

Coral Bay Watershed Management Plan

A Pilot Project for Watershed Planning in the USVI



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LIST OF ACRONYMS

APC	Area of Particular Concern
APR	Area of Preservation and Restoration
BMP	Best Management Practice
CBCC	Coral Bay Community Council
CWP	Center for Watershed Protection
CZM	Division of Coastal Zone Management
DFW	Division of Fish and Wildlife
DP	Division of Planning
DPNR	Department of Planning and Natural Resources
DPW	Department of Public Works
EP	Division of Environmental Protection
EPA	Environmental Protection Agency
GIS	Geographic Information System
HOA	Homeowners Association
IRF	Island Resources Foundation
TMDL	Total Maximum Daily Load
NOAA	National Oceanic and Atmospheric Administration
SEA	St. Croix Environmental Association
TPDES	Territorial Pollutant Discharge and Elimination System
USDA/NRCS	United States Department of Agriculture Natural Resource Conservation Service
UVI	University of the Virgin Islands
VIRC&D	Virgin Islands Resource Conservation & Development Council

INTRODUCTION

This report presents a framework for managing the Coral Bay Watershed, St. John, USVI based on a pilot watershed planning study conducted primarily by the Center for Watershed Protection (CWP) and the USVI Department of Planning and Natural Resources Division of Coastal Zone Management (DPNR CZM) under a National Oceanic and Atmospheric Administration (NOAA) Coral Program funding *NCND3000-6-00007*. CWP and a number of agency and non-government partners have worked together on this project to identify priority management recommendations and implementation strategy for the Coral Bay Watershed based on a review of existing studies, input from stakeholder meetings, and observations from on-the-ground assessments.

Purpose

This project is a follow-up to a Watershed and Stormwater Management Workshop conducted by CWP in August 2006 for technical staff within DPNR and other USVI local agencies with a role in stormwater and watershed management. Workshop products included an inventory of existing watershed planning studies and an evaluation of USVI environmental regulations, program capacity, and inter-agency coordination related to watershed and stormwater management. While it was recognized that efforts have been undertaken in a handful of watersheds (i.e. Fish Bay and other Areas of Particular Concern), implementation of most efforts has not been consistent. To improve success, agency staff highlighted the need for a more comprehensive approach to watershed planning that was directly linked to agency program and regulatory requirements (i.e. new stormwater regulations, water quality impairments, land development, public involvement). Workshop participants ranked watersheds across all three islands to identify where a new generation of watershed assessment and planning activities should start—Coral Bay was listed as a high priority.

The purpose of this report is to outline a comprehensive set of actions and overall management strategy for improving and protecting Coral Bay from nonpoint sources of pollution derived from land use alterations and residential/commercial behaviors in the watershed. The plan is intended to not only identify a set of key recommendations, but to identify specific partners and next steps towards implementation. This effort was not intended to provide hydrologic analyses, pollutant load reduction estimates, and engineering design concepts to address site-specific drainage issues. The recommendations presented here address land use planning, sensitive lands and aquatic buffer conservation, improved site design and construction techniques, and effective post-construction discharge prevention, treatment, and maintenance.

The secondary purpose of the project was to pilot a methodology for assessment and planning appropriate for local agencies to be applied in other watersheds throughout the islands. NOAA and DPNR will use the project to evaluate the level of effort required for developing a relatively comprehensive watershed management plan based on existing studies, limited field observations, and informal meetings with local residents, developers, and agency staff. These findings are not included in this report.

The Coral Bay Watershed

The Coral Bay watershed is located on the eastern side of St. John, USVI. Approximately 4.7 square miles in drainage area, the terrestrial watershed border closely follows Bordeaux Mountain and Centerline Roads, and roughly bisects the East End peninsula. The watershed is currently divided into eight subwatershed drainage units (Figure 1). In 1981 Coral Bay was designated as one of 18 Areas of Particular Concern (APC) in the USVI. APC's are special designations for the purpose of preserving or restoring priority areas for their conservation, recreational, ecological, or esthetic values. The watershed and its receiving waters have over 10 miles of shoreline hosting a diverse land use, protected harbors, as well as some of the islands largest salt ponds, sea grass beds, fringing reefs and extensive mangrove communities which are important fish nursery areas in St. John. Coral Bay waters also include part of the Virgin Islands Coral Reef National Monument, which was established by Presidential Executive Order in 2001. The monument was designated to protect all the federally controlled submerged lands of St. John, including the waters, and coral reef ecosystem resources within a 3-mile belt off the southern shore of St. John and Hurricane Hole. In addition, the Coral Bay area has historical significance related to the original Danish settlement on St. John in 1718, and the 1733 slave uprising at Fortsberg, and the Moravian influence.

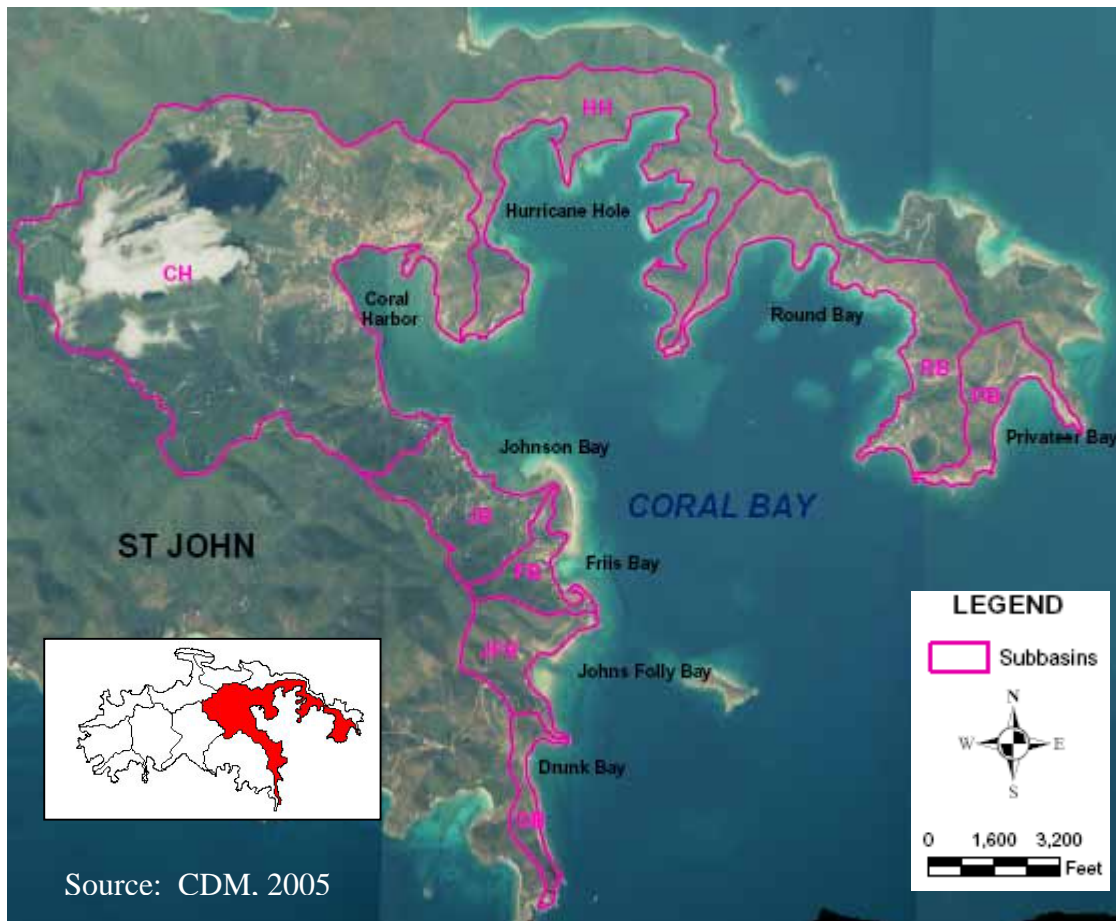


Figure 1. Coral Bay Subwatershed Map (taken from CDM, 2005)

The watershed is characterized by steep slopes (averaging 18%, with a large percentage over 35%), highly erodible soils, and high runoff volumes associated with average rain events. These factors, combined with a large percentage of dirt roads, active construction, and no existing stormwater management, have been shown through previous studies to contribute to excessive sediment loading to the bay (Devine et. al, 2003). In 2007 Coral Bay harbor was added to the 303(d) impaired list for sediment (Figure 2).

The community of Coral Bay is relatively undeveloped with most commercial and residential structures currently clustered along the shoreline or along Centerline Road. While local residents and visitors appreciate the rural, laid back character of Coral Bay, the watershed experienced almost 80% growth between 1990-2000—making it the fastest growing area in the USVI. Given that most of the land in the watershed is privately owned (only a portion of the watershed falls within the U.S. Virgin Islands National Park), development pressures are expected to increase. Table 1 shows a breakdown of land use per subwatershed.



Figure 2. Example photos illustrating sediment-laden runoff from Coral Bay watershed during typical rainfall events. Photos courtesy of Coral Bay Community Council

Table 1. Coral Bay Subwatershed Land Use
(adapted from CDM, 2005)

Subwatershed	Drainage Area (acres)	Land Use	% Subwatershed Land Use	% Total Watershed Land Use
CH – Coral Harbor	1,603	Agriculture	0.8%	0.45%
		Commercial	0.1%	0.03%
		Low Density Residential	10.0%	5.4%
		Forest/Undeveloped	88.5%	48.18%
		Institutional	0.4%	0.22%
		Industrial	0.2%	0.10%
DB – Drunk Bay	60	Commercial	2.3%	0.05%
		Low Density Residential	0.3%	0.01%
		Forest/Undeveloped	96%	1.96%
FB – Friis Bay	78	Low Density Residential	23%	0.60%
		Forest/Undeveloped	76%	2.01%
HH – Hurricane Hole	451	Low Density Residential	1%	0.18%
		Forest/Undeveloped	97%	14.93%
JFB – Johns Folly Bay	124	Low Density Residential	17%	0.71%
		Forest/Undeveloped	8%	5.52%
JB – Johnson Bay	184	Low Density Residential	11%	0.70%
		Forest/Undeveloped	88%	3.50%
PB – Privateer Bay	122	Low Density Residential	1%	0.05%
		Forest/Undeveloped	96%	3.96%
RB – Round Bay	337	Low Density Residential	13%	1.45%
		Forest/Undeveloped	87%	9.93%

In addition to the physical and social environment of this watershed, Coral Bay was identified as a good location for NOAA to fund a pilot watershed planning project because:

1. Numerous studies and management reports have already been done for the watershed to help characterize the watershed quality and identify management opportunities. For example, UVI has spearheaded a number of resource inventory and sedimentation studies in the watershed, as well as a stormwater study to identify potential storage facility locations (see Table 1). This material was reviewed and integrated into the overarching watershed goals and implementation recommendations presented in the next two parts of the report.
2. There is excellent potential for collaboration and leveraging of multiple agency and non-governmental initiatives. Multiple federal and local agencies are sponsoring concurrent initiatives related to Coral Bay, providing a rich platform for shared financial and technical resources. For example, the US EPA stewardship initiative, the USDA and VIRC&D stormwater demonstration project, and DPNR's Coral Bay TMDL development and St. John

comprehensive planning efforts can all be coordinated under a unified watershed plan. These efforts are discussed throughout the remainder of this report as related to implementation of specific recommendations.

3. There is an active community watershed association, the Coral Bay Community Council (CBCC). CBCC—one of two recognized volunteer watershed groups in the USVI (SEA being the other)—is a membership 501(c)(3) organization actively involved in community planning, advocacy, and environmental watchdogging. They have offices in town, hold public meetings, and host the <http://www.coralbaycommunitycouncil.org/> website. CBCC publicizes good stormwater practice, encourages workshops and training opportunities related to stormwater and watershed management; serves as a clearinghouse for watershed studies, mapping and other resources; and demonstrates restoration options through on-the-ground projects. They will have a major role in implementing watershed recommendations and actions.

Table 1. Existing Studies and Materials Reviewed

Study	Description	How Incorporated
2006 Outline for Coral Bay APC Marine Inventory (Meyer)	Initial report on comprehensive inventory of marine and shoreline species in Coral Bay. Provides information on the diversity and location of marine and terrestrial wildlife. It includes inventory maps and species lists for purpose of informing community development/planning processes. Appendix includes vegetative community classification.	This information will be extremely helpful in developing a conservation area plan and should be considered during development plan review; mapping data
2005 Conceptual Stormwater Master Plan Coral Bay Watershed Final Letter Report (CDM)	Prepared for UVI. Using GIS and after a site visit, CDM performed an engineering analysis to estimate stormwater runoff volumes and rates for 1 and 2 year 24 hour storms. They divided the watershed into 8 subwatersheds for this analysis, and generated land cover and soil information for each. They also identified (based on mapping) some potential locations for storage retrofits and end of the pipe practices.	We went to some of these sites in the field to verify potential for storage, and incorporated feasible sites into our list of potential projects; baffle boxes not recommended given ease of clogging
2003 Coral Bay Sediment Deposition and Reef Assessment Study: (Barry Devine, UVI)	Final Project Report/Executive Summary: Provides good background information on watershed characteristics and presents results from a study measuring sedimentation rates in Coral Bay. Devine also makes management recommendations.	Incorporate recommendations; UVI has developed extensive GIS layers for the watershed
2005 Coral Bay Preliminary Vision Statement - Draft 1 (CBCC)	Summary of preliminary community visioning statements from Coral Bay residents	Useful for developing watershed goals and in long range community planning recommendations
1993 Draft Coral Bay APC and APR Analytic Study (Island Resources Foundation/UVI)	Prepared for DPNR/ CZM. The report is the first characterizations of physical, biological, and cultural features. Study provides a brief inventory of the areas water and structural infrastructure, and describes some of the basic resource use conflicts and environmental impacts. Most importantly, the report outlines a management framework for the APC, though focus is on shoreline and water uses	Useful in developing watershed goals and characterizing watershed; shows evolution of impacts and management recommendations.

Table 1. Existing Studies and Materials Reviewed

Study	Description	How Incorporated
2006 Workshop Summary from Watershed/Stormwater Management Workshop (CWP)	This summary provides an introduction to a variety of DPNR regulatory and programmatic tools for managing watersheds (land use planning, land conservation, buffers, site design, erosion and sediment control, stormwater, and stewardship).	Provides recommendations on filling gaps in regulations and programs relevant to Coral Bay.
2005 Analysis of land-based sources of threat to coral reef ecosystems (World Resources Institute, NOAA)	Data CD developed during Reefs at Risk/ Summit to Seas project to support management of coastal resources in USVI and Puerto Rico. Analysis on vulnerability of land to erosion by watershed.	Used for GIS layers and to gain appreciation of erosion rates/factors. Analysis at watershed scale, not smaller
Relevant Regulations	<ul style="list-style-type: none"> • Major /minor land development permit applications • Draft TPDES regulation • 2000 USVI Zoning and Building Codes • USVI Title 12 Conservation/Chapter 21 VI Coastal Management sections 903 and 906 	Reviewed to provide technical and regulatory background on stormwater program, development review requirements, preferred practices designs and infiltration potential
Technical Information	<ul style="list-style-type: none"> • 2002 Environmental Protection Handbook, and Sediment and Erosion Control on Construction Sites Field Guide • 1998 USDA/NRCS Soil Survey for USVI 	

Report Organization

The remainder of this report presents 9 overarching watershed goals, 12 management recommendations, and over 60 implementation activities for the Coral Bay watershed. Overarching watershed goals are presented first, followed by a lengthy discussion on watershed recommendations. Each recommendation is prefaced with observations and findings from fieldwork and input from project partners and other stakeholders and includes specific actions to help agency staff and others move towards implementation. Additional tips on implementation are discussed at the end of the report. A list of sites visited in the field along with a map showing those locations can be found in Appendix A. A hypothetical implementation schedule is provided in Appendix B.

Caveats

The following limitations of this effort should be considered:

- Recommendations and actions presented here are derived from observations made by CWP during site visits, informal interviews with local residents, developers, and agency staff, and feedback from stakeholder and agency staff meetings on August 6 and 7, 2007, respectively. These recommendations do not necessarily reflect the opinions of DPNR, CBCC, or other participants, although project partners and others provided significant comments during the drafting phase of this report. EP and DPW did not provide comments.
- Only 3 full days were allocated for the field assessments (July 31 – August 2, 2007). While we covered a lot of ground (visited approximately 25 sites) and were able to gain a comprehensive understanding of watershed issues, we did not walk all gut miles, drive every

road in the watershed, or spend significant time at individual sites. While ultimately prohibiting us from conducting detailed drainage evaluations or developing concept designs at individual project sites, we were able to identify priority project locations and recommend more comprehensive watershed recommendations. As noted in the recommended actions, correction of individual drainage problems and construction of retrofits will have to be preceded by additional site evaluations.

- There are numerous reports and regulatory materials containing information on the physical, social, and regulatory components of the watershed; however a single document (aka Watershed Characterization Report) summarizing watershed conditions at the subwatershed scale does not currently exist. It was beyond the scope of this effort to create such a compilation, though it is traditional first step of the watershed planning process. As a result, detailed site information (i.e. water quality, land use, conservation areas) supporting recommendations is not consistently included in this report.
- CWP did not utilize conventional assessment protocols (i.e. retrofit inventory, hot spot investigation, stream assessment) as originally anticipated. This was partially due to the reconnaissance-nature of our site visits as well as the inapplicability of assessment forms used stateside.
- The CZM plan reviewer (Carl Howard) for St John was off-island during the site visit, which was unfortunate since he is DPNR staff most familiar with Coral Bay. We were also unable to meet with the public works officials on St. John, who we feel are critical for implementation since so many of the observed problems and recommended solutions involve roads and infrastructure maintenance. Barry Devine with the University was also off-island, and he has extensive background on sedimentation issues, wetlands, and stormwater master planning in the watershed. Barry also has the best access to appropriate mapping and GIS resources available through the Conservation Data Center of the University of the Virgin Islands.
- Project timing coincided with extensive transitioning of agency staff in DPNR post territorial elections. Staff, directors, and the commissioner were able to provide some input. More importantly, however, agency priorities and commitment to watershed planning and stormwater activities are still to be determined.
- This plan is limited in scope: it does not meet EPA's a-i criteria (no pollutant load modeling, or design concepts, or cost estimates), it focuses primarily on surface stormwater runoff resulting from development, and it does not specifically address wastewater, drinking water, agricultural, or designated marine uses.

WATERSHED MANAGEMENT GOALS

A set of proposed watershed management goals for Coral Bay are presented here to guide implementation priorities and long-term evaluation of progress. These goals were derived by CWP from the CBCC community visioning process, the 1993 APC report, and from input provided by local stakeholders during a meeting on August 6th, 2007. Goals are geared towards improving the water quality and ecological health of Coral Bay and minimizing future impacts associated with watershed development.

1. Improve water quality to maintain living marine resources (corals, sea grass, mangroves) and human uses (swimming, fishing) by reducing sources of sediment loading, eliminating illicit discharges, and minimizing dumping of hazardous materials.
2. Minimize the impact of new development on local culture, history, and water resource quality through better land use planning and application of more effective site design, erosion and sediment control, and stormwater management techniques.
3. Create a cooperative atmosphere of engagement between agency staff, local residents, and the development community through public/private partnerships, enhanced communication, and involvement in Coral Bay watershed management activities.
4. Improve erosion and sediment control (ESC) from dirt roads, construction sites, and other exposed areas through improved site design; practice selection, installation, and maintenance; and enforcement activities.
5. Protect public and private property from offsite drainage impacts by recognizing and mitigating altered flows during all stages of the development process (permitting, construction, post-construction, and maintenance).
6. Mitigate the negative impacts of stormwater runoff on hydrology and water quality through stormwater retrofits (i.e. directing runoff into new stormwater practices prior to discharge) and application of new stormwater requirements.
7. Restore natural hydrology to guts and wetlands where feasible to enhance infiltration, prevent erosion and reduce flooding.
8. Enhance collective island expertise in stormwater and watershed management through public education, technical training, and demonstration opportunities.
9. Minimize drainage problems associated with private and public roadways through improved design and permitting standards, maintenance, technical training, and comprehensive roadway planning.

RECOMMENDATIONS AND IMPLEMENTATION ACTIONS

To meet these goals, 11 key watershed recommendations are presented below. These recommendations are loosely ranked by overall priority to watershed management. Priorities were determined by CWP best professional judgment and based on feedback from stakeholder meetings. Recommendations and actions are derived from observations made by CWP during site visits and informal interviews with local residents, developers, and agency staff and do not necessarily reflect the opinions of DPNR, CBCC, or other participants. The key recommendations and the specific watershed goals they address include:

1. Provide direct, on-site technical assistance to watershed residents, businesses, developers, and others to implement watershed recommendations. (*Goals # 1, 3, 4, 6, 8, 9*)
2. Initiate a comprehensive community development planning process to specifically address future roadway, stormwater, wastewater, and land use goals. (*Goals # 2, 3, 9*)
3. Evaluate and repair erosion and drainage problems that are threatening property, damaging infrastructure, or delivering excessive sediment loads to Coral Bay. (*Goals # 4, 5, 6*)
4. Improve enforcement of existing environmental regulations. (*Goals # 4, 5*)
5. Establish a unified permitting approach to public and private road design, construction, ownership, and maintenance. (*Goals #1, 2, 4, 5, 9*)
6. Improve post-construction stormwater management design, permitting, and enforcement. (*Goals # 1, 2, 6*)
7. Identify and protect critical areas that provide natural hydrologic function, unique habitat, potential stormwater storage, historic value, infrastructure protection, and public shoreline access or other amenities. (*Goals # 2, 7*)
8. Implement construction and post-construction demonstration projects. (*Goals # 6, 8*)
9. Detect and eliminate illicit discharges. (*Goals # 1, 3*)
10. Adopt site design standards for new development applicable to steep slopes. (*Goals # 2, 4*)
11. Update agency mapping resources to more accurately reflect current conditions within the Coral Bay and East End watersheds. (*Goals #2, 5, 8, 9*)

Each recommendation is described below in more detail with supportive findings from field observations, interviews, or review of existing materials. Each recommendation is followed by specific implementation actions representing a variety of activities (i.e. regulatory changes, program enhancements, maintenance/restoration projects, and educational activities). Some of these actions are noted as being territorial or island-wide and not restricted to Coral Bay. Local agencies, stakeholders in Coral Bay, and other partners will need to decide which items to tackle first.

Some actions, such as regulatory changes or enhanced enforcement, may be more time sensitive than construction of a stormwater retrofit, particularly in areas expecting significant development pressures in the short-term. Additionally some activities are on going, or require additional

planning to make them happen quickly. Therefore the actions described below are loosely presented as near-term and long-term implementation actions, keeping in mind that opportunities such as upcoming grants, regulatory updates, or local elections might influence implementation timing. Near-term recommendations are typically initial actions to be carried out within the next year or two that protect the watershed from future degradation and set the framework for executing remaining watershed recommendations (i.e. updating environmental regulations, emergency drainage repair, erosion and sediment control enforcement). Long-term activities typically require a year or two to get going (i.e. long range community planning or design and construction of storage retrofits), or are ongoing. Where feasible, maintenance and restoration projects are prioritized based on immediate threat to property and infrastructure, feasibility, and potential water quality benefit.

Recommendation 1: Provide direct, on-site technical assistance to watershed residents, businesses, developers, and others implementing watershed recommendations.

Local residents, agency staff, and federal regulators all cite the lack of technical support and consistent on-the-ground staff presence as an impediment to addressing drainage problems, enforcing regulations, and improving community awareness in Coral Bay. Residents frequently expressed the need for technical and financial assistance for road repair and maintenance, gut restoration, and stormwater management. The need for someone to walk homeowners through regulatory and permitting requirements, recommend feasible retrofit and new construction stormwater mitigation designs and practices, review these practices in implementation to determine the best local BMP's, write grants and identify funding sources, interface with government agencies at all levels, etc., is critical to short term implementation. The lack of technical expertise in hydrology and road drainage engineering is actively hindering the government's ability to tackle existing and future drainage emergencies. The isolation of Coral Bay coupled with the logistical difficulties associated with inter-island travel for regulatory and planning staff, have contributed to limited enforcement and planning activities in the Coral Bay watershed.

Near-term Actions

- 1.1) Use EPA Community Stewardship grant as seed money to support a 1-2 year, full-time hydrologist/watershed manager for Coral Bay. This person should be able to provide conceptual designs, assist in soliciting financial support, and facilitate construction of road repair and stormwater demonstration projects as a service to local residents (primarily), businesses, and developers. Consider Coral Bay Community Council (CBCC), DPNR, NOAA, or NRCS as a hosting agent for this full-time position. The person hired should be located in Coral Bay.
- 1.2) DP currently has a posted position for a planner for STJ. Define one of the major roles of this position to coordinate long range planning activities in Coral Bay (see recommendation #2). (*island-wide*)
- 1.3) DPRN CZM should seek to fill the currently vacant APC coordinator position to work with the EPA hydrologist/watershed manager to help coordinate implementation actions with local and Federal agencies and other project partners, and integrate the watershed management plan into the APC plan process. (*island-wide*)

- 1.4) DPNR and CBCC should consider providing resources needed to support new personnel (ie. GIS, office basics, vehicle, etc)

Long-term Actions

- 1.5) Transition temporary technical support, to long-term watershed coordinator responsible for overseeing implementation of Coral Bay watershed plan. This person may be able to expand reach outside of Coral Bay to St. John.

Recommendation 2: Initiate a comprehensive community development planning process to specifically address future roadway, stormwater, wastewater, and land use goals.

No comprehensive road network planning has been devised to most efficiently access new parcels and safely manage overall traffic flow into and out of Coral Bay. The road network is the defacto stormwater drainage infrastructure in Coral Bay, however permitting for road construction and drainage modifications is done on a site-by-site basis with limited regard for down slope impacts or inter-agency review coordination. At multiple sites, we observed changes in hydrology due to drainage improvements (i.e. culvert modifications, paving, and/or regrading) causing unintentional, yet catastrophic down slope damage. The negative impact of this piecemeal permitting approach is compounded by the lack of effective management of existing stormwater drainage – not to mention a plan to control for additional stormwater generated by future development. Similarly, a unified wastewater management plan has not been completed to comprehensively manage existing and new discharges.

These issues are going to get worse with additional impervious cover (equates to additional stormwater runoff) associated with new development (particularly steep slopes of Bordeaux Mountain and other areas above Centerline Rd). Significant developable areas remain in Coral Bay and despite repeated comprehensive planning efforts, land use planning has not adequately evolved as a tool to manage future growth.

Near-term Actions

- 2.1) CZM and DP to conduct a buildout/vulnerability analysis for Coral Bay subwatersheds based on current zoning (accounting for rezoning amendments, recently approved proposals, and projects in the pipeline) to identify remaining developable lands, illustrate the potential impacts of changes in impervious cover, and identify the most vulnerable aquatic resources (guts, salt ponds, coral reefs, etc) at the catchment level. Utilize WRI and 2005 APC marine inventory study to assist in determining vulnerability. CZM's JP Oriol and the GIS specialist are looking into conducting a buildout analysis, though a completion date has not been set.
- 2.2) Review 2007 Island Resources Foundation Road Erosion Control Program Recommendations for Fish Bay Watershed. Consider contracting IRF directly (using NOAA or EPA grant funds) to conduct similar study in Coral Bay to help set priorities for paving and to offer design alternatives. Use enhanced road network mapping (see Barry Devine) as basis for analysis. The plan should determine priorities for paving (Bordeaux Road 108, King's Hill, Calabash Boom, Hansen Bay (private), or 107 to

- Lameshur (107 is paved, except to there which is technically outside of watershed), consider realignments, and propose designs for preferred road connections for future development.
- 2.3) Establish a joint DPW/DPNR (DP, CZM, EP) workgroup tasked with developing a master stormwater drainage plan. Building on existing the 2005 Stormwater Study conducted by CDM, this workgroup should complete an inventory of all existing and proposed inlets, culverts, and drainage structures. Consider hiring a consultant to develop a master stormwater plan that models current drainage patterns, predicts infrastructure capacity thresholds, and recommends locations for regional detention facilities and incentives for obtaining easements to those lands. The Coral Harbor subwatershed should be a priority for stormwater master planning—particularly along Centerline Rd. (Route 10) and Route 107 where drainage from top of slope (subdivisions on the upper side, (Ajax Peak, Upper Carolina, Lower Bordeaux and others) is impacting developments all the way down.
 - 2.4) Under the direction of DP, complete the community visioning process started by CBCC as the first step towards developing a comprehensive development plan for Coral Bay. Use 1993 APC goals and objectives as an additional framework for visioning sessions. Effort should be made to ensure a diversity of local stakeholder interests is represented, because well-defined community vision statements can be legally binding.
 - 2.5) CZM to make evaluation of Coral Bay APC management plan a priority; linking watershed plan recommendations with APC strategies where feasible.
 - 2.6) Consider a moratorium on rezoning until comprehensive stormwater master plan and community visioning have been completed. This may speed up plan development and improve willing participation of development community.
 - 2.7) Publicize and streamline the permitting, plan review, and site inspection and enforcement process. Consider including DP on initial plan review team. Apply uniform stormwater and erosion control criteria (i.e. Tier 1 standards) across entire watershed. This will be easier now that DP will be responsible for implementing new stormwater regulations. This is key to encouraging compliance of small site owners currently ignoring earth change and stormwater requirements. (*island-wide*)

Long-term Actions

- 2.8) Establish DPW/DPNR (DP, CZM, EP) workgroup to develop a comprehensive road network plan for St John. Investigate planning process on Tortola, which is reportedly more comprehensive. (*island-wide*)
- 2.9) DP take the lead on developing a comprehensive community development plan for Coral Bay and East End that incorporates the stormwater and roadway master plans as well as the community vision. Start with most recent comprehensive plan (1993 or 2006?).

Recommendation 3: Evaluate and repair erosion and drainage problems that are threatening property, damaging infrastructure, or delivering excessive sediment loads to Coral Bay.

Several sites were visited throughout the watershed where severe erosion and drainage problems threaten private property and public infrastructure or are delivering excessive sediment loads to Coral Bay. A map showing the location of these sites can be located in Appendix A. Some problems arise from inadequate public and private road design. Other sites became problematic after reported drainage improvements (i.e. culvert modifications, paving, and/or regrading) by DPW, Federal Highway Department, or private citizens observably altered the hydrology—causing unintentional, yet catastrophic down slope damage. **These sites are locations for immediate drainage study and repair. Other sites will need to be identified and prioritized for repair by DPW and other stakeholders.**

Table 3 summarizes representative sites/projects where existing drainage and erosion problems involving public roads/drainage and adjacent properties (not including construction sites) were observed during our fieldwork (see Figures 3-8). This list is not intended to be a comprehensive inventory of problem sites, rather these were mostly sites known to CBCC. DPW and other residents will likely have additional repair priorities. These sites, and others like them, should be addressed immediately or added to Public Works maintenance plan/capital budget at a minimum. Each site will require some additional assessment to evaluate upslope and down slope drainage patterns, develop engineering designs, identify party responsible for implementation (e.g. DPW for road concerns), and obtain funding prior to construction.

Table 3. Representative Drainage Problem Sites	
Site Location*	Description
Route 108 (Fig. 3)	Ongoing paving and appropriate stormwater culverts and devices for Route 108, Lower Bordeaux Road by DPW. The lower stretch of this road was completed several years ago, culminating in the sediment baffle which is has a completely clogged up culvert under Route107. Too much sediment and rocks still come down the road, which is the major stormwater “swale” from the upland area. More upland parts of this road are due for paving and stormwater devices. Downland there are numerous local homes located in the flats next the bottom of several guts that drain this area. Muddy water reaches the sea from at least three guts at the shoreline – all of which are impacted by DPW and individual actions uphill on Rt 108.
Calabash Boom Rd. (Fig 4)	A dirt road accessing a steep mountain area in zig zags. DPW graded this road in anticipation of paving it in Spring 2006. This changed the drainage putting more flow into the neighboring steep gut by Shipwreck and causing a fine silt sediment plume into the Bay –which has not diminished by December 2007, causing coral damage. This water used to go through the Calabash Boom flat area, now being developed by Reliance, before it reached the ocean.
Centerline Rd./Upper Carolina subdivision drainage area (Fig. 5)	Primary area for stormwater master planning. The combination of illegally blocked storm drain inlets on Centerline Rd. and stormwater culverts and paving dating from 1984 in the Upper Carolina subdivision, coupled with more recent added paved driveway construction and improved road maintenance have increased runoff volumes, undermining the foundation of a private residence, placed 30 ft from center of gut. Increased flows caused by development of lots in the upslope development continue downhill to the flatter area in the valley where the gut has been severely eroded (banks 10 feet high, actively eroding) threatening new construction and a road crossing. Potential actions include clearing blocked/concreted storm drain inlets on Centerline Rd and adding diversion berms to redirect flows back into roadside channels along Centerline; diverting flow back to original gut (greenbelt), installing detention, improving stormwater detention in residential lot new construction, and gut restoration at lower end of drainage area

Table 3. Representative Drainage Problem Sites	
Site Location*	Description
John’s Folly subdivision road and Route 107 (Fig.6)	Drainage "improvements" by DPW, federally funded in 2003, at the intersection of a John’s Folly dirt road and Route 107 have resulted in increased runoff volumes and highly erosive flows causing gut bank failure and threatening two private residences. Consider routing the drainage back into the channel along Route 107 and examine options for reducing runoff from the estate road. Temporary stabilization of rapidly eroding gut banks is recommended in the meantime. Once drainage issue has been corrected, complete gut restoration will be feasible.
Gerda Marsh/ King’s Hill Roads (Fig. 3)	Natural stormwater flows from an uphill residential development have been redirected to the dirt subdivision road network. This sediment-laden flow is then directed into a concrete swale and delivered to paved King’s Hill road and a ¼ mile swale and road surface which flows directly to Coral Harbor. Recommended options include diversion and spread of flow to wooded area along King’s Hill Road, installing detention, paving dirt road.
Johnny Horn Trail (Fig 7)	A highly visible example of chronic drainage problems involves stormwater runoff flows down the Johnny Horn Trail from several new residential road cuts extending up to the ridge line, (including Seagrape Hill) into a gut along the Johnny Horn trail behind the cemetery and commercial restaurant- Sputnicks. Flows frequently jump Route 10 and flood the school, where firefighters have to sandbag during substantial rains. Permanently redirect road flow down Johnny Horn trail to reach existing low, wetlands, and/or construct detention facility to capture flows from the hillsides behind the cemetery to prevent flooding of school. Facility should be designed to capture sediment, with consideration for ease of maintenance.
Hansen Bay subdivision (Fig 8)	Stormwater runoff picks up dirt from the road, enters an inlet (which is chronically clogged), then flows through a culvert under the road and down the gut into Coral Bay. The section of road is owned by one HOA, and falls between two paved sections belonging to another HOA. Previous recommendations for this site included the addition of waterbars or other forest service type practices for dirt roads. Alternatively, pave the road and improve channel to allow for infiltration.

* Locations of sites can be found on Map in Appendix A.

Actions

- 3.1) DPW and CBCC to complete inventory of problem areas and work with all involved parties to rank in terms of priority for implementation.
- 3.2) Include priority projects in capital improvement budget and DPW maintenance schedule.
- 3.3) Use impacted sites and the engineered solutions devised to restore them as training opportunities for DPW staff and other individuals involved in road design and maintenance in the USVI. (*island-wide*)



Figure 3. Route 108 inlet blockage/backup (left); and Gerda Marsh Rd. runoff (right)



Figure 4. Calabash Boom Rd. (dry on left); runoff in Jan 2008 (right, photo courtesy of CBCC)

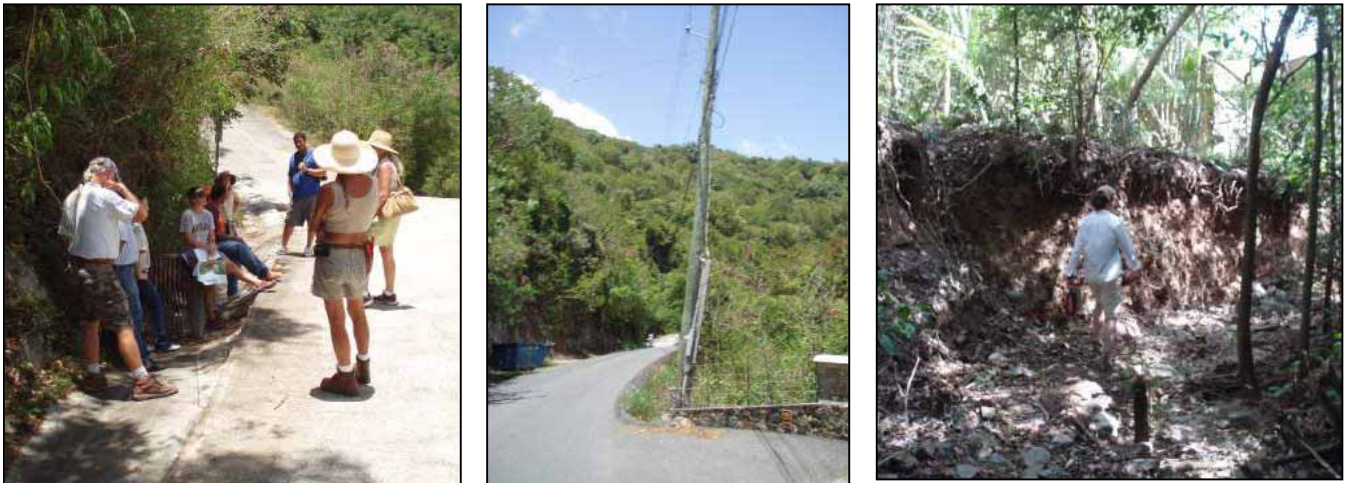


Figure 5. (left to right) Upper Carolina drainage improvement; leaning utility pole due to erosion along Centerline Rd; downstream channel erosion behind new residential construction.



Figure 6. Drainage "improvement" below dirt estate road in Johns Folly Bay (left), creating severe gut erosion behind private residence. DPW temporary fix with rubble/rip rap (right).



Figure 7. Johnny Horn Rd before (left) and during a rain event (right, photo courtesy of CBCC).



Figure 8. Hansen Bay Subdivision. Steep dirt road (left) and drainage through middle of subdivided property (right)

Recommendation 4: Improve enforcement of existing environmental regulations.

Inadequate (or absent) erosion and sediment control practices were observed on many construction sites, and non-permitted earth change work was observed on multiple occasions (Figure 9). This was commonly attributed to lack of a visual presence of enforcement staff in the watershed, inexperienced contractors, and lack of general public knowledge about permit requirements, rather than absence of appropriate regulations. Many property owners and local contractors, backhoe operators, etc. undertake road and drainage improvements with no permits and no evaluation of potential down slope impacts. In addition, access is difficult to some areas due to the terrain, which makes it easy for people to get away with poor construction practices. Despite the territorial wide buffer requirement of 25 ft from the edge (or 30 ft centerline) of guts, we observed numerous instances of encroachment and development in the floodplain. To enhance enforcement, CZM recently opened a St. John office that houses one on-island plan reviewer/ inspector. Two EP earth change inspectors based on St. Thomas are responsible for covering sites on St John.

Near-term Actions

- 4.1) Conduct an “inspection blitz” of subdivision permits and road cuts and earth change in the watershed. Mobilize DPNR staff (including the Commission, Directors, office and field staff) to spend one or two days in the watershed. Cover the entire watershed. Identify constructions sites with no permits. Inspect those that do have permits. Determine if "Sunday" excavation starts are an issue to be addressed.
- 4.2) DPNR to commit to providing additional on-island inspection and enforcement staff to enhance visibility and equity of enforcement actions, EP staff particularly in order to meet new stormwater regulations. Enforce more quickly after significant violations and consider ways to more effectively publicize enforcement activities. Increased fines and penalties, permitting fees, or third party inspectors can be used to help finance additional inspection/enforcement efforts. *(island-wide)*
- 4.3) Remove vagaries in the Major permit (e.g. asks the applicant to “discuss” under provisions for ESC). Should be more action oriented (e.g., “provide plan for cut/fill) in order to clarify review, inspection, and enforcement needs. Require separate drawing sheet for erosion control and stormwater (i.e. no overlays) in site plan submittal. Consider requiring permit applicants to post public notice signage on property to increase participation in public comment period and "watch dog" effectiveness. *(island-wide)*
- 4.4) DPNR Public Education and EP to host series of public meetings describing existing regulations and new TPDES program, and also existing federal laws to protect coral, wetlands and habitat as related to marine/shorefront development proposals. *(island-wide)*

Long Term Actions

- 4.5) Continue to try to raise community awareness of DPNR regulations through education programs, newspaper articles, etc. *(island-wide)*
- 4.6) Establish database of earth change permits; link to DPNR website mapping. *(island-wide)*



Figure 9. Two locations where field team observed road cutting/filling (left) and paving (right) conducted without appropriate permitting.

Recommendation 5: Establish a unified permitting approach to road design, construction, ownership, and maintenance.

Unpaved and paved roads are a significant source and delivery mechanism, respectively, of sediment to the waters of Coral Bay. As described above, many drainage and maintenance problems arise from haphazard road design, construction, and maintenance procedures that are determined independently by individual site developers or homeowners rather than through a coordinated permitting review process. In addition, it is unclear if roads are being permitted separately from final subdivision/development permits. The lack of clearly defined ownership and maintenance responsibilities under road permits exacerbates the problem, particularly where ownership of existing roads is unknown. Limited DPW funds also mean that public roads and drainage are often maintained and altered by private parties “trying to do the right thing.”

Some roadwork maintenance and construction is being done without proper earth change permits (i.e. a road was cut and paved without a permit, road created with fill material without a permit). Some individual homeowners and/or HOAs are maintaining dirt roads without obtaining a permit, which often results in faulty engineering and changes in down slope hydrology. Inlets and culverts do not appear to be consistently maintained. Tent grates and grates on 3 inch stilts appear to work the best for keeping leaves and branches from blocking the water flow, while keeping rocks in the flow from blocking culverts. Constant maintenance is required to keep grates from become clogged. Baffles used at end of culverts may enhance clogging. Permitted and non-permitted alterations on upper slopes (i.e. paving a driveway, blocking a culvert) often result in redirection of flow, either reducing contributions to existing guts or creation of new channels (i.e. Pam Gaffin, Kent Irish, Joan Thomas, Ernest Matthias). Existing developments in the valleys or lower hillside will increasingly be impacted by seemingly innocuous actions above. There is little evidence of coordination between DPW and DPNR (CZM and DPW do have a signed MOA), even though the road network is clearly one of the biggest contributors to water quality degradation in Coral Bay. There is no unified permitting process or oversight for drainage altering actions between DPW and DPNR, nor recourse for adversely affected parties.

The effectiveness of the following actions would be increased if the USVI would seriously commit to expanding the capacity, technical skill, equipment, and training for the Department of Public Works road planning and maintenance program.

Near term Actions

- 5.1) Require DPNR approval as part of DPW permit for all road construction, driveway connection, and drainage modifications involving road infrastructure (culverts, re-grading, etc). Permits should be approved only after reviewer site visit, and should only allow for a 1-2 year period between approval and initiation of construction. (*island-wide*)
- 5.2) Establish requirement for paving exposed dirt roads within a certain time period, and make the time period as short as possible. Improve regulations to require continuous, uninterrupted construction activity till stormwater devices and paving are completed. Flannigan’s Passage (Morrisette) is an example where erosion problems occurred from the mid 90’s when dirt roads were put in, until 2004-5 when paving and stormwater devices were completed. Privateer- Flamboyant is a current example where paving and storm water features are being done first (Figure 10). The recent extension of Flannigan's

Passage, (Roger Harland) is an example of quick paving, but limited stormwater mitigation – and redirected flow impacts on the other properties below. (*island-wide*)

- 5.3) Incorporate stormwater management into all new road construction and establish clear design criteria for inlets and culverts for roadways (there is an amazing diversity of designs within the watershed). For historical dirt roads, often estate roads, or private roads with no clear ownership or scheme for perpetual maintenance, consider effective ways to upgrade via publicly funded paving (allowable under VI law), encouragement of covenants and funding agreements among neighbors, and provision of technical assistance, as mentioned earlier. Consider, as part of recommendation #2, partnering with Island Resources Foundation on developing a Road Erosion Control Program (see Fish Bay Road Stabilization Plan). (*island-wide*)
- 5.4) Ownership and maintenance provisions need to be included in every DPW road permit, approved site development plan, HOA agreements, and in property deeds. (*island-wide*)

Long term Actions

- 5.5) Develop incentives for Home Owner Associations (HOAs) pursuing road maintenance (i.e. technical engineering assistance, match funds, EPA funds, etc). (*island-wide*)
- 5.6) Consider legality of assuming public ownership of abandoned roadways. (*island-wide*)
- 5.7) Identify existing public vs. private vs. unknown ownership roads as well as key roads with maintenance concerns. This can be done primarily through existing mapping (see UVI Barry Devine) and additional field investigations.
- 5.8) Conduct outreach/education for property owners to raise awareness on how to obtain permits and who to go to for technical and operational assistance (e.g. list of certified engineers, architects, contractors). Training for DPW staff on stormwater impacts and road drainage techniques should also be conducted. Tap into Island Green Building and Island Resources Foundation and VI RC&D to utilize demonstration sites to provide technical training to contractors and engineers on steep road design and construction practices. Providing and/or coordinating these services can be a function of the watershed manager, EP stormwater program, or a hired contractor (i.e. Horsley Witten Group, University of Colorado). These activities all can be applied towards meeting TPDES program requirements (Figure 10). (*island-wide*)



Figure 10. Educating homeowners on proper requirements and techniques for road maintenance (left); example of successful "pave as you go" in Flamboyant construction (right)

Recommendation 6: Improve post-construction stormwater management design, permitting, and enforcement.

The USVI post-construction stormwater program is still in its infancy—TPDES regulations were just recently adopted. Administration of this comprehensive program is going to require a significant increase in DPNR staff effort, technical engineering capacity, and budgetary resources than currently allocated. For example, major permit applications have long required modeling to show that required TSS post-construction loads do not exceed pre-construction loads. Despite these requirements, none of the development sites we saw in Coral Bay had post-construction stormwater practices planned, and an engineer on a local development project commented that the USVI doesn't require management for stormwater quality. It's also not clear how calculations are being submitted and reviewed since TR-55 is not an appropriate model. Currently, the Major Land Development Permit Application requires, "Peak flow calculations for runoff should be made for the downstream point of discharge of the existing site as a result of a 25-year, 24-hour storm (50-year, 24-hour storm if drainage area is in excess of 50 acres, or if the site or areas downstream from it are subject to flooding)." Anecdotal evidence suggests that flooding occurs during much smaller, more frequent storms of shorter durations in the Coral Bay watershed.

Stormwater runoff patterns in Coral Bay are dominated by overland flow to either guts or the road network, most often flowing down the road (especially on dirt roads) or in a road-side channel. Most stormwater, with the exception of residential rooftop drainage (most of which drain to cisterns), is currently untreated before discharging into Coral Bay. Culverts are used on some public roads, but the inlets are generally clogged and the culverts are not maintained. The road network in Coral Bay basically serves as the defacto MS4. The natural functions of guts to convey and infiltrate stormwater runoff (from undeveloped areas) are completely overwhelmed by increased flows of sediment-laden runoff from construction sites, dirt roads, and developed areas. The natural function of floodplains to absorb storm flows and trap sediment has been reduced by development, particularly roads, in low, flat areas. The challenge in Coral Bay where slopes are highly erodible is to protect remaining flat areas where feasible and to duplicate this function in new developments.

While approaches to stormwater management in the USVI are far behind what is being done on the mainland, straight application of stormwater treatment practices, as designed on the mainland, would be inappropriate for the unique conditions of the island. Steep slopes, variable rainfall patterns, and very intense storms make it difficult to establish vegetation and require practices to accommodate and treat large flows. Altered drainage patterns in steep sloped areas result in realigned guts and leave little room for stormwater treatment in many locations. Stormwater priorities for Coral Bay should include water quality (focusing on reducing sediment loads); volume reduction; flood control; soil conservation and preventing gut erosion. Practices used on the mainland need to be adapted to the unique conditions of the island.

Near term Actions

- 6.1) Per new stormwater regulations, EP to develop guidance for calculating pre- and post-development TSS loadings (e.g., Tabular method for volume, then apply concentration, include a worksheet that shows exactly how to do the calculations). Consider a water

- quality volume approach with a clearly defined volume that must be treated by an approved stormwater treatment practice on the site. (*island-wide*)
- 6.2) Revisit flood control requirements. May be necessary to provide flood control for more frequent storms of shorter duration. (*island-wide*)
 - 6.3) Before approving practices, EP needs to establish a mechanism for ensuring long-term practice maintenance. This may involve design features (maintenance access, pre-treatment, or native vegetation requirements), performance bonds, and long-term maintenance contracts. (*island-wide*)
 - 6.4) EP to conduct series of meetings for residents, businesses, and developers on new stormwater regulations. (*island-wide*)

Long term Actions

- 6.5) VI RC&D to coordinate review and update of the 2002 Environmental Handbook to include design adaptations for mainland practices that are better adapted to suit the USVI. Consider hiring qualified consultants to assist. (*island-wide*)
- 6.6) Develop performance standards or design guidelines to address other stormwater management priorities, namely, volume reduction, soil conservation, and protection of guts from erosion. (*island-wide*)
- 6.7) Develop a tracking system for mapping stormwater practices. This should include year installed, type of practice, ownership, maintenance schedule, etc. (*island-wide*)
- 6.8) Apply special (stringent) stormwater criteria for Coral Bay as an opportunity to apply new approaches, appropriate for the islands. Eventually, phase in application across all three islands. Implement a single tier system for sizing criteria, review, and enforcement procedures for long-term post-construction stormwater program. (*island-wide*)

Recommendation 7: Identify and protect critical areas that provide natural hydrologic function, unique habitat, potential stormwater storage, historic value, infrastructure protection, and public shoreline access or other amenities.

There is no current open space or land acquisition plan for STJ or the USVI in general; however the 1993 APC plan does identify some significant natural areas. DP has begun work with The Nature Conservancy on comprehensively mapping the ecological and cultural resources on all three islands in anticipation of the completion of the Comprehensive Land and Water Use Plan. DFW has a wetland protection plan that identifies a "short-list" of priority wetlands for protection on STT and STX only. DPNR/Planning has partnered with the Nature Conservancy in completing several ecologically driven initiatives. One of the principal projects is to comprehensively map the ecological and cultural resources on all three islands in anticipation of the completion of the Comprehensive Land and Water Use Plan initiative.

Residents recognize that marine life tends to be best where there is a natural salt pond or other detention feature in the upland drainage area. Most of the valley floor and floodplain areas currently performing critical hydrologic functions (i.e. detention, infiltration, conveyance) are

privately owned. Guts and adjacent buffers are privately owned for the most part—threatening public and private infrastructure when guts widen and alter courses. Major historic sites are within the watershed (i.e. Fortsberg). Field crews observed historic resources at one site damaged by unchecked, upslope development. A few unprotected forested areas are considered some of the most pristine on the island. Concordia conserved a hillside to protect the viewshed for its visitors. Outside of the park boundary, there is not a tremendous amount of public land in the watershed (Guy Benjamin School, Dept Ag. site, fire station, fill storage site). With the exception of the Dept. of Agriculture parcel, no publicly owned land was identified for stormwater retrofit sites. Public access to the shoreline is limited. No tax fund or other dedicated funding source exists that can be applied towards active purchase of land by the territory.

Near term Actions

- 7.1) Complete DP/TNC resource mapping and conservation area inventory mapping. DP to lead a joint workgroup DFW/NPS/Dept of Ag/Historic Preservation/UVI/CBCC/TNC) to develop an open space or land acquisition plan that identifies priority parcels, preferred method of conservation, and sources of funding for acquisition priorities. Incentives to encourage conservation easements and other land conservation should be identified as part of plan. Start with the existing APC and wetlands inventory. (*island-wide*)
- 7.2) Update forest and tree protection regulations, particularly guidelines for selective clearing. (*island-wide*)
- 7.3) Develop incentives for developers to protect conservation areas not required under current regulations. (*island-wide*)

Long term Actions

- 7.4) Investigate funding options. Parcels <\$250k should be pre-identified for mitigation funding, and the potential to use CELCP funds for land acquisition should be investigated. Consider a partnership approach that pools \$ from mitigation funds with NGO \$ to increase purchasing power.
- 7.5) Pursue third party or public/private partnerships to acquire, hold, and transfer conservation easements on priority lands. A third party holder is essential because the government may or may not enforce easements in perpetuity.

Recommendation 8: Implement construction and post-construction demonstration projects.

Opportunities to showcase new and innovative stormwater practices (both for construction sites and for post-construction) exist in the watershed. CDM's stormwater master plan study identified a few locations for stormwater retrofits and enhanced ESC, as did local residents during our field reconnaissance. In addition a few examples of construction and post-construction practices currently exist in the watershed. These demonstration sites can serve as training opportunities for local designers and contractors, help raise general public awareness about stormwater management, and meet educational requirements under the TPDES permit.

Actions

- 8.1) NRCS, CBCC, or UVI should coordinate a series of contractor/developer workshops or tours to showcase existing construction and post-construction demonstration practices as a way to provide technical training, discuss what works and doesn't work, and highlight innovative efforts of local practitioners. VIRC&D is currently working on a grant proposal to do this training. Also, NRCS is now planning Soil Survey training workshops island-wide for ~May 2008. Active sites of interest might include the following (Figure 11):
- Eric Tillett and the Reliance Sites are experimenting with sediment traps.
 - Privateer Bay has two detention basins: one coupled with a concrete swale re-diversion from public beach access and another at Frogs Hollow that is a decade old and is requiring restoration work.
 - The Flamboyant property offers a variety of road design and construction elements such as roadside swales (gravel with wood check dams) and narrow roads with geoweb turnarounds. In addition, the "pave as you go" construction process (they bought a vibrating compactor) could provide an interesting workshop/training for other island contractors.
 - Doug White and Dorothy Muilenberg offer a variety of private driveway disconnection practices (ponds and cisterns).
 - Concordia offers a construction plan that involved gabion baskets for perimeter control and 100% on-site reuse of cut and fill material.
- 8.2) Install new stormwater practices to demonstrate innovative on-site, subdivision-wide, and regional stormwater practices. Table 4 lists potential post-construction projects grouped into high, medium, and low priorities based on relation to repair and maintenance issues, cost and complexity, timing, and potential public visibility. The location map is provided in Appendix A. See Figure 12 for site photos.

These projects represent the top retrofit projects we identified based on fieldwork. Owners of these sites should be contacted in the short term to confirm willingness to participate, then sites should be revisited to develop a concept design for potential practices. Once concepts are developed, planning level costs, construction feasibility, and water quality benefits can be estimated. Actual construction for regional detention basins will require land acquisition, permits, engineering design, maintenance agreements, and funding.

These projects should be added to capital improvement budgets and be on the top of grant funding lists. Smaller on-site projects can be partially supported by developer and or homeowner, but will require significant assistance and incentives by local agencies.

Table 4. Potential Demonstrations Sites for Installation*		
Priority	Site	Comments
<i>High</i>	Retrofit Centerline road (Public Works) and demonstrate driveway disconnection program in Upper Carolina (CBCC and residents) (site # 14, 30 in Appendix A map)	Significant erosion issues down stream. CBCC may be able to generate support for residential disconnection program
	Johnny Horn trail, where runoff comes down behind cemetery (site # 2)**	Highly visible; current drainage issues
	Reliance/Calabash boom (site # 22)	Construction not started; but will be highly visible; controversial public/private project with incentive to incorporate innovative stormwater practices. Stormwater mitigation currently being done under Regulatory order, Post-construction stormwater plans in for DPNR review. COULD be first “success.”
<i>Medium</i>	Agriculture center, detention pond or stormwater cistern for irrigation (site # 16)	CBCC & VIRC&D are investigating assistance to construct a SW retention practice that will also provide supplemental farm water supplies. VIDA is considering subdividing land into farm plots, but are still interested in developing some kind of SW retention practice that can also provide supplemental water to farmers.
	Gerda Marsh Hill divert flow into forested area (site # 15)	Already a drainage maintenance issue; could prevent a lot of sediment from going in Bay Recently, DPW has paved some road and is putting in riprap swale)
	King’s Hill Road (site # 4)	Could include demo stormwater as part of drainage maintenance/repair (update: Flat part has been paved by DPW)
	Detention Off of Estate 6 road to capture a lot of Coral Bay drainage (site # 5)**	Feasible to capture large area, but need to acquire land; not highly visible
	Morrisette (Flannigan’s Passage) detention Johnson Bay (site # 10)	Already has plans for detention pond at bottom of property; expressed willingness
	Hanson Bay un-paved section (site # 18)	Already a drainage issue
<i>Low</i>	Eric Tillett’s site bio retention/swale/step pool down to road (site # 8)	Currently under construction; willingness of developer to use as a potential demonstration site for innovative stormwater practices; multiple attempts in Fall of 07 to improve sediment trap and swale to control erosion, additional grading and paving of road to occur.
	Detention behind pickles and to NE (site # 6)**	Feasible to capture large area prior to discharge, but would need to purchase land
	Froghollow uphill section/remove concrete and put in plunge pool to gabion (site near # 18/19)	Current restoration project underway
* Note that sites are based on quick field assessment and need to be evaluated in more detail in order to develop concept, estimate costs, and determine feasibility		
** Called out in 2005 CDM report as potential site		



Figure 11. Potential Demo Sites. (A and B) two existing basins in Privateer; (C and D) residential retrofits at Muilenberg and White residences; (E) road construction at Flamboyant; and (F) ESC and potential post-construction demos at 4-C Little Plantation.



Figure 12. Potential locations for stormwater detention.
(left) Flannigan's Passage and (right) Estate 6 Rd.

Recommendation 9: Detect and eliminate illicit discharges.

Numerous opportunities exist for illicit discharges (or, discharges not composed entirely of stormwater, discharges from firefighting activities, or other locally permitted discharges) to enter Coral Bay and its contributing guts and culverts. Anecdotal evidence from field visits, along with extensive experience working with illicit discharges nationally, suggests that the following may be of particular concern in the watershed: stormwater flow through community dumpsters; discharges of sewage or liquid wastes from commercial and institutional areas (e.g. gas station, fire station, school, restaurants); failing residential septic systems; dumping of household hazardous waste (e.g., used motor oil, antifreeze); discharges from recreational boating (e.g., sewage, used motor oil, etc.); livestock (sheep, goats, and horses) and donkey excrement and erosion on steep slopes caused by loose and sometimes feral goats; brine discharges from reverse osmosis systems (Figure 13).

Near term Actions

- 9.1) Cover the community dumpsters; fix, rusted dumpsters so they don't leak, install containment and treatment for stormwater flows exiting dumpsters.
- 9.2) If not already done, complete the septic system survey for the Coral Bay watershed and conduct a thorough evaluation of septic systems / on-site systems along the shoreline. Look for straight pipes from households to guts.
- 9.3) Work with VI Waste Management authority to hold annual or bi-annual household hazardous waste collection days at a minimum. Consider feasibility of establishing a general drop off location for hazardous materials on St. John. (*island-wide*)

Long-term Actions

- 9.4) Establish requirements for annual inspections and regular maintenance of residential and commercial systems. Work with property owners or managers at all commercial and

institutional land uses along the shoreline to ensure that sewage and liquid wastes are not discharging into Coral Bay; if necessary, ensure that spill response plans are in place.

- 9.5) Pursue the installation of a sewage pump-out station as part of any future marina improvement projects
- 9.6) Do something about loose livestock (i.e. enforce existing penning laws, institute a tagging program).
- 9.7) Work with EPA and NPS to develop a monitoring program to quantify impact of recreational boat discharges (i.e. nutrients, sewage, fuel, other)



Figure 13. Example of potential pollution generating activities and hotspots.

Recommendation 10: Adopt site design standards for new steep slope developments.

The USVI Environmental Handbook identifies principles of environmentally-sensitive site design for new development. Staff reported that most of these design principles were feasible and applicable in the USVI, however conservation/open space benefits of clustered development or group dwellings often realized on the mainland may not be feasible or desirable in the hills of St John. The steep slopes of Coral Bay provide a challenging setting for major developments, which is compounded by a community reluctance to sacrifice its rural character. Additionally, it is apparent that parcel subdivision and road permitting is often approved without development of a complete site plan. These elements of a site plan have a significant influence on the overall project design, site hydrology, natural area conservation, and long-term stormwater management.

The DPNR Division of Planning is in the process of reviewing and updating development regulations related to steep slopes. They have solicited opinions from the University of Colorado on potential design principals (i.e. narrower hillside roads), have accepted proposals from consultants to update codes.

Near Term Actions

- 10.1) CBCC, VIRC&D, or neutral contractor (i.e. University of Colorado or other consultant) to facilitate a consensus process with DPNR/DPW/Island Greenbuilders/and local developers working group to review the 2002 USVI Environmental Protection Handbook list of 22 principles of Better Site Design and determine which principles can be applied in Coral Bay. As a group, evaluate the following proposed revisions to current development regulations:
 - Establish steep slope restrictions (Figure 14)
 - In excessively steep slopes, or if developable areas remain upslope, consider increasing buffer setbacks to >130 ft per recommendations of the USVI Environmental Handbook.
 - Prevent land subdivisions with guts in middle of lot.
 - Establish site fingerprint restrictions for various zoning categories through impervious caps or open space ratios. Currently there are no incentives during the site planning process (such as density bonuses) to encourage additional open space protection.
 - Provide flexibility in road design and layout to reduce impervious cover. Given the lack of adequate parking, reducing parking ratios is not favorable. Stall dimensions are already small, and shared parking has been perfected.
 - Encourage new major developments to control and treat stormwater generated onsite where feasible (i.e. use permeable pavers, bioretention). Reduce stormwater volumes leaving site by grading roads towards permeable areas (pervious parking, terraced landscape) or by collecting driveway runoff in cisterns or via small detention ponds.
 - Strive for 100% cut/fill reuse on site by requiring cut/fill plan
- 10.2) A unified, integrated project review process is preferred to the sequential review (i.e. Planning, Building Permits, Environmental Protection, CZM, Fish and Wildlife, Historic

Preservation, etc.) for permits in the Coral Bay watershed. Owners should be required to attend a pre-concept meeting and site visit with plan reviewers and site designers to make sure better site design principles are employed where possible and that ESC and stormwater plans are designed to minimize impacts (Figure 14).

- 10.3) DPNR to consider strengthening the one-year statute of limitations on site plans that are approved. Given the amount of time it takes for construction to occur, technologies and site design requirements are likely to change between the time of approval and on the ground construction. Limitations on clearing and grading, timetables for road paving, and performance bonding should also be incorporated. (*island-wide*)

Long Term Actions

- 10.4) Update development regulations to reflect site design principles adopted by site design workgroup. (*island-wide*)
- 10.5) Consider developing a joint landscape architecture and site design program between UVI and the University of Colorado or other institution. (*island-wide*)



Figure 14. Steep slopes like those on Bordeaux Mt. pose a challenge for development (left). Consider having a concept meeting with developers and plan reviewers on site (right).

Recommendation 11: Update agency mapping resources to more accurately reflect current conditions within the Coral Bay and East End watersheds.

In order to accurately complete the watershed buildout analysis, CZM will need to update its watershed mapping information. Data layers provided to CWP do not accurately reflect drainage boundaries, current road network, parcels, or all major or minor guts. For example, existing drainage boundaries for Coral Bay include overall watershed boundary and drainage catchments (obtained from WRI), as well as seven subwatershed boundaries (established under CDM stormwater report). Upon cursory inspection, some portions of the watershed and catchment boundaries cut across guts and saltponds (i.e. Drunk Bay) and the catchments don't completely align with the subwatershed boundaries (Figure 15). In addition, some question as to the influence of the road network on redirecting of runoff from one catchment to another also exists. Road mapping does not match up with aerial photos, or with parcel boundaries. Only three

major guts were identified on mapping, however many of the problematic guts observed in the field do not show up on the gut layer provided (Jonny Horn, Johns Folly, etc). Property boundaries also were suspect in some cases (Round Bay, Ag Department public land, etc).

Near Term Actions:

- 11.1) DPNR to finalize interagency agreement for data sharing and compile existing data from non-agency groups like UVI, WRI, CDM, and Island Resource Foundation. In particular, the following mapping resources will be extremely informative for a variety of planning initiatives proposed for Coral Bay including (*island-wide*):
 - UVI (Barry Devine) has a more accurate and detailed road network that distinguishes between dirt and paved roads
 - UVI also has a detailed gut layer with major and minor drainages
 - Wetlands survey shapefiles from Island Resources Foundation
 - Erosion potential from WRI
 - Terrestrial as well as marine diversity mapping from CBCC or Barry
 - NOAA Shorelines CD mapping
 - Eric Tillet hard copy map showing guts and revised drainage boundaries based on on-the-ground knowledge, consider obtaining a hard copy
 - Zoning from DP
- 11.2) CZM GIS technicians should work with Lt. Governors Office to redelineate watershed drainage boundaries using topography and road network to rectify watershed, subwatershed, and catchment boundary discrepancies.
- 11.3) CZM GIS technician or DP to update parcel boundary map and include recently approved subdivisions

Long-term:

- 11.4) Establish a web accessible clearinghouse in DPNR for watershed related data; post available layers on the website so CBCC and other groups have access. (*island-wide*)
- 11.5) Develop a plan for maintaining updated data layers. (*island-wide*)



Figure 15. Example of drainage boundary cutting across a salt pond in Drunk Bay.

IMPLEMENTATION STRATEGY

Implementation of the watershed recommendations described here will be challenging; however the potential for success can be increased if there is a commitment by project partners and an effort to integrate activities within existing daily operations and program responsibilities. Securing commitments from the territorial departments (VIDPNR and VIDPW, for example), which have primary jurisdiction and responsibility for storm water management within watersheds is critical. Recognizing the role that non-governmental assets such as the CBCC, the Nature Conservancy, Island Resources Foundation, and the University can play is also going to be critical for successful implementation. To facilitate these ends, the following strategic tips are offered:

1. **Designate a single watershed coordinator** responsible for shepherding the watershed plan through the implementation phase. This will likely be a dedicated FTE in DPNR (either DP planner or CZM watershed coordinator per recommendation #1) whose primary responsibility is implementing the watershed plan, and perhaps initiating similar planning activities in other priority watersheds. However, an alternative approach would be to secure funding for a full time watershed coordinator through the CBCC. Some jurisdictions find it helpful to establish a committee or implementation board to assist the coordinator with inter-agency communication, technical guidance, fund raising, etc. The coordinator will be responsible for tracking and reporting progress annually.
2. **Link watershed recommendations with existing program requirements and daily operations.** The last thing everyone needs is something else on their plate, so it is important to show how implementing specific actions in the watershed plan "double dips" into required program activities (i.e. TDPEs and TMDL programs, Earth change and permitting program, floodplain program, building inspection, planning objectives, APC implementation, public works maintenance program, etc). Table 5 maps some of these links, and many of them are called out in the action items for each recommendation. We encourage individual agencies to take a closer look at how individual recommendations and implementation actions fit within their programs (i.e. capital budgets, training opportunities, plan review, etc). There are a handful of territorial and federal agency initiatives currently focused on Coral Bay should provide immediate opportunities/mechanism for implementation including:
 - DPNR Division of Environmental Protection (EP) has newly issued the Territorial Pollution Discharge Elimination System (TPDES) stormwater regulations and is enhancing its stormwater program activities. Implementation of many of the watershed recommendations presented here will help meet stormwater program requirements.
 - Recent Total Maximum Daily Loads (TMDL) requirement/development for sediment in Coral Bay. While EP is ultimately responsible for development and administration of TMDL, EPA has established water quality monitoring sites in Coral Bay as part of a field study to provide data for future modeling and TMDL development. Many of the recommended actions relate to reduction of sediment loads to the Bay.

- CZM is currently evaluating implementation progress of APCs, which will involve revisiting the Coral Bay APC strategy and implementing watershed recommendations that meet APC goals.
 - DP recognizes the need for better hillside development criteria and will be incorporating some of the recommendations from this report into their strategic program plan as well as upcoming revisions to the zoning code. DP is currently advertising for a full time planner for St. John, and has partnered with The Nature Conservancy in completing several ecologically driven initiatives. One of the principal projects is to comprehensively map the ecological and cultural resources on all three islands in anticipation of the completion of the Comprehensive Land and Water Use Plan initiative.
 - VIRC&D is looking to provide construction site demonstration training. Also, NRCS is now planning Soil Survey training workshops island-wide for ~May 2008. VIRC&D & CBCC, with assistance from USDA-NRCS, are seeking to implement a storm water retention demonstration practice within the watershed. VIRC&D has applied for a stormwater practices education grant to bring in a trainer and hold a session in early 2008– CBCC will publicize this for Coral Bay and St. John developers and homeowners.
 - EPA is undertaking a Virgin Islands Environmental Stewardship Initiative, with Coral Bay as a primary site, aimed at addressing degraded environmental conditions through a holistic approach including compliance assistance, capacity building and community outreach, funding assistance, and programs enforcement.
 - Annual NOAA Coral Program grants are also a potential source of funding.
4. **Take advantage of non-government resources** such as the University of Virgin Islands, The Nature Conservancy, and the Island Resources Foundation that have extensive technical and scientific experience in Coral Bay or in other watersheds in the USVI. Look to them for take the lead on contractual work, curriculum development, and updating of mapping resources. For example, the Fish Bay Watershed Assessment Recommendations for a Road Erosion Control Program (Ramos-Scharron et al., 2007) details existing road drainage and erosion issues and project concepts designs for fixing them. It provides background on research quantifying the erosion potential of dirt roads on St John and uses EROS-STJ GIS Model which can be used to develop detailed estimates of runoff and sediment loading for other watersheds in St. John (see Dr. Carlos Ramos for a copy). This project can provides insight into repair options, costs, and funding opportunities for road improvements.
3. **Identify recommendations that are applicable territory or island wide.** There are a number of regulatory, programmatic, and procedure based recommendations included here that apply island-wide, so recognize that implementation of those items will advance watershed management in other priority watersheds, not just in Coral Bay. These actions require more substantial support and commitment from agency staff and elected officials, however they will likely be the most effective in protecting and restoring aquatic resources. Subsequent watershed planning efforts will be able to focus more on on-the-ground projects rather than these larger management issues. Island-wide actions are noted individually the recommendation discussion.

4. **Specify who should take the lead on recommended activities.** Coral Bay is fortunate in that there are a variety of on-going initiatives and implementation partners available for implementation such as agency staff, federal funders, consultants, university researchers, and community groups that have a hand in Coral Bay and could be included in the process. Table 6 summarizes potential responsible parties. It will be up to the watershed coordinator/and or watershed committee to move forward with these assignments, assuming partners identified here are committed to implementation.

5. **Develop an annual schedule** for initiating and/or completing tasks. We took a preliminary stab at this by breaking implementation actions into near and long-term actions. Implementation schedules are a living thing and need to be updated continuously. Appendix B presents a hypothetical implementation horizon, however, expect this schedule to lengthen and plan to update it frequently.

6. **Get a handle on planning level cost estimates** for activities as soon as possible in order to take advantage of upcoming grant opportunities, annual program budgets, and capital improvement allocations. Appendix B provides a relative cost comparison that assumes new costs only—not costs associated with current agency staff and programs. Please note that these costs can vary widely and are for basic planning level only.

Table 5. Links to Existing Programs and Initiatives

Overall Recommendation	Current Initiatives and Programs								
	CZM APC	DEP Stormwater Program	EPA and EP TMDL and WQ Monitoring	Public Works Road and Drainage	CBCC Com. Visioning	DP Comp Planning	EPA Stewardship Grants	VIRC&D Training and Retrofits	UVI/FW/DP Natural Res. Inventories
1) Local technical assistance	X	X			X		X	X	
2) Master stormwater, road, and land use plan	X	X	X	X	X	X			X
3) Erosion & drainage problems	X		X	X	X		X	X	
4) Enforce existing environmental regs		X	X						X
5) Road design, construction, ownership, and maintenance		X	X	X			X		
6) Post-construction stormwater design, permitting, & enfor.	X	X	X		X				
7) Conservation areas	X	X			X			X	X
8) Demonstration projects	X	X	X		X		X	X	
9) Illicit discharges		X	X						
10) Site design standards		X		X	X	X			
11) Mapping		X	X	X	X	X			X

Table 6. Leads on Implementation		
Lead Agency/Org	Recommended Action	Partners
EPA	1.1 Fund FT hydrologist / watershed planner for Coral Bay	CBCC, NOAA
DPNR – CZM	1.3 Fill vacant/Hire new APC/watershed coordinator	NOAA
	1.4 Purchase car, computer, etc for new watershed hire	CBCC, EPA, EP
	2.1 Complete Coral Bay build-out and vulnerability analysis	DP, UVI
	2.3 Agency leadership on establishing a joint DPW/DPNR workgroup tasked with developing a master stormwater drainage plan— particularly along Centerline/Carolina Drainage	DPW, EP, DP, UVI
	2.5 APC implementation/ integration with watershed plan	--
	2.7 and 10.2 Agency lead on streamlining permitting and review	EP, DP
	4.3 Revise major permit	EP
	4.6 Database of earthchange permits	EP, CBCC
	5.1- 5.4 Agency lead on revising road permitting, design, and construction, and maintenance provisions. Maybe hire consultant to facilitate	DPW, EP; UVI, NRCS, IRF, VIRC&D
	11.1-11.5 Update watershed drainage boundaries; parcel boundary map; finalize IAG for data sharing	UVI, DP
DPNR – EP	4.1 Inspection blitz	CZM, USEPA
	4.2 Increase inspection & enforcement presence in Coral Bay. Lead on evaluating current fees/penalties	--
	4.4 and 4.5 Public education for existing and new stormwater regulations	DPNR Public Education, CBCC, VIRC&D
	6.1- 6.4, 6.6-6.8 Agency lead on stormwater regs revisions/ hire consultant to facilitate/ develop tracking systems	USEPA, UVI, NRCS, CZM VIRC&D, consultant
	8.1-8.2 Take the agency lead (with EPA) on building high-medium priority stormwater retrofits and enhanced ESC demo projects. CZM to help raise \$\$	EPA, DPW, NRCS/RC&D, UVI, CZM, individual developers
	9.1- 9.7 Agency lead to coordinate with VIWMA on dumpster, finish septic system survey, hazmat day. Monitoring to be coordinated with TMDL and with EPA	VIWMA, EPA
DPNR – DP	1.2 Hire planner for St. John (position currently posted)	--
	2.4 Coordinate community visioning	CBCC, other agency rep.'s
	2.6 Moratorium on rezoning	CZM, EP
	2.8 Comprehensive road network plan	DPW, CZM, EP, CBCC
	2.9 Coral Bay comprehensive plan	CBCC
	7.1- 7.5 Lead on conservation area planning	Nature Conservancy, DFW, UVI, NPS/Dept of Ag/Historic Preservation, CBCC
	10.4 Update regs based on recommendations	--
DPW	3.1- 3.3 Take lead in inventory, soliciting funds and coordinating with involved parties on needed erosion & drainage repairs (a-c)	CBCC, CZM
	5.6 and 5.7 Road ownership and maintenance	--
VIRC&D	6.5 update BMP handbook	--
	5.8 and 8.1 Contractor/developer workshops & tours to showcase existing good practices	NRCS, UVI, CBCC

Table 6. Leads on Implementation		
Lead Agency/Org	Recommended Action	Partners
	10.1, 10.3 Lead working group to review 2002 USVI Environmental Hdbk to determine which principles can be applied in Coral Bay & evaluate proposed revisions to current development reg.'s	DP UVI, DPNR, CBCC, IRF, Building Inspections, Green builders group, local developers
CBCC	Facilitate and track watershed plan activities and progress	Community members, all partner agency rep.'s
	8.2 Residential driveway disconnection program	UVI, EP(?), EPA(?)
IRF	2.2 Conduct road Erosion control study	CBCC, DPW, CZM, UVI
UVI	10.5 Consider developing joint landscaped architecture and site design program with University of Colorado	CZM

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Appendix A

Site Locations (Description and Map)

1. Sea grape overlook

- a. Town/dock area -overview –reviewed ghut flows;
- b. Flamingo Pond area – drainage routing. Is there a deposition study on salt pond?
- c. Hillside bypass of salt pond now, results in sediment plumes
- d. Did not go onsite - Emmaus Church land, town dock area – site of future major CZM development (marina, commercial, high density potential) (Also missed – Skinny Legs, Coral Bay Marina, Fire station, School) Church not allow us on to property to evaluate. Whole town dock area possibly being redeveloped for marina, moving school, etc. were not allowed onto school property to evaluate potential opportunities

2. Johnny Horn Trail –

- a. Public Works maintains this to avoid damaging drainage. Unprotected, it runs through cemetery and elementary school.
- b. Elvis Marsh joined us for this tour and discussion and after lunch shoreline and drainage tour Gut cuts behind cemetery and donkey diner, floods across street towards school
- c. Johnny Horn only paved first 300 yards, lots of dirt road laterals added in last few years. Johnny Horn Trail - Public Works maintains this to avoid damaging drainage. Unprotected, it runs through cemetery and elementary school.

3. Firestation

- a. Concrete channel behind firestation Sea Grape Hill flow comes done thru parking area at Firestation

4. Kings Hill Road- Marsh property and Gerda Marsh Estate

- a. Area potentially suitable for multiple detention ponds; CDM stormwater recommendations
- b. Potential to pave remaining roadway and add regional devices (talk to federal highway dept)
- c. No view, so consider this area as future developable lands for less expensive housing, services, etc
- d. Valley here catches a lot of water and slows it down, want to retain function
- e. Government should be strategically planning for growth here.
- f. Don't want connection to centerline/coral bay to be done privately—needs to be government property

5. Estate 6 Rd. Potential pond location

6. Pickles area (now Pool Services)

- a. Did not stop at Gas station
- b. Adjacent to low lying church land where they want to fill and move school
- c. Fill material added behind store
- d. Culvert across road to mangroves

- e. A lot of water comes thru here
- f. Andy
- g. Location for storage practice?

7. **Voyages** (meet with E. Tillet)

- a. Eric showed map with minor guts and shared list of issues for management plan:reg authority; type of drainage devices, type of development, covarege/acreage ratios, planned road network, goats, plant species,

8. **4-C Little Plantation** – Recent CZM Subdivision Permit - Left in dirt road state for over 6 months now– mitigation measures

- a. Interest in being demo site
- b. Challenging ESC given steep slope and small area for sediment trap
- c. Trying different practices to see what works

***Drive-bys – at Junction of public road 108, nonfunctioning stormwater baffle; site of planned marina. Little Plantation area:

- Several ghuts drain into bay here – houses being built on flat land, more channeling
- PW Cleared Ghut turned into Garden –

***Harold’s way private road drainage - concrete road, no swales

***Cocolobo shopping center area;

**** Island Blues

9. **Concordia resort** – Construction in “eco-manner” with gabion baskets, minimal site disturbance, Maggie Day 776-0838, Maho Bay Resorts.

- a. Good example of open space protection
- b. Land acquisition

10. **Flannigan’s passage subdivision** – Brion Morrisette - CZM permit, reviewed roads, stormwater features

- d. Potential for storage pond at bottom of hillside
- e. Easement in works to secure site for stormwater practice
- f. Interesting ground cover vegetation in exposed soil area
- g. Example of slope failure under paved roadway

11. **Rupert Marsh Road.** Example of clearing and grading and transport of fill material without proper permit; inconsistent enforcement; example of how sequencing of permit process maybe not so great. Includes cutting road prior to subdivision approval

12. **10-87 Carolina dirt road** – Jay Goldman

Example of local residents being unclear as to who owns/responsible for roadway maintenance; another example of inconsistent enforcement by local agency; need for assistance and education as to proper procedures for earthmoving/ road maintenance.

13. **Bordeaux Mountain Villas**

- a. View steep site for group dwelling

- b. Unapproved road paving
- c. Inaccurate topo/layout on submitted site plans
- d. Example of why open-space design might not work well in STJ

***Evaluation of Route 10 culvert drainage, high unsupported crumbling cliffs for over a mile, causing erosion, blockage of culverts, maintenance expense. (Most significant source of “channeled water” and sediment to valley floor) PW

- 14. **Upper Carolina Homeowners’ Association** –Sharon Coldren, Carey Mercurio (good points, vegetated swales, raised grates, headwalls, groundcover maintenance, 9 years exp.) (bad points – no ownership of road –common problem, no control of drainage channeled to Centerline culverts)

- 30. **Gaffin Property.** Drains blocked on Centerline and rerouting of water from upper Carolina now flowing across property instead of down original gut. Temporary asphalt berm add to edge of Centerline, however loss of private and public infrastructure noted

- 31. **Kent Irish Area.** Bottom of hill, large flows occurring; good example of homeowner stream restoration; also significant active gut bank erosion; threat to new residential construction

- 15. **Kings Hill Road and Gerda Marsh Road** – PW drainage swale taking sediment ¼ mile to ocean; Carolina Hill (Gerda Marsh Road) – dirt road drainage problems – Rupert Marsh

- 16. **USVI Agricultural property;** looking for way to set up ponds for ag. Potential demo site?

- 17. **Residential Ponds.** Collecting runoff from road and driveway. Clever use of trench drain to divert flows into two small fish ponds in a series before discharging to gut. On steep slope. Stormwater catchment pond on subdivision road in Bordeaux – Peter and Dorothy Muilenberg (good point)

- 18. **Hansen Bay Homeowners association** – Jean and Steve Cottrell, , (concrete to dirt road near ocean)
 - a. end of Route 10 – Round Bay; redirected flow from roadway away from beach access to a small shallow detention basin
 - b. issue with dirt road/concrete road and HOA conflicting interests
 - c. example of subdividing land without taking drainage into account
 - d. issue with reopening small access road to beach

- 19. **Privateer Bay Homeowners association** – Doug White (good points, drains to salt ponds) Jay Swartley -Repair of 10 yr old stormwater retention feature at FROG Hollow; example of Irrigation system using driveway runoff and cisterns

- 20. **Flamboyant Realty** new construction. Not sure exactly where we are on map (aerials don’t show new roadway.

- a. New CZM major subdivision permit – road construction half-finished – Bob Carney, Flamboyant Realty (near VERY sensitive coral reef areas, has natural drainage basins, new narrow roads, compacting, quick concrete work) CZM gets weekly water quality monitoring reports.
- b. narrow roads; good example for process to pave as you go
- c. pulloffs and turnarounds
- d. mostly good esc practice

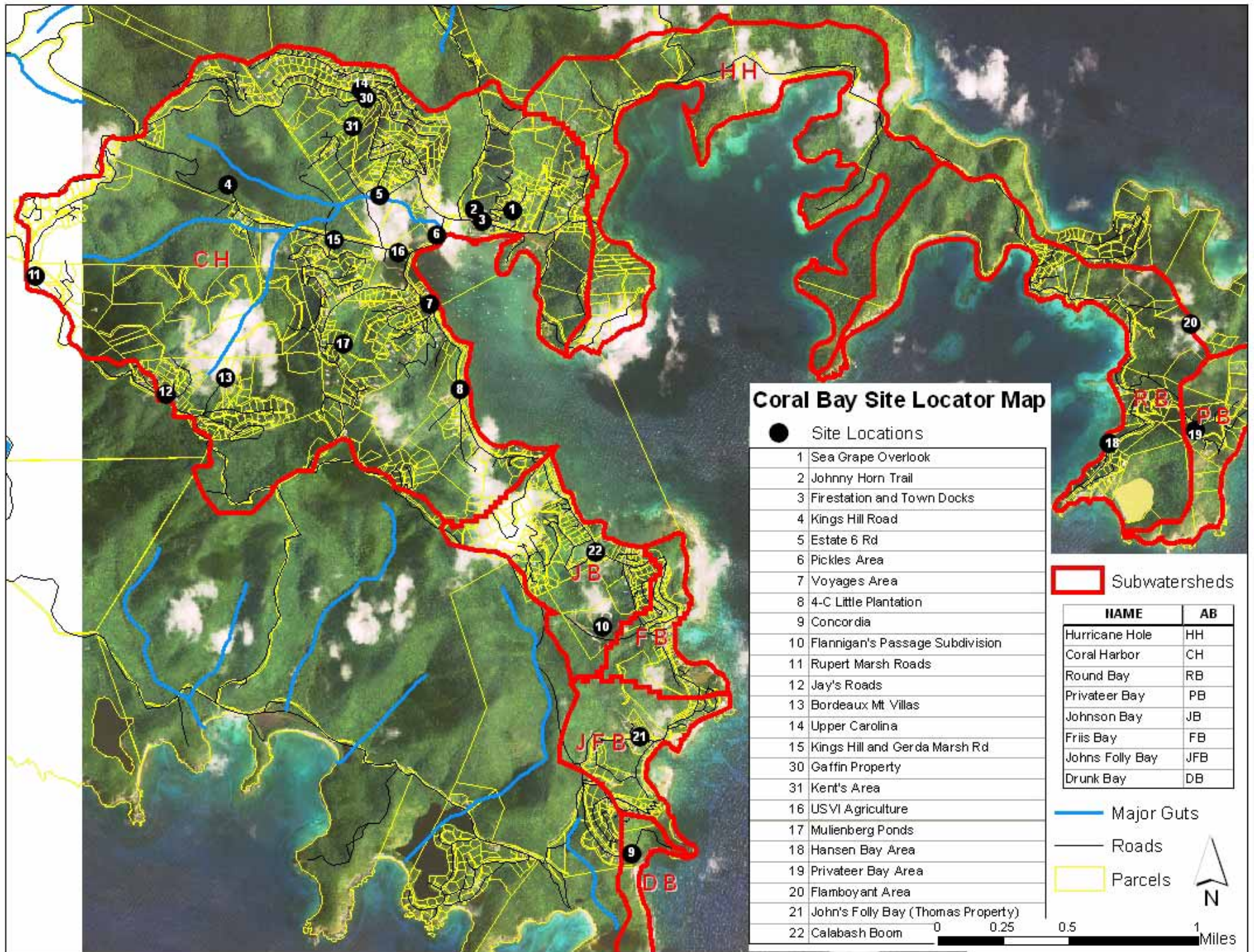
21. John's Folly Bay – PW stormwater work & new subdivision road changed flow along road

- a. flow eroding channel behind Thomas house, threat to expose septic and infrastructure. DPW did a temporary fix
- b. Earnest Matthias – main John's Folly gut and boulders rolling down hill from construction of vacation villas several hundred feet above. Sediment blowout in bay still evident from 2003 storm. Threat to historic structure

22. Reliance Site/ Calabash Boom.

- a. met with Bob McNabb and Jeff Tabar and other on site. Interesting and controversial development site; site plans indicated lack of stormwater treatment and encroachment along gut
- b. Reliance Housing includes channelizing water that has been sheet-flowing across flat land from steep land above.
- c. Calabash Boom Public dirt road up Calabash Boom (legal status unclear) – PW grading/drainage “improvements” killed coral – Bob McNabb
- d. Current violations holding up work
- e. Has potential to implement innovative site design and stormwater practices

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Appendix B
Hypothetical Implementation and Relative Cost Schedule

Watershed Recommendation	YR 1				YR 2				YR 3				Notes on costs
	3	6	9	12	15	18	21	24	27	30	33	36	
1) Local technical assistance													
1.1. EPA stewardship hire					\$\$								EPA grant
1.2. DP hire					\$\$								new expense
1.3. CZM position													In house expense
1.4. provide support													
1.5. long term position												\$	New expense
2) Comprehensive community development plan													
2.1. Buildout analysis													Currently underway, in house
2.2-2.3. Erosion study; Drainage task force					\$								In house with consultant facilitated
2.4. Community visioning													In house
2.5. evaluate APC implementation													Internal policy change
2.6. moratorium													Will probably take a while
2.7. apply uniform plan review													Internal policy
2.8. road network task force													In house with consultant facilitated
2.9. comp plan													
3) Erosion and drainage problems													
3.1 Inventory					\$								Could be expensive; may be in capital budget
3.2 Repair					\$\$\$\$								
3.3 Training					\$								
4) Existing environmental regulations													
4.1 Inspection Blitz	\$				\$				\$				Annual blitz.; costs to include additional travel costs
4.2. increase staff					\$\$								Assumes 1 more for STJ
4.3 update major permit													Assume done in conjunction with 5 and 6
4.4. TPDES public meetings													In house
4.5. continuing education					\$\$								Material costs
4.6. Earthchange permit web database/map					\$								Assume done in conjunction with 11

Watershed Recommendation	YR 1				YR 2				YR 3				Notes on costs
	3	6	9	12	15	18	21	24	27	30	33	36	
5) Road design, construction, ownership, and maintenance													
5.1. establish joint permit	\$												Mostly inhouse
5.2 statutes of limitation													
5.3 designs		\$				\$							In conjunction with design guidance and manual update (6)
5.4. maintenance													In house or done in conjunction with (6)
5.5. incentives													
5.6 ownership													
5.7. mapping													In house
5.8 Training/demonstrations		\$		\$		\$		\$		\$			outsource
6) Post-construction stormwater design, permitting, and enforcement													
6.1 Criteria		\$											Outsource; a-e done all at same time, so costs may be double counting.
6.2 Performance standards		\$											
6.3. modeling guidance		\$											
6.4 flood requirements		\$											
6.6 maintenance		\$											
6.7 meetings													In house
6.5. update handbook						\$							USDA or outsource
6.8 Tracking system					\$								May outsource/same time as GIS website 11
7) Critical conservation areas													
7.1 Conservation area inventory/plan			\$										Grant to UVI to finish effort
7.2. update regulations				\$									Coincides with 10
7.3. develop incentives				\$									
7.4. secure funding								\$					
7.5. purchase/easements									\$				Potentially big expense
8) Demonstration projects													
8.1. Existing sites				\$									Minimal costs to cover travel, materials, and coordination
8.2. New projects						\$							This will be a significant cost to design & construct, purchase land, etc.

Watershed Recommendation	YR 1				YR 2				YR 3				Notes on costs
	3	6	9	12	15	18	21	24	27	30	33	36	
9) Illicit discharges													
9.1. cover dumpsters			\$										Construction of containment and covers
9.2. complete septic survey	\$												Assumes outsource, but almost completed
9.3. hold household hazmat day			\$				\$				\$		Annual collection and disposal costs
9.4. work with owners to ensure proper sewage practices					\$\$\$								Costs could include free inspection program; % repair costs
9.5. pump out station									\$				Include installation and maintenance grant
9.6. goats											\$		Goat tags and curried BBQ sauce
9.7. monitoring program						\$							Pay UVI grad student
10) Site design standards													
10.1. working group to establish principles			\$										Includes non agency participation and meeting expenses
10.2. require consulting meetings													Change of policy inhouse
10.3. add statute of limitations													Change of policy inhouse
10.4. update regulations for remaining items				\$									May outsource reg writing
11) Mapping													
11.1. inter-agency agreement													Already in progress
11.2. redelineate drainage boundaries													Current CZM GIS fellow dedicated to this
11.3. update parcel and zoning													Done in house via CZM or DP
11.4. establish web-based clearing house					\$								May be outsourced
11.5. plan for QC and updates													In house w annual Q/C
* Assumes perfect world cost symbols represent total for entire row. \$= less than \$50k; \$\$ = between \$50 and \$200k; \$\$\$ = between \$200k and \$500k; \$\$\$\$ = > \$500k													