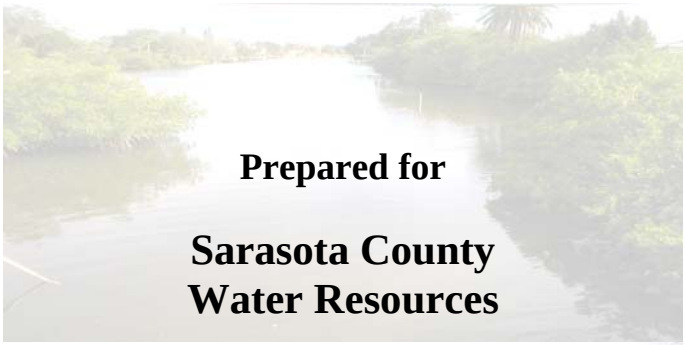
AMERICA DRIVE CANAL
SEDIMENT ABATEMENT STUDY



Prepared for

Sarasota County
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February 2005

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1.0 INTRODUCTION

Sarasota County's Navigable Waterways Program (NWP) routinely conducts feasibility studies for residential canal dredging throughout the unincorporated coastal regions of the County. To compliment some of the feasibility projects, Sarasota County has engaged Berryman & Henigar, Inc. (BHI) to perform a series of sediment abatement analyses to determine if opportunities exist for reducing future land-based sediment accumulation in the canals. Sedimentation is a significant concern to the citizens residing along the canals. Residents with property along canals in the County are typically assessed for the costs of canal dredging.

This report is the second of a series of sediment abatement studies being conducted by BHI for the County. The areas being examined include:

- Baywood Canal
- America Drive Canal
- Cedar Cove
- Hidden Harbor
- Phillippi Cove
- South Creek
- Phillippi/Pinecraft

The area being considered for this study is the America Drive Canal (canal) located north of Constitution Boulevard and east of Tamiami Trail (US 41). Both the upstream and downstream ends of the canal connect to Phillippi Creek, which discharges to Little Sarasota Bay. See Figure 1 for the project location map.

2.0 BACKGROUND

The western portion of the canal is a natural and historic estuarine system that has had anthropogenic modifications for increased draft clearance and navigability. The eastern portion of the canal was constructed as an amenity and to provide fill material for residential developments on America Drive. The eastern portion of the canal is aligned north to south between America Drive and Merrimac Drive. The western portion of the canal runs southeast to northwest from the America Drive bridge to the US 41 bridge where it joins Phillippi Creek. The canal varies in width between 70 and 220 feet, but constricts to approximately 30 feet under the bridge on America Drive.

A review of Florida Department of Environmental Protection (FDEP) permit files revealed no previous dredge permits for this canal system. The FDEP permits database did show a May 1992 dredge permit for the nearby outfall Main A channel in Phillippi Creek. The America Drive feasibility study did find a County minor work permit with authorization from the Army Corps of Engineers. The minor work permit # 94-050 April 14, 1994. The permit was issued to the property owner of 5648 America Dr. Also, a historical report describes the Phillippi Creek primary conveyance system as open channels, originally dredged in the 1920's to improve drainage for agricultural uses (Smalley, et al, 1961).

Figure 1	Project Location Map	Berryman & Henigar

One of the concerns voiced by the citizens along the canal is the possibility of future sedimentation from stormwater runoff causing a loss of canal depth after the expense of the dredging operation. To address those concerns, the County has engaged BHI to analyze the stormwater systems entering the canal and estimate the effects these systems may have on future sediment accumulation.

3.0 SITE CONDITIONS

Canal sedimentation can be the result of many factors, including stormwater discharges, upland erosion, illegal discharges, algae build up from high nutrient levels in the canals, wind blown currents, or tidal influences. Most canals are influenced by a combination of these factors. A careful investigation is required to determine the causes of sedimentation prior to recommending courses of action to reduce sedimentation in canal systems.

Field investigations of the canal were made by BHI staff on December 21, 2004, January 7, 2005, and January 27, 2005. The canal is bordered by single-family residential properties at most locations except for the commercial and services parcels along the west side of the canal adjacent to US 41. The majority of the canal has vertical seawalls, with a few property owners using rock rip-rap and vegetation for stabilization. There were no observed failing sea walls which could be obvious sources of sedimentation. Steep slopes with apparent erosion were observed on the northern end of the eastern canal. Most yards and roads in the bordering streets were well vegetated, maintained, and stabilized, showing no significant sedimentation sources.

The drainage basin for the canal is generally bordered by US 41 on the west, Merrimac Drive on the east, Montclair Drive and America Drive on the north, and Stickney Point Road on the south. The overall drainage basin consists of 177 acres of single family residential, multifamily residential, commercial, recreational, open space, open water and roadway. See Figure 2, which shows subbasins within the study area.

Soils in the area consist predominantly of Pomello, Pople, and Orsino fine sands, with Gator Muck around the pond south of Constitution Boulevard. The soils are nearly level, moderately well-drained, and/or poorly-drained dark sand, with the soils around the Basin 4 pond being very poorly-drained dark muck. Also, it is assumed that natural soils bordering the canal are covered with dredged material.

All of the streets bordering the canal have gutters. The rear portion of all lots bordering the canal drains directly to the canal via sheet flow. The fronts of the lots and the streets drain to the street gutters around the canal. As can be seen in the site photographs, most of the yards and streets are clean and well maintained.

There are seven stormwater pipes and a curb cut that discharge to the canal. The pipes and curb cut are shown on the Existing Conditions Outfall Map, Figure 3. Each outfall is identified and discussed below.

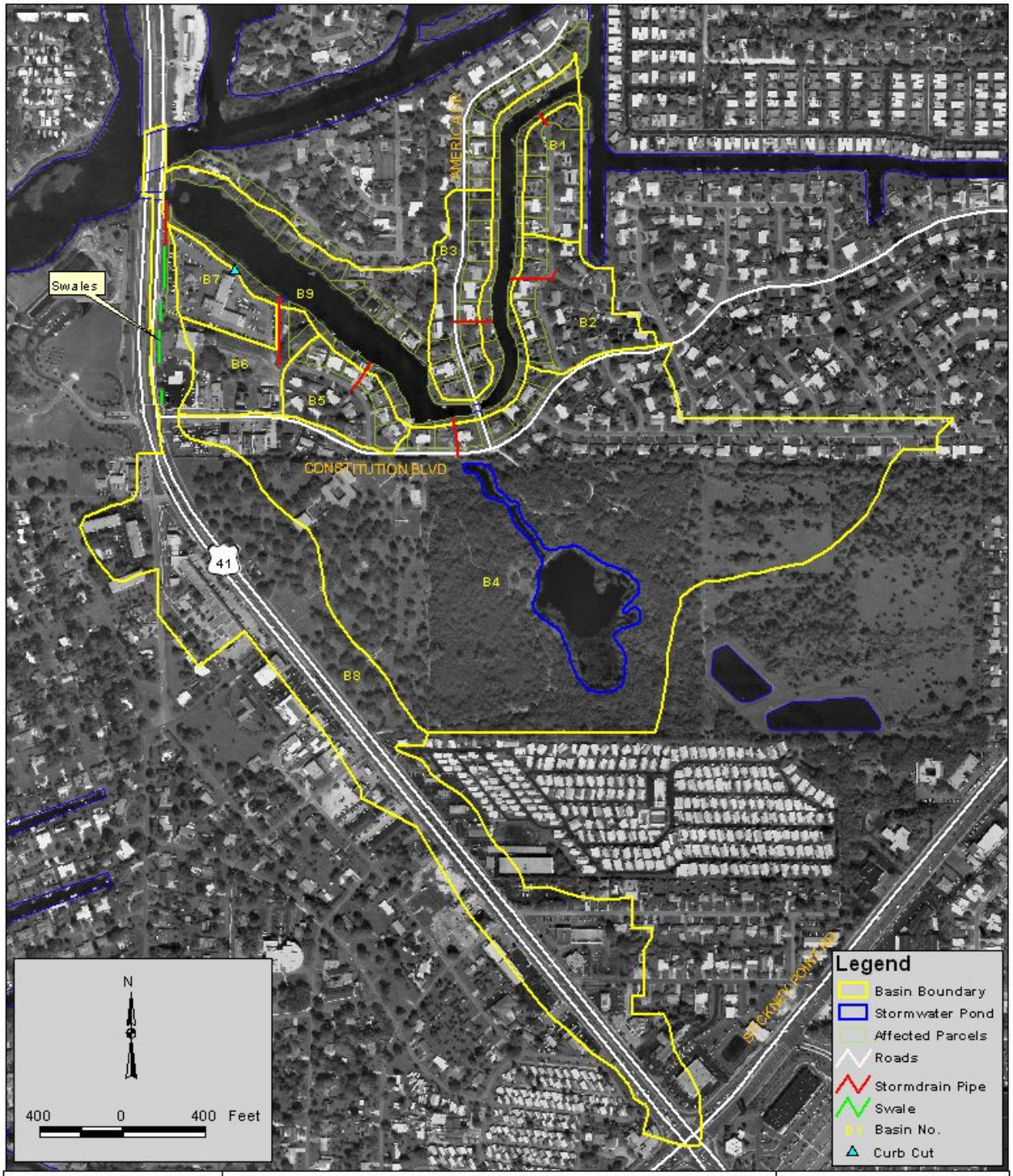

Figure 2	Existing Features Map	Berryman & Henigar

Figure 3	Existing Conditions Outfall Map	Berryman & Henigar

3.1 Outfall AD1

An 18" Reinforced Concrete Pipe (RCP) pipe, outfall AD1, discharges to the northern end of the canal. This pipe drains 3.8 acres of single family residential property into an inlet at the end of Merrimac Drive (Figure 4). This drainage basin area has no stormwater treatment system. The pipe discharges above the water line and there was no sediment build up observed at the outfall.

Steep slopes with apparent erosion were observed in this area. At the outlet it appears that the side of the canal has washed away. The end section of the outlet pipe has separated as shown in Figure 5.

3.2 Outfall AD2

Outfall AD2 is a 24" RCP discharging south of AD1. This pipe drains 6.4 acres of single family residential property along Majestic Way and Merrimac Drive. This drainage basin area has no stormwater treatment system. There was no sediment build up observed along the shoreline at this outfall. The three grated inlets and roads appear to be in good clean condition (see Figure 6), but further inspection inside the downstream most inlet showed some leaf and grass accumulation (see Figure 7).

Figure 4.
AD1 - Inlet in cul-de-sac in Basin B1.

Figure 5.
Outlet AD1 in Basin B1. Note culvert lying in canal and steep bank erosion.

Figure 6.
AD2 - Inlets at the intersection of Majestic Way and Merrimac Drive, Basin B2.

Figure 7.
Inside AD2 - inlet in Basin 2. Note leaf and grass loads.

3.3 Outfall AD3

About half of America Drive drains to two curb inlets discharging at outfall AD3 (Figure 8), which discharges east of the America Drive bridge. The drainage basin consists of 5.7 acres of single family residential property. This drainage basin area has no stormwater treatment system. There was no sediment build up observed along the shoreline at this outfall.

3.4 Outfall AD4

Outfall AD4 is a 48" RCP discharging west of America Drive bridge. This pipe drains 79.8 acres of single family residential, commercial, recreational and open space property including areas south of Constitution Boulevard. This is the largest drainage basin discharging to the canal system and has an existing natural depression with standing water (Figure 9). There are two inlets on Constitution Boulevard which connect to AD4 with no treatment. There was no sediment build up observed along the shoreline at this outfall (Figure 10).

Figure 8.
AD3 - West side America Drive in Basin 3.

Figure 9.
Open water system in Basin B4, upstream of outfall AD4.

Figure 10.
Outfall AD4.

3.5 Outfall AD5

Outfall AD5 is an 18" RCP discharging downstream of Outfall AD4. This pipe drains 4.5 acres of single family residential property along Lusitania Drive. This drainage basin area has no stormwater treatment system. There was no sediment build up observed along the shoreline at this outfall, but one of the two grated inlets, the downstream most on the northeast side of the road, appeared to be clogged with leaves and debris (Figure 11).

3.6 Outfall AD6

Outfall AD6 is a pipe discharging into the middle part of the west reach of the canal. This pipe drains 4.9 acres of single family residential and commercial property along Aquitania Drive and Constitution Boulevard (Figure 12). This drainage basin area has no stormwater treatment system. There was no sediment build up observed along the shoreline at this outfall.

3.7 Outfall AD7

Outfall AD7 is a curb cut discharging into the lower part of the west reach of the canal. This curb cut drains 3.5 acres of commercial property along US41 (Figure 13). This drainage basin area has no stormwater treatment system. There was sediment build up observed along the curb near the outfall and an overflowing trash bin was found east of the outfall (Figure 14).

Figure 11.
AD5 - Inlet clogged with leaves and debris in Basin 5.

Figure 12.
AD6 - Large inlet in Basin 6.

Figure 13.
AD7 – Curb cut in Basin 7. Note sediment build up next to curb.

Figure 14.
AD7 – Overflowing trash bin in Basin 7

3.8 Outfall AD8

Outfall AD8 is a large pipe discharging at the downstream end of the canal. This pipe drains 48.0 acres of single family residential, residential multi family, commercial, and roadway along US 41 (Figure 15). This is the second largest drainage basin discharging to the canal system (Figure 16) and has an existing system of roadway swales to convey and treat roadway runoff. There was no sediment build up observed along the shoreline at this outfall.

Figure 15.
AD8 - Roadway swales and raised inlet along US 41.

4.0 POLLUTANT LOADING ASSESSMENT

A pollutant loading analysis was performed to quantify potential land-based sediment and other pollutant loadings entering the canal. The analysis used a spreadsheet-based model, with loading estimates based on land uses from the Southwest Florida Water Management District (SWFWMD) FLUCCS land use GIS coverage, drainage basin boundaries obtained from Sarasota County that were further discretized around the outfalls, stormwater treatment efficiency rates for Best Management Practices (BMPs) (ASCE, 2001), and annual pollutant loading unit rates (ERD, 1994). Loading rates used are summarized in Table 1. BMP treatment efficiencies are shown in Table 2. Land uses were field verified. This type of planning-level analysis does not take into account short-term erosion from sources such as construction sites or leaking pipe joints.

Figure 16.
Outfall AD8 at base of US 41 bridge.

It should be noted that the swales along US 41 are well established with grass and the swales are broad, giving large contact areas for removal of pollutants in all but the largest storms. In addition, most of the swales have raised inlets for control structures which retain a volume of runoff and prevent much debris and sediment from entering the canal. These features provide a high level of treatment to runoff, so pollutant reduction factors for grassed swales were used where appropriate.

Pollutant loadings were estimated by multiplying the total acreage in each drainage basin by a composite annual loading rate that was developed by weighting the land use specific loading rates by the relative proportion of basin area in that land use. Where appropriate, the gross loadings were adjusted to account for BMP reduction factors to estimate the net pollutant loadings by parameter.

The existing conditions pollutant loadings are presented in Table 3. Loadings were calculated for total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN). While TSS can account for sediment build up in a canal, nutrients from TP and TN can lead to algae blooms and vegetation growth, with subsequent muck accumulation in water bodies. The assessment estimates current TSS loading at 9,203 kg/year, TP loading at 68 kg/year, and TN loading at 566 kg/year.

Using a typical unit weight for sandy silt of 90 lb/cubic foot (Dunn et. al., 1980), the 20,289 lb annual sediment load could contain a volume of approximately 225 cubic feet, or about 0.005

inches annually over the area of the canal bottom. However, under field conditions, the sediment would tend to accumulate near the outfalls, although tidal and stream flows would disperse the sediment throughout the canal and into Phillippi Creek.

Table 1.
Summary of unit pollutant loading rates for central and south Florida (ERD, 1994).

LAND USE CATEGORY	UNIT LOADING RATE (kg/ac-yr)						
	TOTAL N	ORTHO-P	TOTAL P	BOD	TSS	TOTAL Zn	TOTAL Pb
Low Density Residential	2.88	0.169	0.320	7.63	31.9	0.06	0.052
Single-Family	4.68	0.335	0.594	14.3	56.1	0.122	0.083
Multi Family	8.51	0.924	1.72	38.4	256	0.188	0.299
Low-Intensity Commercial	5.18	0.157	0.650	36.1	343	0.511	0.635
High Intensity Commercial	13.0	1.52	1.96	79.3	435	0.782	0.985
Industrial	7.30	0.519	1.24	39.5	383	0.543	0.872
Highway	6.69	0.361	1.32	21.9	182	0.508	0.727
Agricultural							
a. Pasture	4.54	0.732	0.876	7.99	126	---	---
b. Citrus	2.91	0.123	0.197	3.60	21.9	---	---
c. Row Crops	2.84	0.421	0.595	---	---	---	---
d. General Agriculture	3.62	0.380	0.551	5.80	74.0	---	---
Recreational/Open Space	1.07	0.003	0.046	0.956	7.60	0.005	0.021
Mining	2.21	0.131	0.281	18.0	176	0.229	0.378
Wetland	1.81	0.204	0.222	4.96	11.2	0.009	0.039
Open Water	3.23	0.130	0.273	4.02	8.05	0.073	0.065

Table 2.
BMP selection guide (ASCE, 2001).

BMP	Design Factor				Type of Pollutant					
	Land Area Needed	Distance Above Groundwater	Soil Type Needed	Cost	Mainten-ance	Total Nitrogen % Removal	Total Phosphorus% Removal	Suspended Solids % Removal	Heavy Metals % Removal	Floating Trash Removal
Ponds										
Dry Retention Online	High	Low	A or B	High	Medium	60-98	60-98	60-98	60-98	High
Dry Offline Retention or Detention	High	Low	A or B	High	Medium	60	85	90	65-85	High
Wet Detention	High	High	Any	High	Low	26	65	75	25-70	High
Wet Detention With Filtration	High	Low	Any	High	High	25	65	85	60-85	High
Dry Detention	High	Low	A or B	High	Medium	15	25	70	35-70	High
Alum System		NA	NA	High	Medium	50	90	90	80-90	0
Constructed Wetlands	High	0 ft.	C or D	High	High	****	****	High	High	High
Sand Filters										
Austin Sand Filter	Medium	2 ft.			High	31-47	50-65	70-87	20-84	N/A
D.C. Underground Sand Filter	Medium				High					N/A
Delaware Sand Filter	Medium	2 ft.			High	47	41	57	45.2	N/A
Alexandria Stone Reservoir Trench	High				High	47.2	63-72	79-84	***	N/A
Texas Vertical Sand Filter	Medium	7 feet	N/A		High					N/A
Peat Sand Filter	Medium				High					N/A
Washington Compost Filter System	200 S.F/cfs	4 feet	N/A		High	N/A	41	95	75.8	N/A
Other										
Baffle Boxes	Low	NA	NA	Medium	Medium	0	30-40	20-90	Unknown	Low
Vegetated Swales	Medium	Low	A,B, C	Medium	Low	0-25	29-45	60-83	35	Low
Buffer Strips	Low	1 ft-2 ft	A,B,C	Medium	Low	20-60	20-60	20-80	20-80	Low
Infiltration Trenches	Low	2-4 ft	A or B	Medium	High	45-70	50-75	75-99	75-99	High
Inlet Devices	None	NA	NA	Low	High	**	**	Low-Medium	Low	High

** Traps particulate phosphorus and nitrogen in the form of leaves and grass - not effective for dissolved nutrients

*** No Data Available

**** Varies widely

Table 3. American Drive Canal Pollutant Loading Estimates.
Existing Conditions

Basin No.	Area (ac)	Land Use	Type of Treatment System	% TSS Reduction	% TP Reduction	% TN Reduction	TSS Loading Rate (kg/ac-yr)	TP Loading Rate (kg/ac-yr)	TN Loading Rate (kg/ac-yr)	TSS Loading (kg/yr)	TP Loading (kg/yr)	TN Loading (kg/yr)
1	3.75	Single Family Residential	None				56.1	0.59	4.68	210.5	2.2	17.6
2	6.37	Single Family Residential	None				56.1	0.59	4.68	357.5	3.8	29.8
3	5.68	Single Family Residential	None				56.1	0.59	4.68	318.4	3.4	26.6
4A	2.07	Single Family Residential					56.1	0.59	4.68	116.2	1.2	9.7
4A	28.43	Recreational/Open Space					7.6	0.05	1.07	216.0	1.3	30.4
4A	5.36	Open Water					8.1	0.27	3.23	43.1	1.5	17.3
4A	35.86	Total Sub-basin Land Use	Wet Pond	75	65	26				93.8	1.4	42.5
4B	16.44	Single Family Residential					56.1	0.59	4.68	922.0	9.8	76.9
4B	2.10	Commercial					343.0	0.65	5.18	720.3	1.4	10.9
4B	24.31	Recreational/Open Space					7.6	0.05	1.07	184.8	1.1	26.0
4B	1.04	Open Water					8.1	0.27	3.23	8.4	0.3	3.4
4B	43.89	Total Sub-basin Land Use	None							1,835.5	12.5	117.2
4	79.75	Total Basin Land Use								1,929.3	13.9	159.7
5	4.50	Single Family Residential	None				56.1	0.59	4.68	252.4	2.7	21.1
6	0.89	Single Family Residential					56.1	0.59	4.68	49.9	0.5	4.2
6	3.98	Commercial					343.0	0.65	5.18	1,364.5	2.6	20.6
6	4.87	Total Basin Land Use	None							1,414.3	3.1	24.8
7	3.52	Commercial	None				343.0	0.65	5.18	1,207.4	2.3	18.2
8	1.88	Single Family Residential					56.1	0.59	4.68	105.4	1.1	8.8
8	12.28	Residential Multi Family					256.0	1.72	8.51	3,143.2	21.1	104.5
8	10.55	Commercial					343.0	0.65	5.18	3,617.6	6.9	54.6
8	13.97	Roadway					182.0	1.32	6.69	2,542.9	18.4	93.5
8	47.95	Total Basin Land Use	Swales	70	35	15				2,822.7	30.9	222.2

Table 3 continued. American Drive Canal Pollutant Loading Estimates.

Existing Conditions

Basin No.	Area (ac)	Land Use	Type of Treatment System	% TSS Reduction	% TP Reduction	% TN Reduction	TSS Loading Rate (kg/ac-yr)	TP Loading Rate (kg/ac-yr)	TN Loading Rate (kg/ac-yr)	TSS Loading (kg/yr)	TP Loading (kg/yr)	TN Loading (kg/yr)
9	9.34	Single Family Residential					56.1	0.59	4.68	523.7	5.5	43.7
9	0.49	Commercial					343.0	0.65	5.18	166.4	0.3	2.5
9	9.82	Total Basin Land Use	None							690.1	5.9	46.2
TOTALS										9,202.6	68.1	566.0

5.0 DISCUSSION AND RECOMMENDATIONS

Existing conditions land-based pollutant loadings to the canal were calculated for total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN). The estimate loadings are 9,203 kg/year for TSS, 68.1 kg/year for TP, and a TN loading of 566 kg/year.

The 20,289 lb annual sediment load could contain a volume of approximately 225 cubic feet, or about 0.005 inches annually over the area of the canal bottom. As stated above however, under field conditions, the sediment would tend to accumulate near the outfalls, although tidal and stream flows would disperse the sediment throughout the canal and into Phillippi Creek. It should be noted that nutrient control is an important element of water management. Excess enrichment can result in algae blooms, excess aquatic vegetation growth, and subsequent accumulation of detritus turning to muck. Thick layers of muck were observed in other canals in the general area, mainly in dead-end canals with mangrove or overhanging trees and brush.

This section describes recommendations on how to reduce runoff-borne sediment from entering the canal. Nutrients can become adsorbed onto sediment particles, so trapping sediment also can reduce nutrient loading to the estuarine system.

In the America Drive Canal watershed, the two largest of the nine drainage basins provide some level of stormwater treatment, accounting for 84 acres out of 177 acres have BMPs treating the stormwater. Of the 93.5 acres not being treated, 20.9 acres directly discharge to canals or are in the rear of the lots bordering the canals, where it is not generally feasible to install BMPs other than rear lot swales. This leaves 72.6 acres (41%) that are not being treated with BMPs.

Although not widely observed, some silt accumulation was noted on the bottom of the canal and can be indicative of a combination of sediment from soil erosion and muck from high nutrient levels in the canal. Potential nutrient sources include algae from the bay, fertilizers, leaves, grass, organic yard debris, and pet wastes from local runoff, or stream-borne nutrients from Phillippi Creek. Inlet devices and other land-limited BMPs can be effective in capturing TSS from runoff, but not nutrients. Reduction of nutrients in urban settings can be more effectively accomplished with source controls. Educating the homeowners in the area to reduce fertilizer use, prevent grass clippings from entering the canals, and mowing less frequently would benefit the nutrient levels in the canals. Also, small back yard swales to hold runoff instead of letting it run directly into the canal can be effective.

Although not a dead-end canal, the canal likely has limited circulation due to tidal exchange and stream flow. Therefore, conditions similar to dead-end canals may apply such as low dissolved oxygen levels and silt accumulation. High nutrient levels can lead to algae blooms, which lead to muck accumulations.

There were some areas of grass clippings and leaves in the street and in inlets which could end up in the canal. These nutrient sources affect the muck build up in the canal. Limiting runoff flowing over sea walls would be an effective and inexpensive BMP to keep yard debris out of the canal. In addition, lawn mowers should blow the leaves and grass back into the yards instead of into the street or the canal. It is therefore recommended that the County continue to provide

public education regarding methods of source control and single lot design that could reduce sediment and nutrient loadings to the canal.

Specific recommendations for each subbasin outfall are also included in this section. Each outfall to the canal is discussed below.

5.1 Outfall AD1

Merrimac Drive has an inlet that drain to the eastern end of the canal through Outfall AD1. No BMPs are recommended for this outfall because of the small basin size and generally clean system. However, due to the unstable condition of the canal side slopes near the outfall BHI recommends stabilization with riprap and mangroves to avoid further erosion.

5.2 Outfall AD2

The intersection of Majestic Way and Merrimac Drive has three inlets that drain to the eastern canal through Outfall AD2. One of these inlets was noted to contain debris, especially leaves. The inlets should be cleaned regularly to keep debris out of the canal, and an inlet trap installed to capture sediment and debris.

5.3 Outfall AD3

America Drive has two inlets that drain to the eastern canal through Outfall AD3. Because this basin is small and the inlets appear clean, no BMP is recommended.

5.4 Outfall AD4

This is the largest drainage basin (B4) discharging to the canal and has an existing natural depression with standing water. Almost half of the basin is tributary to the pond, which provides sediment attenuation through flow velocity reduction and nutrient treatment by vegetative uptake and settling of particulate materials. The 55 percent of the basin that is downstream of the pond could be treated by using vegetated swales to capture runoff from the developed western portion of the basin. This BMP, with the continued operation of the pond, would greatly reduce sediment conveyance.

5.5 Outfall AD5

Lusitania Drive has two inlets that drain to the western canal through Outfall AD5. These inlets are filled with debris, especially leaves. The inlets should be cleaned to keep debris out of the canal, but because of the small basin size no BMP is recommended.

5.6 Outfall AD6

Outfall AD6 drains a large commercial area that has no stormwater treatment system. Construction of a BMP on this outfall pipe would be beneficial in reducing sediment entering the canal. Exfiltration BMPs will not work well in this area due to the poorly draining soils. There are several vault types of BMPs available which are effective in removing sediment, but a baffle box is being recommended for this outfall. An enhanced nutrient separating baffle box, which has an added benefit of reducing nutrient loads by trapping grass, leaves, and organic debris and keeping this material dry so that the nutrients do not leach out into the stormwater would also be appropriate for this site (BHI, 2004). Other vault-type BMPs do not have this feature. An added

feature of using this second BMP is that it would help the County achieve nutrient reductions recommended for Sarasota Bay.

5.7 Outfall AD7

Outfall AD7 drains a large commercial area that has no stormwater treatment system. Construction of a BMP and an inlet pipe system on this outfall, in addition to providing general housekeeping guidelines, would be beneficial in reducing sediment entering the canal. There are several vault types of BMPs available which are effective in removing sediment, but a baffle box is also being recommended for this outfall.

5.8 Outfall AD8

This outfall along US 41 discharges runoff from mostly roadway and commercial land uses. Roadway runoff is currently treated with existing vegetated swales with raised inlets. Although this is the second largest drainage basin, there is no evidence of sedimentation from this outfall so no BMP is recommended.

6.0 CONCLUSIONS

The America Drive Canal has some, but not severe, sedimentation problems typical of many residential canals along the coastline. Accumulations of sediment occur from natural erosion and anthropogenic activities such as construction and land clearing. In addition, muck accumulates in canal bottoms from algae blooms caused by elevated nutrient levels in the canal waters. Stormwater runoff brings nutrients and other pollutants to the canals where poor circulation allows the pollutants to settle to the bottom. With the canal dredging project being investigated by the County, it is natural that the affected property owners would inquire as to possible methods to reduce future sedimentation and dredging expenses.

An analysis of the land uses and drainage basins of the canal was undertaken to determine possible causes of sediment build up in the canals. Outfall pipes to the canal were inspected for obvious joint leakage or erosion problems. There were no obvious signs of sediment in the pipes themselves, indicating that there were no significant structural problems to the system.

To further examine potential pollution sources to the canals, a pollutant loading analysis of the stormwater runoff from the watershed was undertaken. TSS, TN, and TP loadings were estimated using a spreadsheet calculation accounting for the land areas, land uses, pollutant loadings, and existing stormwater treatment systems. This analysis suggests that the highest pollutant loadings originate in basins B4, B6, B7, and B8, despite the pond in B4 and the roadside swales in B8. Most of the residential basins were small but had no treatment system in place. Recommendations are summarized in Figure 17.

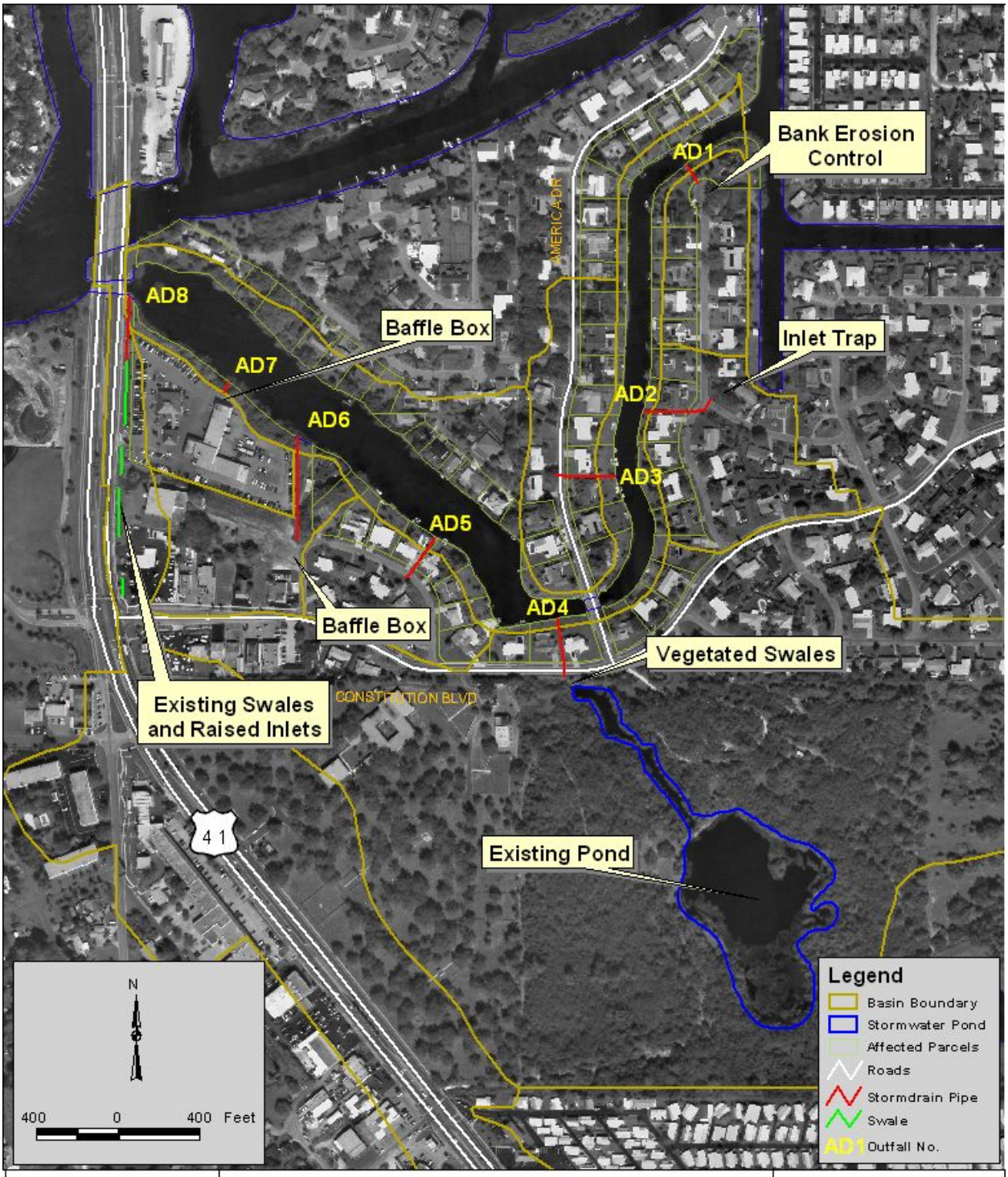

Figure 17	Recommended Sediment Abatement Facilities	Berryman & Henigar

There are eight stormwater outfalls to the canal. Based on the field investigations and analysis in this report, it is recommended that two baffle boxes be constructed, one on outfall pipe AD6 and another at a proposed inlet pipe system on AD7. In addition, it is recommended that inlet traps be installed in inlets for outfall AD2. Also, the outlet pipe for AD1 and the side slopes of the canal at that location should be stabilized with rip-rap and mangroves to avoid further erosion. Finally vegetated swales are proposed for outfall AD4. This is the largest drainage basin discharging to the canal system and has an existing pond that provides treatment for a portion of the basin. The swale will provide treatment for areas of this drainage basin downstream of the pond.

One of the most important aspects of pollutant reduction is source control. At some locations it was observed that residents were allowing grass clippings to wash or blow into the inlets. A strong public education effort will inform residents that changing their day to day activities can be one of the best methods of pollution control. By reducing fertilizer application amounts and frequencies, reducing lawn sprinkling to twice a week, reducing mowing, controlling disposal of grass and yard debris, and cleaning pet refuse, the homeowners can take a large part in reducing nutrient loading to the canals and thereby reducing muck accumulations in the canals.

7.0 REFERENCES

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