

St. Thomas East End Reserves Watershed Management Plan

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Prepared for:

NOAA Coral Reef Conservation Program
USVI Department of Planning and Natural Resources
The Nature Conservancy

Prepared by:

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The STEER Watersheds Assessment and Planning Project is part of a broader effort by the NOAA Coral Reef Conservation Program to support the St. Thomas East End Reserves (STEER) through monitoring, use studies, and watershed restoration activities. This plan is supplemented by the 2013 STEER Watershed Existing Condition Report.

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List of Acronyms

ACOE	US Army Corps of Engineering	MLWTP	Mangrove Lagoon Wastewater Treatment Plant
APC	Area of Particular Concern		
BMP	Best Management Practice	NOAA	National Oceanic and Atmospheric Administration
BP	Building and Permits		
CLCC	Caribbean Landscape Conservation Cooperative	OSDS	On-Site Disposal System
		STEER	St. Thomas East End Reserves
CRCP	Coral Reef Conservation Program	TBT	Tributyltin
CZM	Coastal Zone Management	TMDL	Total Maximum Daily Load
DPNR	Department of Planning and Natural Resources	TNC	The Nature Conservancy
		TPDES	Territorial Pollution Discharge Elimination System
DEE	Division of Environmental Enforcement		
DEP	Division of Environmental Protection	USFWS	US Fish and Wildlife Services
DFW	Division of Fish and Wildlife	USDA	US Department of Agriculture
DP	Division of Planning	VICCC	Virgin Islands Caribbean Cultural Center
DPW	Department of Public Works		
EAST	Environmental Association of St. Thomas-St. John	VIDE	Virgin Islands Department of Education
		VIHA	Virgin Islands Housing Authority
EPA	Environmental Protection Agency	VIHTA	Virgin Islands Hotel and Tourism Association
ESC	Erosion and Sediment Control		
FEMA	Federal Emergency Management Agency	VINE	Virgin Island Network of Environmental Educators
LBSP	Land-Based Sources of Pollution	VIRG	Virgin Islands Recycling Group
IDDE	Illicit Discharge Detection and Elimination	VIWMA	Virgin Islands Waste Management Authority
IGBA	Island Green Building Association		



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Introduction

This management report provides watershed restoration recommendations for the lands surrounding the St. Thomas East End Reserves (STEER). STEER is a 3.7 sq. mile collection of marine reserves and wildlife sanctuaries that includes the last remaining mangrove lagoon on St. Thomas. Widely recognized as one of the Territory's most significant nursery grounds for commercially and recreationally-important fisheries, STEER encompasses Mangrove Lagoon, Benner Bay, Compass Pt. Salt Pond, Jersey Bay, Nazareth Bay, Cowpet Bay, and Great Bay. The STEER watershed is 6.2 sq. miles of upland area that drain directly to these waters. More information on the environmental, social, and economic aspects of STEER can be found in the **2011 STEER Management Plan** and in the **2012 STEER Coastal Use Survey**.

In 2011, NOAA CRCP sponsored a watershed assessment and planning effort to identify potential land-based threats to STEER. This project was conducted concurrently with a sediment sampling and biological monitoring project, and with a study of current uses within STEER. Collectively, this information will be used to inform territorial management decisions related to STEER protection and restoration.

Purpose and Limitations of this Plan

The purpose of this plan is to identify priority watershed management

recommendations and an approach to implementation based on three main objectives:

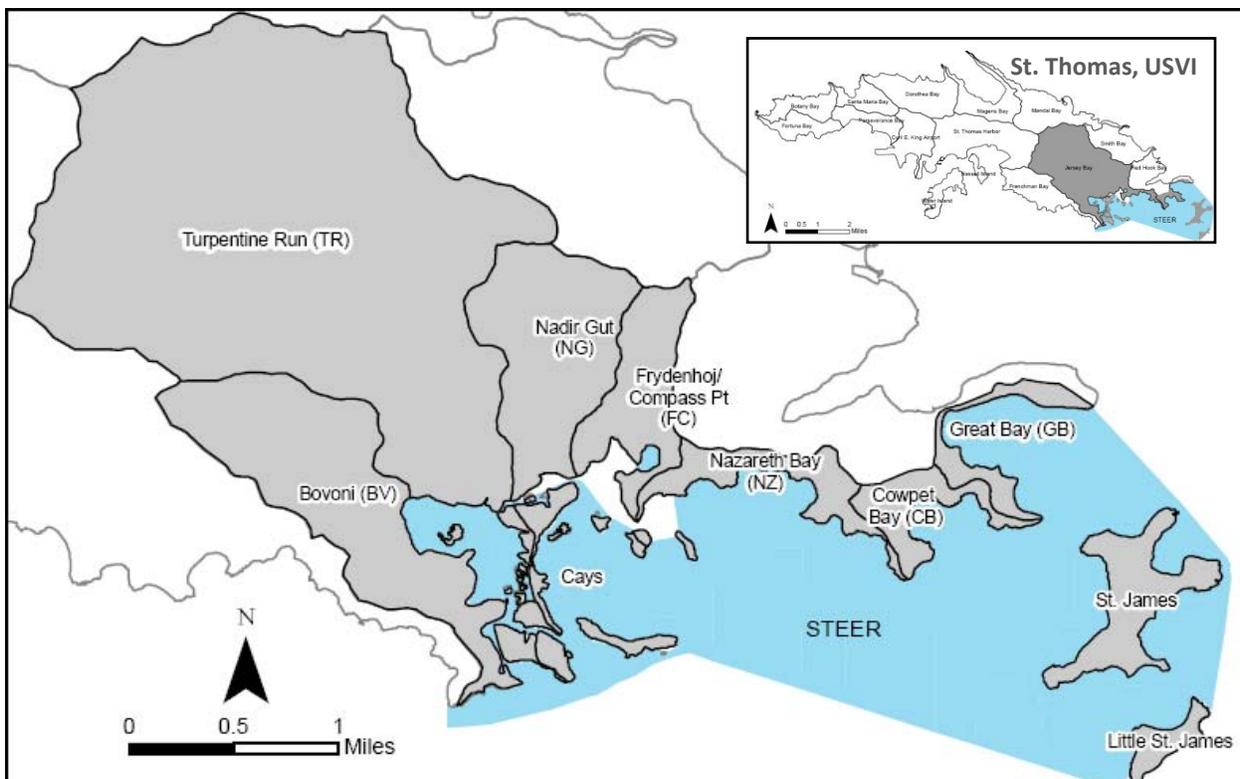
- 1. To meet existing federal and territorial public health criteria and water quality standards by reducing sediment, bacteria, nutrients, and other contaminant loading to STEER.*
- 2. To engage a diversity of local residents and businesses in STEER watershed restoration activities and inspire a sense of community ownership and activism.*
- 3. To support existing efforts to improve development regulations and advance sensitive habitat conservation goals.*

This plan summarizes 8 key watershed recommendations, 39 strategic actions, and potential projects at 93 locations throughout the watershed. The information presented here is based on a review of previous studies and existing territorial planning documents, input from a subset of watershed stakeholders, and a rapid field assessment. The size and complexity of the watershed coupled with budgetary limitations and inaccurate mapping information necessitated a broad approach to the watershed planning process (e.g., limitations on the number of sites visited, number of public meetings held, extent of project concept designs and cost estimates). The implementation strategy is preliminary, and is expected to

evolve as funding opportunities arise, management priorities shift, and additional information is collected.

The following list summarizes gaps to fill in order to develop a more comprehensive watershed management plan:

- Evaluate conditions and opportunities on Great St. James, Little St. James, and on individual commercial/ industrial properties where issues have been raised, but assessments not completed;
- Further refine concept designs, cost estimates, and potential benefits of structural restoration projects;
- Collect information on the location, capacity, and condition of existing stormwater and wastewater infrastructure (e.g., effluent concentrations, extent of combined system, design of existing BMPs);
- Estimate the extent of impervious cover managed by cisterns and their capacity/drawdown for small storms;
- Estimate potential pollutant loading based on best professional knowledge of wastewater inputs, land use event mean concentrations, and other secondary sources (this will require calibration with existing TMDL models and available water quality data);
- Investigate the role of climate change and anticipated sea level rise on shoreline properties, groundwater, and rainfall;
- Review Bovoni Landfill closure plans; and
- Engage a broader cross-section of the watershed community in the management planning process (e.g., homeowner associations, DPW, EPA).



The STEER Watershed includes the land area draining to waters within the STEER boundary. The watershed was divided into 10 smaller subwatershed drainage units for ease of future management.

The STEER Watershed

The STEER watershed is one of the largest and, arguably, most heavily impacted watersheds in the USVI. It includes the Jersey Bay and a portion of Red Hook Bay Watersheds—extending eastward from Bovoni to Cabrita Pt., and northward to the ridgeline above Anna’s Retreat and New Tutu Valley. The watershed was divided into 10 smaller subwatershed drainages, listed in **Table 1**.

This highly urban watershed is home to over 1/3 of the population of St. Thomas and is a mosaic of compact residential, commercial, and industrial uses including the Bovoni Landfill, Tutu Park Mall, and Heavy Materials quarry. Sited directly along the shoreline are the Clinton Phipps Racetrack, a dense string of marinas and boatyards, and half a dozen resorts and condominiums. The steep slopes of the interior watershed remain largely undeveloped, although a handful of planned residential developments are under construction or have been proposed.

Roughly 20% of the watershed is impervious, which is equivalent to over 800 acres of roads, rooftops, and parking lots. The vast majority of the developed area in the STEER watershed is not managed for stormwater; thus, sediments eroded from construction sites and other pollutants washed off impervious surfaces are carried directly to guts (or *ghuts*), ponds, and waters of STEER. Turpentine Run, which drains over 60% of the watershed, discharges untreated stormwater and sewage overflows directly into Mangrove Lagoon. The Bovoni Landfill is unlined, and the extent of groundwater contamination and leachate seepage into the adjacent

Mangrove Lagoon is unknown. Poor soils and steep slopes render a majority of the watershed unsuitable for convention septic systems, but less than a quarter of the developed area is currently serviced by the Mangrove Lagoon Wastewater Treatment Plant (MLWTP). A significant portion of the sanitary sewer system consists of old, failing pipe; is combined with stormwater drainage; and is often subject to overflows.

Table 1. Summary of STEER Subwatershed Characteristics

Water-shed	STEER Sub-watershed	Area (Acres)	% IC	Impaired Waters (DPNR, 2010)
Jersey Bay	Bovoni (BV)	531.4	15%	Mangrove Lagoon (bacteria, turbidity, temp.)
	Frydenhoj/Compass Pt. (FC)	193.5	23%	Benner Bay Lagoon Marina (bacteria, turbidity)
	Nadir Gut (NG)	385.2	15%	
	Nazareth Bay (NB)	117.6	28%	Nazareth Bay (turbidity)
	Turpentine Run (TR)	2265.8	23%	Mangrove Lagoon (bacteria, turbidity, temp.)
Redhook Bay	Cowpet Bay (CB)	91.5	39%	Cowpet Bay (DO)
	Great Bay (GB)	68.2	31%	Great Bay (DO, turbidity)
Other	Cays	123.0	0	Mangrove Lagoon (bacteria, turbidity, temp.)
	Little St. James (LSJ)	36.4	14%	No*
	Great St. James (GSJ)	153.5	0	Great Bay (DO, turbidity)
Total		3966.0	20%	

IC = Impervious Cover, DO = Dissolved Oxygen

*Waterbodies on LSJ not included by DPNR (2010)

More detail on existing conditions, hydrology, geology, land use and other watershed factors can be found in the supplemental **2013 STEER Watershed**

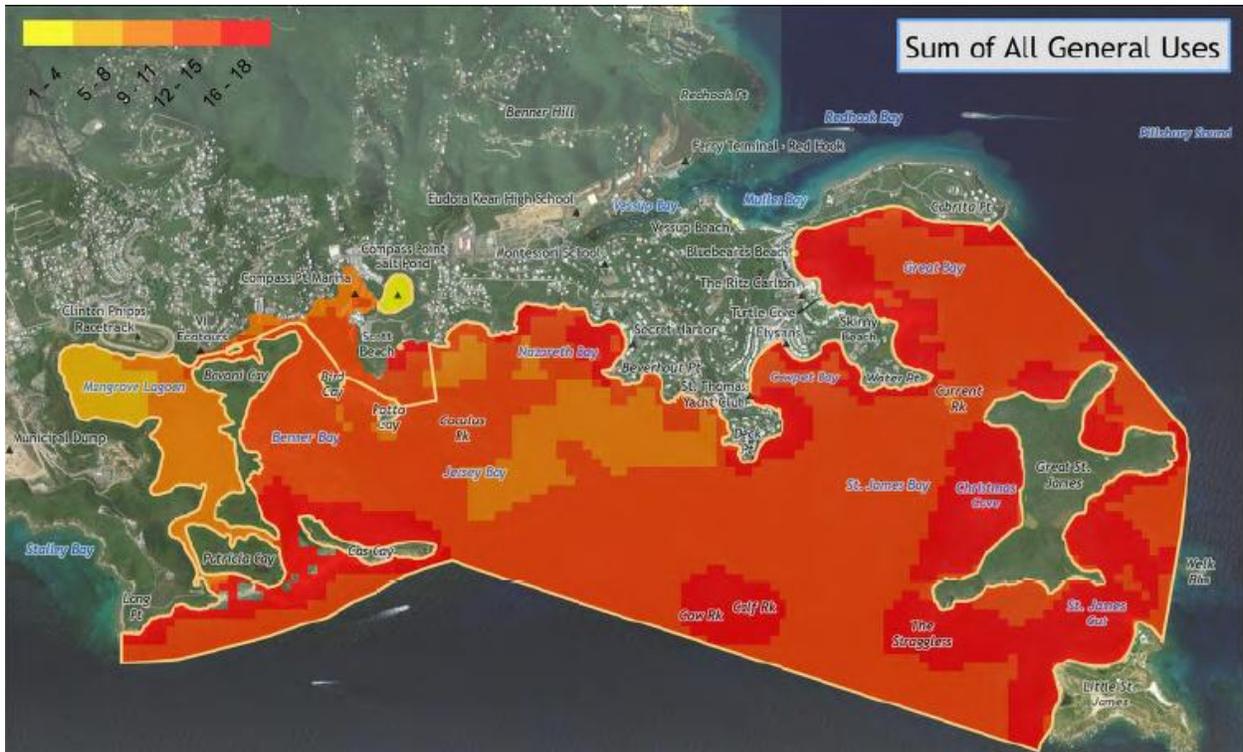
Existing Conditions Report. Given the intensity of urbanization and limited treatment infrastructure, it is not surprising that:

- Most of the bays within STEER are currently listed as impaired by DPNR for dissolved oxygen, bacteria, temperature, and/or turbidity;
- Two TMDLs have been established for dissolved oxygen and bacteria in Mangrove Lagoon and Benner Bay;
- Sediments in northern Benner Bay and Mangrove Lagoon are contaminated and have the third highest TBT concentration ever recorded by NOAA. Biological sampling shows that the health of benthic organisms has been negatively impacted in STEER;
- A federal consent decree has been issued for the Bovoni landfill requiring

leachate interception, stormwater management, and other cleanup activities prior to closure;

- The Tutu Wellfield Superfund Site was established to clean groundwater in that was contaminated from gas stations and dry cleaners;
- Classic impacts of urbanization are observed in many of the guts and wetlands (e.g., sedimentation, water level fluctuation, channelization, water quality impacts, buffer encroachment, bank erosion, dumping, and loss of native vegetation); and
- Watershed impacts have translated into impacts on human health and on recreational and commercial uses of STEER (boating, fishing, swimming, diving, etc.).





This map from NOAA's 2012 STEER Coastal Use Survey shows where most commercial and recreational uses (fishing, boating, diving, swimming, etc.) occur. Red indicates more uses. They found that due to water quality impacts, historic uses of Mangrove Lagoon have declined.



Monitoring well caps located in the parking lot of the Four Winds Plaza are reminders of the ongoing groundwater treatment efforts at the Tutu Wellfield Superfund Site.

Watershed Recommendation Summary

Table 2 summarizes watershed recommendations and strategic actions that are described in more detail in the remaining sections of this report. Each section includes a description of the issue, an elaboration on each strategic action, and a list of next steps for moving forward with implementation. Table 2 includes a preliminary schedule for initiating actions in the short-term (1-2 years), mid-term (2-5 years) and long-term (5-10 years and beyond). Suggested partners for coordinating, funding, or technical implementation of each activity are also listed; however, there may be other potential partners not listed here that may also be involved (see discussion in subsequent sections of this report).

Tables summarizing proposed projects identified at 89 sites throughout the

watershed are provided in **Appendix A**. These tables are organized by subwatershed. Each table includes a site ID# and name, a description of the proposed project, an initial feasibility ranking, and comments on implementation. Ranking is not based on a formal prioritization process. It merely represents an initial assessment of feasibility based on property ownership, cost, visibility, and stakeholder priorities, and should be adjusted as more information is collected. Implementation of projects ultimately comes down to opportunity and interest.

Site locations can be found on the subwatershed management maps located in **Appendix B**.

Field notes and concept sketches for each site visited can be found in **Appendix C**.



This section of Turpentine Run reveals the impact of upstream urbanization on water quality, gut ecology, and natural floodplains (e.g., channelization, loss of buffer, lack of in-stream habitat, and algal mats).

Table 2. Summary of STEER Watershed Recommendations

Watershed Recommendation	Strategic Actions	Implement (years from 2013)	Key Partners
<p>#1. Quantify and reduce water quality and wetland impacts on Mangrove Lagoon from the Bovoni Landfill <u>prior</u> to proposed closure in 2021.</p>	<p>1.1 Provide public access to regularly updated information on compliance activities, enforcement actions, and closure plans on federal and territorial agency websites.</p>	<p>1</p>	<p>EPA, VIWMA, DPNR</p>
	<p>1.2 Conduct groundwater monitoring to quantify the amount, flow rates, and spatial extent of contaminated leachate reaching Mangrove Lagoon.</p>	<p>1-2</p>	<p>UVI, VIWMA, EPA</p>
	<p>1.3 Advance temporary measures to manage and treat stormwater runoff in the short-term where necessary.</p>	<p>1-2</p>	<p>VIWMA, DPNR</p>
	<p>1.4 In addition to the scrap tire removal requirements of the CD, develop a plan for restoring the fringing mangrove and enhancing the vegetated wetland buffer, where feasible.</p>	<p>1-2</p>	<p>UVI, DFW, NOAA, Bovoni Tire</p>
	<p>1.5 Design and implementation of leachate controls (i.e., pumping or perimeter interceptor prior to treatment).</p>	<p>1-2</p>	<p>VIWMA, TNC, DPNR, EPA</p>
<p>#2. Reduce nutrient and pathogen loading to STEER through improvements to sanitary sewer infrastructure and by addressing inadequacies of privately-operated systems.</p>	<p>2.1 Provide immediate public access to monthly effluent monitoring reports and enforcement actions for small package systems by posting on agency website.</p>	<p>1</p>	<p>DPNR</p>
	<p>2.2 Complete mapping of sanitary sewer and combined network for MLWTP. Collect information on pipe diameter, structural condition, invert elevations, manholes, outfalls, and suspicious discharges.</p>	<p>2-5</p>	<p>VIWMA, EPA</p>
	<p>2.3 Conduct inventory of on-site sewage disposal systems (OSDS) including system type and location, maintenance, and feasibility of sewer connection.</p>	<p>2-5</p>	<p>DPNR, EPA, local businesses</p>
	<p>2.4 Identify and secure funding to replace failing pipes, disconnect the combined system, and extend sewer service to priority areas.</p>	<p>5-10+</p>	<p>VIWMA, EPA, DPNR</p>
	<p>2.5 Develop a subsidy program for sewer service connection or advanced OSDS installation.</p>	<p>5-10+</p>	<p>VIWMA, DPNR, EPA</p>
<p>#3. Reduce flooding, gut erosion, and water quality impacts through the improved management of stormwater runoff from existing and future developments.</p>	<p>3.1 Establish pollutant removal, recharge, and channel protection criteria for post-construction stormwater management for new development and redevelopment projects. Investigate new regulatory or policy updates to improve technical review capacity and mechanisms to encourage private properties to retrofit.</p>	<p>2-5</p>	<p>DEP, CZM, DPW, VIHA, EPA, NOAA</p>
	<p>3.2 Enforce existing TPDES, Earth Change, and other environmental regulations through stop-work orders and/or mitigation. Clarify the mechanism for stakeholder reporting of observed violations.</p>	<p>2-5</p>	<p>DEP, CZM, BP, DPW, FEMA, ACOE</p>
	<p>3.3 Complete mapping of stormwater infrastructure (e.g., catch basins, pipe diameter, invert elevations, culverts, manholes, outfalls, BMPs, and suspected illicit discharges). Coordinate with sewer mapping.</p>	<p>2-5</p>	<p>DEP, DPW, VIWMA, EPA</p>
	<p>3.4 Design and implement priority stormwater retrofits and drainage improvements to improve water quality and reduce flooding and erosion problems.</p>	<p>2-10+</p>	<p>DPNR, DPW, VIDE, VIHA, NOAA</p>

Watershed Recommendation	Strategic Actions	Implement (years from 2013)	Key Partners
<p>#4. Implement non-structural and other pollution prevention measures to minimize exposure of trash, oil, sediment, TBT, and other chemicals to the drainage system.</p>	<p>4.1 Conduct site inspections at each marina/boatyard facility to document potential sources of TBT, boat fluids, and other contaminants, and to provide technical assistance in the development of a cost-effective and practical pollution prevention plan.</p>	1-2	TNC, CZM, business owners, Blue Flag, EPA, NOAA
	<p>4.2 Work with Heavy Materials to develop a plan for reducing sediment, equipment fluids, and wastewater loads from quarry-related activities (e.g., secondary containment at truck filling station, bathrooms for workers).</p>	1-2	TNC, DPNR, EPA, business owner
	<p>4.3 Conduct site inspection of Clinton Phipps horse track to document animal waste management procedures and to develop a pollution prevention plan for the facility.</p>	1-2	DPNR, EPA, operator
	<p>4.4 Conduct site inspections at each automotive repair business along Turpentine Run Rd. and near Tutu Park Mall to document potential sources of stormwater contamination and to provide technical assistance in the development of a cost-effective and practical pollution prevention plan for each business.</p>	1-2	DEP, business owners; EPA
	<p>4.5 Retrofit trash collection/roll-off dumpster stations to provide secondary containment, covered storage, and signage announcing household hazardous waste collection opportunities.</p>	2-5	VIWMA, DPW
	<p>4.6 Work through the Inter-Virgin Islands Council to ban TBT used in products in the British Virgin Islands.</p>	2-5	TNC, CLCC, business owners
<p>#5. Protect and restore existing wetland habitats through land conservation, benthic restoration, and gut corridor enhancements.</p>	<p>5.1 Remove trash and prevent dumping at key locations within the gut corridor.</p>	1-2	EAST, VIWMA
	<p>5.2 Enforce <i>USVI Buffer Protection Regulations</i> and require mitigation where recent violations occurred.</p>	1-5	DPNR
	<p>5.3 Conserve land surrounding priority freshwater and salt ponds (e.g., Herrnhut, Tutu Reservoir, Cabrita Pt.) via conservation easements, land acquisition, or stringent development criteria.</p>	2-5	TNC, DFW, CZM, DEP
	<p>5.4 Develop design plans/feasibility studies for Compass Pt. Salt Pond restoration, opening of Mangrove Lagoon false entrance, and removal of contaminated sediments in Benner Bay.</p>	2-5	DFW, CZM, UVI, USFWS, ACOE, NOAA
	<p>5.5 Implement priority gut stabilization and buffer restoration projects.</p>	2-10+	USDA, DPNR, NOAA
<p>#6. Develop a unified watershed monitoring program that integrates and tracks various sampling efforts in STEER.</p>	<p>6.1 Develop a STEER monitoring plan that identifies key elements of known monitoring efforts, information needs and technical gaps, links to regulatory priorities, proposed future monitoring projects, and a data sharing plan.</p>	1	UVI, DEP, DFW, VIWMA, EPA, NOAA, USGS
	<p>6.2 Update watershed residents on the status of the Tutu Wellfield Superfund Site cleanup and monitoring efforts.</p>	1-2	EPA, DPNR

Watershed Recommendation	Strategic Actions	Implement (years from 2013)	Key Partners
	6.3 Install rain & stream gauges throughout watershed in order to correlate sedimentation with rainfall quantity and intensity.	1-2	UVI, DPNR, USGS
	6.4 Provide access on the STEER website to annual monitoring reports, trends analyses, and/or links to data.	2-5	TNC, UVI, DPNR, EPA
	6.5 Conduct illicit discharge detection and elimination sampling concurrently with sanitary sewer system mapping efforts.	2-5	UVI, VIWMA, EPA, DPNR
#7. Implement a long-term education plan that provides opportunities for residents and businesses to actively engage in watershed stewardship activities.	7.1. Engage community centers and homeowners associations in a residential education campaign linking STEER (and human) health with proper maintenance of septic systems, vegetated buffer protection, and household waste disposal.	1	EAST, VICCC, DPNR, EPA, VIWMA, VIHA, HOAs
	7.2. Convene boating-related businesses and boaters to investigate benefits of participation in the Blue Flag marina program or other certification program.	1-2	TNC, DPNR, Blue Flag, NOAA, site managers
	7.3. Convene resort managers workshop to discuss potential waste disposal, lawn care, visitor education, and stormwater improvements that could be advanced to improve STEER.	1-2	TNC, VIHTA, Blue Flag, resort managers
	7.4. Conduct a watershed tour for politicians and commissioners to highlight big ticket items.	1-2	DPNR
	7.5. Link recycling efforts to STEER watershed benefits and increase the number of household hazardous waste collection days and/or stations.	1-2	VIWMA, VIRG
	7.6. Use demonstration projects (e.g., drainage improvements, storm drain stenciling, trash cleanups, rain gauges) at schools and community centers to educate and engage kids and residents in STEER.	2-5+	VIDE, DPNR, EAST, VINE, NOAA, EPA
	7.7. Increase overall awareness of the STEER watershed through storm drain stenciling, watershed radio series, and watershed signage.	2-5+	TNC, EAST, UVI, DPNR, DPW
	7.8. Target engineers, designers, contractors, and agency staff with training on implementing stormwater design criteria and green construction techniques.	2-5+	DPNR, NOAA, IGBA
#8. Establish a formal mechanism for implementation oversight.	8.1 Designate or hire a STEER watershed coordinator.	1	DPNR, NOAA, EPA
	8.2 Organize a STEER working group to serve as watershed implementation steering committee.	1	DPNR, EPA, TNC, UVI



1. Bovoni Landfill

Quantify and reduce water quality and wetland impacts on Mangrove Lagoon from the Bovoni Landfill prior to proposed closure in 2021.

Problem

The Bovoni Landfill is unlined, and over thirty years of subsurface seepage of contaminated leachate is thought to contribute to the observed die-off of adjacent mangroves. Lack of stormwater management controls indicates that rainwater falling on the site becomes contaminated before it drains into Mangrove Lagoon or into the groundwater. The historical expansion of dumping areas in the adjacent wetland has reduced the separation distance between the landfill and the primary fish nursery and the largest remaining mangrove forest in the USVI. Leachate seepage was cited by the USVI District Court as a cause of sediment contamination in Mangrove Lagoon. Air quality and other public health concerns are significant for surrounding residents.

A Consent Decree (CD) between the US Government, the VI Government, VIWMA, and Joseph and Zulma Hodge (owners of Bovoni Tire) was entered by the U.S. District Court for the Virgin Islands in 2012 for: 1) the continued operation of the Bovoni Landfill in a manner that may present *“imminent and substantial endangerment to public health and the environment;”* 2) illegal dumping of scrap tires in the adjacent wetland; and 3) failure to comply with 1998

and 2008 Administrative Orders on Consent regarding these regulatory violations. The Virgin Islands Port Authority (VIPA) is also a party to the CD for regulatory violations at the Anguilla Landfill. Until closure in 2021, VIWMA has been directed to operate the landfill in accordance with the CD and the federal municipal landfill operating criteria. The CD requires substantial engineering improvements to control stormwater runoff, leachate seepage, and gas collection, as well as:

- Implementation of a groundwater monitoring program;
- Implementation and maintenance of a program for detecting and preventing disposal of regulated hazardous wastes;
- Application of adequate cover material;
- Control of disease vectors;
- Control of explosive gases;
- Prohibition on open burning of solid wastes;
- Control of access to the Landfill;
- Control of stormwater run-off;
- Prevention of discharges of pollutants into waters of United States; and
- Prevention of bulk or non-containerized liquid wastes disposal in landfill.

The CD does not include explicit language regarding the impacts of landfill operations on STEER. A *Wetlands Impact and Compensation Plan* is required for submittal

based on the closure schedule (Table 3); however, other than scrap tire removal, specific measures for the restoration of adjacent wetlands or vegetated buffers are not detailed in the CD.

Table 3. Closure Schedule (from CD, Appendix B)

Phase	Task	Deadline
--	Complete temporary road	4/15/12
	Submit Closure Plan Engineering Report	5/1/12
	Submit Wetlands Impact Minimization Plan	5/31/12
	Submit 2012 Closure Plan	7/15/12
	Submit Wetlands Impact Compensation Plan	8/31/12
	Complete Subsurface Debris and Earthen Fill Removal	12/31/12
	Complete Land Acquisition to West (unless not to be used for waste disposal)	6/30/13
1	East – Install storm water detention pond, storm water control	5/31/14
1B	East – Complete permanent roadway relocation, leachate interceptor system, sewer force main relocation,	5/31/14
2	North – Complete slope stabilization , detention pond, storm water control	12/31/14
3	West – Complete slope stabilization, detention pond, storm water control	12/31/14
4	Top – Complete fill/grade and storm water control	1/1/16
5	South – Complete slope stabilization and storm water control	8/31/17
	Permanently cease accepting waste at landfill.	4/30/19
6	East – Complete slope stabilization and storm water control	8 months after deadline above
7	Final closure – Complete well field adjustments, closure/fill/grade, impermeable cap & cover over entire filled landfill area	18 months after Phase 6 deadline

Potential Restoration Opportunities

Many of the mitigation requirements for the landfill are in-line with STEER watershed management objectives. VIWMA has indicated that the following mitigation activities are being considered, among others:

- Restoration of a section of white mangrove where previous dumping has occurred;
- Installation of a leachate collection system at the landfill boundary, which may include treatment at the WWTP, relocation of the service road, and additional encroachment into the adjacent wetland;
- Top cover and reshaping of the landfill, which will redirect drainage for a portion of the site out of the STEER watershed and into Bovoni/Stalley Bay;
- Installation of three permanent stormwater detention basins to manage surface runoff after final grading and cover have been completed; and
- Methane gas collection and control system and construction of a gas-to-energy facility (operational).

Closure design plans are currently undergoing revision, but VIWMA anticipates a final plan release at the end of 2013. At this time, details on the proposed control measures and wetland mitigation, if any, will be publicly available. Additional opportunities may exist for mangrove restoration and vegetative buffer enhancements, as well as temporary stormwater control measures in areas where permanent controls are not expected to be installed in the next few years.

Implementation Actions

Compliance with the CD and closure planning for 2021 will ultimately drive the schedule for implementation of restoration activities. The following actions are recommended for short-term implementation over the next one to two years:

1. Provide public access to updated information on compliance activities, enforcement actions, and closure plans on federal and/or territorial agency websites. While EPA confirms that proper public notification procedures were followed prior to issuance of the final CD, many watershed stakeholders were unaware that a public comment period was open and suggested EPA expand its notification effort in the future. In addition, access to related documents (e.g., Administrative Orders, compliance reports, draft closure plans) has been difficult to obtain without formal requests through the Freedom of

Information Act. Given the relevance of Bovoni activities on the STEER, US EPA or VIWMA should post relevant documents on their website for easy public download within the year and commit to posting regular compliance updates as well. The CD includes a number of reporting requirements that include quarterly submittals to EPA, which could easily be used to meet this objective.

2. Conduct groundwater monitoring to quantify the amount, flow rates, and spatial extent of contaminated leachate reaching Mangrove Lagoon. In 2012, researchers from UVI began applying for grant funding to establish additional groundwater monitoring wells to better characterize leachate impacts. Letters of support and permission to access the site were requested from VIWMA. Since groundwater monitoring and control is a requirement of the CD, collaboration between VIWMA and UVI could be cost effective.



Black streams of liquefied wastewater sludge dumped at the Bovoni landfill flow directly to Mangrove Lagoon after storm events.

Over the next two years, UVI and VIWMA should work together to secure funding and initiate monitoring. This information will be important to quantify the impact of the landfill on groundwater and the extent and rate of seepage into the adjacent marine environment. Official wetland delineation has been completed. Results from this effort should help inform wetland restoration planning efforts.

3. Advance temporary measures to manage and treat stormwater runoff in the short-term where necessary. The design details for proposed stormwater management practices are unknown, but based on the closure schedule (see Table 3), it appears that a number of detention basins have been proposed for installation. The capacity of these facilities to provide water quality treatment is unknown and will depend on their design and maintenance. The CD requires the immediate control of stormwater on site rather than waiting until final grading and

cover have been completed for closure. VIWMA should work with DPNR and EPA to develop and implement temporary stormwater management measures where controls may not be proposed for installation within the next few years. Temporary controls should consist of both structural and non-structural measures, as necessary.

4. In addition to the scrap tire removal requirements of the CD, develop a plan for restoring the fringing mangrove and enhancing the vegetated wetland buffer, where feasible. The CD does not specify mangrove restoration requirements other than removal of scrap tires. The CD closure schedule includes submittal of a wetlands impact and compensation plan; however, the proposed contents of this plan have not been widely distributed. Over the next two years, VIWMA should coordinate with DFW, wetland scientists at UVI, and the ACOE to develop a comprehensive wetland restoration plan.



Cover operations leave acres of exposed soils vulnerable to erosion during rain events, indicating a need for temporary and permanent stormwater control measures to prevent sediment loading to adjacent mangroves.

This plan should include looking at options for mangrove restoration and/or mitigation at other sites, as well as enhancement of the vegetated wetland buffer. It has been reported that VIWMA is planning on moving an existing road further east towards the mangroves in order to achieve the proper slope for closure. Where further buffer encroachment is anticipated, additional effort should be made to improve vegetation density and prevent direct discharges of stormwater and leachate. Fencing or other barriers to public access may be necessary to restrict illegal dumping activities and promote vegetative regeneration. Increased buffer widths should be proposed for other portions of the property or elsewhere in Mangrove Lagoon, wherever feasible.

Investigate funding opportunities for restoration planning and implementation through the NOAA Restoration Center, NFWF, or USFWS.

5. Design and implementation of a leachate control system (i.e., pumping or perimeter interceptor prior to treatment).

Typically, two alternatives for implementing gas and leachate collection systems include: 1) the installation of drilled wells for both gas and leachate extraction; or (2) separate collection systems where wells are used for gas extraction and collection, and a gravity, perimeter trench system directs leachate to a treatment facility. A combined system may be the most cost-effective alternative; depending on how the existing gas collection system was designed. The closure schedule in the CD indicates that the leachate control system should be installed in 2014.





2. Wastewater

Reduce nutrient and pathogen loading to STEER through improvements to sanitary sewer infrastructure and by addressing inadequacies of privately-operated systems.

Problem

The source of water quality impairments in four STEER waterbodies is cited by DPNR as being related to overflows from the combined sanitary sewer network into guts in the headwaters of the watershed, as well as direct discharges into STEER from small package plants and vessels.

The Mangrove Lagoon Wastewater Treatment Plant (MLWTP) was constructed in 2002 to replace four smaller treatment systems in the upper watershed—Old Tutu, New Tutu, Donoe, and Nadir. It was designed to handle 0.75 MGD with a 1.2 MGD capacity, and discharges offshore to the west of the Bovoni Landfill. It serves a population of approximately 13,500 persons (Cadmus, 2011) over roughly 20% of the STEER watershed area. The MLWTP accepts septic system pumpout loads by private companies at a smaller, adjacent facility and has recently begun accepting marine vessel pumpout from one entrepreneur on a limited scale.

This improved sewage treatment was the primary recommendation of the Benner Bay/Mangrove Lagoon dissolved oxygen and bacteria TMDLs, which assumed that upgrades to an advanced wastewater

facility would significantly reduce water quality impairments in Benner Bay and Mangrove Lagoon. However, conversion of the system did not include replacement of the extensive pipe network throughout Anna’s Retreat or the New Tutu Valley. The majority of these pipes were installed in the 1960s and have far exceeded their life expectancy. According to VIWMA, breaks in the system are frequent, manholes and joints are leaky, sewer overflows are common, and there is a significant amount of inflow and infiltration occurring (>30%). Portions of the service area are a combined storm and sewer system, but complete mapping of the sewer system is not available and no active program to eliminate sewage discharges into the stormwater system exists (although these measures are reportedly underway). Because much of the pipe network is behind homes and in heavily vegetated areas, maintenance access is reportedly difficult.

To compound the wastewater problem, approximately 40% of the watershed still relies on conventional on-site disposal systems (OSDS) to manage wastewater. Most of these systems (80%) are located on poor soils where there is a medium to high likelihood of OSDS failure. An inventory of

septic systems has not been conducted; thus, little is known about the condition of these systems or the feasibility and cost of sewer hookups.

In addition, a number of resorts/condos and commercial properties operate small package plants. Managers routinely monitor effluent concentrations and submit reports to DPNR as required; however, information on the capacity, effectiveness, or maintenance of these systems is not easily accessible.

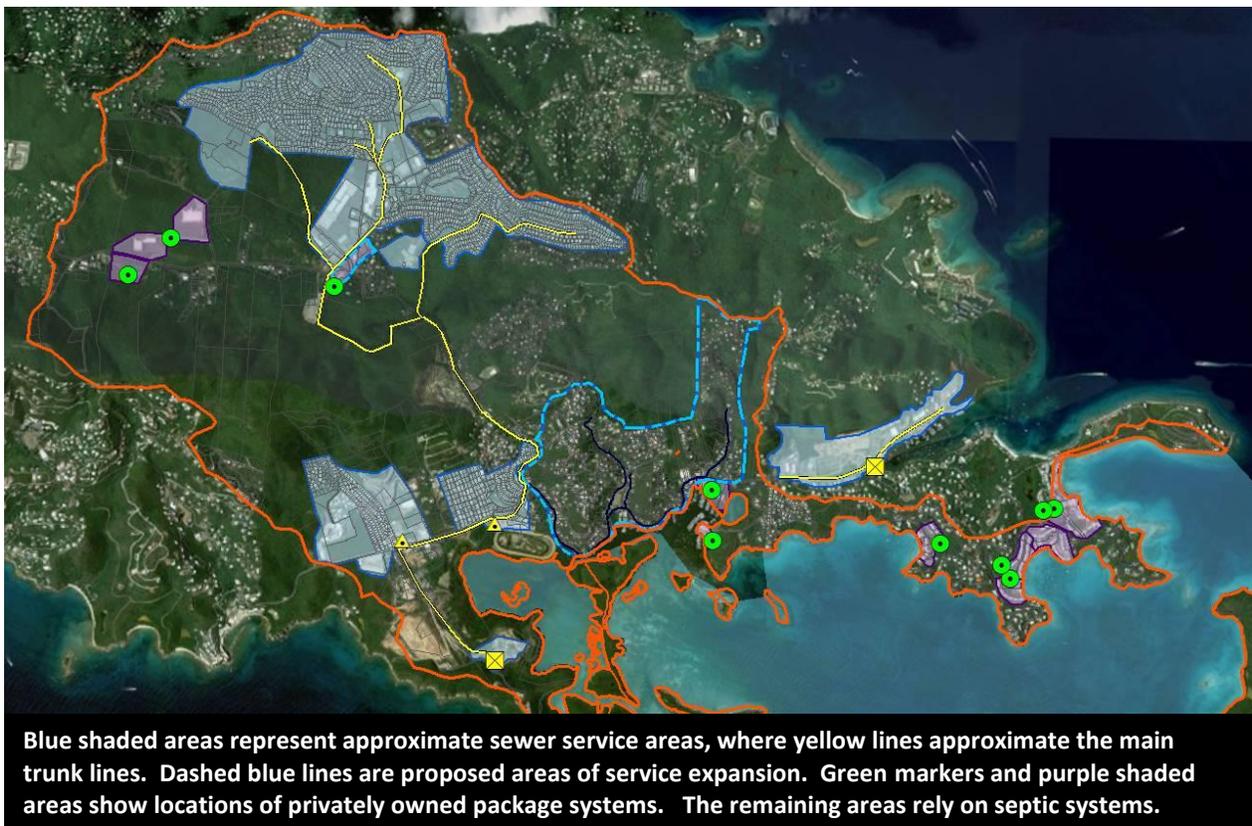
Preliminary mapping of the wastewater system in the STEER watershed was presented in the **2013 STEER Watershed Existing Conditions Report**.

Potential Restoration Opportunities

A number of potential projects were identified by VIWMA, stakeholders, and

field crews related to reducing the impact of wastewater on STEER. These include:

- Future extension of sewer service along Route 38 to bring Cost-U-Less, Ft. Mylner Plaza, and other businesses or residences on-line (e.g., Whispering Hills development). The installation of a pump station near Tropical Marine and trunk line extension further east on Bovoni Rd. would allow the marinas/boatyards and residential areas in Frydenhoj/Compass Pt. subwatershed to connect (see map **Appendix B**).
- Replacement of failing pipes, repair of leaky connections, and disconnection from the stormwater system in Anna's Retreat and New Tutu Valley (specific locations not identified).
- Investigation and replacement of on-site systems that are suspected of failure, or illegal discharge of raw sewage (see **Table 4**).



- Installation of an alternative OSDS for demonstration purposes at a willing residence on Water Pt.
- Tracking and reporting of effluent monitoring results and maintenance logs at 11 small package plants (see **Table 4**).
- Continued support of vessel pumpout options and enforcement of illegal discharges.

Table 4. Sites for Wastewater Investigations

Type	Site ID*	Name
Sewage discharge investigation and elimination and/or structural improvement	BV-5	Premier Wines and Spirits
	BV-10	Lew Henley's
	BV-12	Sweet Pie's/Laundry
	TR-8	Grandview Apartments
	TR-38	Heavy Materials
	NG-5	The Patch
	FC-2	Food Center
	FC-8	Compass Pt. Marina
Tracking of system effluent concentrations and maintenance	TR-3	Humane Society
	TR-5	Cost-U-Less
	TR-31	Ft. Mylner Plaza
	FC-4	Independent Boat Yard/ Budget Marine
	FC-8	Compass Pt. Marina
	NZ-3	Secret Harbor Condos
	CB-1/2	Anchorage Resort/ Yacht Club
	CB-3	Cowpet Bay West
	CB-4/5	Elysian/ Cowpet Bay East
GB-2	Ritz Carlton	

* Site ID includes abbreviated subwatershed name. See Appendix for location map and site description.

Implementation Actions

Wastewater system expansions and pipe replacements are a long-term capital effort

that will require upfront mapping, design, and permitting in order to secure the funds necessary for implementation. The following early action is recommended for short-term implementation over the next year:

1. Provide immediate public access to monthly effluent monitoring reports and enforcement actions for small package systems by posting on agency website. This is not intended to put an additional burden on facility managers, since they are already monitoring and submitting reports in compliance with discharge permits. To make better use of these reports and to improve our understanding of the effectiveness of these technologies in reducing impacts on STEER, DPNR or EPA should provide access to these reports by posting them on a website for easy download. DPNR should produce and make publicly available an annual report summarizing system capacity, average effluent concentrations and standards, number of water quality violations, and general maintenance or enforcement actions of all permitted systems.

The following actions are recommended for mid-term implementation over the next two to five years:

2. Complete mapping of the sanitary (and combined) sewer network for MLWTP. Collect information on pipe diameter, structural condition, invert elevations, manholes, outfalls, and suspected illicit discharges. EPA and VIWMA reportedly have agreed to develop a comprehensive program to investigate, map and repair the collection system. EPA reports that the agreement is in a Court Order that should be signed by the District Judge in the very

near future. According to local engineers and VIWMA staff, some progress on mapping has been initiated. VIWMA should elevate completion of system mapping to a high priority over the next two years. Customers should be notified of the effort in advance to improve access in residential areas. Ideally, as much information should be collected on the system as possible so priorities can be set and costs estimated for maintenance, repair, and replacement of infrastructure.

3. Conduct inventory of on-site sewage disposal systems (OSDS) including system type and location, maintenance, and feasibility of sewer connection. Over the next two years, DPNR and EPA should conduct a septic system inventory to verify the location, type, and condition of existing OSDS in the watershed. Coordinate this effort with local businesses that provide pump outs and system maintenance.

Inventory crews should provide owners with educational brochures on proper maintenance, system replacement options, and information on sewer connection. This information could help determine priorities for sewer service expansion or direct pilot incentive programs for maintenance or system replacement.

In the long-term (5 to 10 years and beyond), VIWMA, DPNR, and EPA should make strides towards implementing the following:

4. Identify and secure funding to replace failing pipes, disconnect the combined system, and extend sewer service to priority areas. While VIWMA receives approximately \$2-4 million per year in grant monies to address sewer system problems across all three islands, additional sources of funding will likely be necessary to fully address the MLWTP system. EPA reports that repairs of some of these sewer lines



Effluent from small package systems was cited by DPNR as a source of water quality impairment for Cowpet Bay. There are at least nine of these systems and two advanced OSDS in the watershed to track.

are included in an Order soon to be signed with VIWMA. Through the EPA grants program, some of these repairs are already being funded. Service expansion and pipe replacement should be put on the priority list for Capital Improvements as soon as possible in order to be eligible for funding in the next 5-10 years. The sooner mapping is completed and infrastructure priorities determined, cost estimations can be made. Because this infrastructure improvement can be directly tied to federal water quality impairments, there may be additional sources of funding available for this work (e.g., Department of Interior).

As part of sewer service expansion efforts, additional technical and financial assistance should be devoted to addressing issues associated with the MLWTP capacity to accept vessel pump outs. Vessel waste water is high in salinity and often mixed

with oil and gas, which is harmful to the bacteria used in the treatment process. VIWMA should work closely with EPA, the boating community, and other experts to address this capacity problem.

5. Develop a subsidy or incentive program for sewer service connection or advanced OSDS installation. Pilot programs have been used in other US jurisdictions to incentivize maintenance, upgrades, and sewer connection through partial subsidies to homeowners and businesses. VIWMA and DPNR should brainstorm how a program like this could be established in the USVI, and target a residential area where soils are poor and OSDS failure was highest based on findings from the septic system inventory. EPA is involved in supporting alternative septic system installations in Puerto Rico and may be a funding option.



Deteriorating on-site sewage systems and evidence of recent wastewater discharges to guts were observed at multiple locations in the watershed.



Between the restrooms and Benner Bay is the onsite wastewater system at “the Patch.” The access manhole for this OSDS is less than 15 ft from the water’s edge, leaving little distance for groundwater



Manholes in the newly installed Grandview sanitary sewer line lack covers. This creates a public safety hazard and exposes the system to additional volume during rain events.



3. Stormwater

Reduce flooding, gut erosion, and water quality impacts through the improved management of stormwater runoff from existing and future development.

Problem

When it rains on the STEER watershed, trash, sediment, and other pollutants (e.g., oils, brake fluid, fertilizer) that have collected on roads, parking lots, and other impervious surfaces is washed off into the drainage system. Either through a network of storm drains and underground pipes—or by direct discharge—contaminated runoff finds its way to guts, ponds, or the bay. Once vegetation is removed during the development process, exposed soils are subject to erosion, and rainfall is no longer absorbed by trees or allowed to seep into the ground. Over 20% of the watershed is impervious cover, which generates large volumes of surface runoff that can lead to flooding problems, gut erosion, and warmer temperatures of receiving waterbodies.

Approximately 60% of the watershed drains to Turpentine Run and ultimately into Mangrove Lagoon. This means that used oil dripped on roads from home car repair in Anna’s Retreat, soapy water from car washes near Tutu Park mall, eroded sediment from Grandview construction, and human and animal waste deposited near the gut are carried into Mangrove Lagoon.

The source of water quality impairments in five STEER waterbodies is cited by DPNR as

urban runoff and erosion and sediment. This should not be surprising given that watersheds with as little as 10% impervious cover generally exhibit water quality, biological, and hydrologic impacts.

A number of techniques are used to reduce the impacts of urban stormwater:

- Avoidance—minimizing the clearing of native vegetation, loss of top soil, and creation of impervious cover is the best way to reduce the amount of stormwater runoff generated in the first place.
- Erosion and sediment control (ESC)—temporary ESC measures during construction can help to stabilize exposed soils and prevent muddy runoff.
- Post-construction stormwater management—apply practices that capture runoff and either reuse it, allow for evapotranspiration by plants and the sun, or infiltrate it into the ground to reduce the volume of surface runoff leaving a site. Another option is to filter pollutants out of runoff before discharging it, or at a minimum, slow it down long enough to prevent downstream erosion and flooding. Cisterns and detention ponds are the primary practices used in the USVI.



The oil stains seen here are one of a number of pollutants collecting on impervious surfaces throughout the watershed that are washed into Turpentine Run and discharged into Mangrove Lagoon when it rains.



Discharge pipes visible on the beach drain parking lots, roads, and other developed areas in the watershed. In most cases throughout STEER, this runoff is not cleaned prior to discharge.



Two examples of existing stormwater management facilities are the dry detention basins at Cost-U-less and the wet basin at the Ritz Carlton.

Unfortunately—with the exception of cisterns and a handful of detention basins—most of the existing development in the STEER watershed is not managed for stormwater. Cisterns intercept rooftop runoff for water reuse in most houses and businesses. This helps reduce the amount of rooftop runoff that then flows across more polluted surfaces like parking lots. The number and capacity of cisterns in use in the STEER watershed is unknown, and estimates on their overall contribution to stormwater management has not been measured. Cisterns are generally required in the USVI, however, the disconnection of existing cisterns and new construction lacking cisterns has been observed (including some public housing projects, for example). Reduction in the use of cisterns runs contrary to stormwater management objectives.

For the management of non-roof impervious cover, there are only six stormwater detention basins in the watershed that collectively manage less than 30 impervious acres (e.g., Tutu Park Mall, Ritz Carlton, Cost-U-less, PriceSmart, Home Depot, and Raphune Vista). In general, these facilities tend to manage only a portion of the site, are not designed to effectively remove pollutants, and may have originally been natural wetlands. Some appear non-functional.

More disconcerting, some new development projects appear to lack post-construction stormwater management all together. Numerous active construction sites were observed during field assessments where temporary and permanent stormwater controls were inadequate or absent. For example, Grandview, a 6-acre publicly-financed

apartment complex, lacks comprehensive ESC practices, and appears to discharge unmanaged stormwater from parking areas and roadways directly to the gut. Where practical, public construction projects should demonstrate the application of preferred design and construction techniques, serving as a model for private sector construction.

Another example includes three newly-constructed parking lots built without any stormwater management practices—one parking lot was constructed in a gut and none had required permit information posted.

Each of these examples represents a “lost opportunity” during the review and inspection phase of development to address stormwater and hold developers to the same standards expected in other parts of the US.

As stormwater from unmanaged development increases, downstream culverts must pass higher volumes of flow than they were initially designed for. This is no more evident than at the three culverts along Turpentine Run Rd. At the lowermost culvert, hillside development in Mariendahl adds uncontrolled runoff volumes to an already swelling Turpentine Run causing chronic flooding, road deterioration, and gut erosion problems at the culvert.

DEP is the delegated authority for administering the Territorial Pollution Discharge Elimination Program (TPDES), and EPA is responsible for ensuring that the program is in compliance with approved measures of the territorial discharge permit. The Division of Building Permits oversees the Earth Change

Program for construction activities. The permitting and review process for development projects differs depending where the site is located in the island's two-tier system. CZM and DEP are responsible for processing Tier I and Tier II projects, respectively, which leads to differing levels of oversight and enforcement. In many cases, additional environmental protection permits are also required related to endangered species or ACOE wetland jurisdictions.

Currently, there are no post-construction stormwater design standards in the USVI that state how much runoff must be managed on site or criteria for pollutant removal, recharge, volume reduction, or

channel protection. The *2002 Environmental Protection Handbook* provides some recommended guidance for site design and stormwater BMPs, but this manual is not mandatory and does not necessarily reflect modern stormwater designs for a changing climate. The DPW has established road design standards as a matter of policy, but there are currently no design requirements mandated by the regulations. The *2001 Hydrologic Design of Highway Culverts* by US Department of Transportation and the Federal Highway Administration is a reference guide used by DPW and DPNR staff. IGBA and NOAA also provide design and construction guidance for "green building" in the USVI.



Grandview uses erosion control blankets and riprap to stabilize some slopes, but there remain acres of exposed soils and failing perimeter silt fencing that result in sedimentation downstream.



Outfalls discharge stormwater from Grandview roads and parking lots directly to the gut without any form of water quality treatment or flow detention.

The lack of regulatory stormwater standards and clear design guidance is a critical gap in the USVI's capacity to protect natural resources from the impacts of development.

Potential Restoration Opportunities

Table 5 summarizes potential stormwater improvement projects that were identified during field assessments. **Appendix A** provides more information on each of these sites and an initial feasibility ranking of high, medium, and low. **Appendix B** and **C** show the locations and provide notes and sketches of proposed activities, respectively. The projects include:

- Seven sites where enforcement of stormwater regulations is recommended. This includes sites currently under construction; where stormwater infrastructure raises safety concerns; and where a review of proposed drainage plans should be conducted to ensure stormwater management is adequate.
- The installation of additional ESC measures at six sites specifically to prevent sediment loading from exposed soils and unpaved roads. ESC may also be needed on other sites listed elsewhere in **Table 5**.
- Specific locations where culvert repair and/or replacement is recommended to reduce flooding on roads and protect stream beds from erosion.
- Stormwater retrofits to manage existing runoff on 48 public and private properties. This includes the potential retrofit of existing detention basins to improve water quality treatment.
- Four proposed locations where opportunities exist on undeveloped

parcels for stormwater retrofits that can manage runoff from multiple locations. These locations may be priorities for acquiring drainage easements or purchasing land.

Implementation Actions

Given the total number of projects that would need to be implemented to show measurable downstream results, improved stormwater management at a watershed scale can be expensive and challenging. At a minimum, efforts should be made to prevent new development from further contributing to the problem. Likewise, opportunities to improve conditions during redevelopment and repair activities should be aggressively seized.

The following actions are recommended for mid-term implementation over the next two to five years:

1. *Establish pollutant removal, recharge, and channel protection criteria for post-construction stormwater management for new development and redevelopment projects. Investigate new regulatory or policy updates to improve technical review capacity and mechanisms to encourage private properties to retrofit.* Agency staff and local stakeholders have been aware of the need for better stormwater regulations for some time. NOAA and EPA have been working on funding to support revisions to the *Environmental Handbook* that would provide an opportunity for engineers, environmental groups, and agencies to reach consensus on post-construction stormwater performance standards and design criteria that are practical for the USVI.

Table 5. Sites for Stormwater Improvement

Type	Site ID*	Name
Enforcement or stormwater design review activities	TR-4	Whispering Hills
	TR-8	Grandview Apartments
	TR-16	New parking lot in gut behind Curriculum Center
	TR-20	Four Winds Plaza
	FC-9	New parking lots
	NZ-1	Dolphin Cove
	NZ-2	Secret Harbor Estates
Erosion and Sediment Control	TR-1	Flag Hill/Signal Hill Rd.
	TR-38	Heavy Materials**
	TR-41	Equipment storage area
	TR-43	Cheyenne’s Excavating
	TR-45	Old truck disposal area
	NG-4	Tropical Marine
Culvert Replacements	TR-35	Turpentine Run Rd. Culvert (upper)
	TR-37	Turpentine Run Rd. Culvert (Mid)
	TR-40	Mariendahl/ Turpentine Rd. Culvert (lower)
	NG-2	Gold Hill & Elm Rds.
	FC-2	Food Center
	FC-5	Fryd. gut/Rt 32 culvert
Post-construction Stormwater Retrofits (public property)	BV-1	BCB School**
	BV-2	Thomasville Cooperative
	BV-4	Bovoni Projects
	BV-14	Bovoni Landfill
	BV-15	Mangrove Lagoon WTP
	TR-9	Alvin MacBean Rec. Center
	TR-10	DPW land across from Alvin MacBean
	TR-12	Anna’s Retreat Community Center
	TR-14	Tutu I High Rise/Gut Confluence
	TR-15	Joseph A Gomez Elementary School
	TR-17	Fire Station
	TR-18	VI Housing Authority
	TR-30	Edith Williams Alternative Academy
	TR-33	EB Oliver Elementary School

Type	Site ID*	Name
Post-construction Retrofits (cont.)	TR-34	Willy George Community Center
	TR-44	Nadir Bridge Park
	NG-3	Nadir Ball Park
Post-construction Stormwater Retrofits (private property)	BV-7	Texaco
	BV-9	Bovoni Center Storage
	BV-11	Gas Station
	TR-2	7 th Day Adventist Church
	TR-5	Cost-U-Less**
	TR-6	Home Depot**
	TR-7	Raphune Vista**
	TR-13	Faith Christian Fellowship Church/ School
	TR-19	Holy Family Church
	TR-20	Four Winds Plaza
	TR-21	Tutu Park Mall**
	TR-22	Merchants Com.Bank
	TR-23	Lutheran Church
	TR-24	Innovation Parking Lot
	TR-26	Mr. Rodriguez Auto Body/ Total Gas
	TR-27	First Bank
	TR-28	Church Schools
	TR-32	Price Smart**
	TR-47	Clinton Phipps Racetrack
	TR-51	Behind old humane society
	NG-5	The Patch
	FC-2	Food Center
	FC-3	East End boat yard
	FC-4	Independent Boat Yard/ Budget Marine**
FC-8	Compass Pt. Marina	
NZ-3	Secret Harbor Condos	
CB-1	Anchorage Resort	
CB-2	Yacht Club	
CB-4	Elysian	
CB-5	Cowpet Bay East	
GB-2	Ritz Carlton**	
Easements/ land acquisition targets for stormwater	BV-3	Wooded area below BV-2
	BV-8	Luton Storage Area
	TR-31	Smith Bay Rd./ Ft. Mylner Plaza
	TR-46	Lima Property

* Site ID includes abbreviated subwatershed name.

See Appendix for location map and description.

**Sites with existing stormwater facilities.

These standards, for example, would outline how much rainfall needs to be managed at a site for given return intervals; pollutant removal targets; infiltration requirements; and practice sizing calculation methods and design criteria needed to meet performance standards. Adopting clear standards will help engineers design better stormwater facilities; provide consistent guidance to reviewers on how to evaluate proposed projects; and incentivize site design techniques that minimize the amount of stormwater generated on site to begin with. DEP should be the lead on developing stormwater criteria, with extensive participation by knowledgeable CZM and DPW staff. VIHA also should be included in the effort, given their involvement in the development and financing of new public housing projects.

In addition DEP and EPA should consider alternatives for expanding technical review capacity and encourage private properties to retrofit, such as:

- Provisions to allow third-party peer reviews of proposed plans at a cost to the Applicant. This practice helps supplement overburdened agency staff, while educating all parties on how to best apply stormwater management requirements on individual sites.
- Expanded EPA involvement to provide additional technical assistance for stormwater reviews and site inspections.
- Issue retro-active permits requiring private properties with unmanaged impervious cover (e.g., >1 acre) to retrofit where necessary to meet water quality standards. This is being done in New England by EPA Region 1; perhaps there is some adaptation of this

approach that could be used to engage private properties in the USVI in stormwater retrofitting.

2. Enforce existing TPDES, Earth Change, and other environmental regulations through stop-work orders and/or mitigation. Clarify mechanism for stakeholder reporting of observed violations. Consistent enforcement of environmental regulations during permitting and construction is critical. DEP, DEE, CZM, BP, DPW, and EPA should reach agreement on how to improve enforcement of existing regulations, particularly as relates to increased inspection frequency and meaningful mitigation penalties. Otherwise, DPNR and EPA may leave themselves vulnerable to actions for failure to enforce stormwater discharge provisions of the federal Clean Water Act and associated Territorial laws. Where FEMA, ACOE, and USFWS are involved in development projects additional enforcement support may be available.

3. Complete mapping of stormwater infrastructure (e.g., catch basins, pipe diameter, invert elevations, culverts, manholes, outfalls, BMPs, and suspected illicit discharges). DEP and DPW should work with VIWMA and EPA to map stormwater infrastructure in coordination with current sanitary sewer mapping efforts. Each agency has internal knowledge of where existing BMPs, drainpipes, outfalls and culverts are located, but information sharing is limited. Departmental tracking of the maintenance and condition of existing facilities should be a long-term stormwater program goal.

Over the long-term (10 years+), DPNR, DPW, VIDE, and VIHA should coordinate with appropriate federal partners to:

4. *Design and implement priority stormwater retrofits and drainage improvements to improve water quality and reduce flooding and erosion problems.* The list of opportunities provided herein is not exclusive and lacks design detail. A review of the list will show that there are a significant number of opportunities on publicly-owned properties (e.g., schools, public housing sites, parks, and road rights-of-way). If there are sites of interest, further investigation of those sites is recommended in order to develop a design plan sufficient to determine feasibility, cost, pollutant load reduction estimates, and permitting requirements. Having design

plans already prepared can come in handy as grant funding becomes available for implementation of shovel-ready projects.

EPA's 319 program and capital improvement grants, CZM funds, NFWF, FEMA, USFWS, and NOAA are potential sources of future grant funding for urban stormwater retrofitting, particularly where impaired waters, sensitive habitats, or flooding issues are involved. Where retrofits can be associated with road runoff or culvert replacement, the Department of Transportation may offer funding.

Applicants and reviewers should keep retrofitting opportunities in mind as new permit requests for redevelopment or repair are made at individual, private sites.



Retrofitting can help improve existing conditions. An easy fix at Home Depot is to block this inlet and allow parking lot runoff to flow into landscaping via curb cuts, allowing for plant uptake, infiltration, and filtering.



4. Pollution Prevention

Implement pollution prevention measures to minimize exposure of trash, oil, sediment, TBT, and other chemicals to the drainage system.

Problem

No drive through the STEER watershed is complete without observations of scattered solid waste and debris, leaky grease traps, and the outdoor storage of unidentified liquids just waiting for the next rain event to make their way into Turpentine Run. Fortunately, pollution prevention is one of the most proactive and cost-effective ways of improving water quality. Pollution prevention requires: 1) identifying pollutants on a site with a high potential of coming into contact with stormwater; and 2) changing behaviors or implementing simple solutions to prevent that exposure. Examples include dumping wash water down the sink instead of into the gutter on the road, covering dumpsters and outdoor storage areas, storing buckets of oil or other fluids within a secondary containment unit, and moving operations away from guts and storm drain inlets.

Pollution prevention can be done on any property, though commercial and industrial “hotspots” tend to generate the highest concentrations of some pollutants. In the STEER watershed, there are a few key commercial activities where an emphasis on pollution prevention is recommended: quarry operations, car-related businesses, marinas and boat repair yards,

resorts/condos, and the horse track. Trash collection stations are a highly visible site where pollution prevention measures can be implemented. VIWMA can play a significant role in not only spreading the word about pollution prevention, but also by providing watershed residents and businesses with options for disposing of solid waste and collection of hazardous materials often.

Potential Restoration Opportunities

A number of specific sites were identified during field assessments where opportunities for pollution prevention measures were observed. **Table 6** divides sites up into the following general categories, recognizing that a wider range of opportunities may exist at many of these sites:

- Improved dumpster management and outdoor storage—these sites offer opportunities to cover or relocate dumpsters and to provide secondary containment for hazardous materials or other pollutants. Covers reduce the amount of direct rainfall onto materials and secondary containment provides a barrier to leaking containers. Placing materials in a shed, elevating them or moving them away from drains are relatively inexpensive solutions.



Overflowing buckets of used oil were found along the gut at locations where easy access allows for dumping and the abandonment of vehicular equipment.



Unused cistern overflows, mop bucket waste, and dumpster juice at this site drain across the parking lot carrying pollutants into the storm drain system and discharging them downstream even when it is not

- Collection and disposal of fluids from vehicle maintenance activities— whether at car repair shops, fleet storage areas, or at home, some options include: providing a designated location for all repair work where fluids can be drained and properly disposed; cleaning up spills; and disconnecting floor drains from the stormwater system.
- Structural maintenance—includes paying attention to the chemicals and procedures used for cleaning buildings, resurfacing roads and parking lots, and general repair.
- Disposal of wash water—generally related to the best procedures for disposing of dirty mop buckets and the selection of cleaning products used. Commercial car washes should not discharge to the storm drain system without some form of advanced treatment or they should be connected to the sanitary sewer system).
- Boating-related practices—a variety of industry-specific practices that could help reduce impact of boat repair and maintenance operations on water quality, such as designated areas for changing hydrologic fluids and disposing of used oil and filters; vacuums, ground tarps, and covers for paint stripping areas; and absorbent pads and booms for spill cleanup/response.
- Proper landscape management—limited application of fertilizers, spray irrigation, pesticides, or other chemicals to turf and landscaping, as well as targeted irrigation can help prevent pollution (not included in Table 6).

Table 6. Sites for Pollution Prevention Activities

Type	Site ID*	Name
Dumpster management and outdoor material storage	BV-1	BCB School
	BV-4	Bovoni Projects
	BV-11	Gas Station
	BV-13	Unregulated Dumping Site
	BV-14	Bovoni Landfill
	TR-24	Innovation Parking Lot
	TR-41	Equipment storage area
	TR-42	Dumpsters/ collection station
	TR-43	Cheyenne’s Excavating
	TR-45	Old truck disposal area
Vehicle maintenance	TR-48	Trash collection station
	BV-2	Thomasville Cooperative
	BV-9	Bovoni Center Storage
	TR-18	VI Housing Authority
	TR-24	Innovation Parking Lot
	TR-25	Auto/tire hotspot
	TR-26	Mr. Rodriguez Auto Body/ Total Gas
	TR-36	Auto Salvage Yard
Structural maintenance	TR-39	The Best Tires
	CB-3	Cowpet Bay West
Proper disposal of wash water and other	GB-1	Water Point
	BV-6	Bulk Storage
	BV-10	Lew Henley’s
	BV-12	Sweet Pie’s/Laundromat
	TR-5	Cost-U-Less
	TR-20	Four Winds Plaza
	TR-38	Heavy Materials
	TR-39	Best Car Wash
Boating-related practices	TR-47	Clinton Phipps Racetrack
	TR-50	Derelict Vessels
	NG-4	Tropical Marine
	NG-5	The Patch
	FC-1	Saga Haven Marina
	FC-3	East End Boat Park
	FC-4	Independent/Budget Mar.
FC-8	Compass Pt. Marina	

* Site ID includes abbreviated subwatershed name. See Appendix for location map and description.

Implementation Actions

Once aware of the issues, owners and operators should have the most knowledge of their on-site materials and procedures that may inadvertently lead to contaminated runoff. They are ultimately responsible for the implementation of voluntary and regulated pollution prevention measures on their properties.

Therefore, in the short-term, we recommend that TNC and DPNR's Small Business Environmental Assistance Program coordinate on providing technical support and/or training for willing business owners in the development of pollution prevention plans specific to their property. DPNR could also assist by providing adaptable, industry-specific pollution prevention plan template that prompts businesses to evaluate and address common issues. Many of these efforts will be linked with education priorities as well.

Over the next two years, this could include the following actions:

1. *Conduct site inspections at each marina/boatyard facility to document potential sources of TBT, boat fluids, and other contaminants, and to provide technical assistance in the development of a cost-effective and practical pollution prevention plan.* We recommend starting with the key properties including Independent Boatyard (which will also provide ideas for potential solutions), Compass Pt., East End, and the Patch. DPNR, EPA, and the Blue Flag program coordinator in USVI could provide technical assistance. Crown Bay Marina on STT is a member of the Blue Flag marina program, and may be able to offer some technical advice on assessment and planning. NOAA's Clean Marina Program also has assessment checklists that could be used. The Coast Guard may also be able to provide technical assistance.



Tarps used below lifts where hydrologic fluids are being changed is an example of a simple, non-structural practice that can be implemented at little cost.

2. Work with Heavy Materials to reduce sediment, equipment fluids, and wastewater loads from quarry-related activities (e.g., secondary containment at truck filling and wash stations, bathrooms for workers). TNC has already been in contact with managers regarding potential restoration activities. Start by reviewing copies of the original pollution prevention plan submitted under the approved, TPDES industrial discharge permit for the site.

3. Conduct site inspection of Clinton Phipps horse track to document animal waste management procedures and to develop a pollution prevention plan for the facility. This location houses a dozen horses at any given time. Investigate the procedures for handling horse waste, as well as the solid waste generated by large crowds to determine if pollution prevention options are available.

4. Conduct site inspections at each automotive repair businesses along Turpentine Run Rd. and near Tutu Park Mall to document potential sources of stormwater contamination and to provide technical assistance in the development of a cost-effective and practical pollution prevention plan for each business. Given time constraints, many of these individual sites were not investigated during field assessments.

The remaining actions are proposed for mid-term implementation over the next 2-5 years.

5. Retrofit trash collection/roll-off dumpster stations to provide secondary containment, covered storage, and signage announcing household hazardous waste

collection opportunities. There are a number of locations where roll-off dumpsters are located adjacent to wetlands. These dumpster are uncovered, and trash often overflows or is blown into adjacent wetlands. VIWMA and DPW (where appropriate) should investigate options for installing covered areas with fencing or other containment design. These sites are frequently visited by watershed residents and would be good locations to publicize recycling programs and household hazardous waste collection opportunities.

6. Work through the Inter-Virgin Islands Council to ban TBT used in products in the British Virgin Islands. With the weight of compelling evidence provided by the sediment contaminants monitoring study, boating supply and repair businesses, TNC, CLCC, and boaters in STEER should work with DPNR to raise the issue of TBT to the Governor's office and formally petition the British Virgin Islands to stop the sale of products with TBT and identify preferred paint alternatives.



5. Wetland Habitats

Protect and restore existing wetland habitats through land conservation, benthic restoration, and gut corridor enhancements.

Problem

The mangroves in STEER represent the largest remaining mangrove forest in the USVI. Sediment and biological sampling of the benthic community has shown that this ecosystem has been measurably impacted by land-based sources of pollution. Many of the remaining salt and freshwater ponds have reduced capacity and other water quality problems due to stormwater contributions. The fringing mangroves of these systems, as well as the terrestrial vegetated buffers, have been encroached upon by development and illegal dumping activities.

Turpentine Run, while not the only gut in the STEER watershed, is the largest and the only with perennial flow. It displays typical characteristics of an urban stream corridor impacted by changes in water quality, morphology, and hydrology. Given the paucity of information on the ecology of guts in the USVI, the consequences of in-stream habitat degradation on intermittent and perennial guts is not well known. Conversely, the capacity of guts to transport harmful sediment and pollutants to ponds and nearshore waters is much better documented.

The *USVI Buffer Protection Regulations* require a minimum 25-30 ft undisturbed

vegetated buffer from the edge or center, respectively, of guts. This requirement is intended to protect property and structures from flooding issues by requiring a minimal setback, but it is also intended to maintain a vegetated gut corridor important for wildlife. Adherence to this requirement is not regularly enforced. In fact, recent construction of a parking lot in the gut was observed behind the Curriculum Center and Fire station during the watershed assessment. This project involved relocating the gut and installing weir barriers within the channel.

DFW, UVI, and others have inventoried the wetland habitats of the USVI and identified priorities for wetland protection and restoration. Some of the following key management recommendations from the *2005 USVI Marine Resources and Fisheries Strategic Plan*, *2006 Draft Wetlands Conservation Plan*, and *2008 Strategy for Management of Ghuts in the USVI* include:

- Mangrove Lagoon/Benner Bay; Compass Pt. and Cabrita Pt. salt ponds; a fresh pond at the Humane Society and Hernhutt; and the Tutu Reservoir are priorities for conservation;
- Turpentine Run and Nadir guts are of significant interest for research and restoration;
- Restoration of pond functionality may involve dredging, but should also

include mangrove restoration, buffer enhancements, and improved recreational access;

- Addressing land-based sources of pollution in the watershed areas draining to each wetland and gut is necessary, particularly wastewater and stormwater discharges;
- Removing derelict vessels and wastewater discharges from boats; and
- Reduced lighting around ponds.

These habitats not only have a value for wildlife, but also provide recreational and historical interests for East End residents.

Potential Restoration Opportunities

A number of specific sites were identified by DFW staff, other stakeholders, and field crews where opportunities exist for wetland habitat restoration and protection. **Table 7** divides sites up into the following general categories:

- Gut corridor restoration and trash removal—opportunities for reestablishing natural gut channels; stabilizing eroding banks; or enhancing the vegetated buffer through trash cleanups, blocking vehicular access, invasive plant removal or planting.
- Wetland restoration—bigger-scale mangrove restoration, derelict vessel removal, and potential wetland expansion activities.
- Pond protection and restoration opportunities—land conservation and development restrictions to protect ponds, dredging, and fringe habitat and buffer restoration activities.
- Other—includes flow restoration and contaminated sediment removal projects in the bays.

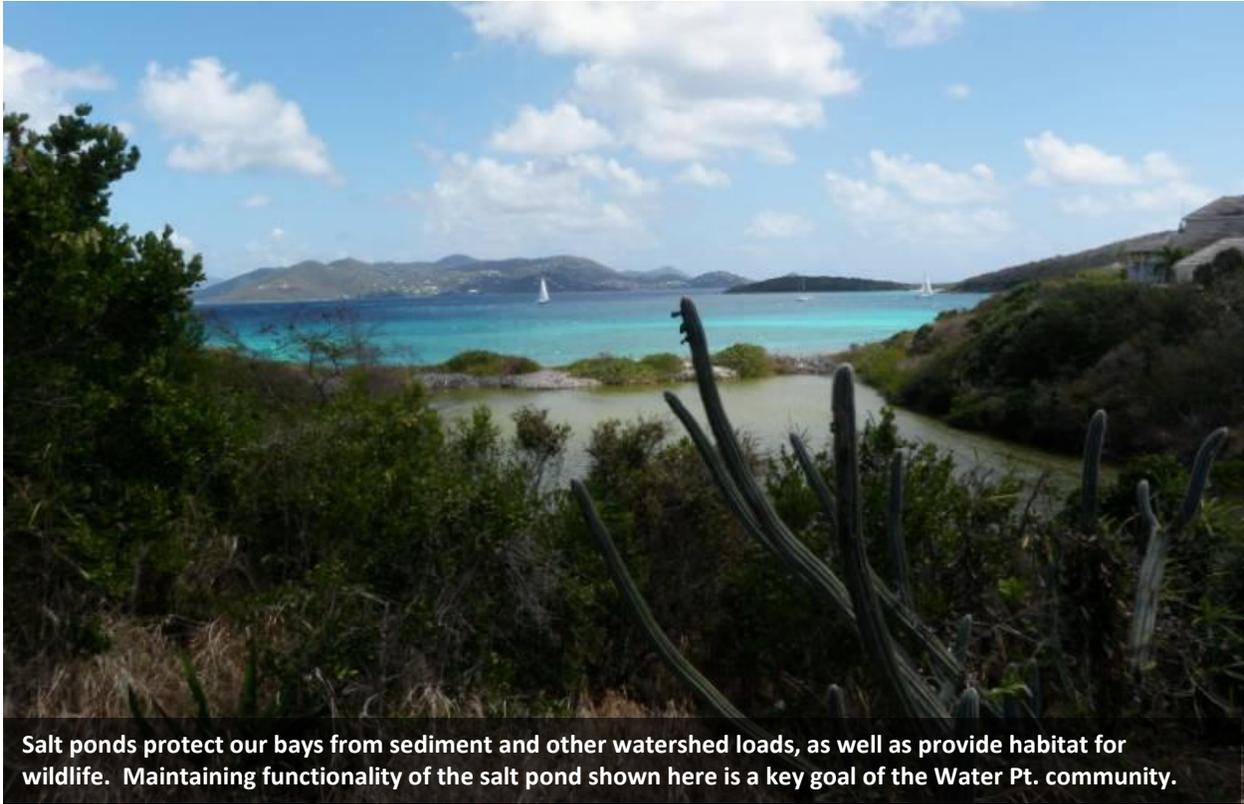
Table 7. Sites for Wetland Habitat Restoration

Type	Site ID*	Name
Gut corridor restoration and trash removal	BV-2	Thomasville Cooperative
	BV-8	Luton Property/ Storage Area
	TR-8	Grandview Apartments
	TR-12	Anna’s Retreat Community Center
	TR-13	Faith Christian Fellowship Church/ School
	TR-15	Joseph A Gomez School
	TR-16	Parking lot behind Curr. Cntr.
	TR-32	Price Smart**
	TR-36	Auto Salvage Yard**
	TR-37	Turpentine Run Rd. Culvert (Mid)
	TR-41	Equipment storage area**
	TR-42	Dumpsters/ collection station**
	TR-44	Nadir Bridge Park
	TR-45	Old truck disposal area**
	TR-46	Lima Property**
	TR-48	Trash collection station**
	Wetland restoration	NG-1
NG-4		Tropical Marine
FC-5		Fryd. gut/Rt 32 culvert**
BV-14		Bovoni Landfill**
TR-31		Smith Bay Rd./ Ft. Mylner**
Pond protection/ restoration ⁺	TR-47	Clinton Phipps Racetrack
	TR-50	Derelict Vessels
	TR-51	Behind old humane society
	TR-3	Humane Society
	TR-11	Tutu Reservoir/ Hartman’s
	TR-29	Herrnhut Pond
	FC-6	Compass Pt. Salt Pond
Other	GB-1	Water Point
	GB-3	Cabrita Pt Salt Pond
	BV-16	Second False Entrance
	FC-7	Benner Bay/Marina sediments

*Site ID includes abbreviated subwatershed name. See Appendix for location map and description.

**Significant trash/dumping cleanup effort

⁺ Great St. James and Little St. James were not included in this assessment, but are likely conservation targets.



Salt ponds protect our bays from sediment and other watershed loads, as well as provide habitat for wildlife. Maintaining functionality of the salt pond shown here is a key goal of the Water Pt. community.



DPNR staff inspecting the installation of a new parking lot. Construction activities included the re-grading of the natural gut channel and floodplain and the installation of stone weirs and low flow pipes.

Table 8 summarizes a list of specific parcels where options for land acquisition, conservation easements, or drainage easements should be investigated. These parcels were identified for potential wetland protection and restoration, stormwater, or recreational projects.

Table 8. Potential Properties for Conservation

Name	Purpose	Acres
BV-3. Wooded lot on corner next to BCB School	Stormwater retrofit and community park. Area may include a small existing wetland.	14.7
BV-7. Luton Property	Stormwater retrofit/drainage improvement and gut restoration project.	1.1
TR-46. Lima Property	Stormwater retrofit/community park adjacent to wetland. Involves removal of dumping.	13.3
TR-31. PriceSmart Entrance/Smith Bay Rd.	Stormwater retrofit potential along gut and existing wetland area.	2.6
TR-29. Hernhutt Pond	Conservation of freshwater pond resources	41.2
TR-11. Tutu Reservoir/Hartmans Pond	Conservation of freshwater pond resources	70.4
GB-3. Cabrita Salt Pond	Conservation of salt pond/wetland s	3.7

Great St. James and Little St. James were not included in this assessment, but may be candidates for restoration/conservation. Though privately-owned, these areas are still subject to environmental regulations, and issues on Little St. James have been reported.

Implementation Actions

With the exception of the stream restoration project at Tropical Marine, no

detailed design plans have been developed for the projects and opportunities identified. In the short-term, however, the following actions can be implemented.

1. Remove trash and prevent dumping at key locations within the gut corridor. A good way to kick-off watershed implementation efforts and build community support is to initiate trash cleanups. The Environmental Association of St. Thomas-St. John should work with VIWMA to schedule cleanups and transportation of collected material to the landfill. Some of the cleanups will require removal of large objects (e.g., cars), and possibly will include hazardous materials. Start by going to each of the sites identified and determine the level of effort, access, and potential community or business involvement required to complete each cleanup. Evaluate any options for reducing future dumping in these locations.

2. Enforce USVI Buffer Protection Regulations and require mitigation where recent violations occurred. DPNR, and in some cases ACOE, needs to improve the consistency of enforcement with the current regulations starting at plan review and earth change permitting, and followed through at the site during clearing and grading. BP staff should ensure that buffer setbacks are visibly demarcated in the field before any earth change activities begin. Penalties for violations should be revised to include removal of structures and mitigation planting. Consider updates to this regulation that increases a “no-touch” buffer width to a minimum of 50 ft for guts and 100 ft from ponds and other wetlands to get the attention of developers and provide a better chance of actual protection of remaining vegetated buffers.

Over the next two to five years, the recommended mid-term actions are:

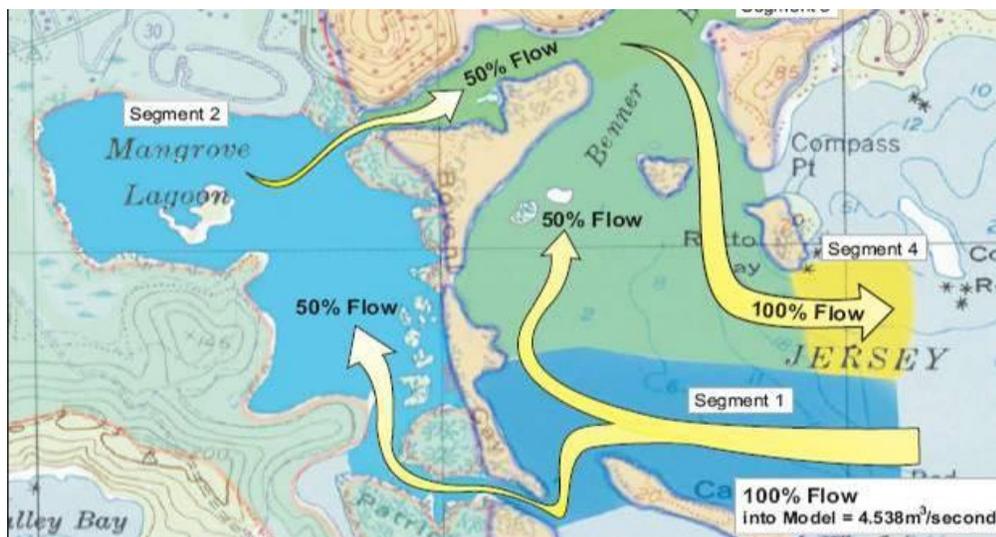
3. Develop design plans/feasibility studies for Compass Pt. salt pond restoration, opening of Mangrove Lagoon false entrance, and removal of contaminated sediments in Benner Bay. DFW has identified restoration of the Compass Pt. salt pond, opening of the second false entrance to Mangrove Lagoon, and restoration of Redhook Bay salt ponds as priorities. Additional studies are proposed for each to ascertain feasibility and priorities including: an analysis of aerial photos to establish historic conditions; bathymetric studies to establish dredging capacity; sediment contaminant sampling of organic and inorganic parameters; and water modeling to better understanding flushing rates. Given the commercial interest in dredging Benner Bay for proposed marina expansion, perhaps there is an opportunity for private sector funding of a feasibility study looking specifically at dredging and contaminated sediment removal. UVI, NOAA's Restoration Center and National Marine Fisheries Services, USFWS, and ACOE may be good partners in advancing these studies. The US Coast

Guard may provide assistance for derelict vessel removal. Proposed changes to mooring fees and boat registration by DPNR may also help with derelict vessel issues.

4. Conserve land surrounding priority freshwater and salt ponds (e.g., Herrnhut, Tutu Reservoir, Cabrita Pt.) via conservation easements, land acquisition, or stringent development criteria. TNC, DFW, CZM, and DEP should investigate parcel ownership and communicate with property owners on future plans and level of interest in working with the Territory to protect these sensitive habitats. Explore feasible mechanisms for government or third-party land acquisition and/or easement holdings.

For long-term implementation (10 years):

5. Implement priority gut stabilization & buffer restoration projects. Additional site investigations and hydrologic analyses will need to be conducted at potential sites in order to develop more refined design plans, invasive control and native planting plans, and cost estimates. USDA, DPNR, DPW, potentially ACOE, and local plant specialists should coordinate on implementing these projects.



Models used to develop TMDLs for Mangrove Lagoon assumed predominant clockwise currents. A feasibility analysis of opening the second false entrance should more accurately document flow patterns.



6. Monitoring

Develop a unified watershed monitoring program that integrates and tracks various sampling efforts in STEER.

Problem

There are many federal and territorial entities—currently and historically—that have conducted monitoring in STEER and the surrounding watershed. These efforts range from groundwater quality, rainfall and flow measurements, surface water quality, sediment contaminant studies, and biological sampling. In many cases, the data gathered under these efforts are used for regulatory purposes, such as establishing groundwater quality monitoring at the Tutu Wellfield Superfund Site to meet remediation requirements. In other cases, results are used to make routine management decisions, such as determining if beaches are safe for swimming under DPNR’s beach monitoring program.

While filling critical information gaps, these monitoring efforts do not yet provide enough information to establish baseline conditions from which performance of restoration efforts can be measured. In addition, there remain outstanding questions that may need to be answered before some restoration efforts are implemented (e.g., what is the extent of leachate seepage into Mangrove Lagoon and how does this influence mangrove restoration in this area? What is the

flushing rate of coastal ponds and mangrove lagoon?).

Sampling stations and parameters are not always easily comparable across efforts (e.g., measuring different bacteria species in one study when regulatory impairments are measured using a different species). Data is not always accessible or widely shared (e.g., difficult to access water quality data collected by DPNR). In some cases, datasets critical to other efforts are no longer being populated (e.g., flow gauge no longer operating in Turpentine Run). In other cases, entities historically responsible for certain data collection efforts have changed hands (e.g., EPA shifting Tutu Superfund monitoring to DPNR). A broad look across STEER and the watershed to put the pieces together and summarize long-term trends has never been done.

Monitoring data that is being or has been collected in STEER includes, but is certainly not limited to:

- Rainfall information at USGS and DPW weather gauges;
- Stream flow in Turpentine Run, although USGS has abandoned this station;
- Water quality of groundwater wells and the contaminated plume at the Tutu Wellfield Superfund Site;

- Sediment contaminants, benthic fauna, and water column samples at sites across STEER by NOAA and UVI;
- Recent sedimentation rate studies by UVI;
- Regulatory sampling by DPNR to ensure waters are meeting designated uses;
- Wastewater discharge effluent monitoring by operators and EPA;
- Biological surveys of in-stream fauna, pond ecology, and marine habitats by DFW, UVI, and NOAA; and
- Proposed groundwater monitoring near Bovoni Landfill by UVI.

To better utilize existing information, fill in data gaps with current and future efforts, and be more cost effective in future sampling and analysis, it makes sense to work cooperatively within a more comprehensive framework.

Implementation Actions

UVI and TNC are currently in the process of developing a monitoring plan for STEER. This process could be expanded to include watershed inputs, but also to create a consensus-based framework for monitoring efforts for the next decade. As part of this process, we recommend the following in the short-term (within the next two years):

1. *Develop a STEER monitoring plan that identifies key elements of known monitoring efforts, information needs and technical gaps, links to regulatory priorities, proposed future monitoring projects, and a data sharing plan.* UVI should continue to take the lead on developing a long-term monitoring plan, soliciting input from other agencies and organizations involved in monitoring projects in the area including

DEP, DFW, VIWMA, NOAA, USGS, and EPA. This plan should identify:

- a. Key elements of existing monitoring efforts (e.g., station locations, parameters sampled, equipment, reports) in order to identify commonalities and gaps;
- b. Information gaps and technical needs (e.g., flow in Turpentine Run, groundwater monitoring at Bovoni, flushing rates, lab capacity, sampling equipment);
- c. Guidance to sampling conundrums (e.g., methods for monitoring intermittent guts);
- d. Regulatory program needs (e.g., 303(d), TMDL, beach monitoring, Tutu Wellfield Superfund, Bovoni Consent Decree, Benner Bay TBT contamination);
- e. A list of future monitoring activities ranked based on need. Top projects should be refined to provide a basic description of the questions to be answered, a sampling plan, and a preliminary cost estimate; and
- f. A proposed mechanism for sharing data and reporting findings.

This plan can then be used to apply for funds, provide graduate students with projects, etc.

2. *Update watershed residents on the status of the Tutu Wellfield Superfund cleanup and monitoring efforts.* The operation and maintenance of the Tutu Wellfield Superfund Site has passed from EPA to DPNR, and DPNR will be responsible for continued monitoring and operation of the treatment system. DPNR and EPA should make publicly available the details of this transition plan, as well as monitoring

reports, plume spatial mapping, and progress updates.

3. *Install rain & stream gauges in order to better correlate sedimentation with rainfall quantity and intensity.* UVI and DPNR should work with local schools to install rain gauges as part of an overall watershed education effort. A monitoring priority needs to be the re-establishment of the stream gauge at Turpentine Run. USGS has been cutting back on the gauging commitment over the past few years; however, given the importance of Turpentine Run flow information to so many federal and territorial programs, the case can be made for re-establishment.

In the mid-term (2-5 year), the following actions are recommended:

4. *Provide access on the STEER website to annual monitoring reports, trends analyses, and/or links to data.* TNC and UVI should determine the best forum for such a clearing house. Posting of regulatory

monitoring information has been recommended for DPNR and/or EPA as well. To more easily establish the links between effluent discharge violations from a resort with surface water quality violations in the receiving water, for example, having quick access to these disparate data sources would be helpful. It is also recommended that an annual meeting be held with the objective of producing a summary report of monitoring efforts and findings, trends, and next steps.

5. *Conduct illicit discharge detection and elimination sampling concurrently with sanitary sewer system mapping efforts.* Ideally, watershed monitoring efforts can be integrated with recommended infrastructure investigations, specifically water quality sampling, to identify and eliminate raw sewage and other non-stormwater discharges from outfalls in the guts and ponds in the watershed. VIWMA should coordinate with UVI and DPNR on these efforts. NOAA has funded similar IDDE investigations in Puerto Rico.



Biological characterizations of STEER included quantifying benthic habitat composition using quadrants (shown here), as well as establishing transects to document the abundance and diversity of fish, debris, and macro-invertebrates.

(Photo: NOAA NCCOS)



7. Education & Stewardship

Implement a long-term education plan that provides opportunities for residents and businesses to actively engage in watershed stewardship activities.

Problem

Perhaps the most important and implementable recommendation in the watershed plan is the continued effort to educate those that live or work in the watershed, and those that use the resources of STEER. The case must be made to these stakeholders as to why they should engage in watershed stewardship activities, either through simple adjustments to everyday behaviors (e.g., I will start recycling) to more substantial commitments of time and resources (e.g., I will install this stormwater retrofit to manage runoff from my parking lot). Raising awareness of the issues is not enough. The goal of a good education program is to inspire long-term engagement and activism.

DPNR has an education program that can provide support for nonpoint source messaging. VIWMA, VIHA, and VIDE are other agencies with education programs and established delivery mechanisms for reaching their constituents. TNC, EAST, and VINE are non-government organizations involved in environmental education in the USVI. VICCC has the expertise to craft the watershed message in a way that is culturally meaningful. IGBA is trying to expand membership to St. Thomas and is developing commercials and other

advertisements for green construction. CLCC may be a good regional partner for promoting watershed messages.

Recent action on STEER management planning coordinated by TNC has resurrected stakeholder education and involvement on the East End; although the boating industry, residents at Water Pt., and arguably, residents in Bovoni, are the most engaged communities. Little work to date has been done to connect those who work and reside in the upper watershed to the STEER management movement. Without broader representation and participation in the process, watershed priorities and long-term management strategies may not be fully implemented.

Fortunately, there is a wide range of watershed restoration topics to choose from when targeting selected audiences; there is a compelling story of a visible resource that can be told; and there are a number of schools, community centers, resorts, and other businesses that can be targeted over the next few years. Also, with completion of the 2012 STEER Coastal Use Survey by NOAA, there is a better understanding of who the resource users are and how they interact with STEER.

The key challenges for successful education and outreach are likely to include:

- Overcoming the cynicism and frustrations arising from repeated efforts to improve environmental conditions by those who are already educated on the issues;
- Piquing the interest of the youth in the upper watershed in activities that benefit downstream resources;
- Strategically implementing demonstration projects that can engage a diversity of stakeholders and inspire continued activism;
- Convincing others that individuals can make a difference; and
- Remembering that watershed restoration is a long-term endeavor that will evolve overtime.

Table 9 summarizes a number of locations where specific public education and outreach efforts could reach the broader watershed community. These sites include schools, neighborhoods, community gathering areas, as well as high-traffic businesses where the public is likely to patron or demonstrations can be marketed. While overarching messages relating land use activities directly to STEER health are needed throughout the watershed, audience-specific messages should also be targeted to businesses, government employees, and in some cases, tourists. Audience-specific messages are discussed below in more detail.

Table 9. Sites for Community Education & Stewardship Activities

Type	Site ID*	Name	Comments
Schools	BV-1	BCB School	Retrofit demos, rain gauges, pollution prevention, and watershed school curriculum
	TR-13	Faith Christian Fellowship Church/School	Great location for simple retrofit demonstration project and gut restoration
	TR-15	Joseph A Gomez Elementary School	Watershed curriculum; rain gauge installation
	TR-28	Church Schools	Watershed curriculum
	TR-30	Edith Williams Alternative Academy	Watershed curriculum
	TR-33	EB Oliver Elementary School	Great location for retrofit, high visibility, parents participation, rain gauge
Neighborhoods	BV-2	Thomasville Cooperative	Link with stormwater retrofits; residential pollution prevention
	TR-7	Raphune Vista	Good site for green construction training; possible rain garden demonstration for homeowners
	TR-8	Grandview Apartments	Good site for green construction training.
	TR-14	Tutu I High Rise	Public housing, good location for signage and priority stormwater retrofit
	NG-1	Elm Road/Frydenhoj	Target residents with education on septic system maintenance, gut protection, and residential pollution prevention; organize community trash cleanup days; lay groundwork for obtaining early buy-in from residents for sewer expansion projects.

Type	Site ID*	Name	Comments
	GB-1	Water Point	Good community for demo wastewater project; active members in environmental issues
	--	Nadir Crescent	Two cul-de-sacs that could be retrofitted; focus education on car maintenance (parking was directly over stormwater swale), cistern use, and general watershed issues. Education in this neighborhood would be effective (seemed like a cohesive community).
	--	Estate Bovoni	Active HOA. Lots of drainage and landfill related issues for these residents. Residential education on disconnecting driveway runoff; car maintenance may be successful here.
	--	Mariendahl	Target residents with volume reduction (e.g., driveway disconnection, rain gardens), septic system maintenance, and green construction messaging.
	--	Nadir	Target residents with education on septic system maintenance, gut protection, and residential pollution prevention; lay groundwork for obtaining early buy-in from residents for sewer expansion projects. Link with Nadir ballpark retrofits.
	--	Cabrita Point	Target residents with green construction messaging.
	--	Nazareth Bay	Target residents with septic maintenance and residential pollution prevention messaging.
Community Centers/Parks/ Other	TR-1	Flag Hill/Signal Hill Rd.	Top of hill, watershed overview linked to STEER
	TR-9	Alvin MacBean Rec. Center	Great visibility and way to engage the Anna's retreat community with signage and retrofit demonstration projects
	TR-12	Anna's Retreat Community Center	
	TR-34	Willy George Community Center	Good way to reach Tutu Valley community
	TR-44	Nadir Bridge Park	Highly visible location for watershed signage
	TR-48	Trash collection station	High visibility, post signage on recycling and hazmat pickup schedules
	NG-3	Nadir Ball Park	Great location for signage and events
CB-2	Yacht Club	Good location for signage and events	
Churches	TR-2	7 th Day Adventist Church	Example of impervious cover impacts; could provide a forum for reaching out to community
	TR-19	Holy Family Church	Good opportunity to reach community on cistern uses
	TR-23	Lutheran Church	Inexpensive stormwater retrofit demonstration
Commercial	TR-3	Humane Society	Good examples of green construction; site users probably receptive to watershed message
	TR-5	Cost-U-Less	High foot traffic area, signage; good site for stormwater training
	TR-6	Home Depot	Good location to hold stormwater and green construction training; use for stormwater manual design examples
	TR-21	Tutu Park Mall	High foot traffic area, signage; good site for stormwater training
	TR-47	Clinton Phipps Racetrack	High visibility, good location for signage, maybe events

Type	Site ID*	Name	Comments
	TR-49	Sea Kayak Tours	Good location for signage, but also to give STEER watershed information; primarily tourists
	FC-2	Food Center	High traffic, good for signage
	FC-4	Independent Boat Yard/ Budget Marine	Good site for pollution prevention training
	FC-8	Compass Pt. Marina	Relatively high visibility; Good site for watershed signage
	GB-2	Ritz Carlton	Participates in Blue Flag Beach Program; good site for education of tourists & resort managers

Implementation Actions

STEER education and outreach efforts are already underway. The following actions are suggested to supplement these efforts. In the short-term (within the next two years):

1. Engage community centers and homeowners associations in a residential education campaign linking STEER (and human) health with proper maintenance of septic systems, vegetated buffer protection, and household waste disposal. EAST and DPNR could take the lead on identifying homeowner association and community group leaders. Meet with them and VICCC to solicit recommendations for how to best reach residents (e.g., flyers, attend association meetings, present at a church picnic, social marketing), and what messages might resonate. If there is a project that can be implemented in the vicinity, use that as a way to initiate stewardship efforts.

Use the information provided in **Table 9** to inform this effort. VIWMA could contact residents through its sanitary sewer and solid waste education program. VIHA can reach residents of public housing communities.

2. Convene boating-related businesses and boaters to investigate benefits of participation in the Blue Flag Marina program or other certification program. Given TNC's working relationship with the boating community, consider organizing a focus group meeting with the owners and users to review watershed issues targeting the industry, present information on the Blue Flag marina program, and solicit input on the value of imitating such a program (or adopting elements of this or similar program) in the USVI. The Blue Flag Marina coordinator, and potentially representatives from the Coast Guard may be able to lend additional insight to the group. . Specifically, the focus group could provide DEP with input on practical performance standards or certifications for marinas and boatyards.

3. Convene a workshop for resort managers to discuss potential waste disposal, lawn care, visitor education, and stormwater improvements that could be advanced to improve STEER. TNC, the Blue Flag Beach coordinator, and the VI Hotel and Tourism Association could organize a similar focus group meeting with resort managers on the west end of STEER to gauge interest in eco-friendly practices to improve water quality and habitat conditions in Nazareth, Cowpet, and Great

Bays while promoting tourism. The Ritz Carlton is part of the Blue Flag Beach program and may have suggestions for other resorts. What incentives could be provided to encourage implementation of potential restoration projects?

4. *Conduct a watershed tour for politicians and agency Commissioners to highlight big-ticket items.* DPNR should take the lead on organizing a watershed tour to make sure politicians are aware of the impacts land development, waste management, and capital improvement budgeting decisions have on the unique resources of STEER, public health, and the economy. Specific regulatory and policy solutions to help alleviate impairments should be discussed (e.g., enforcement, buffer protection, stormwater requirements, and TBT bans).

Over the next few years (2-5+ years), initiate the following mid-term actions:

5. *Link recycling efforts to STEER watershed benefits and increase the number of household hazardous waste collection days and/or stations.* VIWMA and VIRG educational messaging should explicitly state that recycling, proper solid waste management, and sewer hookups all are individual actions that benefit STEER. As closure planning continues, investigate the potential for increasing options for proper hazardous waste disposal.

6. *Use demonstration projects (e.g., drainage improvements, storm drain stenciling, trash cleanups, rain gauges) at schools and community centers to educate and engage kids and residents in STEER.* VIDE should review the proposed opportunities identified at each school in the watershed and identify the most feasible for implementation. Work with DPNR, EAST, NOAA, EPA, and CLCC to secure funding to advance demonstration designs.



Implementation of each project should involve a hands-on experience for kids and their parents, as well as a classroom teaching lesson. Work with VINE to develop a STEER watershed program for educators.

7. Increase overall awareness of the STEER watershed through storm drain stenciling, watershed radio series, and watershed signage. Install STEER-specific storm drain markers in the watershed as infrastructure mapping is occurring (2-5 years). TNC, EAST, UVI, and DPNR should coordinate on the type, design, and placement of watershed signage throughout the watershed. DPW will need to be involved if signage is placed along roads (“You are now entering the STEER watershed!”). TNC could work with local radio contacts to set up a bi-monthly radio spot (e.g., Watershed Wednesday) to talk about ongoing STEER Watershed activities. Special guests from UVI, EAST, DPNR, Budget Marine, Water Pt., VIDE, VIHA, VIWMA, and others involved in implementation efforts could discuss how their agencies, businesses, etc. are making a

difference in the STEER and offer suggestions for what listeners can do.

8. Target engineers, designers, contractors, and agency staff with training on implementing stormwater design criteria and green construction techniques. DPNR, IGBA, and NOAA are in the process of kicking off a green construction training series on each of the islands over the next two years. These trainings provide classroom and field opportunities for practitioners on how to design, build, and live green. Many of these messages resonate with the STEER watershed management objectives. In the short-term, there is a potential to showcase field sites within the STEER watershed during the training planned for St. Thomas. Key sites for field trips during trainings may include: the Humane Society; Whispering Hills; Grandview; Raphune Vista; Home Depot/Cost-U-less; parking lot behind the Curriculum Center; Thomasville Cooperative; and the Ritz Carlton.





8. Watershed Oversight

Establish a formal mechanism for implementation oversight.

Problem

As the number of watershed planning efforts has exponentially grown over the last 20 years, it has become widely apparent that implementation is unlikely to occur without a dedicated watershed champion to provide implementation oversight. There is less agreement on the actual mechanism for providing that oversight, but consensus is growing that designating a watershed coordinator is ideal.

Experience on other islands confirms this notion. For example, Coral Bay Community Council is the lead organization responsible for implementing and updating the 2008 Coral Bay Watershed plan. With CBCC leadership, millions of dollars have been secured for implementation; dozens of projects have been installed; performance monitoring initiated; and measurable improvements in sediment load reduction to the Bay have been made. A similar approach was taken in the Guanica watershed in Puerto Rico, where a local non-profit was established to serve as the watershed coordinator. NOAA has provided financial support for Guanica watershed coordination efforts over the past few years. DOI, NOAA, and NFWF have also supported watershed coordinators in the Pacific Islands.

Alternatively, clear leadership for the 2011 St. Croix East End Watershed Plan has not yet fully formed (primarily due to changes in staffing at the St. Croix East End Marine Park). Early implementation efforts were initiated by the St. Croix Environmental Association. The STXEEMP has moved the watershed plan information to the park's website and will soon be taking on implementation leadership.

The primary role of a coordinator is to connect the activities identified in the watershed plan with the key people required to implement them (including funders). A working group represented by the key individuals identified as strategic action leads should be organized and administered by the watershed coordinator, although selection of a chairperson from the committee is recommended. The chair would be responsible for running meetings, extracting decisions from the group, and assigning action items. The chairmanship should rotate on an annual or semi-annual basis to other members of the committee. The current STEER advisory committee includes most of the individuals that would ideally participate in a watershed implementation group.

These efforts need to be tracked over time and the watershed plan updated as

priorities shift, new opportunities arise, and implementation lessons are learned. The coordinator is responsible for being the face of the watershed restoration effort and must communicate with stakeholders on a regular basis regarding the successes (and failures) of the management effort.

Implementation Actions

Over the next year, some decisions need to be made regarding the desired approach to coordination temporarily or for the long-term. The following actions are recommended:

1. Designate or hire a STEER watershed coordinator. CZM and DFW should approach the DPNR Commissioner with a recommended approach to supporting a watershed coordinator. Suggestions to consider include, but are not limited to:

- Re-assign the CZM's APC coordinator position to a full or part-time STEER watershed coordinator position;
- Create a new position under CZM, DFW, or both dedicated to implementation;
- Secure grant funding to expand TNC's STEER planning role to include

watershed implementation for a minimum of three years;

- Build financial and staffing capacity of EAST to support a full-time position dedicated to the STEER watershed efforts;
- Establish a new non-profit; and/or
- Provide office space at DFW in Redhook for a federal contractor position to oversee implementation efforts. Consider discussing options with NOAA, USDA, USGS, EPA, and other CLCC partners.

2. Organize a STEER working group to serve as watershed implementation steering committee. In the short-term, it makes sense to use the existing STEER Core Team; although, representatives from VIWMA, DPW, VIHA, DE, and a few additional watershed residents from Bovoni and the upper watershed would make good additions. TNC and UVI may want to suggest an appropriate size and mix of members. Consider including key federal partners who can also guide projects that might require permits and/or consultations.



Implementation Strategy

There are many potential restoration activities presented in this management plan. Efforts were made throughout this report to provide suggested timeframes for implementation and potential leads for those efforts. While an initial attempt to prioritize projects was made (see [Appendix A](#)), there was not sufficient detail for most of these projects to estimate costs at this time.

Obviously, millions of dollars will be required to implement remediation efforts at the Bovoni landfill and for sewer system upgrades. Land acquisition, dredging projects, culvert replacements, and large stormwater retrofits will cost less on an individual basis, yet collectively may require an equivalent investment. Small demonstration projects, education activities, trash cleanups, and coordination meetings are comparatively minimal.

In order to advance implementation efforts, this section presents a preliminary strategy for allocating a hypothetical budget of **\$2,500,000** in grant funds over the next five years. This estimate is not meant to suggest that full implementation of all the watershed recommendations in this report can be implemented.

The schedule presented in [Table 10](#) is preliminary in nature, and is intended to

provide a platform to launch internal planning discussions among the STEER Core Team, implementation partners, and funders.

It should be noted that implementation is already underway on a number of priority recommendations, and many of the activities presented here already fall under existing program budgets, are within existing job descriptions (public or private sector), or are in the grant request pipeline.



This rain garden installation at the boat yard in Coral Bay is an implementation success story.

The hypothetical budget excludes costs associated with implementing the minimum compliance measures at the Bovoni landfill and wastewater infrastructure improvements. In addition, the local lead identified should not be interpreted to

exclude potential partners, rather to identify a single entity on the ground ideally positioned to spearhead implementation.

Table 10. Hypothetical 5-yr Implementation Schedule

Action	Local Lead	Implementation Year and Planning Level Cost Estimate (thousands of \$)					
		2014	2015	2016	2017	2018	Total
Hire a watershed coordinator.	CZM	\$50	\$50	\$50	\$55	\$60	\$265
Refine concepts for top stormwater retrofit concepts; estimate costs and load reduction benefits.	CZM	\$30					\$30
Conduct feasibility studies for priority wetland habitat restoration projects.	DFW	\$100	\$150				\$250
Adopt post-construction stormwater standards and design criteria, and train agency staff and engineers.	DEP	\$75	\$50	\$25			\$150
Map drainage infrastructure and conduct illicit discharge investigations.	VIWMA/ DPNR	\$50	\$100				\$150
Annual education and outreach coordination efforts.	EAST/ TNC	\$10	\$5	\$5	\$5	\$5	\$30
Pollution prevention planning.	TNC	\$30					\$30
Implement small-scale demonstration projects.	CZM/DEP	\$25	\$50	\$50	\$100		\$225
Design and implement larger stormwater and wetland restoration projects (including drainage improvements).	CZM/DEP/ DPW		\$20	\$300	\$350	\$500	\$1,170
Monitor guts and outfalls, including establishment of rain and stream gauge; supplement for groundwater monitoring.	UVI	\$25	\$50	\$50		\$75	\$200
Annual Total		\$395	\$475	\$480	\$510	\$640	\$2,500

Appendix A:

Potential Restoration Projects by Subwatershed

A1. Bovoni Subwatershed 1

A2. Turpentine Run Subwatershed 4

A3. Nadir Gut Subwatershed..... 11

A4. Frydenhoj/Compass Pt. Subwatershed..... 12

A5. Nazareth, Cowpet, and Great Bay Subwatersheds..... 13

Table A1: Potential Project Opportunities in the Bovoni Subwatershed

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
BV-1	BCB School		✓		✓				<p>A) Retrofit concrete channel up-gradient of school’s infrastructure to detain and infiltrate as much offsite run-on as possible. B) Retrofit existing open field (which is supposed to be a detention basin) by modifying existing infrastructure (large outlet baffle, a few catch basins, etc.). C) All courtyards at the school have vegetated areas where downspouts are currently directed; convert these to actual rain gardens with signage. A few other areas could be converted to rain gardens where existing catch basins/parking lot islands exist. D) Stabilize eroding slope in main courtyard; restrict driving in this area or formalize specific driveways/parking areas. E) Excessive impervious cover could be reduced throughout school property, and additional cisterns use could be explored (observed it overflowing). F) Pollution prevention opportunities include moving/covering the dumpster to reduce pollution directly discharging into gut.</p>	High	Excellent retrofit and educational opportunities here. Most cost-effective and achievable retrofit in the watershed, particularly when done in phases. Will help reduce flooding on Bovoni Rd.
BV-2	Thomasville Cooperative		✓		✓		✓	✓	<p>There is major flooding downstream from this area, particularly where Bovoni Rd intersects with runoff from BCB School Gut. Several locations were identified where existing parking lot runoff could be managed with rain gardens. Restore unvegetated slopes on gut. Trash was observed as well as staining in parking lots, and an exposed sewer pipe was observed crossing gut at downstream end of development.</p>	Med	Good locations for retrofit; would need buy-in from development, which doesn’t have many existing problems.
BV-3	Wooded parcel below BV-2				✓				<p>Wooded area downstream of development would be ideal for a storage practice in conjunction with, or upstream of, existing wetland. Install roadside swale to direct runoff to open parcel. This area could be converted to a community park.</p>	High	Could help alleviate downstream flooding by collecting road drainage. Area actively used for cock fighting and other activities.
BV-4	Bovoni Projects				✓			✓	<p>Projects built on steep slope with parking lot runoff directed underneath buildings in paved chutes with trash racks – headwaters of gut that crosses Bovoni Rd at Sweet Pie’s, may also contribute some to Texaco gut. Cisterns are no longer used and pump chambers were closed up due to pigeon waste on roofs as well as airborne trash from landfill. Erosion was observed on steep, maintained lawn around buildings. Space is available to formalize stable drainage swales and provide storage, particularly at downstream edge of projects where a large, flat area exists. Open dumpsters should be covered.</p>	Low	Retrofits are relatively easy here and would beautify the area. Would be great to reconnect cistern pumps for use in toilets, etc. May be hard to convince because there are no real problems here now (on hill), but would help address flooding downgradient.

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
BV-5	Premier Wines and Spirits	✓				✓			Recommend to evaluate the septic system that is immediately adjacent to the gut and repair as needed.	High	
BV-6	Bulk Storage	✓						✓	Currently, sink discharge, floor cleaning, and possibly roof runoff is being directed to a paved swale that discharges directly into the gut at back of property (which is paved at this location). Owners should be made aware of illicit discharges and make infrastructure changes to address them.	High	Easy reduction of pollutants directly discharging to the gut.
BV-7	Texaco				✓				Neighborhood development resulted in re-routing of the gut into the road from its historic drainage path, with no drainage infrastructure – only paved swales. Flooding occurs at intersection with Bovoni Rd. at the old Texaco. There is open space adjacent to gas station that could be used for minor runoff treatment. Addressing runoff here alone will not solve problem due to off-site run-on; however, It could be good example of how to manage runoff generated at a gas station.	Low	Gas station is currently closed, but good opportunity if redevelopment/new business opens.
BV-8	Luton Property/ Storage Area				✓			✓	Create more natural stream channel for gut and provide storage/treatment in large open area adjacent to gut just prior to Bovoni Rd. Area already showed signs of ponding. Fix clogged/damaged/potentially undersized culvert under road. Possible to bring drainage from Texaco/Estate Bovoni here via catchbasin/pipes.	High	Great location and potential restoration project! Private ownership is a big hurdle for this one, but the Luton family owns the property and may be interested in such a project.
BV-9	Bovoni Center Storage				✓			✓	Retrofit existing drainage system to help reduce parking lot flooding while providing additional storage/treatment. Educate facility manager on ways to reduce parking lot pollution. Could also create formal swale to help manage flooding from gut overflows/road runoff.	Low	Relatively easy to retrofit existing system, but adjacent land ownership might be an issue.
BV-10	Lew Henley's	✓				✓		✓	This sewage disposal site requires massive clean-up and ideally would be moved to a different location. Currently, located in the gut near an area of repeated flooding (see BV-7) – owner has tried to block off runoff, adding to the flooding problem.	High	This is a severe water quality issue that should be addressed in some way.
BV-11	Gas Station				✓			✓	Uncovered dumpster should be dealt with and restricted from private use. The open grass area on property could accommodate a stormwater facility to manage parking lot runoff, as well as a covered vehicle storage/maintenance area. Existing landscape swale along edge of property could be converted into stormwater swale.	Med	Relatively easy retrofits, but may be difficult to convince private owner; except for the dumpster, which they would most likely be in favor of based on existing signage.

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
BV-12	Sweet Pie's/Laundromat	✓				✓		✓	An illicit sewage discharge was observed at Sweet Pie's, and an illicit laundry discharge was observed at the adjacent Laundromat. Both discharged directly into gut behind the property.	High	High priority. Both could access sewer in Bovoni Rd, easy to address.
BV-13	Unregulated Dumping Site	✓						✓	Area requires extensive clean-up, signage, and owner education.	Low	Scale of required clean-up and extensive long-term dumping would make this a difficult project to undertake at this time.
BV-14	Bovoni Landfill				✓		✓	✓	Need to provide stormwater management in interim between now and closure. Conduct groundwater monitoring to determine extent/movement of leachate; address wetland restoration requirements; and enhance buffer.	High	High priority; requirements under Consent Decree.
BV-15	Mangrove Lagoon WWTP				✓				Bioretention area to treat parking lot runoff at operations building.	Low	Ledge removal is likely
BV-16	Second False Entrance						✓		Opening/dredging of false entrance has been proposed by a number of agency staff as potential mechanism for increasing flushing of mangrove lagoon. Feasibility study required to evaluate historic conditions, understand bathymetry and required dredging extent, contaminant sampling, and modeling of flushing rates.	Low	DFW identified as one of three priority sites for assessment; Army Corps of Engineers would likely need to be involved.

¹ Site IDs correspond to site locations on Subwatershed Management Maps and Field Notes found in Appendix B and C of this report, respectively. Numbering is based on geographic location, primarily in a west to east and upstream to downstream pattern.

² See Appendix C of this report for a more detailed description of existing and proposed conditions.

³ Initial ranking across all sites in the STEER Watershed is not based on a formal prioritization process. It merely represents an initial assessment of feasibility based on property ownership, cost, visibility, and stakeholder priorities, and should be adjusted as more information is collected. Implementation of projects ultimately comes down to opportunity and interest.

Table A2: Potential Project Opportunities in the Turpentine Run Subwatershed

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
TR-1	Flag Hill/Signal Hill Rd.		✓	✓					Stabilize unpaved road network. Sedimentation from unpaved road observed at entrance and guard house. Eroded discharge point evident across entrance from red-roofed apartment complex. Install STEER watershed signage at overlook on top of hill.	Med	Further investigation required to determine maintenance needs for existing road side traps, swales, and stabilization options.
TR-2	7 th Day Adventist Church		✓		✓				Site generates a tremendous amount of runoff that goes directly to roadside gut. Propose new parking layout to incorporate landscape bioretention and minimize loss of parking spaces. May be good forum for getting watershed message to community.	Low	Chance of implementation low since it is a private property.
TR-3	Humane Society		✓			✓	✓		Under construction. Site has LID parking lot, alternative wastewater system, many native plants in landscaping, and could serve as a demonstration site for green construction training. Develop plan to protect small freshwater pond along road.	Low	Need to re-visit when project is completed. Reach out to owner.
TR-4	Whispering Hills	✓		✓					New construction project; ESC practices observed on site. Keep an eye on effectiveness of practices; check plans to ensure post-construction stormwater management has been provided.	High	Get site plans from DEP.
TR-5	Cost-U-Less		✓		✓	✓		✓	A) Retrofit existing stormwater basin to accept more runoff from entrance road by installing speed hump to ensure water enters existing inlet under sidewalk. Add sediment forebays for easier maintenance and more vegetation for additional pollutant uptake. B) Retrofit existing drainage swales to reduce erosion and improve performance. Add pipe from concrete forebay to existing Home Depot basin to prevent overflows directly into the gut. Train Cost-U-Less workers to stop dumping wash water. Maintain package plant that is located directly adjacent to gut; this location is priority sewer expansion area.	Med	Despite the fact that this is private property, it is low-hanging fruit – easy and inexpensive fixes for a large amount of impervious area. High visibility for educational signage.
TR-6	Home Depot		✓		✓				Retrofit existing basin adjacent to Cost-U-Less with sediment forebay, vegetation, and an outlet structure to detain stormwater. Reduce excessive pavement in parking lot. Add curb cuts in landscape islands to accept runoff – already depressed in some cases. Divert some runoff across street to open area for storage before discharging to gut.	Med	Retrofits here are easy and relatively inexpensive, especially the existing basin. A highly visible site for a demonstration project.

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
TR-7	Raphune Vista		✓		✓				Very little water appears to reach existing large detention basin. Retrofit existing basin to accept more road runoff. Possible rain garden sites as demonstration for homeowners. Site provides interesting LID components (solar, cisterns, narrow roads, construction materials, etc.)	Med	Need to look at site plans, but this could be an easy fix of an existing practice. Potential green construction training site.
TR-8	Grandview Apartments	✓	✓	✓	✓	✓	✓		No long-term stormwater management is evident at the new multifamily residential development. Some ESC measures (e.g., erosion control blankets, silt fence) are in place, but additional erosion control measures are needed. A new sewer line was installed in the gut between construction and the Tutu Reservoir. Sewage was flowing in the lines, but none of the manholes were covered, posing a water quality and public safety threat. The gut below the construction site should be restored, and sediment and trash removed (old cars, etc.).	High	Look at site plans and determine how to retrofit site. How was this permitted with no long-term stormwater management? Is stormwater connected to the sanitary sewer? How does this impact Tutu Reservoir? Green construction training site?
TR-9	Alvin MacBean Rec. Center		✓		✓				A) Fix existing drainage issue by redirecting runoff from roadway above rec. center to grassy open area along ball field. B) Fix flooding near playground by adjusting invert of yard drain and adding/enlarging weep holes in wall. C) Opportunity to disconnect roof runoff. Add public educational signage about stormwater and watershed issues.	High	Great location for easy retrofits and public outreach. Potential land use conflict with area along ball field (may be an area where spectators stand).
TR-10	DPW land across from Alvin MacBean				✓				Potential for storage retrofit available in DPW land across the street for road runoff – this area currently has a lot of trash and stored vehicles adjacent to the gut/reservoir that should be cleaned up. Project could alleviate chronic flooding along road.	High	Public land makes project more feasible.
TR-11	Tutu Reservoir/Hartman's						✓		Upstream development likely contributes sediment and other pollutants to reservoir, which was a manmade farm impoundment. Restore the storage capacity of reservoir by dredging accumulated sediment and revegetating with wetland species where possible. Consider long-term options for land conservation around pond.	Low	Large-scale project that could restore significant freshwater wetland habitat. One of DFW priority wetlands for conservation.
TR-12	Anna's Retreat Community Center		✓		✓			✓	Construct rain garden for parking lot runoff; restore/supplement gut capacity, potentially removing one or both basketball courts; fix upstream culvert to reduce roadway flooding; add educational signage, particularly on guts and importance of maintaining capacity (e.g., no material storage in gut).	High	Good project – one of the few in Anna's Retreat.

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
TR-13	Faith Christian Fellowship Church/ School		✓		✓			✓	Convert existing open grass areas into additional, off-line storage for gut flow during large storm events. Retrofit existing, eroding swale along driveway to improve performance/capacity and direct runoff from new paved swale into it. Restore gut channel with natural stream features/keep downstream box culvert clear of woody debris. Educate students on watershed issues.	Med	Great location for effective project. Private ownership could be an issue.
TR-14	Tutu I High Rise/Gut Confluence		✓		✓				Tutu High Rises are built around a flat, depressed open grass area where two branches of the gut merge—one from the Christian school to the north, and one from the other Tutu High Rise area to the east. This gut flows down towards the Curriculum Center. Convert open area into a stormwater storage/treatment facility; could possibly get more storage to the east, but the gut there is highly vegetated. Clean up existing trash and cock fighting ring; educate residents.	High	This would be an inexpensive, effective project showcased at public housing – work with VIHA
TR-15	Joseph A Gomez Elementary School		✓		✓			✓	Gut divides school property; upper part of school on a steep slope and lower buildings and ball field in floodplain. Offsite run-on and roof runoff may be an issue. Opportunities may exist for rain gardens and gut restoration; however, additional assessment is required.	Low	Challenging site given steepness
TR-16	New parking lot in gut behind Curriculum Center	✓			✓			✓	New parking lot created behind curriculum center. Gut was channelized and weirs installed. Not clear whether this construction and gut alteration was permitted, or the consequences on downstream properties. Restore gut behind curriculum center to original capacity and deal with runoff from new parking lot as possible.	High	High priority to address enforcement issue.
TR-17	Fire Station				✓				Retrofit roadside swale to keep runoff out of fire station; do on-site management where possible, potentially converting paved swale to vegetated swale (lined if necessary due to Superfund site); and enlarge existing opening into road inlet, adding a trash rack.	Med	Good, easy projects.
TR-18	VI Housing Authority				✓			✓	Extra impervious cover in both upper and lower parking lots that could be retrofitted with stormwater BMPs. Vehicle maintenance area and a dumping site behind building should be cleaned up.	Low	Not a good demonstration site. VIHA may be a good partner in efforts throughout watershed.
TR-19	Holy Family Church		✓		✓				Almost a completely impervious site – runoff flows directly to Smith Bay Rd. Some possible rain garden locations, and education opportunities about using cistern water (cistern was just overflowing).	Low	Possible demonstration site if church is interested, but not great watershed value.

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
TR-20	Four Winds Plaza	✓			✓			✓	Currently no stormwater management for large parking lot. Retrofit large parking lot with lined bioretention (no recharge due to superfund site?) underground detention, or additional rooftop detention via cisterns or blue roof. Large open outfall is a potential safety concern and should be inspected and covered. Car wash drainage goes directly to outfall so look for pollution prevention.	Med	Private property and expensive, unless redoing parking area. Public safety concern at outfall.
TR-21	Tutu Park Mall		✓		✓				Large expanse of impervious cover. Portion of lot drains to large existing detention basin in rear of mall. A) Further investigate retrofit potential of basin to improve water quality treatment. Install small bios in parking lot at B) Plaza Extra and C) McDonalds. D) Possible conversion of spillover parking to grass-pavers.	Low	Retrofit of existing basin could be inexpensive. Difficult and expensive for in-lot solutions, but highly visible and good location for signage.
TR-22	Merchants Commercial Bank				✓				Retrofit with a swale and bioretention in corner of parking lot and alongside the road utilizing existing landscaped area.	Low	Good demo for managing commercial parking lot. Relatively inexpensive.
TR-23	Lutheran Church		✓		✓				Intercept drainage from existing concrete swale in a large rain garden between church and parking lot. Overflow onto road via existing paved channel.	Low	Inexpensive, maybe a good project demo to engage community
TR-24	Innovation Parking Lot				✓			✓	Large parking lot drains to catchbasin in southwest corner. Further investigate opportunities for retrofitting (e.g., underground chambers or forebay/sediment trap beyond wall, stabilize unpaved upper lot) and pollution prevention for vehicle and outdoor storage areas.	Low	Private property
TR-25	Auto/tire hotspot							✓	Investigate this area and surrounding automotive businesses to identify easy pollution prevention practices to reduce potential for stormwater contamination.	Med	Did not investigate
TR-26	Mr. Rodriguez Auto Body/ Total Gas				✓			✓	Install perimeter sand filters in central aisle and at entrance to fueling station to provide WQ treatment prior to discharge to gut. Auto shop is built over the gut; ensure proper pollution prevention practices for material storage and washing and maintenance activities.	Med	Private property, could be expensive
TR-27	First Bank				✓				Convert existing landscaping along road into bioretention. Use curb cuts to direct flows into practice. Overflow to drain in street via piped outlet or overflow into existing paved flume.	Low	Could be good demonstration project for commercial/road right-of-way treatments
TR-28	Church Schools		✓		✓				Disconnection of runoff; bioretention in front parking lot along stream	Low	Steep, difficult, loss of parking likely. Low priority

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
TR-29	Herrnhut Pond						✓		Investigate options for land conservation easements and/or acquisition. Potential enhancement of the Herrnhut Pond to promote access, recreation, and education.	High	Recommendation of the 2006 Wetlands Management Plan
TR-30	Edith Williams Alternative Academy		✓		✓				School reports having to pay for water when cistern runs dry. Hook up rest of rooftops to cistern. Rest of site is difficult for retrofits, although a portion of roof could be used to supplement garden or for demonstration rain garden in the back.	High	Easy downspout additions.
TR-31	Smith Bay Rd./ Ft. Mylner Plaza	✓			✓	✓	✓		There is a package WTP adjacent to gut. Capacity and functionality of the WTP is unknown and should be inspected; this area is on the list for potential hook up to MLWTP. A constructed stormwater wetland retrofit is recommended near the shopping center entrance on Smith Bay Road. There is an existing paved flume that directly discharges road runoff to a nearby wetland area.	High	Highly visible retrofit location for treating road runoff; potential issues with existing wetland.
TR-32	Price Smart				✓		✓		Several opportunities for bioretention areas and/or pavement removal within the parking lot. Investigate existing BMP to see if water quality improvements can be made through simple modification of orifice in outlet structure. Remove trash and debris from gut corridor.	Low	Easy retrofit of existing facility. Highly visible location but private property
TR-33	EB Oliver Elementary School		✓		✓				Demonstration rain garden in courtyard; bioretention in landscaped island in front. The school reports flooding issues in interior courtyard.	High	School eager; community group involvement likely; high visibility
TR-34	Willy George Community Center		✓		✓				Two locations where stormwater retrofits are feasible to reduce existing ponding, provide treatment/storage, and serve as demonstration project. Great location for educating the community about watershed issues and retrofit opportunities.	Med	Steep site may pose some implementation challenges.
TR-35	Turpentine Run Rd. Culvert (upper)				✓				~8x4 ft box culvert north of quarry on Turpentine Gut Rd. at confluence of guts and road. Reportedly, culvert backs up during heavy rains; evidence of flooding was observed. Recommend replacing box culvert with a bridge.	High	Stakeholder priority
TR-36	Auto Salvage Yard						✓	✓	Possible pollutants observed – trash, oils, and grease. Gut runs through middle of property. Further investigate for pollution prevention activities and buffer protection opportunities	Med	Coordinate with broad cleanup and pollution prevention efforts along Turpentine Run Rd.

ID # ¹	Site Name	Type						Description ²	Initial Site Rank ³	Comments/Next Steps	
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut				Pollution Prv.
TR-37	Turpentine Run Rd. Culvert (Mid)				✓		✓	~48" CMP near northern entrance to quarry. Significant erosion from concrete drainage channel along road and large scour hole in channel exposing 15 ft of CMP. Recommend upgrading/replacing culvert, stabilizing stream bank, and repairing road drainage channel.	High	Stakeholder priority	
TR-38	Heavy Materials			✓	✓	✓		Possible pollutants observed – sediment, turbidity (concrete), bacteria (human waste), temperature, pH, oils, and grease. Drainage improvements to control on-site runoff from directly discharging into gut. Erosion control lacking for much of the quarried areas.	High	Manager seemed receptive to possible ideas. High priority site.	
TR-39	Best Car Wash /The Best Tires						✓	Possible pollutants observed – phosphorus, oils, and grease, metals. A vehicle washing station is recommended with a wash water collection and treatment system. Wash water currently runoffs directly to gut. Develop pollution prevention plan.	Med	Coordinate with broad cleanup and pollution prevention efforts along Turpentine Run Rd.	
TR-40	Mariendahl/ Turpentine Rd. Culvert (lower)				✓			24" undersized and misaligned culvert under road. High runoff velocity and volume from the uphill neighborhood are contributing to undermining of Turpentine Rd. and significant gut erosion. Recommend culvert replacement and relocation, as well as additional drainage control throughout the very steep road network.	High	High priority due to damage on Turpentine Run Rd. Need to link with stormwater management in Mariendahl neighborhood. Requires additional investigation.	
TR-41	Equipment storage area			✓			✓	✓	Trash and debris dumped near gut and material stockpiles observed with no containment or stabilization. Open barrels of used oil found sitting on site. Basic pollution prevention and dumping prevention required at this site. Recommend trash cleanup and oil recycling.	Med	Coordinate with broad cleanup and pollution prevention efforts along Turpentine Run Rd.
TR-42	Dumpsters/ collection station						✓	✓	Dumpster areas should be retrofitted to provide covered storage and secondary containment to prevent trash from migrating into gut corridor. Investigate options for restricting access to reduce dumping and reducing sedimentation from unpaved vehicle access.	Med	Coordinate with broad cleanup and pollution prevention efforts along Turpentine Run Rd.
TR-43	Cheyenne's Excavating			✓				✓	Construction equipment and other vehicles and parts are parked on an oil-stained, dirt parking area with no drainage infrastructure or stormwater treatment practice. Unprotected soil stockpiles were observed within the parking area. Recommend application of basic ESC practices at a minimum to prevent sediment mobilization via stormwater. Simple pollution prevention practices to better manage waste and outdoor material storage.	Med	Easy to apply ESC practices. Coordinate with broad cleanup and pollution prevention efforts along Turpentine Run Rd.

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
TR-44	Nadir Bridge Park	✓	✓		✓		✓		Improve park grading and drainage to limit flooding; install bioretention facilities to provide water quality treatment and enhanced aesthetics. Restore gut by reconnecting it to the floodplain and removing the concrete liner. Good location for educational signage.	High	Review existing design plans for improved intersection. Link with cul-de-sac rain garden demo in adjacent Nadir neighborhood.
TR-45	Old truck disposal area			✓			✓	✓	Site has dirt parking area/road shoulders that discharge directly to the gut. Investigate further to develop a pollution prevention plan, remove trash and debris, and prevent sediment loading to gut.	Med	Review existing design plans for improved intersection and coordinate with other activities along Turpentine Run Rd.
TR-46	Lima Property				✓		✓		Consider conservation easements for stormwater drainage improvements. Retrofit upland area for constructed wetland to treat runoff from road and uphill neighborhood (current and future). Trash cleanup (tires), and wetland buffer restoration.	Low	Initial concept already developed; owner interested; work with DPW
TR-47	Clinton Phipps Racetrack		✓		✓		✓	✓	Turpentine run discharges at race track; further investigation required to confirm that facility is sewered, and to evaluate potential to divert and manage additional off-site runoff here. Investigate how horse waste is managed. Most of the dirt track is cross-sloped toward the infield where there is a mangrove/wetland area. Sediment management practices and/or mangrove restoration may be feasible.	Med	Requires additional investigation. Could be an opportunity for improved treatment of stormwater runoff.
TR-48	Trash collection station		✓				✓	✓	Work with VIWMA to redesign dump site for covered storage and secondary containment to keep windblown trash out of wetland. Provide recycling and special collection schedules.	High	Low hanging fruit. Good demonstration location to pilot structural improvements.
TR-49	Sea Kayak Tours		✓						Located in the floodplain making it an low priority site for retrofitting; however, this site is ideal for watershed education.	Low	
TR-50	Derelict Vessels						✓	✓	Removal of marine debris and derelict vessels.	High	Priority in STEER Management Plan.
TR-51	Behind old humane society				✓		✓		Additional investigation needed to determine if upland areas behind humane society provide available space for wetland expansion or stormwater storage/treatment.	Low	Linked with restoration activities at Nadir Bridge Park (TR-44).

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² See Appendix C of this report for a more detailed description of existing and proposed conditions.

³ Initial ranking across all sites in the STEER Watershed is not based on a formal prioritization process. It merely represents an initial assessment of feasibility based on property ownership, cost, visibility, and stakeholder priorities, and should be adjusted as more information is collected. Implementation of projects ultimately comes down to opportunity and interest.

Table A3: Potential Project Opportunities in the Nadir Gut Subwatershed

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps	
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.				
NG-1	Elm Road		✓					✓	Encroachment of Nadir gut is common in this community and eroding/un-vegetated slopes along gut were observed; unauthorized vegetation removal along gut banks, particularly at goat farm in gut. Target residents with education regarding buffer protection; restore vegetated buffer and stabilize slopes. Organize community trash cleanup day.	Low	Limitations include private properties and lack of a homeowners association to help organize.	
NG-2	Gold Hill & Elm Rds.				✓			✓	Trash/debris removal. Possible bioretention in road shoulder. Headcut at end of culvert splash pad – more energy dissipation required.	Low		
NG-3	Nadir Ball Park		✓		✓				Constructed wetland or wetland restoration at Elm Rd/Route 32 intersection. Bioretention area in dirt parking area.	High	Highly visible location; good opportunity for education; public property	
NG-4	Tropical Marine			✓				✓	✓	Undersized culverts and poor channel alignment exacerbate flooding. No erosion control for newly graded driveway adjacent to mangrove. Rainwater harvesting opportunities for large rooftops. Develop pollution prevention plan for boatyard. Investigate reports of potential discharges of non-stormwater at culvert location.	Med	Existing culvert realignment design plans. Owner receptive to improvements. Include in broader marina/boatyard pollution prevention planning.
NG-5	The Patch			✓	✓	✓			✓	Need to upgrade cesspool and relocate, which sits less than 10 ft from edge of water. Drainage from road cuts through property in a small outlet channel, which is clogged. Unpaved parking and drive aisles highly erodible. Develop site specific pollution prevention plan.	High	Further investigation required. Include in broader marina/boatyard pollution prevention planning.

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Table A4: Potential Project Opportunities in the Frydenhoj/Compass Pt. Subwatershed

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
FC-1	Saga Haven Marina							✓	Observed oils stains on parking area; did not access docks. Educate residents and owner on pollution prevention practices.	Low	Include in marina/boatyard pollution prevention planning.
FC-2	Food Center		✓		✓	✓			Rerouted drainage contributes to flooding issue at culvert. Site constructed into rock. Above grade septic system likely underperforming and should be inspected. Runoff attenuation is required to relieve downstream flooding. Evaluate potential for diversion to retrofits on adjacent properties, or added cisterns or blue roof to extend detention. Replace culvert and reconfigure discharge channel.	Med	Local priority for culvert redesign. Potential on-site options not likely to solve full problem. Additional investigations needed.
FC-3	East End Boat Park				✓		✓	✓	Possible pollutants observed – oil and grease. Flooding at adjacent restaurant. Scour at building foundation. Drainage should be treated with oil/grit separator or sand filter, then piped to outfall.	Med	Include in broader marina/boatyard pollution prevention planning.
FC-4	Independent Boat Yard/ Budget Marine		✓		✓	✓		✓	Site adjacent to highest recorded TBT levels in STEER. There are good examples of pollution prevention BMPs currently in use that could be emulated elsewhere. Drainage improvements in roadway to divert flow away from site recommended.	High	TNC has requested funding to support retrofit efforts. Include in marina/boatyard pollution prevention planning.
FC-5	Fryd. gut/Rt 32 culvert				✓		✓		Flooding; undersized and deteriorated culvert. Routine maintenance required. Trash cleanup needed.	Low	Gut fairly stable
FC-6	Compass Pt. Salt Pond							✓	Feasibility study required to evaluate historic conditions, understand bathymetry and required dredging extent, contaminant sampling, and modeling of flushing rates.	High	DFW conservation plan identifies this for restoration.
FC-7	Benner Bay/Marina sediments							✓	Proposed remediation of TBT contaminated sediments located off the Independent slipway. Likely part of a larger Benner Bay dredging discussion and feasibility assessment; with political implications related to proposed Compass Point Marina dock expansion.	Low	Include in broader marina/boatyard pollution prevention planning.
FC-8	Compass Pt. Marina		✓		✓	✓		✓	Treated wastewater and parking lot runoff flows in an open channel across parking lot to Benner Bay. Should separate stormwater and wastewater and keep wastewater discharge covered or piped. Bioretention possible in parking lot. Routine drainage infrastructure maintenance required.	Med	Interested property manager; high visibility for education opportunities. TNC office location.
FC-9	New parking lots	✓			✓				Clearing, grading, and installation of two new (unpermitted) gravel parking lots on hillside at Compass Pt. Marina entrance. Investigate enforcement options and require mitigation and stormwater retrofit.	High	Example of disregard for existing development regulations.

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Table A5: Potential Project Opportunities in the Nazareth Bay, Cowpet Bay, and Great Bay Subwatersheds

ID # ¹	Site Name	Type							Description ²	Initial Site Rank ³	Comments/Next Steps
		Enforcement	Education	ESC	SWM/Repair	WW	Wetland/Gut	Pollution Prv.			
NZ-1	Dolphin Cove	✓		✓					Planned development project in one of last remaining undeveloped coastal areas. Employ strict development standards and make a high priority for enforcement and inspections. Consider applying water quality standards since it drains to impaired waterbody (turbidity).	High	Easier to be proactive; focus on limiting turbidity
NZ-2	Secret Harbor Estates	✓		✓					Planned development project in one of last remaining undeveloped coastal areas. Employ strict development and water quality standards.	High	Easier to be proactive; focus on limiting turbidity
NZ-3	Secret Harbor Condos				✓	✓			Bioretention to treat upper parking lot.	Low	Private ownership.
CB-1	Anchorage Resort				✓	✓			Retrofit with a shallow bio or wet swale near tennis courts. Parking lot runoff discharges to beach. Investigate existing yard drains. Track package plant effluent readings due to impaired water status.	Med	Private ownership, but could help solve Yacht Club problem.
CB-2	Yacht Club		✓		✓	✓			Undersized culverts and lack of infrastructure along access road contribute to flooding issues around boat shed. Drainage path blocked by Anchorage.	Med	High visibility for watershed projects.
CB-3	Cowpet Bay West		✓			✓		✓	Residents observed repairing vehicles in parking lot; no real drainage issues at site; limited opportunities for demo projects. Track package plant effluent due to impaired water status.	Low	Limited opportunities
CB-4	Elysian				✓	✓			Track package plant effluent readings due to impaired water status. 36" stormwater drain pipe discharges untreated onto beach. There are a number of opportunities for parking lot retrofits.	Low	Private property; some drainage from Cowpet East comes through here also.
CB-5	Cowpet Bay East				✓	✓			Bioretention area to treat runoff from eastern-most parking lot. Opportunities for pavement removal. Heightened attention to package plant effluent readings due to impaired water status.	Low	Adequate head; possible poor soils or ledge. May be difficult to convince owner.
GB-1	Water Point		✓			✓	✓	✓	Talk to them about asphalt sealants; demo advanced on-site system	Med	Active HOA that can help with implementation.
GB-2	Ritz Carlton		✓		✓	✓			Add new outlet to existing wetland near beach to prevent wetland overtopping and restaurant flooding. Potential bioretention area in upper parking lot, but challenging. Check maintenance logs on other existing BMPs on site (e.g., Stormceptor and detention basin).	Low	Private property; part of Blue Flag Beach Program; good site for education of tourists & resort managers.
GB-3	Cabrita Pt Salt Pond	✓						✓	Investigate opportunities for land acquisition/conservation easement to protect remaining salt pond. Alternatively, be proactive about flagging this site for stringent development requirements.	High	Check if under existing easement already; could be expensive to purchase.

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Appendix B:

Subwatershed Management Maps

Bovoni Subwatershed..... 1

Turpentine Run Subwatershed- North..... 2

Turpentine Run Subwatershed- South..... 3

Nadir Gut Subwatershed..... 4

Frydenhoj/Compass Pt. Subwatershed..... 5

Nazareth, Cowpet, and Great Bay Subwatersheds..... 6

Appendix C:

Concept Sketches and Field Notes

Bovoni Sites

Turpentine Run Sites (TR-1 through TR-25)

Turpentine Run Sites (TR-26 through TR-51)

Nadir Gut Sites

Frydenhoj/Compass Pt. Sites

Nazareth, Cowpet, and Great Bay Sites