

## 4.0 Solitude Bay Watershed

This section summarizes baseline information specifically for the Solitude Bay Watershed and includes a description of the unique watershed features, a summary of existing water quality conditions, descriptions of potential restoration sites investigated during field assessments, and neighborhood descriptions. Table 4.1 summarizes basic watershed features.

Appendix A contains a basemap of the Solitude Bay Watershed depicting locations of water quality impairments, roads, hydrology, topography, and potential restoration sites.


### 4.1 General Description

The Solitude Bay Watershed is the north-central portion of the East End watersheds and is the second largest of the six. Topography within the watershed ranges from 0 feet (ft) in elevation at the northern shoreline to upwards of 800 feet in elevation at the southern ridge of the watershed. The center of the watershed is relatively flat; however, the majority of the area is made up of steep hills and ridges. There are six gut systems within the watershed. There are many small ponds located along these guts, some of which hold water into the dry season (Figure 4.1). There are also two larger ponds in the northwest portion of the watershed: Coakley Bay Pond and an unnamed pond.

#### Land Use

The main road that runs through the watershed is the East End Road (Rt. 82), which runs east/west along the northern coast. There are eight distinct residential neighborhoods within the watershed that can be accessed via East End Rd.: Sierra Verde, Yellow Cliff North, Hope and Carton Hill, Cotton Valley, Solitude North, Seven Flags, Pleasant Valley, and Green Cay/Prune Bay. Most of the neighborhoods consist of single family homes on one-acre lots, and around 40% or 50% developed; there are also a few areas that have been subdivided or planned for future development. Most neighborhoods within the watershed extend from the generally flat areas along East End Rd. up through the steep hilly areas to the south (Figure 4.2). The

**Table 4.1.** Watershed Summary

|  |  |
|--|--|
|    |  |
| <b>Drainage area<sup>1</sup></b>   | 1,641 acres; 2.6 sq miles  |
| <b>Length of guts<sup>2</sup></b>  | 4.9 miles  |
| <b>Road length<sup>2</sup></b>   | 14.6 paved miles;<br>12.4 unpaved miles                                |
| <b># Road culverts<sup>2</sup></b>   | 28 mapped culverts   |
| <b>Impervious Cover<sup>3</sup></b>  | 153 acres; 9%  |
| <b>Dominant land use %<sup>4</sup></b>   | Undeveloped: 50%   |
|  | LDR: 29%   |
|  | Ag: 18%  |
| <b>Area within 100-yr floodplain<sup>5</sup></b>   | 303 acres;<br>18% of watershed   |
| <b># Small ponds<sup>4</sup></b>   | 8 (not including Coakley Bay and unnamed pond near Candle Reef condos) |
| <b># Mapped wells<sup>6</sup></b>  | 16   |
| <b>Watershed erosion potential<sup>7</sup></b>   | Vulnerability: Med-High  |
|  | Road-based: High   |
|  | Mean Relative: High  |
| <b>2010 WQ Impairments<sup>8</sup></b>   | None listed  |
| <sup>1</sup> IRF/UVI/USGS 2001 watershed boundaries<br><sup>2</sup> HW revised/or created, 2011<br><sup>3</sup> NOAA CSC, CCAP data, 2005<br><sup>4</sup> UVI-CDC data 2003 (land use) and 2001 (ponds)<br><sup>5</sup> DPNR, dated 2005<br><sup>6</sup> Received from DPNR Feb, 2011<br><sup>7</sup> WRI/NOAA, 2005<br><sup>8</sup> DPNR, 2010 Integrated Waters Report |  |

roads within these neighborhoods vary from dirt or gravel to paved roads. The condition of the roads fluctuates as well, but there are many dirt and gravel roads that are significantly eroded. Three condominium complexes exist within the watershed: the Candle Reef (I and II) Condominiums within the Prune Bay neighborhood; the Carden Beach Condominiums off East End Rd. to the north; and the Coakley Bay Condominiums, which are across East End Rd. from the Carden Beach Condominiums to the south.

Commercial (including municipal services) and some industrial uses also exist within the watershed. Commercial/municipal properties of interest include Ziggy's Island Market and Gas Station, the Fire Station, Blue Water Terrace Restaurant and Deli, and Top Side Restaurant. There is also an industrial area on a portion of Seven Flags Rd.; current tenants include a self-storage facility, Budget Marine boat and marine equipment retailer, and a tile storage area, among others.

Agricultural uses make up a substantial portion of the watershed as well. The majority of the agricultural land is part of the Roebuck Goat Farm. This farm was one of the first settled areas of the East End Watershed. The major crop has changed over time – it has been a sugar cane farm, as well as a dairy farm in the past. Today, the primary use of the agricultural property is for raising goats.

Like the rest of the East End, there are no central sewer lines located in the watershed; therefore, residential and small commercial areas rely on individual on-site septic systems, with small package plants used at condos.



**Figure 4.1.** Pond along gut in Cotton Valley Neighborhood (left) and culvert at East End Road discharge location to Yellowcliff Bay (right).



**Figure 4.2.** Characteristic landscape of Solitude Bay Watershed; views from Pleasant Valley and Hope and Carton Hill neighborhoods (left to right).

### *Water Quality*

There is one water quality assessment unit associated with this watershed, and it is not listed in the 2010 Integrated Waters Report (DPNR, 2010) as impaired.

**Table 4.2.** Water Quality Impairments (derived from DPNR, 2010)

| Assessment Unit ID/Name                                   | Monitoring Station Name | Impairment | Source of Impairment | TMDL (Priority) |
|---|-------------------------|------------|----------------------|-----------------|
| VI-STC-38 / Solitude Backreef                             | None                    | (N/A)      | (N/A)                | (N/A)           |
| VI-STC-43 / Solitude & Teague Bay subwatersheds, offshore | None                    | (N/A)      | (N/A)                | (N/A)           |

## **4.2 Potential Watershed Restoration/Project Sites**

A number of specific sites were identified by project partners, local residents, and field assessment teams as potential sources of pollution or as drainage improvement opportunities. Table 4.3 summarizes candidate projects to be considered during the watershed planning process. A more detailed description of existing conditions and potential opportunities at these sites is provided below.

**Table 4.3.** Summary of Candidate Restoration/Project Sites

| Project ID/Site Name <sup>1</sup>   | Description   | Initial Ranking |
|---|---|-----------------|
| <b>Road Improvements</b>  |   |                 |
| Private Unnamed Rd. off Sierra Verde – Bajamar Rd. (SB-RC-1)                | Erosion observed on dirt road; candidate for paving   | Low             |
| Hope and Carton Hill Neighborhood Road Network (SB-RC-8)                    | Entire neighborhood is candidate for paving; Implement and/or improve existing drainage facilities, such as water bars and roadside swales, at time of paving | Medium          |
| Seven Flags Road (SB-RC-9)  | Significant erosion and gullying of dirt roadway within downstream end of major gut; candidate for paving, and drainage improvements.                         | High            |
| <b>Pollution Prevention</b>   |   |                 |
| Blue Water Terrace (SB-H-1)   | Restaurant cleaning area, dumpster, and storage area management required to prevent pollution from entering the adjacent gut                                  | High            |
| Fire Station (SB-H-2)   | Construct shelters at Cotton Valley Dumpster Site; improve maintenance and public education to prevent pollution from entering the adjacent gut               | High            |
| <b>Stormwater Retrofits</b>   |   |                 |
| Fire Station (SB-R-1)   | Retrofit to improve drainage and provide treatment along main road; adjacent to gut, and susceptible to flooding; highly visible demonstration site           | Medium          |
| Blue Water Terrace (SB-R-2)   | Retrofits to capture and treat polluted parking lot runoff; public education opportunity  | Medium          |
| Seven Flags Road Housing Development (SB-R-3)                               | Housing was built within gut up-gradient of already highly eroded Seven Flags Road; On-site storage retrofits to help slow/reduce runoff                      | High            |
| Ziggy's Island Market (SB-R-4)  | Swale retrofit to treat gas station/market parking lot runoff; culvert maintenance; public education opportunity  | Low             |
| Coakley Bay Condos (SB-R-5)   | Retrofits to capture and treat polluted parking lot runoff  | Medium          |
| East End Road - Dirt Road Discharge across from Coakley Bay Condos (SB-R-6) | Retrofit to capture roadway runoff and divert drainage from eroding dirt access road; public education opportunity  | Medium          |
| Carden Beach (SB-R-7)   | Maintenance and improvement of existing stormwater management facilities  | Low             |
| Candle Reef II Condos Cul-de-sac (SB-R-8)                                   | Retrofits to capture and treat polluted roadway and parking lot runoff; public education opportunity  | Low             |
| <b>Culvert Maintenance and Repair</b>                                       |   |                 |
| Private Rd. between Sierra Verde and Yellow Cliff North Culvert (SB-RC-2)   | Two culverts; both 24" corrugated metal pipe (CMP); need basic vegetative maintenance and debris removal.   | Low             |
| Pony Club Trail (Tr) Culvert (SB-RC-3)                                      | 30" CMP; Bent from weight of road; 15' deep / 20' wide scour hole at downstream end; tire dumping   | High            |
| Cotton Valley Neighborhood Southeast Culvert (SB-RC-4)                      | 24" DIP; significantly corroded; downstream scour hole  | Medium          |



| Project ID/Site Name <sup>1</sup>                             | Description   | Initial Ranking |
|---|---|-----------------|
| Cotton Valley Neighborhood Northeast Culvert (SB-RC-5)        | Two culverts; 24" DIP; downstream scour hole and erosion of channel; grated structures placed on upstream end   | Medium          |
| East End Rd. Major Gut East Culvert (SB-RC-6)                 | Two culverts; one on East End Rd. (30" CMP/RCP) and one on north side on private property (15" CMP); not sized/maintained properly; structural issues; ponding  | High            |
| East End Rd. near Blue Water Terrace Culvert (SB-RC-7)        | 15" CMP; blocked; causing road flooding issues; conveyance directly to ocean via concrete swale above culvert; need maintenance and debris removal  | Medium          |
| Seven Flags Road Culverts (SB-RC-9)                           | Three culverts; two on East End Rd. (24" reinforced concrete pipe (RCP)/CMP), which are mostly blocked by sediment. The CMP culvert is damaged on downstream end. Both need to be replaced by larger culverts. One culvert on Cotton Valley Trail (unknown diameter circular CMP). The downstream end of this culvert is likely completely clogged. | High            |
| Solitude Road Culvert (SB-RC-10)                              | Two culverts on Solitude Rd. (30" CMP). Some erosion issues.  | Low             |
| East End Rd. Culverts near Ziggy's and Top Side (SB-RC-11)    | Four culverts; one on Solitude Rd. (30" CMP) that frequently becomes blocked with sediment/debris from Solitude Rd. and needs regular maintenance; two on East End Rd. (30" CMP) that become blocked with sediment/debris from Solitude Rd., and require regular maintenance; and one culvert on East End Rd. (30" CMP), in good condition.         | Medium          |
| Large Culvert to Coakley Bay from Ziggy's/Top Side (SB-RC-12) | One culvert off East End Rd. (48" CMP) with multiple manhole covers missing along the length of the pipe; outlet submerged.   | High            |
| Unnamed Rd. Culvert near Fire Station (SB-RC-13)              | One culvert near the fire station (24" CMP/DI); could not locate upstream end due to vegetation at edge of pond; downstream end scoured and clogged with vegetation. Appears to be blocked.   | High            |
| East End Rd. Culvert near Fire Station (SB-RC-14)             | One culvert on East End Rd. (30" RCP); downstream end is mostly submerged; scour hole present; gabion baskets need repair   | Medium          |
| East End Rd. Culverts – West (SB-RC-15)                       | Three culverts along East End Rd. between Prune Bay and Coakley Bay Condos (SB-R-5); from west to east: 18" RCP needing riprap, with scouring on downstream end; 18" RCP with some chipping of pipe and blockage; 15" RCP with upstream blockage (sediment/vegetation).   | Low             |
| East End Rd. Culvert – Coakley Bay Condos (SB-RC-16)          | One culvert along East End Rd. just northeast from the entrance to Coakley Bay Condos (SB-R-5); 18" RCP needing stabilization and/or larger culvert with scour hole at downstream end and dry weather flow from discharge.  | High            |
| East End Rd. Culvert–East of Coakley Bay Condos (SB-RC-17)    | One culvert along East End Rd., east of Coakley Bay Condos; 15" RCP with upstream blockage (sediment/vegetation).   | Low             |

| Project ID/Site Name <sup>1</sup>  | Description   | Initial Ranking |
|--|---|-----------------|
| Seven Flags Neighborhood Culvert (SB-RC-18)                                | 12" CMP on Seven Flags Rd.; appears to be completely blocked.   | Medium          |
| East End Rd. Culverts – East (SB-RC-19)                                    | 3 culverts on East End Rd. just west of Sierra Verde Road; one 24" CMP, and two 8" PVC; septic smell coming from downstream end; two PVC pipes from unknown source. | High (septic?)  |
| <sup>1</sup> ID matches basemap locations and field sheets in the Appendix |   |                 |

#### *Private Unnamed Road off Bajamar Road (SB-RC-1)*

This private road currently serves two houses in the Sierra Verde Neighborhood. While the individual driveways are paved, the private road is unpaved and eroding. Concentrated runoff flows from the southwest side of the road to the northeast where the surface transitions from paved to unpaved, creating deep ruts and gullies (see Figure 4.3). This gully continues along the side of the road, eventually discharging to a small gut that crosses East End Rd. near the intersection with Sierra Verde Road. This eroding road may serve as a source of sediment into Yellowcliff Bay.

Some minor, low maintenance improvements could be conducted along the road. A water bar and stabilized swale along each side of the road would reduce erosion and, therefore, the associated potential sediment load from this area would be reduced.



**Figure 4.3.** Erosion gully at the transition from paved driveway to unpaved private road looking up-gradient (left) and down-gradient (right).

#### *Hope and Carton Hill Neighborhood Road Network (SB-RC-8)*

The roads in the Hope and Carton Hill Neighborhood are in general very steep, mountainous, and unpaved. The roads of interest include Yellow Cliff Trail, Coral Reef Trail, Divi Divi Trail, and Pony Club Trail. The roads have many deep ruts and gullies that carry stormwater and large amounts of sediment during rain events. An extremely steep, unpaved cell tower access road at the southeastern edge of the neighborhood is particularly in need of maintenance. All of this

runoff and sediment load ultimately discharge to the main gut at the Pony Club Trail Culvert (SB-RC-3; described in detail below). Large quantities of sediment can be seen along the road at this location. At some point, paved water bars and swales were constructed to try to reduce the erosion issue on these roads, but runoff has bypassed and scoured around these structures. Only one section of this road network, a portion of Divi Divi Trail, is relatively flat; this section has issues with ponding water during and after storms due to poor drainage.

In general, the roads in this neighborhood likely provide a large sediment source to the gut, the associated ponds, and eventually Yellowcliff Bay. These steep roads are ideal candidates for paving to stabilize the roads and reduce the sediment load to the gut. Drainage infrastructure should be constructed at the time of paving.



**Figure 4.4.** Roads in the Hope and Carton Neighborhood are unpaved and very steep (left). Runoff from this road bypasses and undermines the paved swale (right).

#### *Seven Flags Road (SB-R-3 and SB-RC-9)*

Seven Flags Road is bordered on the east side by commercial land uses. It appears as though this road and commercial properties were built along a historic gut that discharges into Solitude Bay. The unpaved road (approximately 1,000 feet) is experiencing extreme erosion between the commercial properties and the road (see Figure 4.5). The two culverts that receive and discharge flow from Seven Flags Road are significantly blocked with sediment (See Figure 4.6). The eroded gully is actively undercutting the road and threatening the surrounding infrastructure. The 50-acre drainage area consists of steep, paved mountainous roads and residential properties. Six new houses have been built recently just southwest of the commercial properties, further encroaching on the gut (Figure 4.7). In addition, there is a culvert of unknown size and material that is completely blocked on the corner of Cotton Valley Tr. and Seven Flags Rd.

This stretch of road is an ideal candidate for paving and constructing proper stormwater infrastructure. The culverts under East End Rd. and at the corner of Cotton Valley and Seven Flags should be replaced with properly sized pipes. In addition, the gut behind the new houses should be retrofitted into a series of stepped depressions to allow for more storage and reduced velocities to help protect the downstream road and infrastructure.





**Figure 4.5.** Erosion gullies are undermining the unpaved Seven Flags Rd. (left), scouring around and under existing infrastructure (middle), and creating dangerous public hazards (right).



**Figure 4.6.** The two culverts that carry flow from Seven Flags Rd. and a portion of East End Rd. to Solitude Bay blocked with sediment on both the upstream (left) and downstream ends (right).



**Figure 4.7.** New homes were built in the gut upstream from the Seven Flags Rd. erosion (left). The areas behind the houses should be retrofitted to create a series of terraced depressions to help provide more storage and decrease velocities (right).



*Fire Station (SB-R-1), Dumpster Site (SB-H-2) and culverts (SB-RC-13 and 14)*

The fire station/dumpster site is an ideal location for a demonstration project, since it is a very visible community area, located on the southwest corner of the East End Rd. and Cotton Valley Trail intersection. The dumpster area is an important amenity to the surrounding community since it is the only disposal area in the East End (Figure 4.8). It is also utilized as an informal swap shop where people leave items out for others to reuse. The fire station is located next to the dumpster area to the south in a very flat, grassy area. Just south of the fire station entrance is a bus stop, which is heavily used by the community. A short paved road borders the site to the south and a small, extremely overgrown gut provides the western bound. A pond with a permanent pool of water is just upstream from the site, separated from the gut by the short road. Residents have stated that this pond overflows the road during storm events, causing erosion alongside the road. There is a 24-inch culvert connecting the pond area to the gut that may be corroded and/or blocked on the southern end. The gut ultimately discharges to Yellowcliff Bay via a 30-inch culvert, which is mostly submerged on the downstream end and in need of repair.

The retrofit for the site is comprised of four parts: 1) a bioretention facility located in front of the bus stop to treat runoff from up-gradient roads and to provide an education opportunity with signage (Figure 4.9); 2) a linear bioretention between the fire station property and the dumpster area to manage runoff from the fire station driveway, building, and some of the roadway (Figure 4.9); 3) covered lean-tos for the dumpsters as well as for an official “swap shop” area and educational signage about pollution prevention and the adjacent gut; and 4) repairing/replacing the culverts and stabilizing the gut.



**Figure 4.8.** The rebuilt dumpster site is an important resource for the community (left). However, the dumpsters are uncovered, overflowing, and located directly adjacent to a gut (middle). Potentially hazardous materials are left in this area (right).



**Figure 4.9.** The area in front of the bus stop could be retrofitted to manage stormwater from the roadway (left). Stormwater from the fire station could be managed in a retrofitted bioretention system in the existing depression before discharging into the gut behind the property (right).

#### *Blue Water Terrace (SB-R-2) and (SB-H-1)*

The Blue Water Terrace is a new (opened in 2010) restaurant, deli, and market in the Sierra Verde neighborhood. It currently has a large unpaved parking lot to the south of the main building, as well as some unpaved parking along the road to the east and in front of the building, to the north. A small gut is located along the west side of the property. Currently, all of the runoff from this site flows in a northeastern direction to the gut, which eventually crosses East End Rd. via a culvert that discharges into Yellowcliff Bay. While there were no signs of major erosion at the site during the field visit, the unpaved parking area is a constant source of sediment to the bay. In addition, this site was identified as a potential hotspot due to an uncovered outdoor cleaning area, uncovered dumpster, and potentially hazardous storage area (see Figure 4.10). Because of the restaurant's proximity to a gut, septic system discharge at the site is also an important concern; however, in order to evaluate the septic system, more information is needed regarding the system's design and performance.



**Figure 4.10.** Blue Water Terrace has an uncovered area where cleaning products appear to be rinsed (left) and an uncovered dumpster/materials storage area with evident leaking and staining (right).

The proposed retrofit at the site includes directing runoff from the southern entrance and parking area into a bioretention facility constructed in an existing grassy area alongside the gut. In addition, runoff from the roadside parking, the parking in front (north) of the building, and the driveway along the west of the building can be directed into a shallow grass swale leading to a bioretention facility (Figure 4.11). Soils in this area do not appear to be highly infiltrative, so overflow from the bioretentions would flow into the adjacent gut. Since the contributing drainage area is unpaved, these stormwater retrofits would need frequent maintenance (removal of sediment) to ensure long-term viability. Paving of the parking lot and driveways would reduce this sediment source. The hotspot issues at the site should be addressed by educating the staff on the proper pollution prevention procedures related to cleaning products, washwater, and storage of hazardous materials; as well as ensuring that the dumpster is covered at all times.



**Figure 4.11.** The grassy area in the far left of this photograph is a good location for a bioretention facility for runoff from the parking area (left). This depression on the north side of the building could also be converted to manage stormwater from the property (right).

#### *East End Rd. near Blue Water Terrace Culvert (SB-RC-7)*

The gut located along the Blue Water Terrace property joins with another gut and crosses the East End Rd. through a 15-inch RCP (Figure 4.12), where flow enters Yellowcliff Bay between the homes at addresses 22 and 21 Cotton Valley. This culvert appears to be mostly blocked (Figure 4.13), and homeowners have constructed a concrete swale on top of the culvert, seemingly to handle stormwater that flows over East End Rd. onto their property.

Possible options for this site are to 1) create additional storage in the gut upstream of the culvert, allowing sediment to settle out before flowing to the bay; and 2) repair and/or enlarge existing culvert and concrete swale by working with the adjacent homeowners who are affected by this problem.





**Figure 4.12.** View upstream along one fork of the gut system (left). Concrete headwall for 15-inch reinforced concrete culvert (right).



**Figure 4.13.** The outlet of the culvert is barely visible from the beach, with a crumbling concrete swale on top of it (left). Better view of the concrete swale constructed to convey runoff that overflows over East End Rd. between two private residences, bypassing the culvert (right).

#### *Ziggy's Island Market (SB-R-4) and Culverts (SB-RC-11, and 12)*

Ziggy's Island Market is located near several culverts that eventually discharge into Coakley Bay. One 30-inch culvert crosses underneath Solitude Rd., and then two 30-inch culverts continue under East End Rd. (Figure 4.14). The two 30-inch culverts converge with a 30-inch pipe from a catch basin in front of Ziggy's at a large manhole, where a 48-inch culvert then carries flow approximately 1,000 ft down to the bay. The culvert under Solitude Rd. and the two under East End Rd. often become clogged with sediment flowing down from Solitude Rd. Manhole covers all along the 48-inch culvert have deteriorated, creating safety hazards (Figure 4.15).



Regular maintenance is needed at these culverts to prevent flooding and keep sediment out of Coakley Bay. The manholes along the 48-inch culvert should be repaired as soon as possible. In addition, there is an opportunity to retrofit Ziggy's Island Market in a highly visible location where public education would be possible. As shown in Figure 4.15, a strip of pavement in front of the site could be removed to construct a treatment swale for this drainage area, creating two discrete access points for the market. In this way, sediment and other pollutants could be removed prior to discharging into the existing catch basin.



**Figure 4.14.** 30-inch culvert under Solitude Rd (left) and two 30-inch culverts under East End Rd., leading to a 48-inch culvert that discharges to Coakley Bay (right).



**Figure 4.15.** Some pavement could be removed at the gas station to create a treatment swale (shown in green) up-gradient from the existing catch basin indicated with an arrow (left). Manhole covers are missing all along the 48-inch culvert leading out to Coakley Bay, creating a safety hazard (right).

### *Coakley Bay Condos (SB-R-5)*

The Coakley Bay Condominiums are located on a very steep slope to the south of East End Rd. There are 14 buildings, including a restaurant and a pool, and several parking areas connected by two extremely steep driveways. The existing stormwater management at this site is very minimal, comprised of various shallow, paved conveyance channels along the driveways (Figure

4.16). Some of the runoff is directed into the vegetation on either side of the development, but the majority of runoff is carried down to the entrance and discharged into the shallow roadside swale on the south side of East End Rd. (Figure 4.17). Stormwater retrofits should be implemented throughout this site to direct runoff into stabilized treatment areas along the pavement edges.



**Figure 4.16.** Coakley Bay condos are located on a steep hillside overlooking Coakley Bay (left). Stormwater is conveyed through the site via paved swales (middle and right).



**Figure 4.17.** The majority of uncontrolled stormwater from the site flows down to the entrance and then along the edge of East End Rd. (left). This is an area in the southwest corner of the upper parking area where water would puddle after rain events. Small PVC pipes have recently been added to drain this area, creating an ideal location for a retrofit BMP (right).

#### *East End Road - Dirt Road Discharge across from Coakley Bay Condos (SB-R-6 and SB-RC-16)*

Runoff from this section of East End Rd. as well as Coakley Bay Condos (see above) should be carried into Coakley Bay via an existing 18-inch RCP culvert (Figure 4.18). However, over time, the roadside swale has filled in, resulting in much of the runoff to flow across East End Rd. and down an unpaved beach access road (Figure 4.19). As a result, this road has severely eroded, rendering it unpassable, and a significant amount of sediment likely transported into Coakley Bay.



The retrofit for this site should include the construction of a stabilized conveyance swale on the south side of East End Rd. to carry runoff down to the culvert (SB-RC-16) instead of the beach access road. The access road itself should be stabilized using large boulders to prohibit vehicular entrance, but encouraging pedestrian access. The existing culvert should be replaced by a new culvert sized properly for the contributing drainage area, and should have a stabilized outlet. In addition, we observed a black plastic pipe discharging dry weather flow into this culvert (Figure 4.18): this pipe should be investigated to find the owner and source of flow.



**Figure 4.18.** Arrow indicates PVC pipe discharging dry weather flow into culvert (left). Dry weather flow observed at downstream end (right).



**Figure 4.19.** Runoff from Coakley Bay Condos flows across East End Rd. and down a beach access road (left) causing erosion gullies (middle), and this sediment-laden runoff enters Coakley Bay (right).

#### *Carden Beach (SB-R-7)*

This site focuses on the eastern portion of Carden Beach. Currently, runoff from the entrance driveway and half of the western driveway flows across the pavement and down into a grassy depression (wetland?) that was formerly a storage pond (Figure 4.20). This grassy area is also an undeveloped lot. Stormwater flows across the cul-de-sac at the far eastern edge of the site



and into a riprap-lined channel with a sediment forebay that carries flow out to Coakley Bay (Figures 4.21 and 4.22). This channel is experiencing erosion at the downstream end. Residents at the stakeholder meeting indicated that this area has experienced flooding recently due to new construction.

Recommendations for this site are to 1) construct a bioretention facility at the edge of the parking area near the dumpster to treat flows from that area; 2) perform regular maintenance at the sediment forebay in the riprap-channel; 3) stabilize the channel to prevent further erosion along the sides; and 4) protect the existing grassy area from future development, preserving it for stormwater treatment and storage.



**Figure 4.20.** Stormwater runoff is conveyed across the entrance road with a shallow water bar (left) and continues towards the parking area near the dumpster (middle), eventually, flowing down into a grassy depression that exists in an undeveloped lot (right).



**Figure 4.21.** Stormwater flows from the grass depression and the cul-de-sac to a riprap-lined channel (left). A sediment forebay was constructed with a rock weir (right).



**Figure 4.22.** The channel flows directly to Coakley Bay (left). A portion of the downstream end of the channel has eroded (right).

#### *Candle Reef II Condos Cul-de-sac (SB-R-8)*

The Candle Reef II Condominiums are located in the west edge of the Solitude Bay watershed. This location is ideal for a demonstration project to not only improve water quality but also help to educate the residents about the East End Marine Park, stormwater pollution, and how they can help reduce land-based sources of pollution to the marine environment. The proposed BMP includes a bioretention area in or around the cul-de-sac providing access to Prune Bay (Figure 4.23).



**Figure 4.23.** Prune Bay can be seen just beyond this large cul-de-sac near Candle Reef Condos II (left) and the drainage area to the cul-de-sac, consisting of roadway, parking areas, and walkways (right).

#### *Private Road between Sierra Verde and Yellow Cliff North Culvert (SB-RC-2)*

An unpaved private road that connects the Sierra Verde and Yellow Cliff Neighborhoods crosses a gut with a drainage area of roughly 60 acres of mostly farmland and low-density residential lots. There are two 24-inch CMP culverts (see Figure 4.24) that are in relatively good condition with little blockage and only slight scouring at the downstream end. The upstream end is a depression that dries out in the dry season. While these culverts are not currently a significant problem, issues could arise if the upstream watershed becomes more developed.





**Figure 4.24.** Two 24-inch CMP culverts that cross an unnamed road (left). A depression exists at the upstream end that only holds water in the wet season (right).

#### *Pony Club Trail Culvert (SB-RC-3)*

The Pony Club Trail culvert is located at a major crossing point of the main gut in this area. It is a 30-inch CMP that appears to be greatly undersized given the large upstream drainage area (450 acres) and resulting large scour hole at the downstream end (15 ft deep, 20 ft wide, and 50 ft long). This is also an area where a great deal of sediment is deposited from the up-gradient Hope and Carton Neighborhood road network (SB-RC-8). Sediment builds up on the road at this low point and is then pushed off into the gut to clear the road (see Figure 4.25). Tire dumping was also observed at the site. The recommended actions at this site are to 1) replace the damaged, undersized culvert with one appropriately sized for the drainage area and gut characteristics; 2) provide a stabilized outfall on the downstream end of the culvert to reduce further erosion in this area; and 3) perform regular road maintenance that removes sediment from the area rather than depositing it directly into the gut. Educational signage in this area could also help reduce dumping.



**Figure 4.25.** The arrow shows the sediment that gets cleared off Pony Club Trail and pushed into the gut (left). The upstream end of the culvert is clear of debris and is in generally good shape (middle); however, a large scour hole has formed at the downstream end (right).



#### *Cotton Valley Neighborhood Southeast Culvert (SB-RC-4)*

The Cotton Valley Neighborhood Southeast Culvert is a 24-inch ductile iron pipe that carries flow from an unnamed gut underneath an unpaved road and discharges to a pond that holds water year-round. This culvert has corroded and deformed over time (see Figure 4.26). This culvert should be replaced by an appropriately sized culvert, and the outlet should be stabilized.



**Figure 4.26.** The upstream end of this ductile iron culvert is completely blocked (left). The downstream end is corroded and disintegrating (right).



**Figure 4.27.** Scouring was observed downstream of this culvert (left), which leads to sedimentation of the large pond downstream (right).

#### *Cotton Valley Neighborhood Northeast Culvert (SB-RC-5)*

The Cotton Valley Neighborhood Northeast Culvert consists of two 24-inch ductile iron pipes that carry flow from the major gut in this area underneath a partially paved road. These pipes have corroded and deformed over time and have become clogged with sediment and vegetation (see Figure 4.28). A small pond that dries out during the dry season is located upstream from the culverts (Figure 4.29). A scour hole has formed downstream. The road in



this area is deteriorating, creating a sediment source to the gut. The culverts should be replaced by appropriately sized culverts that maintain or increase the amount of storage in the upstream pond system. Regular road and culvert maintenance should be performed in this area to reduce the sediment load into the gut.



**Figure 4.28.** The two 24-inch ductile iron culverts have damaged trash racks – one made of rebar grate and one made of wire fencing and sticks (left). The downstream end is clogged with vegetation (right).



**Figure 4.29.** A pond is located upstream from the culverts – dry at the time of observation (left). The road itself is deteriorating and providing a sediment load to the gut (right).

#### *East End Rd. Major Gut East Culvert (SB-RC-6)*

The major gut system in this watershed carries flow from an approximately 600-acre area and channels it under East End Rd. through a 30-inch CMP culvert into a private lot at 30 Cotton Valley (Figure 4.30), where it then flows under a private driveway through a 15-inch CMP culvert before discharging to Yellowcliff Bay (Figure 4.31). The resident at 30 Cotton Valley indicated that the now permanent pool of water in the swale is a nuisance, and breeds



mosquitoes. She is eager to have conditions restored to a functioning conveyance system that does not maintain standing water year-round. Runoff from East End Rd., and most likely from the gut itself when it overflows during large storm events, flows into a grassy depression on the south side of the road, and then into a swale and depression on the north side of the road on an adjacent private lot (Figure 4.32). Potential projects at this location include 1) analyzing the existing culverts to ensure they are sized correctly and fix as needed; 2) perform simple maintenance to remove sediment and stabilize outfalls; 3) convert the stagnant swale into a functioning stormwater treatment practice such as a constructed wetland or filtering practice; and 4) convert the grassy area to the south of East End Rd. into a bioretention area to manage road runoff.



**Figure 4.30.** The gut upstream from the culvert (left). The downstream end of the culvert (middle). Ponded water in the front of a private residence (right).



**Figure 4.31.** The second culvert underneath a driveway (left) leads to a shallow channel out to Yellowcliff Bay (right).





**Figure 4.32.** Runoff from the East End Rd. flows into the grassy depression along the south side of the road (left) as well as the swale and depression between and to the left of the driveways, respectively (right).

#### *Solitude Rd. Culverts (SB-RC-10)*

The Solitude Rd. Culverts consist of two 30-inch corrugated metal pipes that carry flow from the southern portion of the Pleasant Valley Neighborhood into a gut. These pipes have corroded and deformed over time and have caused substantial erosion along the road in these areas (see Figure 4.32). The culverts should be replaced by appropriately sized culverts and be maintained regularly.



**Figure 4.32.** Erosion caused by deteriorating culverts in the southern portion of Pleasant Valley.

#### *East End Rd. Culverts - West (SB-RC-15)*

The East End Rd. Culverts - West consist of three RCP culverts between Prune Bay and Coakley Bay Condos. The first (starting from the west), an 18-inch culvert, has some downstream scouring that needs to be stabilized. The second, an 18-inch culvert, is deteriorating and needs maintenance to remove sediment and vegetation. The third, a 15-inch culvert, needs maintenance to clear blockages on the upstream end (see Figure 4.33).





**Figure 4.33.** Erosion downstream from the first culvert (left); the second, chipped culvert (middle); and the partially blocked third culvert (right).

#### *East End Rd. Culvert – East of Coakley Bay Condos (SB-RC-17)*

This culvert is a 24-inch RCP culvert that has a large scour hole at the downstream end. The outlet area should be stabilized and a larger culvert may be needed in this area (see Figure 4.34).



**Figure 4.34.** Upstream end of culvert has large headwall separating it from an unpaved drive (left); the downstream end is scoured out and clogged with vegetation (right).

#### *Seven Flags Neighborhood Culvert (SB-RC-18)*

This culvert is a 12-inch CMP culvert that appears to be completely blocked. In addition, the downstream end of this culvert should be located and stabilized. This culvert should have regular maintenance to prevent complete bypass, which would cause further erosion problems down-gradient on Seven Flags Rd. (see Figure 4.35).





**Figure 4.35.** Blocked inlet to this culvert on Seven Flags Rd.

#### *East End Rd. Culvert - East (SB-RC-19)*

The East End Rd. Culvert - East consist of one culvert and two additional pipes near the intersection with Sierra Verde Rd. The main culvert is a 24-inch CMP culvert for road runoff. In addition, two 8-inch PVC pipes were observed, as well as a strong septic odor, at the downstream end of the culvert (see Figure 4.36). The ultimate discharge to Yellowcliff Bay was not observed. The PVC pipes should be inspected for illicit discharges from upstream septic systems and disconnected as necessary.



**Figure 4.36.** Upstream end of 24-inch culvert and headwall; Sierra Verde Rd. in the background (left); the two PVC pipes in the drainage structure at the downstream end of the culvert (middle); and the ultimate discharge pipe to the bay where runoff leaves the drainage structure (right).

### 4.3 Neighborhood Summaries

A summary of general neighborhood conditions is provided below in order to identify which neighborhoods are likely to generate pollutants of concern, what the common sources are, and which areas/sources should be targeted for watershed stewardship activities. Unless otherwise noted, it is assumed that neighborhoods consist of single-family, detached residences, with cisterns, on-site septic systems, and open section/drainage roads (without curb and gutter). Table 4.4 is a comparative summary of each neighborhood, and more detail is provided below. Pollution source is determined by number of observed pollutants (1-2=Medium; >2 = High).

**Table 4.4.** Summary of Neighborhood Restoration Opportunities

| Name                    | Road/<br>Driveway Condition                                  | % Lots Un-<br>developed | Pollution<br>Source | Potential Stewardship<br>Activities   |
|-------------------------|--|-------------------------|---------------------|---|
| Sierra Verde            | Mixed, mostly paved;<br>good/mostly good<br>condition        | 60%                     | Low                 | On-lot demonstrations;<br>regular road maintenance of<br>the unpaved roads  |
| Yellow Cliff<br>North   | Mixed, mostly<br>unpaved; significant<br>maintenance issues  | 65%                     | Medium              | Regular road maintenance  |
| Hope and<br>Carton Hill | Unpaved; most road<br>sections need<br>attention             | 60%                     | High                | ROW retrofits; road repair and<br>regular road maintenance;<br>riparian buffer protection                                     |
| Cotton Valley           | Mixed, mostly paved;<br>some road sections<br>need attention | 60%                     | High                | Trash clean-up; regular road<br>maintenance; riparian buffer<br>protection; septic survey                                     |
| Solitude North          | Mixed, mostly paved;<br>good/mostly good<br>condition        | 70%                     | Low                 | Residential construction<br>management  |
| Seven Flags             | Mixed, mostly paved;<br>good/mostly good<br>condition        | 50%                     | Low                 | On-lot demonstrations; road<br>repair and maintenance for<br>unpaved portion; ROW<br>retrofits                                |
| Pleasant<br>Valley      | Mixed, mostly paved;<br>good/mostly good<br>condition        | 60%                     | Low                 | Better lawn care/landscaping;<br>on-lot demonstrations; ROW<br>retrofits; riparian buffer<br>protection                       |
| Green Cay/<br>Prune Bay | Mixed, mostly paved;<br>some road sections<br>need attention | 45%                     | Low                 | Better lawn care/landscaping;<br>on-lot demonstrations; ROW<br>retrofits; regular road<br>maintenance of the unpaved<br>roads |



### *Sierra Verde*

The Sierra Verde neighborhood (approximately 85 acres) is the eastern-most neighborhood within the Solitude watershed. The neighborhood is accessed primarily by East End Rd. to the north. The neighborhood sits upon a steep hilly area, reaching up to about 370 feet in elevation at the steepest points. About 40% of the neighborhood is developed, and many homes are gated and set back from the street. At the northern entrance to the neighborhood, and base of the neighborhood's hill, the recently established Blue Water Terrace restaurant is located at the intersection of East End Rd. and Sierra Verde Road (The Blue Water Terrace Restaurant is discussed as a retrofit project under Section 4.3).

Roadways within the neighborhood are a mix of paved and dirt/gravel. Driveways are mostly paved; however, the parking lot of the Blue Water Terrace restaurant is dirt. The main road is open section, with some water bars, and at least one identified culvert. The paved roads are in good condition; although, significant erosion was observed on the dirt roads, contributing sediment to the neighborhood's low-point near the Blue Water Terrace restaurant. A gut was identified, which flows from the south-eastern portion of the neighborhood, through the neighborhood, and eventually towards the Cotton Valley neighborhood. A separate, but potentially connected gut, was also identified at the northwestern end of the neighborhood, which parallels Sierra Verde Road, and is adjacent to the Blue Water Terrace restaurant.



**Figure 4.37.** Erosion along private road within Sierra Verde neighborhood at meeting point between paved and gravel roadways (left) and water bar installed along main dirt road in Sierra Verde neighborhood.

### *Yellow Cliff North*

The Yellow Cliff North neighborhood is a small (approximately 20-acre) residential area, sandwiched between the Sierra Verde, Cotton Valley, and Hope and Carton Hill neighborhoods. The neighborhood is generally comprised of a horseshoe shaped road, Yellow Cliff Trail and Hibiscus Circle/Dustie Rhode. The neighborhood is characterized by topography ranging from 100- to 200-foot elevations. Homes in the neighborhood are single-family detached homes on about an acre of land. Most of the neighborhood is unpaved, although a small section of the roadway is paved. Erosion was observed along the dirt roads and driveways, which has caused some substantial gullies.

### *Hope and Carton Hill*

The approximately 100-acre Hope and Carton Hill neighborhood is made up of mostly dirt/gravel roads and is about 40% developed, with single-family detached homes on one-acre lots. The neighborhood is primarily accessed by Pony Club Trail through the Cotton Valley neighborhood, which is located off of East End Rd. There is also an entrance from the east via the Sierra Verde neighborhood. The neighborhood has an active Homeowners Association (HOA), and at the time of this report, the Chairman of the HOA was Josh Tate. Mr. Tate suggested that the dirt roads are graded on at least an annual basis. The HOA has hired multiple contractors for the grading over the last several years and has been having trouble finding a contractor that grades the roadways properly. The HOA has also been having trouble with receiving payment from members, which according to Mr. Tate, has also led to the HOA being unable to afford adequate grading or paving services.

There is a Pony Club and associated horse pasture within the northwestern portion of the Hope and Carton Hill neighborhood. The horse pasture lies within a gut that flows from the west, along the northern end of the neighborhood and crosses Pony Club Trail through a culvert, and eventually flows north to Yellowcliff Bay. Sizing and maintenance issues were observed at the Pony Club Trail culvert, and there was a significant scour hole on the downstream end of the culvert (The Pony Club Trail culvert is discussed as a retrofit project under Section 4.3).



**Figure 4.38.** Concrete swale installed along dirt road in Hope and Carton Hill neighborhood (left) and erosion along dirt road where a paved swale ends (right).

### *Cotton Valley*

The 140-acre Cotton Valley neighborhood is located off East End Rd. There is a Fire Station and adjacent public dumpster area at the entrance to the Cotton Valley neighborhood located at the intersection of Cotton Valley Trail and East End Rd. The roadways are a mix of paved and unpaved roads. The neighborhood is 40% developed; homes within the neighborhood are single-family detached on an average of ½-acre lots.



Two portions of the neighborhood, the western side and the central/eastern side, are distinct from each other with respect to road layout design, topography, and roadway surfacing. The western end of the neighborhood is comprised of a long dirt/gravel road, which remains largely undeveloped. This roadway cuts across a steep slope, where topography on the adjacent lots varies from about 150 to 300 feet in elevation. One gut parallels this road to the southeast for almost the entire length, and a second gut crosses the road on the northern end. This roadway is significantly eroded and is a sediment source to the adjacent guts.

The central/eastern side of the neighborhood is comprised of multiple dirt/gravel and paved roads in somewhat of a grid layout. The topography on this side of the neighborhood is much flatter, with elevations ranging from about 20 to 80 feet. Both aforementioned guts also transect the central/eastern side of the neighborhood from south to north, eventually crossing East End Rd. and discharging to Yellowcliff Bay. Some culverts were identified within this area of the neighborhood where the guts cross roads. It was observed that horses are kept on at least one of the small residential lots.

The gut on the western side of the neighborhood flows behind the Fire Station and adjacent public dumping area. Trash and debris were observed within this gut. A representative at the Fire Station noted that the station has experienced some flooding in recent years. He also suggested that the Fire Department would be interested in education related to how they should manage the areas adjacent to the gut. There is also great interest in getting the Fire Department more involved with the community, constructing demonstration projects on the property, and perhaps hosting public meetings.

Three pond areas were also observed within the neighborhood, two of which had standing water. One of the ponds with standing water was located along the gut on the western side of the neighborhood, and the other was located along the gut on the eastern end of the neighborhood. Wildlife, such as deer and waterfowl, were observed at both ponds.



**Figure 4.39.** Horse kept on private lot (left) and pond with standing water (right) within Cotton Valley neighborhood.

### *Solitude North*

The approximately 55-acre Solitude North neighborhood is set atop a hilly peninsula located to the north of East End Rd., terminating at the coastline of Solitude Bay. The neighborhood is comprised of two distinct road networks: one to the west, which is primarily dirt/gravel; and one to the east, which is primarily paved. The neighborhood, which is made up of single-family detached homes, is only about 30% developed, and most of the lots are over an acre in size. Most of the roadways within the neighborhood are considered to be in very good condition; however, there are a few dirt road segments which could use maintenance.

### *Seven Flags*

The approximately 120-acre Seven Flags neighborhood is accessed primarily off East End Rd. via Seven Flags Road. The neighborhood is about 50% developed and is currently comprised of single-family detached homes on lots over one acre in size. There are a few large industrial/commercial properties located at the entrance to the neighborhood, at the intersection of East End Rd. and Seven Flags Road. Current tenants or uses of these properties include a self-storage facility, Budget Marine boat and marine equipment retailer, and a tile storage area, among others.

Topography within the neighborhood varies greatly from about 30 feet in elevation at the northernmost end to about 810 feet in elevation at the southern terminus, which is one of the highest points on the East End of St. Croix. There is a gut that transects the neighborhood and flows parallel to Seven Flags Road.

Roadways within the Seven Flags neighborhood are a mix of paved and unpaved roads. The approximately 1,000-foot road segment of Seven Flags Rd. at the entrance from East End Rd. is unpaved and is significantly eroded. There are two partially clogged culverts at the intersection of Seven Flags Rd. and East End Rd. The owner of the Seven Flags Rd. industrial properties has also installed large concrete culverts beneath their driveways to divert drainage off the road and driveways and through these culverts. Despite these drainage facilities, the roadway is significantly eroded and contains large gullies. Roadway conditions are much better throughout the rest of the neighborhood.



**Figure 4.40.** View from Rt. 82 south of dirt portion of Seven Flags Road (left) and new single family dwellings constructed along steep paved portion of Seven Flags Road (right).





**Figure 4.41.** View from paved road within Seven Flags neighborhood (left) and posted Neighborhood Watch sign and Earth Change permit (right).

### *Pleasant Valley*

The Pleasant Valley neighborhood is accessed via Solitude Road, which is off East End Rd. It is comprised of single-family detached homes on approximately one-acre lots. Topography in the neighborhood ranges from about 60 feet in elevation up to 500 feet in elevation. Most of the roadways are paved, with just a few sections being gravel. The roadways are generally in good condition, and culverts have been installed at a few locations at the southern end of the neighborhood. There were some observed sizing and maintenance issues with these culverts that should be repaired. These culverts are further discussed under Section 4.3. Without including the Roebuck Goat farm, which is a large agricultural property located adjacent to Solitude Road, the neighborhood is about 75 acres. About 40% of the residential lots have been developed. In addition, there is a large undeveloped parcel on the southwestern end of the neighborhood where a paved roadway has been constructed. Signs at the entrance to this parcel indicate that it is a new subdivision, “Estates Solitude.” There is a gut that flows through the Pleasant Valley neighborhood from south to north. Some clearing and farmland activity were observed in the gut area.



**Figure 4.42.** Single-family home built on steep slope within Pleasant Valley neighborhood (left) and paved Solitude Rd. adjacent to Roebuck Goat Farm in Pleasant Valley neighborhood (right).



**Figure 4.43.** Entrance to undeveloped Estate Solitude Ridge subdivision (left) and paved roadway within undeveloped Estate Solitude Ridge subdivision (right).

#### *Green Cay (Prune Bay)*

The approximately 100-acre Green Cay neighborhood is situated between East End Rd. and Prune Bay. The neighborhood is accessed by Ms. Bea Road. Topography varies from 0 to about 200 feet in elevation, but most developed areas are relatively flat. The neighborhood is about 50% developed, with mostly single-family detached dwellings on one-acre lots. There is also a condominium complex, Candle Reef I and II, located within the neighborhood on the northeastern end adjacent to Prune Bay. Roadways within the neighborhood are mostly paved, with some sections of unpaved roads. The paved roads are in good condition; although, there are some unpaved areas that could use maintenance. There are also some gravel spurs that focus drainage from the roadways directly to the beach, creating an active sediment source to the Bay.



**Figure 4.44.** Entrance to Green Cay neighborhood (left) and manicured grass field within the neighborhood; high-end residential properties on peninsula within the community with Prune Bay in the distance (right).





**Figure 4.45.** Entrance to Candle Reef condominium complex (left) and paved road leading to condominium units (right).