Exhibit 4, Attachment A

Watershed Mitigation Reports
Background Report

1.1 Background

In 2003, Coral Bay residents formed the non-profit organization, CBCC, with the main environmental goal of reducing sediment-laden stormwater reaching the bay, by urging private and government actions. In 2007, NOAA funded the Coral Bay Watershed Management Plan (WMP) as a DPNR pilot watershed plan to provide a demonstration site for the whole USVI. Upon publication of the WMP in 2008, CBCC applied for a $300,000 U.S. Environmental Protection Agency Community for a Renewed Environment grant, and received it in early 2009 to begin implementation of the WMP as part of the overall Coral Bay Watershed Management Project. These NOAA ARRA funds allowed for the restoration of natural drainage functions and paving of roads in six subwatersheds in Coral Bay in order to eliminate or reduce the sediment-laden stormwater runoff plumes entering Coral Bay.

In 2017, additional grant funds of $74,250 were awarded to CBCC from the VI DPNR/EPA, and also $68,000 from the National Fish and Wildlife Foundation and NOAA. These grant funds are to continue the previous work of the CBCC, reducing the sediment entering Coral Bay by constructing stormwater best management practices, such as road stabilization / paving, vegetated swales and other measures.

1.2 Project Summary

Land-based sources of pollution (LBSP) including terrestrial sediment have been identified at both Federal and local levels as high priority threats to coral reef ecosystem health. Due to the significant and chronic impacts LBSP can have on coral reefs, NOAA's Coral Reef Conservation Program has identified LBSP as one of its three strategic program goals, acknowledging that land-based sources of pollution are a widespread stressor to USVI reefs that can be effectively managed locally through the application of watershed-based management actions including the installation of BMPs. LBSP were also highlighted as one of four targets in the USVI Local Action Strategies (latest revision - 2010) and the USVI Coral Reef Management Priorities (2005). Therefore, the overarching theme of the USVI Watershed Stabilization Project was to improve coastal ecosystems conditions in Coral Bay through a reduction in sediment loading to the bay.

Below is a brief summary of the issues and the work the CBCC has conducted under the NOAA ARRA grant.

1.2.1 Implemented Actions

Coral Bay

Studies have shown that steep slopes, highly erodible soils, and high runoff volumes, combined with a large percentage of dirt roads, active construction, and no existing stormwater management contribute to excessive sediment loading (CBCC and V.I. RC&D 2009). Research on St. John has also shown that unpaved roads can erode at rates that are up to 10,000 times higher than on undisturbed hillslopes (Ramos-Scharrón and MacDonald 2007). As such, for Coral Bay the project partners focused on stormwater management improvements along roads and associated ghuts.

Actions proposed in the NOAA ARRA Coral Bay Work plan were located in six drainage basins

(Johnny Horn Trail, Hansen Bay, Lower Bordeaux, John's Folly Bay, Calabash Boom, and Carolina Valley) identified by CBCC as having sediment issues requiring attention. The proposed actions were based on a list of watershed stabilization techniques appropriate for the Virgin Islands environment. Project locations were selected based on CBCC announcing in March 2009 that it was applying for the NOAA ARRA grant and asking residents and homeowners associations to provide CBCC with information on erosion problems in their neighborhoods and an indication of their willingness to participate both as volunteers and financially in this project, if the grant was received.

1.2.2 Selected Best Management Practices

A wide variety of BMPs were used to help reduce sediment loads. These BMPs focused on targeting the source of sediment and trying to prevent or reduce its generation in the first place. If the project partners were unable to reduce sediment at the source, then BMPs were selected that would provide methods to remove sediment from stormwater once sediment transport had begun. The majority of the implemented BMPs (75%) were implemented to provide sediment source control.

1.3 Sediment Reduction Monitoring

Researchers conducted sediment and turbidity monitoring at terrestrial sites within all three watersheds. Marine sediment monitoring occurred in the Coral Bay Watershed. Details on these monitoring efforts and their relation to the eight work areas can be found in the individual reports.

1.3.1 Terrestrial

For terrestrial monitoring, Dr. Barry Devine led a monitoring team that tracked turbidity in the Coral Bay Watershed over a two-year period (September 2009 through November 2011) at over 30 sites (10 reliably). Although a longer post-construction monitoring period is necessary, his early results show that at two of his long-term sites there is a reduction in number of events and level of runoff turbidity meaning there has been a reduction in sediment entering the bay (Devine 2012).

1.3.2 Marine

Dr. Sarah Gray, University of San Diego, and her team (partially NOAA ARRA funded) conducted marine sediment and water quality monitoring in Coral Bay from July 2007 to early March 2012. She selected 11 main sites throughout Coral Bay: three in Hurricane Hole to capture sediment coming off an undisturbed watershed; two offshore reef areas; and, the other six sites were along the developed Coral Bay shoreline.

Her results showed: "Total and terrigenous sediment accumulation was generally higher below the steepest and most developed watersheds (such as Shipwreck [TC-3B] and Coral Harbor [TC-5, TC-8]) than below the [less] developed watersheds (such as [Little Plantation]) for equivalent environments. Finally, total sedimentation accumulation rates below all ARRA mitigated watersheds (North Mangrove [TC-5], South Mangrove [TC-8], Shipwreck Shore [TC-3B]) were lower during the fall of 2011, which was the post-mitigation period compared to 2010. But these 2011 accumulation rates do not appear to be measurably lower than they were pre-mitigation during the fall rainy season of 2009" (Gray 2012). This seems to indicate that longer term monitoring is necessary to determine if the implemented measures are reducing the sediment reaching the bay

1.4 Lessons Learned

Each action conducted by the project partners provided unique successes and challenges. The challenges are documented here as lessons learned so that future efforts can take advantage of this valuable knowledge gained. For additional detail, please see the eight individual project reports in the series available at the CBCC website, www. http://coralbaycommunitycouncil.org/.

To quantitatively evaluate the success of this type of project, appropriate monitoring plans and timelines are necessary. As part of this mitigation proposed in this document, regular scheduled inspections and sample collection will be performed to establish a body of data that can be studied and allow for areas of concern to be addressed.

1.5 Next Steps

The BMP's installed initially provided visible results in redirecting stormwater flows and reducing sediment reaching the bay, based upon observations upon completion of the BMP's. Lack of maintenance, whether by landowners, VI Department of Public Works, or the CBCC, has rendered many of the installed BMP's ineffective, and the visual evidence is apparent during moderate to heavy rainfall events. The following items should be considered to correct the BMP maintenance deficiencies that are occurring.

Continue water quality monitoring to build a sufficient dataset for analysis of post-construction turbidity levels. This will also verify that the implemented BMP measures are effective in reducing the sediment reaching the bay.

Continue marine habitat data collection to build a sufficient dataset for analysis and monitoring.

Perform ghut revegetation efforts in areas where prior ghut maintenance has removed the vegetation. Ensure that ghuts remain in a vegetated state.

A stormwater BMP maintenance schedule should be coordinated with local landowners, Public Works, and other responsible parties to ensure devices continue to function properly.

2. BMP Inspection and Maintenance

2.1. The Importance of Maintaining BMPs

Once they are constructed, BMPs are crucial in protecting water quality from the impacts of development projects. If designed correctly, BMPs can also be an aesthetic asset to the development. However, no matter how well they are designed and constructed, BMPs will not function correctly nor look attractive unless they are properly maintained. Most maintenance problems with BMPs are less costly to correct when they are caught early – as the old adage goes, "an ounce of prevention is worth a pound of cure."

Regular inspection and maintenance is an ongoing legal requirement after the BMP is constructed – inspections must be completed at appropriate times throughout the year and inspection records must be available upon request. An appropriate professional should conduct BMP inspections.

2.2. Legal and Financial Issues

2.2.1. Access and Maintenance Easements

BMPs must have access and maintenance easements to provide the legal authority for inspections, maintenance personnel and equipment. The location and configuration of easements must be established during the design phase and should be clearly shown on the design drawings. The entire footprint of the BMP system must be included in the access and maintenance easement, plus an additional ten or more feet around the BMP to provide enough room to complete maintenance tasks. This BMP system includes the side slopes, forebay, riser structure, BMP device, and basin outlet, dam embankment, outlet, and emergency spillway.

2.2.2. Inspection and Maintenance Agreements

BMP facilities are typically built, owned and maintained by non-governmental entities. To insure proper long-term maintenance, a signed and notarized Inspection and Maintenance Agreement must accompany the design plans for any BMP. An Inspection and Maintenance Agreement will include the following:

- The frequency of inspections that are needed (based on the type of BMP proposed).

- The components of the BMP that need to be inspected.

- The types of problems that may be observed with each BMP component.

- The appropriate remedy for any problems that may occur.

The most effective Inspection and Maintenance Agreements are site specific for the particular BMP components that are used on the site as well as any conditions that are unique to the site (for example, the presence of steep slopes that should be inspected for soil stability).

Required Inspection Frequency for BMPs

Inspection Frequency - Monthly and within 24 hours after every water quality storm (greater than 1.5 inches)

BMPs Stormwater wetlands - Wet detention basins - Bioretention cells

Inspection Frequency - Quarterly and within 24 hours after every water quality storm (greater than 1.5 inches)

BMPs Level spreaders - Infiltration devices - Sand filters - Extended dry detention basins -Permeable pavement - Rooftop runoff management - Filter strips - Grassed swales - Restored riparian buffers

To summarize, devices that include vegetation in a highly engineered system require inspection monthly and after large storm events to catch any problems with flow conveyance or vegetative health before they become serious. All other BMPs should be inspected quarterly and after large storm events.

The signed and notarized Inspection and Maintenance Agreement should be filed with the appropriate Register of Deeds. The responsible party should keep a copy of the Inspection and Maintenance Agreement along with a current set of BMP plans at a known set location.

2.2.3. Inspection and Maintenance Record-Keeping

All inspection and maintenance activities should be recorded. One easy way to do this is to create an Inspection and Maintenance checklist based on the Inspection and Maintenance Agreement. The checklist, at a minimum, should include the following:

- Date of inspection.

- Condition of each of the BMP elements.

- Any maintenance work that was performed (as well as who performed the work).

- Any issues noted for future maintenance (sediment accumulating, vegetation needing pruning or replacement, etc.).

Each BMP should have a maintenance record. Records should be kept in a log in a known set location. Any deficient BMP elements noted in the inspection should be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

Major repairs or maintenance work should include the same level of inspection and documentation as original installations. Inspection checklists and record logs should be kept in a known set location.

2.2.4. Maintenance Responsibilities

As stated in the section above, maintenance is usually the responsibility of the owner, which in most cases is a private individual, corporation, or homeowners association. Simple maintenance items such as minor landscaping tasks, litter removal, and mowing can be done by the owner, or can be incorporated in conventional grounds maintenance contracts for the overall property.

Although a nonprofessional can undertake many maintenance tasks effectively, a professional should be consulted periodically to ensure that all needs of the BMP facility are met. Some elements that can need professional judgment include structures, outlets, and embankments/dams by a professional engineer, as well as plant system health by an appropriate plant professional. Some developing problems may not be obvious to the untrained eye.

In addition, it is advisable to have professionals do the more difficult or specialized work. Filling eroded areas and soil-disturbing activities, such as re-sodding or replanting vegetation, are tasks that are best assigned to a professional landscaping firm. If the work is not done properly the first time, not only will the effort have been wasted, but also the facility may have been damaged by excessive erosion. Grading and sediment removal are best left to professional contractors. Appropriate professionals (e.g. BMP maintenance specialists, professional engineers, aquatic plant specialists, etc.) should be hired for specialized tasks such as inspections of vegetation and structures.

2.2.5. Providing for Maintenance Expenses

The expenses associated with maintaining a BMP are highly dependent on the BMP type and design. However, the most important factor that determines the cost of BMP maintenance is the condition of the drainage area upstream of the BMP. If a drainage area conveys a high load of sediment and other pollutants to a BMP, the cost of maintaining the BMP will increase dramatically. Preventing pollution in the drainage area as much as possible will reduce the cost of BMP maintenance.

Routine maintenance costs are relatively easy to estimate, and include the expenses associated with the following activities:

- Conducting BMP inspections at the intervals shown above.

- Maintaining site safety, including any perimeter fences and other access inhibitors (trash racks or pipe grates).

- Removing trash.

- Removing sediment that has accumulated in any components of the BMP.

- For infiltration-type systems, maintaining the filtering media and cleaning or replacing it when necessary.

- Restoring soils to assure performance.

- Pruning woody vegetation pruning.

- Replacing dead vegetation.

- Stabilizing any eroding side slopes.

- Repairing damaged or eroded outlet devices and conveyance systems.

- Repairing embankments, dams, and channels due to erosion or rodents.

Emergency maintenance costs are more difficult to estimate. They depend on the frequency of occurrence and the nature of the problem, which could vary from storm erosion repairs to complete failure of a structure.

2.3. Summary of BMP Maintenance Tasks

2.3.1. Emergency Maintenance

Maintenance after floods and other emergencies requires immediate mobilization. It can include replanting and repairs to structures. Living systems are likely to need at least minor repairs after emergencies. Following an emergency such as a flood, standing water may pose health risks because of mosquitoes. Mosquito control should be considered if this becomes a problem.

For all installations obstructions and debris deposited during storm events should be removed immediately. Exceptions include debris that provides habitat and does not damage vegetation or divert currents to, from, or in the BMP. In fact, because of the high quality habitat that can be found in woody debris, careful re-positioning rather than complete removal may be desirable. There may be instances where debris is even added. Such locations should be noted so that this debris is not accidentally removed. Educating adjacent property owners about the habitat benefits of debris and vegetation can decrease requests for removal.

2.3.2. Debris and Litter Removal

Regularly removing debris and litter is well worth the effort and can be expected to help in the following ways:

- Reduce the chance of clogging in outlet structures, trash racks, and other facility components.

- Prevent damage to vegetated areas.

- Reduce mosquito breeding habitats.

- Maintain facility appearance.

- Reduce conditions for excessive surface algae.

- Reduce the likelihood of stagnant pool formation.

Special attention should be given to removing floating debris, which can clog the outlet device or riser.

2.3.3. Sediment Removal and Disposal

Sediment gradually accumulates in many BMPs. For most BMPs, accumulated sediment must eventually be removed. However, removal intervals vary so dramatically among facilities that no "rules of thumb" are applicable. The specific setting of a BMP is important in determining how often sediment must be removed. Important factors that determine rates of sedimentation include the current and future land uses upstream and the presence of other sediment-trapping BMPs upstream.

The frequency of sediment removal is based on the sediment accumulation rate versus the amount of sediment storage volume that is inherently provided in the BMP without affecting treatment efficiency or stormwater storage volume. Again, the frequency of sediment removal is BMP and site specific, and could be as frequent as every couple years, or as long as 15-25 years. The volume of sediment needing to be removed and disposed of per dredging cycle is the volume calculated above multiplied by any density or dewatering factors, as appropriate.

Wet sediment is more difficult and expensive to remove than dry sediment. Ideally, the entire facility can be drained and allowed to dry sufficiently so that heavy equipment can operate on the bottom. However, in many impoundments periodic rainfall keeps the sediment soft, preventing access by heavy equipment. In these cases, sediment may have to be removed from the shoreline by using backhoes, grade-alls, or similar equipment.

Proper disposal of the sediment removed from a BMP is required. It is least expensive if an onsite area or a nearby site has been set aside for the sediment. This area must be located outside of the floodplain. If such a disposal area is not set aside, transportation and landfill tipping fees can greatly increase the cost of the BMP, especially where disposal of wet sediment is not allowed in the local landfill. Often, the material must be dewatered before disposal, which again adds more cost and requires land area where wet material can be temporarily placed to dry.

Sediment removal is usually the largest single cost of maintaining a BMP facility, so the necessary funds should be allocated in advance. Since sediment removal costs are so site specific and dependent on disposal plans, it is difficult to provide good estimates. Actual estimates should be

obtained during the design phase of the BMP from sediment removal contractors based on the planned situation. The estimates should include: mobilization expenses, sediment removal expenses, material transport expenses (if applicable), and disposal expenses (if applicable).

2.3.4. Stability and Erosion Control

The best way to promote soil stability and erosion control is to maintain a healthy ground cover in and around BMPs. Areas of bare soil quickly erode, potentially clogging the facility with soil and threatening its integrity. Therefore, bare areas must be restabilized as quickly as possible. Newly seeded areas should be protected with mulch and/or an erosion mat that is securely staked. For BMP's that rely on filtration, such as bioretention facilities, it is critical that adjacent soils do not contaminate the selected media during or after construction. If the site is not permanently stabilized with vegetation when the filter media is installed, the best design practice is to specify sod or other robust erosion control practices for all slopes in and immediately around the BMP.

Erosion is quite common in or around the inlet and outlet of the BMP facility and should be repaired as soon as possible. Erosion control activities should also extend to areas immediately downstream of the BMP.

The roots of woody growth such as young trees and bushes in embankments are destabilizing. Consistent mowing of the embankment controls stray seedlings that take root. Woody growth, such as trees and bushes, further away from the embankment should not pose a threat to the stability of the embankment and can provide important runoff filtering benefits. Trees and bushes should be planted outside maintenance and access areas.

Animal burrows also diminish the structural integrity of an embankment. Muskrats, in particular, burrow tunnels up to 6 inches in diameter. Efforts should be made to control animal burrowing. Burrows should be filled as soon as possible.

2.3.5. Maintenance of Mechanical Components

Each type of BMP may have mechanical components that need periodic attention. For example, valves, sluice gates, fence gates, locks, and access hatches should be functional at all times. The routine inspection, exercising, and preventive maintenance on such mechanical components should be included on a routine inspection/maintenance checklist.

2.3.6. Vegetation Maintenance

Vegetation maintenance is an important component of any maintenance program. The grasses and plants in all BMPs, but particularly in vegetative BMPs such as filter strips, grass swales, restored riparian buffers, bioretention facilities, and stormwater wetlands, require regular attention. The development of distressed vegetation, bare spots, and rills indicates that a BMP is not functioning properly. Problems can have many sources, such as:

- Excessive sediment accumulation, which clogs the soil pores and produces anaerobic conditions.

- Nutrient deficiencies or imbalances, including pH and potassium.

- Water-logged conditions caused by reduced soil drainage or high seasonal water table.

- Invasive weeds.

The soil in vegetated areas should be tested every other year and adjustments made to sustain vigorous plant growth with deep, well-developed root systems. Aeration of soils is recommended for filter strips and grassed swales where sediment accumulation rates are high. Ideally, vegetative covers should be mown infrequently, allowing them to develop thick stands of tall grass and other plant vegetation. Also, trampling from pedestrian traffic should be prevented.

Areas immediately up- and downstream of some BMP plant installations often experience increased erosion. Although properly designed, located, and transitioned installations experience this effect to only a minor degree, all erosion should be repaired immediately to prevent spreading. Live stakes, live fascines, and other soil bioengineering techniques, possibly in combination with 3-D geotextiles, can be applied to erosion in natural drainage ways with minor grading.

The list below describes some specific vegetation maintenance activities at various types of BMPs. It is important to note some specific requirements related to some management practices, such as those performed within buffers, that must be followed. In addition, any vegetation that poses threats to human safety, buildings, fences, and other important structures should be removed. Finally, vegetation maintenance activities naturally change as the project ages from construction, when the vegetation is still getting established, to a mature state.

2.3.7. Maintenance of the Aquatic Environment

An important yet often overlooked aspect of non-routine maintenance of BMPs that maintain a permanent pool of water is the need to regularly monitor and manage conditions to promote a healthy aquatic environment. An indicator of excess nutrients (a common problem) is excessive algae growth in the permanent pool of water. In most cases, these problems can be addressed by encouraging the growth of more desirable aquatic and semi-aquatic vegetation in and around the permanent pool. The plants selected should be tolerant of varying water levels and have a high capacity to incorporate the specific nutrients associated with the problem. If algae proliferation is not addressed, algae-laden water will be washed downstream during rain events and may contribute to nuisance odors and stresses in downstream aquatic habitat.

2.3.8. Insect Control

Ponded water can function as breeding grounds for mosquitoes and other insects. Mosquito problems can be minimized through proper design and maintenance. The best control technique for BMPs that maintain a permanent pool of water is to ensure that it does not develop stagnant areas. BMPs with permanent pools should include a source of steady dry-weather flow. Promptly removing floatable debris helps eliminate areas where water can collect and then stagnate. In larger basins, fish, which feed on mosquito larvae, can be stocked. Additionally, splash aerators can be employed to prevent stagnant water, however, this requires electricity at the site, increases maintenance costs, and must be properly designed so as to not decrease the settling efficiency of the BMP.

2.3.9 Vegetation Maintenance for BMPs

Replacement of Dead Plants

All dead plants should be removed and disposed of. Before vegetation that has failed on a large scale is replaced, the cause of such failure should be investigated. If the cause can be determined, it should be eliminated before any reinstallation.

Fertilization

The objective of fertilizing at a BMP is to secure optimum vegetative growth rather than yield (often the objective with other activities such as farming). Infertile soils should be amended before installation and then fertilized periodically thereafter. Fertilizer can be composed of minerals, organic matter (manure), compost, green crops, or other materials.

Irrigation/ Watering

Watering of the vegetation can often be required during the germination and establishment of the vegetation, as well as occasionally to preserve the vegetation through drought conditions. This can typically be accomplished by pumping water retained in the BMP or from the stream, installing a permanent irrigation system or frost-proof hose bib, or using portable water trucks.

Mulching

Mulching should be used to maintain soil temperature and moisture, as well as site aesthetics. A half-inch layer is typically adequate. Ideally, mulch should be removed before winter to prevent an infestation of rodents.

Weeding

Weeding is often necessary in the first growing season, particularly if herbaceous grasses are out-competing the young woody vegetation growth. The need for weeding may be largely eliminated by minimizing the amount of seed used for temporary erosion control. Weeding may also be required if, over time, invasive or undesirable species are entering the site and outcompeting plants that are specifically involved in the treatment of the stormwater.

Cultivating/ Hoeing

Hoeing is often required to loosen overly compacted soil and eliminate weeds that compete with the desirable vegetation.

Pruning

Pruning is used to trim to shape and remove dead wood. It can force single shoot shrubs and trees to assume a bushier configuration.

Thinning

Thinning dense brush may be necessary for particular species to thrive, increase the vigor of individual specimens, to reduce flow obstructions, and to increase the ability of maintenance staff to access the entire BMP. Tall maturing trees, for the most part, have no place in a BMP (except for buffers) and should be removed as soon as possible.

Staking

Saplings of tall trees planted in or near the BMP may require staking. Care should be taken not to damage the tree's roots with stakes. Stakes should be kept in place for 6 to 18 months, and the condition of stakes and ties should be checked periodically.

Wound Dressing

The wounds on any trees found broken off or damaged should be dressed following recommendations from a trained arborist.

Disease Control

Based on monitoring observations, either insecticides or (preferably) organic means of pest and fungal control should be used.

Protection from Animals and Human Foot Traffic

Fencing and signage should be installed to warn pedestrians and to prevent damage due to trampling. These measures are often most necessary during the early phases of installation but may be required at any time. Measures for controlling human foot traffic include signs, fencing, floating log barriers, impenetrable bushes, ditches, paths, and piled brush. Wildlife damage is caused by the animals browsing, grazing, and rubbing the plants. The use of chemical wildlife repellents should be avoided. Fences and meshes can be used to deter entry to the BMP. Tree tubes can be used to prevent damage to individual specimens.

Mowing

Mowing of perennial herbaceous grasses and wildflowers, especially once seed heads have set, promotes redistribution of seed for this self-sustaining system. Mowing should be carefully controlled, however, especially when performed for aesthetics. As adjacent property owners and customers in general learn more about BMPs, their vision of what is aesthetically pleasing can change. Grasses, in healthy herbaceous stands, should never be mown more than once per year.

2.3.10 Maintenance of Other Project Features

All other devices and features associated with the BMP should be monitored and maintained appropriately. These additional items could affect the safety or aesthetics of the facility, which can be as important if not more important than the operational efficiency of the facility. Such items could include:

- Fences
- Access roads
- Trails
- Lighting
- Signage (e.g. no trespassing, emergency notification contact information, etc.)
- Nest boxes
- Platforms
- Watering systems

3 Proposed Mitigation Measures

3.1 Overview of Current Conditions

In July and August 2016, and in May 2017 site visits were made to Coral Bay to assess the effectiveness and capacity of the BMP measures placed in three of the study areas – Johnny Horn Trail, Carolina Valley and Lower Bordeaux.

3.1.1 Johnny Horn Trail

The BMP measures installed in this basin consisted of concrete swales to direct runoff into the ghut, driveway pipes (48" dia) in two places, and a rain garden behind the fire station.

All concrete swales were functioning properly and were in need of only minor cleaning. The rip rap outfalls were also in good condition.

Both 48" diameter driveway pipes are in good condition.

The rain garden is functioning as designed but is in need of routine maintenance.

3.1.2 Carolina Valley

The BMP measures installed in this basin consisted of a bioretention pond at the Kings Hill / Gerda Marsh intersection and a detention basin at Parcel 6-4 Carolina.

On Gerda Marsh Road a waterbar, inlet, piping and swales were installed.

In the area known as LaLa Land paving was installed and a pipe-arch culvert constructed at the ghut crossing.

In the Mill Vista neighborhood several areas of paving were completed. New culverts were installed and rip rap aprons were placed at the downstream outlets. Roadside ditches were cleaned and waterbars installed to direct runoff off of the roads in to the ditches. Concrete swales were installed to direct water from pipe outlets to the roadside ditches.

3.1.3 Lower Bordeaux

The BMP measures installed in this basin include modified inlet and outlet structures at the 107/108 intersection, as well as installing sediment sacks to the inlet grates. Along Route 108 a trenchdrain was installed to direct runoff off of the road in to the ghut.

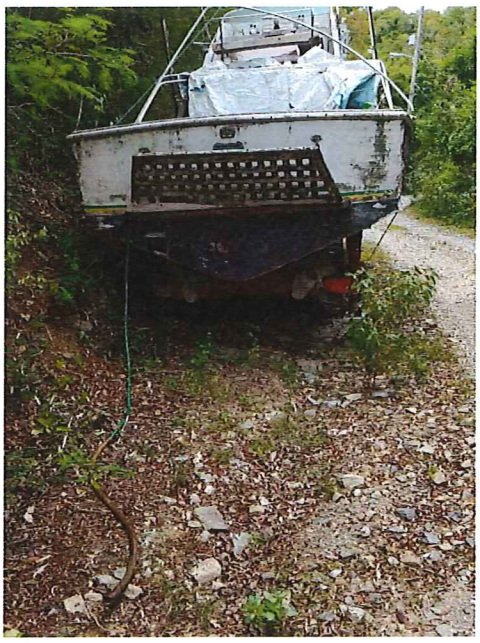
In the Spring Garden area a concrete swale was installed along with a rip rap drainage channel.

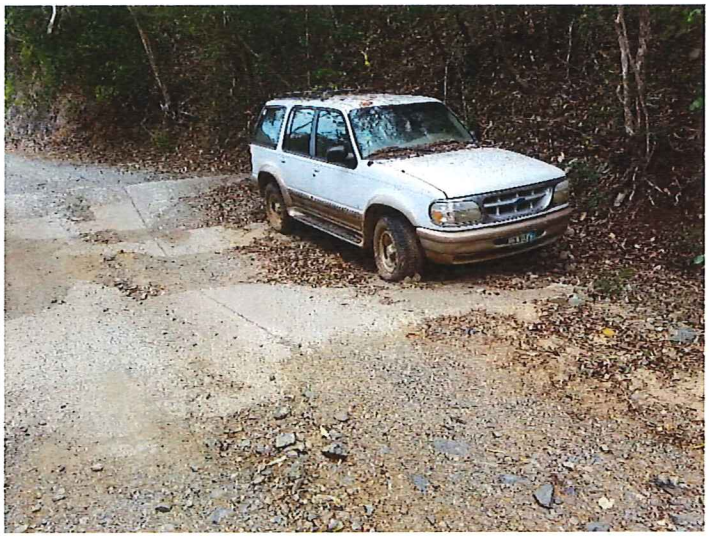
3.2 Maintenance Required

3.2.1 Johnny Horn Trail

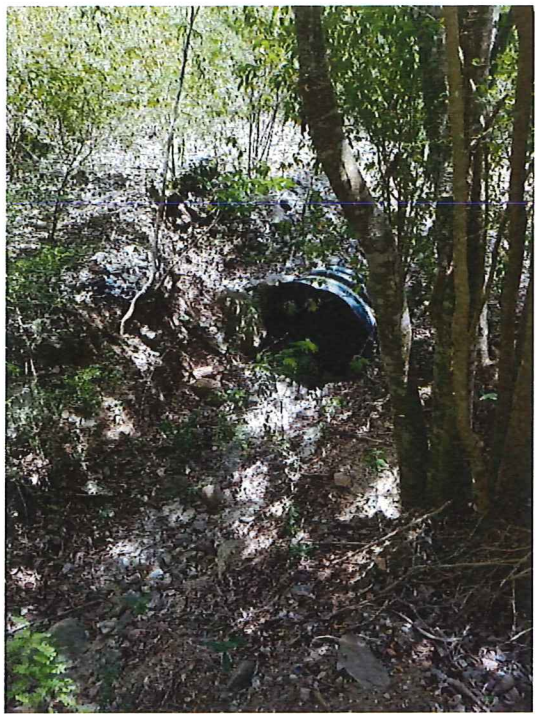
The BMP measures in this basin are in relatively good shape. The waterbars and concrete swales within the roadway need minimal cleaning and are functioning as intended. The rip rap outlet protection needs to be inspected as suggested in the schedule provided, as it appears to be migrating down the steep slope onto the ghut. Additional rip rap will be needed in the future.

Approximately mid-way up the road there is an abandoned boat and a vehicle in the roadside ditch, as shown in the pictures below. These both need to be removed.





The driveway culverts installed are functioning as designed. They both have sediment filling approximately 25% of the pipes, and it is recommended that they be cleaned. See the picture below for a view of the pipe.

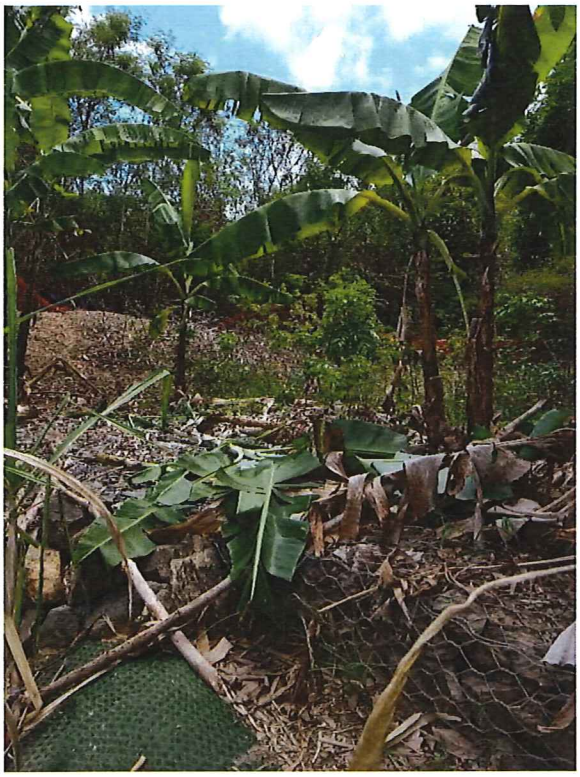


The roadside swale will need regular maintenance as shown in the schedule. As noted in the original report, with the addition of the concrete swales and waterbars, this ditch is no longer necessary since the runoff is directed into the ghut. The roadbed could move closer to the cut slope, allowing a more gradual slope on the ghut side of the road. This improvement would need to be coordinated with the Department of Public Works.

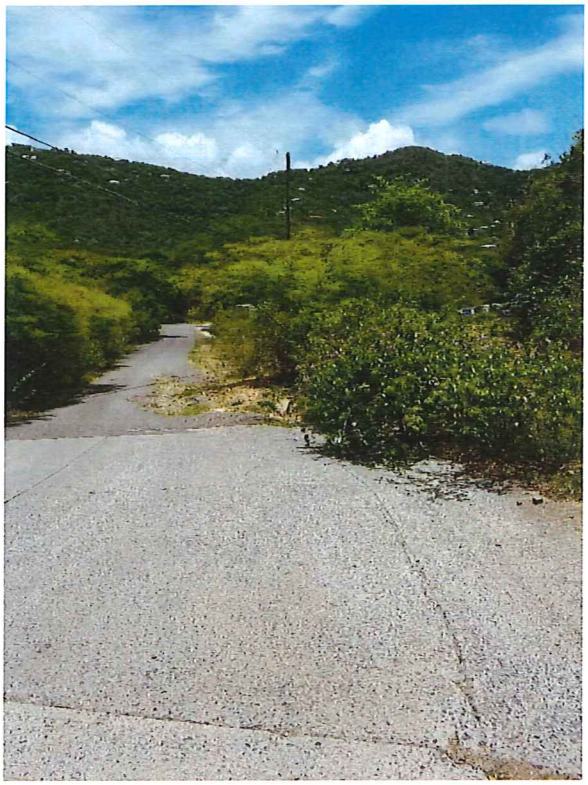
The raingarden at the rear of the fire station appears to be functioning as intended. Regular maintenance as shown in the schedule must be completed to insure this BMP is working as designed. Maintenance required immediately includes refuse removal, weeding and removing dead vegetation, as well as cleaning sediment from the inlet and outlet. Plants that have died or are sickly need to be replaced. See the pictures below for current pictures of the rain garden.

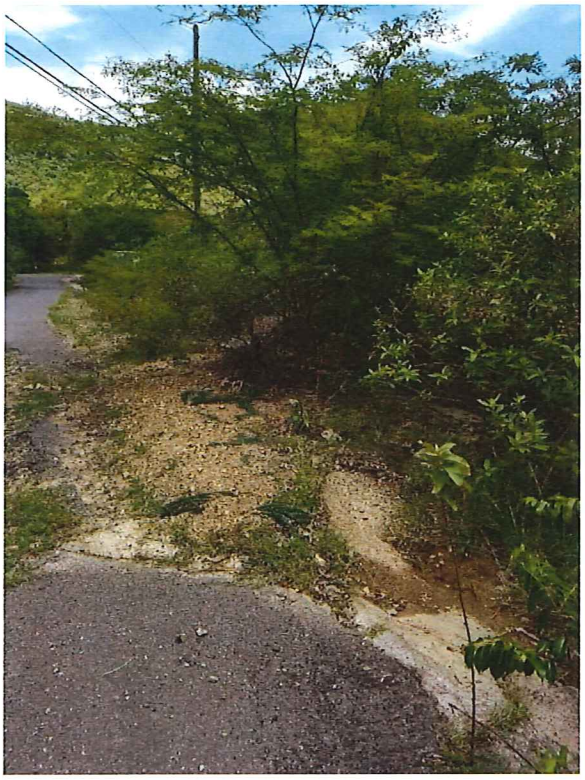
3.2.2 Carolina Valley

In the Greda Marsh Basin the following BMP's need varying amounts of maintenance. The bioretention basin at the intersection of Greda Marsh Road and King's Hill Road is working as designed and only needs minor maintenance and vegetation removal. The outfall and overflow areas are functioning and will only need regular inspections to determine maintenance needs. The basin will need sediment removed sometime in the future. The original design will need to be consulted and compared to current conditions to determine the amount of sediment being held in the basin, and whether the amount is at the threshold of removal. The concrete flume and approach into the basin that directs runoff into the basin needs to be cleared of sediment as shown in the pictures below.

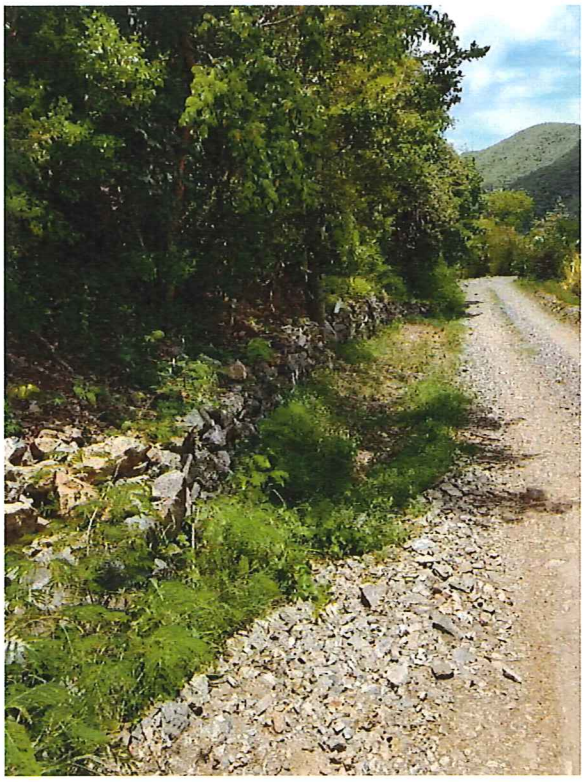


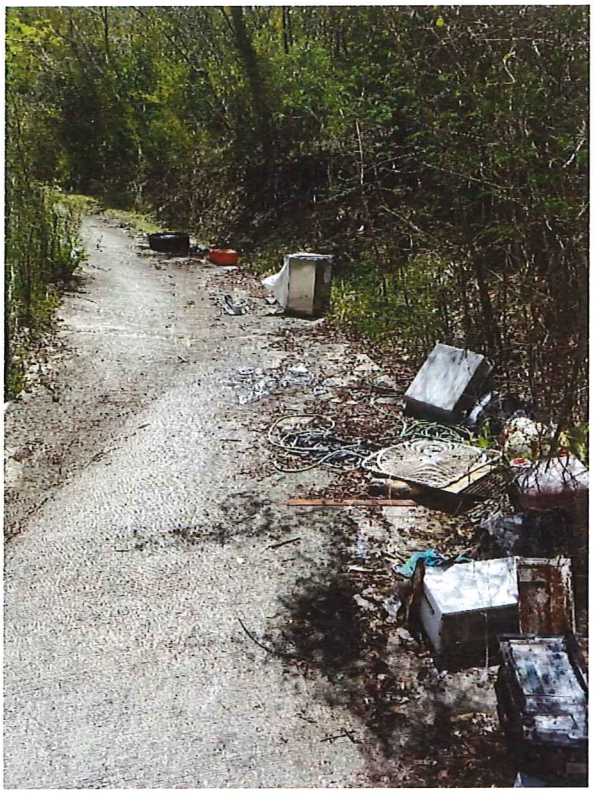
On Greda Marsh Road there exists a large area where sediment deposits within the roadway. There are two curbs at the southern end of the road. This area needs additional engineering and will need owner and Public Works approval. The current conditions can be seen in the photos below.





The Mill Vista area improvements all are working as designed and are only in need of minor, and regular, maintenance. Roadside swales and waterbars need to be cleaned, inlets are in need of sediment removal, and trash and vegetation removal needs to be completed. The pictures below highlight some of the areas needing maintenance.



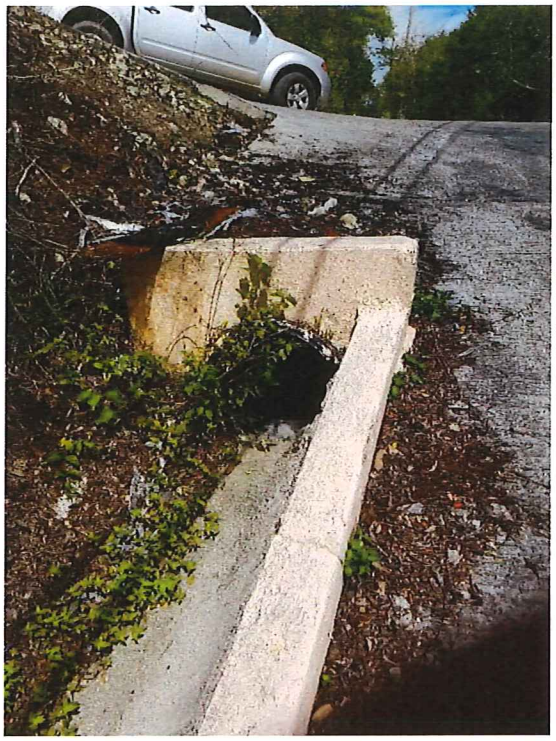


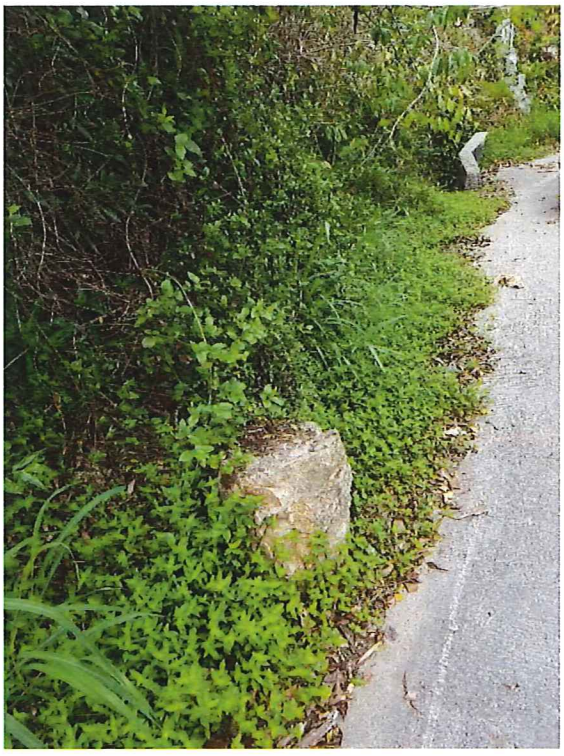
3.2.3 Lower Bordeaux

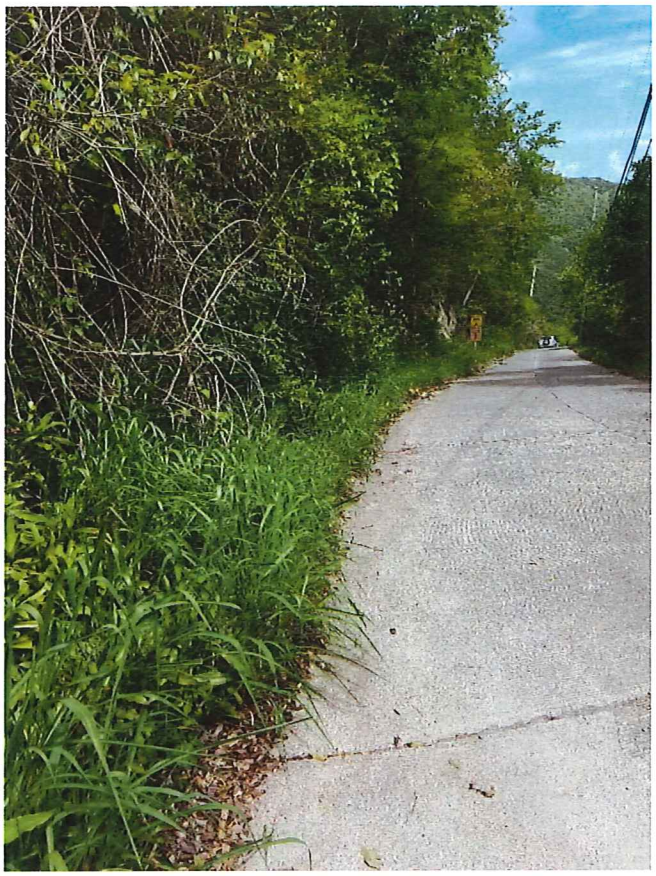
The BMP measures in this basin are all in need of maintenance.

The inlet at the 107/108 intersection is completely covered with sediment as shown in the picture below. The inlet and swale both need to be cleaned.

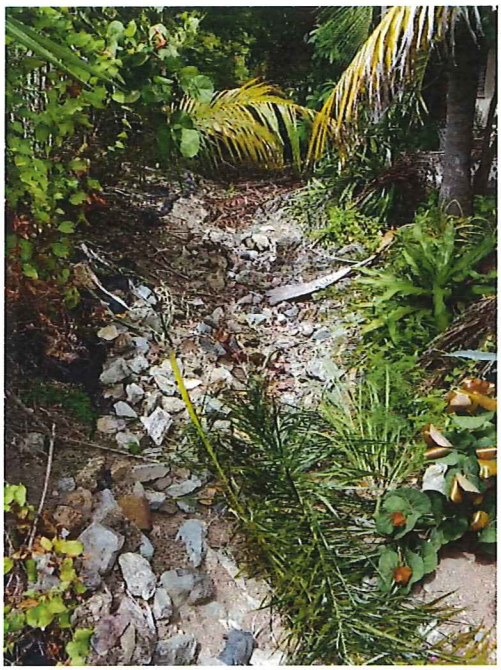
The inlet and trench drain both have sediment that needs to be removed. The roadside ditch is overgrown and needs to be mowed, and trash needs to be removed. The concrete swale across the road is also filled with sediment which needs to be removed. All other inlets and swales in this basin need maintenance as the pictures below show.



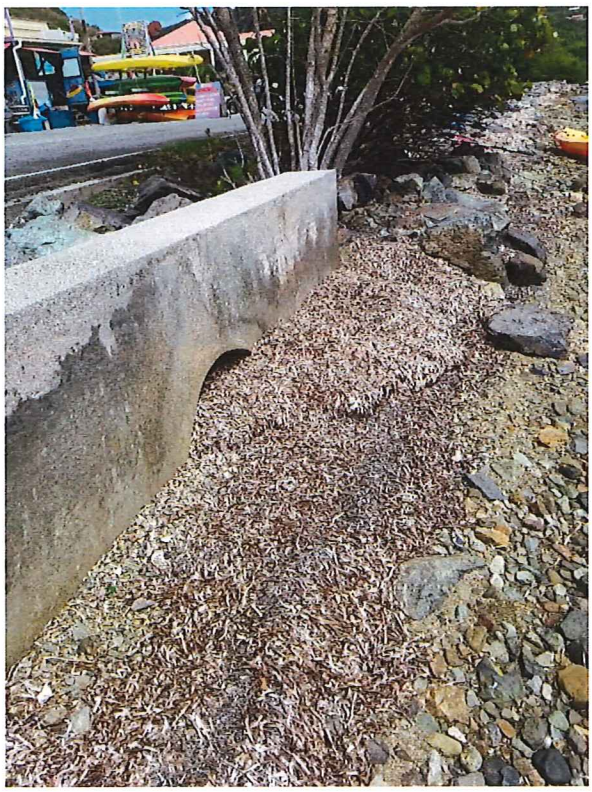




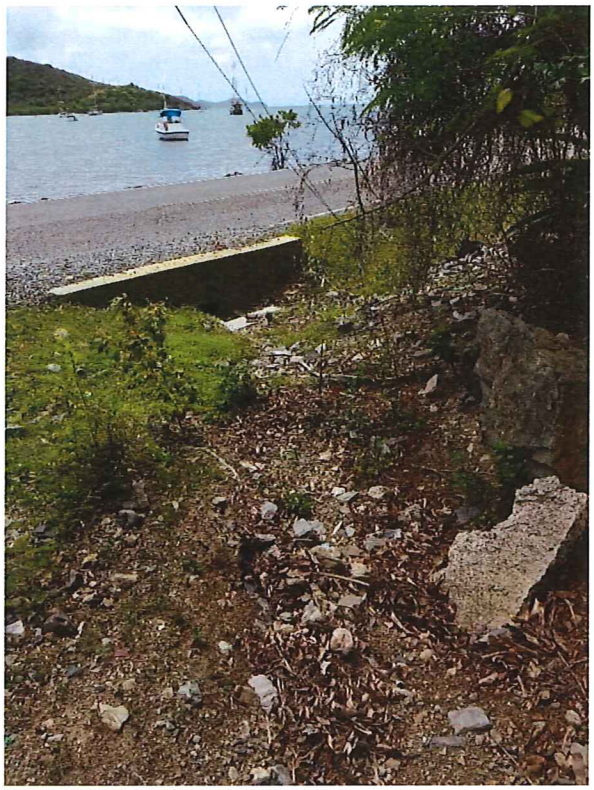
At the Little Plantation Ghut outlet, the roadside concrete swale needs cleaning, the inlet is partially obstructed due to debris, and the ghut needs minor cleaning of debris and vegetation as shown in the pictures below.



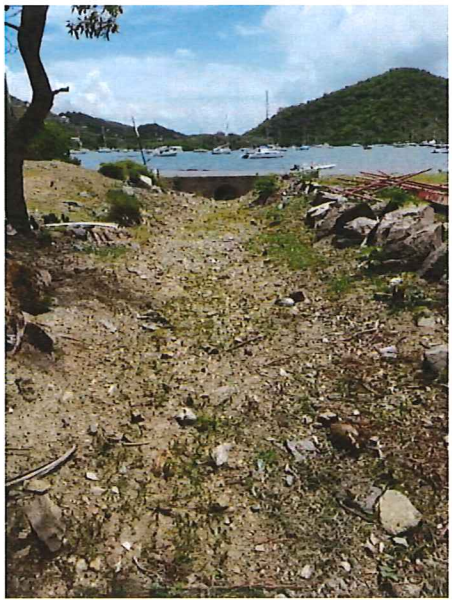
At the intersection of Route 107 and Harold's Way there are several areas of concern that need maintenance. The culvert under the road needs cleaning at both ends as they are partially clogged with debris and vegetation as shown below.

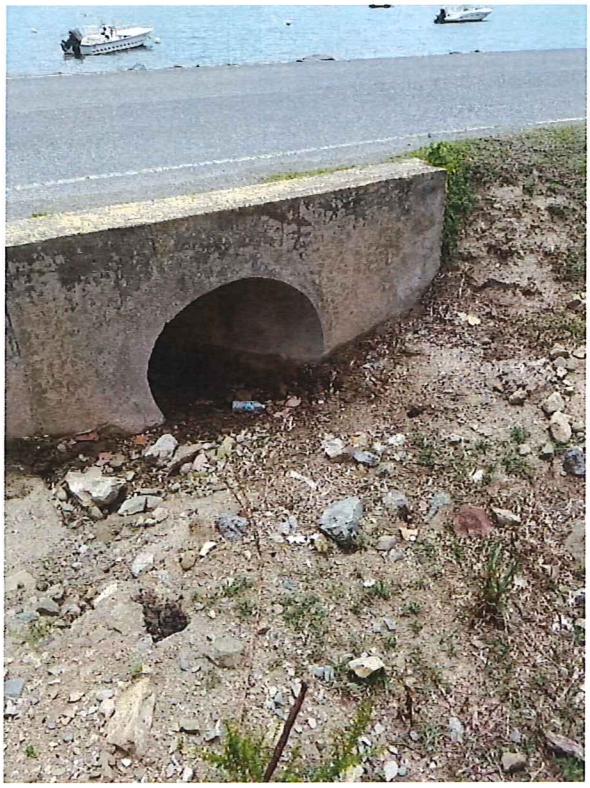


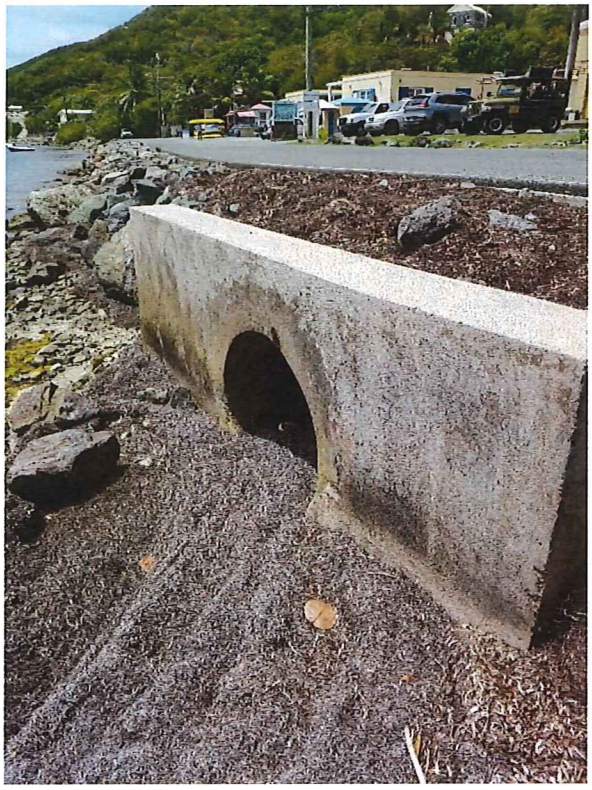
On Harold's Way the roadside swale needs to be cleaned. At the bottom of the road near where the swale drains into the roadway culvert there is an area of bare soil that needs to vegetated to reduce sediment carried into the culvert, as well as partially slowing the runoff. The pictures below represent these conditions.



The Voyages Ghut has recently been cleared and will likely re-vegetate itself over the next month. Minor maintenance is needed to remove debris and dead vegetation. The culvert under the road also needs minor maintenance to clean debris. The inlet at the end of the ghut needs vegetation to help filter sediment from the runoff and to slow the runoff velocities. See the pictures below for the current conditions.







In the Spring Garden area, the ghut was stabilized and a concrete swale was installed. The ghut needs minor maintenance to allow runoff to flow from the concrete swale and the swale needs to have sediment removed to function properly. The current conditions are as shown below.

3.3 Maintenance Schedule

3.3.1 BMP Operations and Maintenance

With any storm water sewer system infrastructure, operations and maintenance are critical activities to ensure long-term function and benefit. Post-construction controls become part of the storm sewer system infrastructure once constructed and need to be operated and maintained just like the storm sewer system. These controls are designed to perform certain functions, some of the controls collect and hold runoff for a period of time, some allow the runoff to pass through the system either horizontally or vertically, and others function more as a filter. With each control potentially performing or functioning differently, the maintenance needs to address these differences and be tailored for each BMP or BMP type.

The following are signs or indicators that the control needs to have maintenance performed:

Decline in Controls Appearance – Vegetation overgrown, litter collecting in the basin, and general decrease in the appearance of the control.

Standing Water – Outlet controls may need to be maintained, settling or erosion which has caused isolated areas of standing water. Health issues associated with mosquito breeding areas. Lack of controls' ability to infiltrate runoff.

Odors – Standing water collecting in the control.

Accumulation of material in the control.

Erosion at inflow areas or outlets of side slopes.

Illegal dumping within or adjacent to the control

Vandalism

Invasive vegetation and overgrown vegetation

Encroachment

Obstructed access for maintenance

Condition of downstream receiving stream – Degrading

Public or third party requests/complaints

As part of the BMP operations and maintenance program, the items above are incorporated into the BMP checklists for the different types of controls. The information mentioned above is not intended to be a comprehensive list, however these are indicators of when maintenance should be scheduled or inspection performed to identify the appropriate maintenance. The checklists incorporate these issues and can be revised as necessary to meet additional post-construction BMP operation and maintenance requirements or issues.

Each BMP must have regular maintenance and will need occasional repair. In Appendix A is a typical Work Order for BMP Maintenance that occurs outside of the normal routine maintenance, or to document maintenance or repairs performed by outside contractors. This form should be made known to the residents of the area, to ensure areas needing maintenance are identified and rectified as soon as possible.

This form includes information about the BMP – identification, date, description of maintenance or repairs needed. There are also fields for sketches, notes on special requirements and the activities performed.

In Appendix B there are the individual Inspection and Report Forms for each of the BMP's in the study area. Forms are also included for BMP measures not currently being used, but that may be implemented in the future.

3.4 GIS / GPS Database

In the 2009 report, it was suggested that the Lower Bordeaux basin be a pilot area for a GIS database. This would allow each individual BMP to have their own record – dates of inspection, maintenance schedule, repairs completed, pictures, etc. Reminders for scheduled maintenance can be generated by time and by BMP.

3.4.1 Implementation

The implementation of the GIS pilot project will begin with the assignment of a unique identification code for each BMP within the study area. Baseline photographs will be taken at each location, as well as the GPS coordinates.

Each BMP will have an inspection and maintenance schedule that will be available on a tablet data collection device. This device will provide the inspection forms, maintenance notes, historical information about the device, as well as the capability to take photographs and upload the information from the field.

In general most of the maintenance performed by maintenance/operations staff will not require any additional verification, other than to document that the maintenance was

performed. However, we shall require a VI Professional Engineer's certification stamp or equivalent certification/inspection or evaluation associated with proper re-sizing of the control to ensure that the basin/control has retained the original design dimensions per plan. Summer's End Group will require controls of this type to include a "Maintained in-place As-built drawing" that is stamped to verify the following:

Correct elevations - Inverts - Slopes (sides, bottom) - Control storage dimensions

The engineer's required approval is for post-construction controls that collect sediment and this sediment needs to be mechanically removed. These BMP types include wet and dry basins and forebay areas. The estimated frequency for the maintenance and corresponding certification are addressed Appendix B.

A website will be created to provide access to the inspection forms for the use of residents and for governmental review.

3.5 Monitoring

For this project to achieve the intended result of decreasing sedimentation entering the Bay, frequent, accurate monitoring must be performed. This monitoring will be conducted at stormwater outfall points, and in the Bay itself. By having a regular monitoring plan in place, any results that deviate from the expected can be analyzed and recommendations for improvement can be made.

3.5.1 Terrestrial

For terrestrial monitoring, samples will be taken at each outfall after rainfall events of 1.5" or more, or when sufficient runoff is present to sample. These samples will be analyzed for pH and Total Suspended Solids.

3.5.2 Marine

For marine monitoring, samples will be taken at five (5) locations within Coral Bay to track turbidity and establish baseline data for analysis. The long-term monitoring plan is attached as .....

4 Conclusions

The sedimentation entering Coral Bay is harming the aquatic environment. Recent installation of stormwater BMP's have helped to reduce the sediment entering the Bay. The BMP's have fallen into disrepair due to lack of maintenance. The disconnect between property owners and the VI Department of Public Works in regards to this maintenance is apparent.

Summer's End Group, LLC proposes to conduct the maintenance and regular inspections of the BMP's to ensure their functionality. The inspections will be regularly scheduled events that will be submitted to the appropriate government agency to allow their review and to track

compliance with this mitigation plan. A GIS system will be developed which will be combined with the inspection reports, so each specific BMP can be queried for inspections, repairs, photos, etc.

Only by having regular maintenance will these BMP's function as intended. Detailed inspection forms are included in Appendix B of this report, and they will be customized to fit this project as we progress towards performing the inspections.

Summers End Group is proposing long-term monitoring of the bay, its water quality, and its environs to properly document the effectiveness of the implemented BMP measures, as well as regularly scheduled maintenance of each BMP.