposed and compacted soil in courtyards at the Rios Middle School can contribute large volumes of runoff and sediment during intense storm events (upper left and upper right). This runoff has been known to flood classrooms and parking lots (lower left), and sends sediment plumes to roadside ditches which discharge into Piti Bay (lower right).

6. Improve watershed awareness and stewardship through storm drain stenciling, trash cleanups, watershed signage, residential rain garden programs, radio announcements, etc. A number of opportunities to educate and engage the public in watershed restoration exist in the Piti-Asan watershed, including the existing Masso River trash cleanups and a rain garden program run by Peggy Denney, which targets residents of the Piti subwatershed. Elevating community awareness through the installation of stormdrain markers on curb inlets and watershed signage at Santos Memorial Park, for example, can help make residents and visitors aware of how land use activities can impact Piti Bay. Additional outreach activities for tree planting, stream cleanups, and residential stewardship were identified at key locations in the watershed (Figures 14 and 15).

An education and outreach strategy should be developed as a component of the watershed plan to help support implementation efforts

Figure 14. Peggy's weekly environmental radio show frequently covers watershed and stormwater related topics, and could be a vehicle for promoting additional watershed messages (photo top left), such as being aware of automotive fluids making their way into the storm drain with do-it-yourself repairs (bottom left). This storm drain inlet near the Asan Village shows evidence of a previous stormdrain marking effort (top right). Use opportunities to link trash cleanup at outfalls with upstream pollution prevention (bottom right).

Figure 15. While on Guam, CWP and HW staff met with representatives of the Piti Community Association (along with Peggy Denney) to discuss various stormwater and water quality initiatives, including the possibility of residential rain gardens. We also visited an interested landowner to discuss specific possibilities to capture and treat runoff from a residential compound. Residential (and commercial) stewardship programs can be an important part of the watershed plan.

7. Establish a municipal and commercial pollution prevention program. Pollution prevention includes the proper management of outdoor storage and waste materials; preventing wastewater or other illicit discharges into the stormwater network; street sweeping and catch basin cleanouts; and other activities to prevent pollutants from coming into contact with stormwater runoff. Long-term maintenance of existing BMP's to ensure proper function can also be considered a pollution prevention activity. There are a number of public and commercial sites in the watershed that could use technical assistance with evaluating on-site sources of pollution and developing strategies to minimize them (Figure 16).

Figure 16. Outdoor material storage at commercial facilities draining to the Asan River should be protected via secondary containment and/or covered to prevent contact with stormwater runoff (top left and right). Large debris in Asan River backed up against sewer line could result in a leak/break (middle left). Loading docks and areas where materials are transferred have a high potential for spills (middle right). At or near the GSA, the storage of hazardous, unlabeled waste material adjacent to ditches is risky (bottom left), and evidence of dumpster juice draining from uncovered collection bin is suspect (bottom right).

8. Assign a watershed coordinator to oversee implementation of the watershed plan, track and report restoration progress, and integrate monitoring efforts of WERI, Park Service, and other federal/territorial agencies. Hiring or assigning dedicated staff to oversee implementation of the watershed plan is critical to ensuring that the watershed plan doesn't sit on a shelf. Given the number of concurrent efforts and future restoration activities, proper tracking and progress reporting will allow GCMP to take credit for these activities for meeting LAS, NPDES, and other federal program requirements. Between DANR, the Park Service, and WERI, a variety of monitoring efforts are in place to measure sedimentation rates throughout the watershed. Integrating these efforts with performance monitoring for restoration projects will help show the effectiveness of watershed plan implementation on meeting watershed goals.

3.2 Restoration Projects

A number of restoration projects are underway in the Piti-Asan watershed, including retrofitting at Santos Memorial Park, Masso River streambank stabilization, Masso Reservoir dredging, and badland restoration by DANR and NPS. The CWP and HW team identified a number of additional opportunities for stormwater retrofitting, pollution prevention and stewardship activities, and stream buffer enhancement. Table 3 summarizes the major restoration projects we are aware of in the watershed and potential projects identified during the field assessment. Projects marked with an asterisk are considered by CWP/HW to be high priorities for stormwater retrofit demonstrations and further detail is provided as an attachment to this memo. The locations of these sites are depicted on the map in Figure 17.

It should be noted that a number of locations throughout the watershed were either not visited during our field investigations or require further evaluation. For example, none of the military properties along the watershed ridgeline or the industrial area around the power plant was visited. Further exploration of the surface hydrology in the Asan Village is recommended as there were a number of locations where drainage flow (either intermittent streams or springs) was discharging across individual yards, staircases, and driveways before entering the storm drain network (Figure 19). There may be upstream retrofit options upstream that could alleviate some of these flooding concerns.

As part of the watershed planning process, we recommend reviewing this list of projects, and adding any other efforts/opportunities known. As a group, consider which projects are implementation priorities and begin establishing a strategy for moving forward that includes a timeline, cost estimate, who will take the lead on it, and how can it fit into an overall watershed education and monitoring plan. Answering these questions for each priority project will serve as the foundation for building your watershed implementation strategy.

Table 3. Summary of Existing and Potential Restoration Projects in Piti-Asan								
Map ID	**Name**	**Site Description**	Badland Restoration	Stormwater Retrofit	Stream Restoration	Maintenance/ Pollution Prevention	Stewardship
1	**GSA***	• Government disposal/recycling yard • Bioretention in grassed area out front to capture rooftop and parking area runoff • Consider cisterns for rooftop downspouts • Relocate barrels behind fire station; cover dumpsters; provide secondary containment for hazardous substances; prevent automotive fluids from dripping on pavement		✓		✓	
2	**Rios Middle School***	• Flooding of first floor classrooms and parking lot during rain events; sediment from eroding courtyards and turf areas in back flows to roadside ditches then to Bay • Mulch and erosion control matting in courtyards; grid/grass pavers in side parking • Install diversion trench to redirect runoff to large bioretention practice • Maintenance of sediment sumps/forebays		✓			✓
3	Masso Reservoir Dredging and Badlands Restoration (see Figure 6)	• Dredging reservoir back to 8 ft depth in open water; anticipated 30 year capacity; dredge material dewatered on slope with some distribution of material to farmers. • 8 acres of replanting in upland badlands area (Navy mitigation funds); 4 additional acres (funded by Fish and Wildlife); fencing; Navy Vetiver and ECB study plots. • 2 on-line sediment traps in channel; each 10 ft wide concrete base, v-notch weir 14" above stream invert.	✓		✓		
4	Masso River/ Assumption Stream Restoration and Buffer Planting (see Figures 9 and 18)	• Streambank stabilization near Assumption Rd. bridge crossing already designed. Will include use of gabion baskets. • Bamboo removal on downstream side of bridge. • Recommend additional tree planting along buffer (school side) and removal of debris from scupper drains. • Recommend removal of residential debris and yard waste from edge of stream. • Location of Masso River Cleanup events.			✓	✓	✓
5	Pedro Santos Memorial Park (see Figure 9)	• Park restoration activities underway that may include shoreline stabilization; rainwater harvesting at bathouse; and permeable pavers in parking lot. • Bioswales to be used along roadside. • Educational watershed signage to be included.		✓	✓		✓

Table 3. Summary of Existing and Potential Restoration Projects in Piti-Asan

Map ID	Name	Site Description	Badland Restoration	Stormwater Retrofit	Stream Restoration	Maintenance/ Pollution Prevention	Stewardship
6/15	Cleanup at Piti Outfall and Asan River Outlet (see Figure 14)	• Link with existing volunteer trash /debris cleanup efforts. • Host Biannual events.					✓
7A/B	**Fish Eye Parking Lot and Bus Loop***	• Install stormwater wetland in grassed area near parking lot to alleviate flooding. • At bus loop area, install perimeter coral stone filter for water quality treatment. • Highly visible public site, good for demonstration and education, particularly showing link between stormwater and aquatic resources such as the adjacent coral reef.		✓			✓
8	NRCS 2007 Slope Restoration (see Figure 7)	• Residential slope stabilization in the Nimitz Hill Subdivsion showcases a combination of "hard" and "soft" stabilization techniques. • Monitoring vegetative establishment and success at reducing erosion.	✓				
9	JHP inactive construction site (see Figure 8)	• Seed and stabilize exposed soils and slopes on site. • Install or repair erosion control practices, particularly perimeter controls. • Inspect site after significant rainfall events.				✓	
10	SWL Diamond stormwater practice (see Figure 12)	• Consider using as a demonstration site for a water quality stormwater practice with pretreatment grass swale. • Perform maintenance as needed, primarily on vegetation.				✓	✓
11/12 (same map location)	**Asan River/ Limtiaco St. Community Rain Garden and Plantings***	• Residential street draining to cul-de-sac adjacent to river. • Install community rain garden and plant native canopy trees along stream buffer. • Install educational signage and picnic tables.		✓	✓		✓
13/17	Asan River/ Unnamed Tributary Management (Figure 18)	• The River corridor through the Asan Village has been channelized and banks hardened with concrete. The native buffer has been encroached upon by houses/yards, and the buffer vegetation has been replaced with grasses requiring constant mowing/weeding • Livestock/domesticated animals in the stream (caribou, chickens, goats, and dogs) could contribute to bacteria loads. • Trash cleanups, and native canopy tree planting along stream, and no-mow zone along streambanks where feasible. • Remove debris blockages at all bridge and utility line crossings to prevent water backup and sewer/water line breaks.			✓	✓	✓

Table 3. Summary of Existing and Potential Restoration Projects in Piti-Asan

Map ID	Name	Site Description	Badland Restoration	Stormwater Retrofit	Stream Restoration	Maintenance/ Pollution Prevention	Stewardship
14	Stream Restoration/ Sediment Trap (Figure 18)	• Stream comes out of forest to open, exposed area. Turbid conditions observed. • If instream sediment traps or weir systems (like in Masso) are being pursued, this could potentially be a location with easy maintenance access. • A more thorough evaluation is required			✓		✓
16	**Asan Mayor's Office/ Community Center ***	• Good opportunity for demonstration raingarden to manage rooftop runoff, and enhance existing drainage swale to alleviate parking lot flooding • Trash cleanup in wetland and stream buffer areas • Pollution prevention activities related to facility cleaning and material collection. • Native tree planting.		✓		✓	✓
18	Adeloupe Government Complex (Figure 18)	• Determine which portions of site are in the Asan drainage boundary. • Investigate potential to install raingardens in grassed areas adjacent to parking lot, along one-way loop road (exiting) and at beach acces/boat landing. • Highly visible area for educational signage • Consider collecting rooftop runoff in cisterns shaped liked latte stones, to be used to water landscaping		✓			✓
19	NPS Badland Restoration Area	• NPS owns large parcel between Asan Beach and Nimitz Hill Memorial and has active badland reforestation plan • NPS monitoring sediment; coordinate with Marine Lab to compare loads from Piti and Asan and link to coral cover and changes in fish populations.	✓				

* More detailed concept description is provided as an attachment

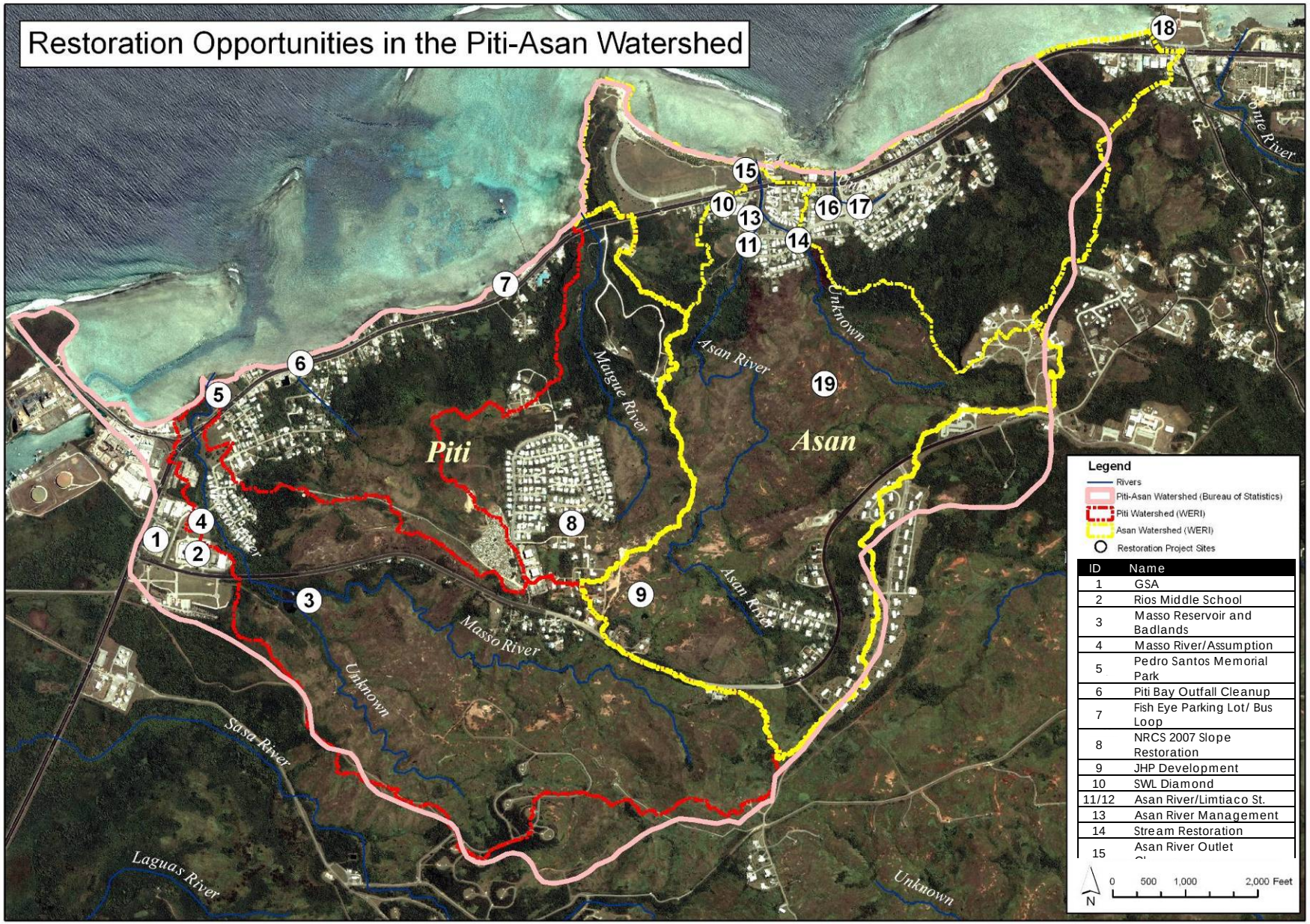

Figure 17. Location of Known and Potential Restoration Projects

Figure 18. Bamboo removal at Masso River/Assumption Rd. bridge and stream restoration site (top left); Channelized and heavily maintained section of River in the Asan Village (top right); potential location for on-line sediment trap (bottom left); and a good location for a rain garden to collect runoff from one way exit road leaving Adeloupe government complex (bottom right).

3.3 Next Steps in the Watershed Planning Process

GCMP is working on the drafting of a comprehensive watershed plan for the Piti-Asan. We offer the following suggestions for moving forward with plan development.

1. **Perform Mapping Analysis:** Update watershed boundary to reconcile differences between WERI versus Bureau of Statistics drainages for Piti and Asan. This may require field verification and interagency consensus. Once this is completed, generate basic baseline statistics for each subwatershed to include: total drainage area, stream miles, % impervious cover (rooftops, roads, parking lots), % land use (residential, commercial, industrial, etc), % forested, % badlands, % publically owned, % developable (under construction or to be developed), # outfalls and existing stormwater infrastructure, soils; septic systems, monitoring sites, restoration sites. Consider projecting a 10-20 year buildout scenario to predict changes in land use, impervious cover, and forest cover.

2. **Develop Watershed Plan Outline**: Keep the plan short and simple, but include at least the following sections:

    a. Brief description of existing water quality conditions and baseline statistics;
    b. Watershed goals and management strategies;
    c. Priority restoration projects with estimates of pollutant load reductions and other watershed benefits;
    d. Implementation strategy with proposed schedule, estimated costs, and key responsible agencies or individuals. Estimating the watershed benefits of priority projects is an eligibility requirement for USEPA implementation funding.
    e. Education and outreach plan for residents, municipal and agency staff, and the private sector to support implementation
    f. Monitoring plan for how to best integrate existing monitoring efforts with measures to track implementation success. These measures can be programmatic (e.g., adoption of regulations, # of inspections, # of stakeholders involved in training, # of rain gardens installed) and resource based (e.g., water quality monitoring, coral health metrics).

3. **Establish Watershed Clearinghouse:** Establish a dedicated website to house mapping, monitoring data (or links), reports, photos, and other information pertaining to the Pit-Asan. This URL can also serve as a site for both implementation partners and the public to access meeting materials and announcements, review progress reports, or register for outreach events. Perhaps this information can be housed under Guam's Watershed Planning Committee homepage http://node.guamepa.net/programs/water/wpc.html.

4. **Host Key Partners Meeting**: Meet with key agency and non-agency partners with current projects in the watershed to compile additional information on ongoing research and restoration activities; reach consensus on a set of goals and priorities; and formulate a strategy to integrate implementation efforts. For example, it is important to include a Department of Navy representative, Mark Capone at NPS, and Brent from DANR to solicit their restoration objectives. Others key stakeholders include TNC, Peggy Denney for assistance with the residential education program, and WERI to understand monitoring efforts. Appropriate staff from GCMP, GEPA, and DPW should also be included, as well as the mayors (or their representatives) from Piti and Asan Villages.

5. **Fill Field Gaps**: Visit the sites we didn't get to in the field, primarily existing military property and some of the commercial areas along Marine Corps Drive, to identify any other restoration opportunities or potential pollution sources.

6. **Write Draft Watershed Plan**: Remember to try and keep it simple. Circulate for partner review and comment. Be specific when asking for feedback on certain elements of the plan that is within their area of expertise. It is particularly important that key partners all have a clearly defined role in the implementation process.

7. **Solicit Public Input**: Present draft plan to local residents and businesses at Piti and Asan Village meetings, to get feedback on goals and priorities and implementation approach. Be

sure to have maps available at the meeting so participants can mark it up. Set expectations for attendees that their participation is useful and give them the opportunity to review the draft plan on the website and post comments.

8. **Write Final Plan**: Based on input from key partners and local stakeholders, draft the final plan. It will be a living document subject to change and will likely need to be updated in five years.

Once the plan has been developed, we recommend the following actions to move forward with implementation:

9. **Secure Funding**. Apply for grant funding to implement a few projects; leverage project work conducted by watershed partners.

10. **Take Early Action**: Start implementing. Every project completed helps build momentum, encourage participation, and shows success. It might be advisable to start with some of the public land retrofit projects identified as concept designs in the appendix of this report.

11. **Develop Tracking System**: Establish a simple tracking system for restoration projects and monitoring results; preferably this should be georeferenced and integrated with a GIS BMP maintenance database that Victor is working on.

12. **Provide Progress Reports**: Commit to quarterly or biannual watershed partner meetings, and annual public watershed forums to report implementation progress. Annual progress reports should be posted on website, tracking implementation progress and monitoring results. These reports will be helpful for agencies that have to provide annual reports for various federal programs (i.e., NPDES) as well as to show funders success to date.

4.0 Progress on February 2008 Workshop Summary Recommendations

To recap progress to date on meeting recommendations that were generated during CWP's 2008 workshop, key recommendations from the April, 2008 Summary Report are listed in Table 5, with an indication of their implementation status (based on our current understanding).

Table 5. Summary and Status of 2008 Recommendations

Key Recommendations	Status*
Conduct a BSD Workshop specifically for developers, designers and architects on the principles, benefits and implementation of better site design techniques	Completed
Conduct a watershed planning effort in Piti/Asan and northern watersheds.	In progress for Piti; Northern and Ugum not completed
Revise stormwater regulations to address post-construction and adopt the new criteria outlined in the stormwater manual	Draft regulations sent for legal review on 02/02/2010; Adoption pending
Develop a BMP design manual supplement with Guam-specific design adaptations for multi-cell ponding basins, various parking lot practices (i.e. bioretention, permeable pavers, coral stone sand filter), and rainwater harvesting options.	In Progress

Table 5. Summary and Status of 2008 Recommendations	
Key Recommendations	**Status***
Post the stormwater manual on the GEPA website.	Not done, it can be downloaded from CNMI DEQ webpage
Pursue Santos Memorial Park as a stormwater demonstration and watershed education demonstration site	In Progress, no construction
Update ESC Regulations to incorporate standards of 2006 CNMI/Guam Stormwater Manual	In progress
Provide inspector/contractor training for Erosion and Sediment Control. This training program can eventually evolve into a certification program. Perhaps a joint program can be developed between CNMI and Guam.	Completed on CNMI; Guam training and certification can follow adoption of revised regulations
Develop an ARC plan review checklist to help reviewers and developers apply better site design techniques	Status unknown
Begin building a stormwater facility tracking geodatabase	In Progress (Victor has started collecting data)
Hire someone to serve as a liaison between GCMP and Dept of Land Management. GCMP needs to insert itself in the comprehensive land use planning process update.	Status unknown
Continue to investigate DOD development and redevelopment plans in light of recent federal and DON policies on LID and stormwater management.	Completed
* We could be wrong	