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Coastal Management For Traditional Villages

Community of Newcomb

Inland Stormwater Management, Shoreline Investigation and Retrofit Project Recommendation

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Prepared For:

Talbot County Office of Planning and Zoning

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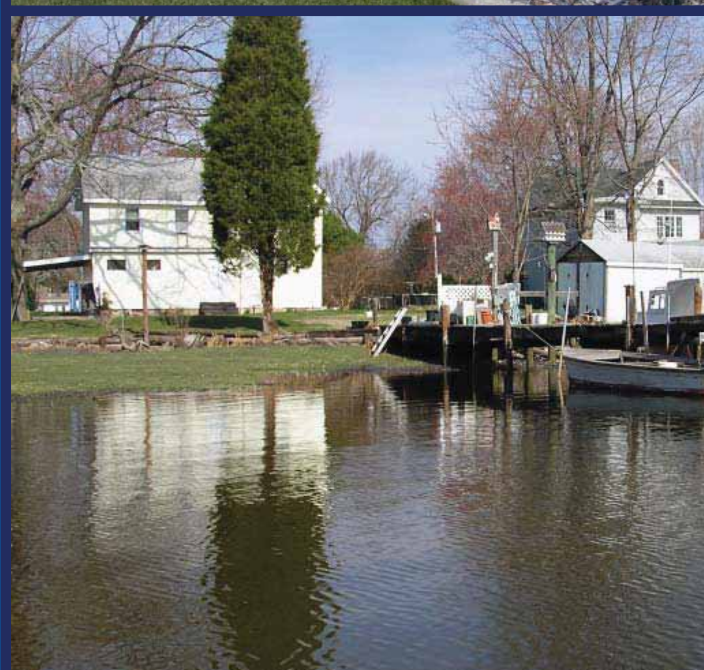


Coastal Management for Traditional Villages
Talbot County – Village of Newcomb

OVERVIEW

Talbot County is located on the Maryland's Eastern Shore, situated along the eastern coast of the Chesapeake Bay with a population of **37,782 residents (US Census Bureau, 2010)**. Although a majority of the County is inland agricultural areas, there are approximately **600 miles of shoreline** along the Chesapeake Bay and several smaller waterways. The two major rivers that feed into the Bay from Talbot County are the Miles and Choptank Rivers. The Miles River, to the north, and the Choptank River, to the south, create a large peninsula in Talbot County referred to as the 'Bay Hundred'. This area is defined as the area from the Town of Easton to the tip of Tilghman Island. From these two rivers, several smaller tributaries branch off inland, including Harris Creek, Broad Creek, Wye River, Tred Avon River, and Island Creek.

Within the Bay Hundred, St. Micheals and Tilghman Island have the highest population, averaging between 800 and 1,000 residents. Other than these two towns, the Bay Hundred is comprised of small rural villages, of which twelve are located along a waterway. A collaborative pilot program between Talbot County Planning and Zoning and Maryland's Department of Natural Resources, Chesapeake and Coastal Program, is being initiated to investigate the upland runoff and the shoreline conditions of three of these twelve villages. The program tasks are as follows:

- Analyze and describe existing conditions,
- Estimate nutrient and pollutant loading from upland sources, specifically impervious services,
- Compute quantitative flowrates entering the surrounding waterways,
- Document areas of possible inundation due to a sea level rise of 0-2',
- Determine areas of historic shoreline erosion,
- Identify possible retrofit and/or improvement locations within the Village for stormwater management and shoreline stabilization,
- Develop strategies for quantitative and qualitative management for storm runoff,
- Investigate possible sources of project funding, and
- Reach out to the community for input, feedback, project development and projected long-term schedule.

The initiative of this program, as part of the overall effort of many private and public entities, is to improve the condition of the Chesapeake Bay. In the big picture of improving the condition of the Chesapeake Bay, treating the runoff in three small villages is incidental. However, this program is joining the efforts of many other programs throughout the Chesapeake Bay watershed in a wide-scale effort to improve its quality and maintains the Bay's health.

The three villages chosen for this pilot program are Royal Oak, Bellevue, and Newcomb. These villages were chosen as representative projects for the overall twelve due to their similarities of population, land use, and topography. It is anticipated that the investigation and recommendations of these three villages can be extracted to the other nine in the Bay Hundred.

Andrews, Miller & Associates (AMA), a Division of Davis, Bowen & Friedel, Inc. is tasked with providing the investigation and recommendation report for the Village of Newcomb.

VILLAGE OF NEWCOMB

Newcomb is a 160.3 acre community located on St. Michaels Road approximately six miles southwest of Easton and three miles southeast of St. Michaels. The village is fronted by the Miles River to the north and Oak Creek to the east. The community of Royal Oak directly adjoins Newcomb to the south. Newcomb has approximately 180 residents and is comprised of single family homes with lots ranging from ¼ acre to over 5 acres. A four-building storage facility located on St. Michaels Road are the largest buildings within the Village. Royal Oak Road is the approximate boundary to the west and Acorn Road to the South. Oak Creek is a small waterway that fronts the east side of the town. Much of the investigation for this report was done along Oak Creek. With the exception of St. Michaels Road, all the roads in Newcomb are narrow paved roads with no shoulders. ***Exhibit 1*** provides an aerial photograph of Newcomb showing the Village limits, roads, waterways, and other features. ***Exhibit 2*** provides a summary map of land cover and, floodplain areas. Table 1 provides a breakdown of the land cover within the Village of Newcomb.

TABLE 1

Land Cover	Area (Ac.)	Percentage Cover (%)
Impervious Area	22.4	14
Light Woods	24.0	15
Heavy Woods	27.3	17
Open Grass Areas	86.6	54

Like many towns and villages on the Maryland's Eastern Shore, the topography in Newcomb is relatively flat with slopes ranging from 0 – 2%. According to contours from USGS aerial topography, elevations in the village range from 0.0' to +8.0'. All the roads in the village are an open-road, ditch system. Ditches are shallow trapezoidal shaped with side slopes ranging from 2:1 to 4:1 (limited to St. Michaels Road). As previously mentioned, the interior roads do not have shoulders, thus the ditch systems are directly located off a road's drive lanes. Culverts were installed, apparently many years ago, to provide roadside drainage directly into the two waterways.

UPLAND FIELD INVESTIGATION

For the purpose of this study, aerial topography and photographs were used to delineate drainage patterns for Newcomb. Since much of Newcomb is flat, and because the aerial topography is developed in 2' contours, much of the limits of the drainage areas were estimated based on relative high points and land cover. Table 2 lists the delineated drainage areas and their respective areas.

TABLE 2

Drainage Area	Total Area (Ac.)
DA-1	1.72
DA-2	3.41
DA-3	3.86
DA-4	4.84
DA-5	12.25
DA-6	8.93
DA-7	6.90
DA-8	17.48
DA-9	4.24
DA-10	6.75
DA-11	3.46
DA-12	22.13
DA-13	0.58
DA-14	2.02
DA-15	28.01
DA-16	36.01

Drainage Area	Total Area (Ac.)
DA-18	5.82
DA-19	11.27
DA-20	4.27
DA-21	1.97
DA-22	2.35
DA-23	3.25
DA-24	9.23
DA-25	3.21
DA-26	0.69
DA-27	3.14
DA-28	3.66
DA-29	1.33
DA-30	1.91
DA-31	2.68
DA-32	1.17
DA-33	0.73

DA-17	14.67	DA-34	1.05

Within each drainage area, the impervious cover was measured using the aerial photographs. Impervious cover is defined as road, rooftops, driveways, and parking lots. All gravel surfaces are considered to be impervious areas. Further, using the aerial photographs, the amount of heavy tree cover (forest) and light tree cover (sparse trees) were measured. These three items were totaled and the remaining balance within the drainage area was considered to be open grass (lawns, road right-of-ways, etc.).

Following the delineation of the drainage areas, a field investigation was performed in March and August, 2011 to either confirm or alter the drainage patterns estimated from the aerial topo. The field investigation also researched problematic areas in upland areas and along the shoreline, conditions of drainage systems (culvert, ditches, etc.), and land cover. A Drainage Area Map showing land cover and approximate limits of drainage areas is provided in ***Exhibit 3***. Photographs were taken showing the village's drainage system, both problematic and working areas. ***Exhibit 4*** provides a location map of where photographs were taken, both upland and shoreline. Some pictures are provided in this narrative. Pictures not shown herein are provided on the enclosed CD.

The most noteworthy item discovered from the field investigation was that a majority of the driveway and cross culverts were clogged between 50-75% with sediment. This factor of clogged culverts and minimum slopes in ditches results in extended ponding or flooding in the low lying areas.

Photo 63

Photo 74

Photo 104

The roadside drainage ditches are typically usually 1-2' deep, and in the case of the ditch system along Royal Oak Road, the ditch was a minimum of 2.5' up to 3.5'. Ditch bottom widths range from 6-12". The Royal Oak Road ditch system is located immediately off the driving lane. Some evidence of pavement failure is evident along the ditch system. Ditches near or under trees are filled with leaves and other debris. River and Woodside Roads have shallow parabolic grass swales that are approximately 6" deep. The drainage system along the St. Michaels Road (Rt. 33) is located off the road's shoulder on each side and tends to have milder side slopes, roughly 4:1 or less, as is typical with most State roads. All drainage ditch systems discharge into the Miles River or Oak Creek without any stormwater management devices in place.

Photo 27
(St. Michaels Road)

Photo 53
(St. Michaels Road)

Photo 65
(St. Michaels Road)

Photo 73
(Station Road)

Photo 75
(Station Road)

Photo 113
(Station Road)

Photo 106
(River Road)

Photo 107
(Woodside Road)

Photo 126
(Royal Oak Road)

Typical cross sections, approximate slopes, and ground cover were investigated in all areas of concentrated flow in the field. The information from the field investigation was incorporated into the delineated drainage areas, and after estimating a travel time and path for runoff, the drainage areas were hydrologically combined to determine the area and volume of runoff draining to a particular discharge point. The exception to this is where sheet flow discharges directly into a waterway. These areas were collectively combined to determine pollutant and sediment loading from overland flow. Table 3 lists the hydrologically combined drainage areas and their designated Drainage Group.

TABLE 3

Drainage Group	Total Drainage Area (Ac.)	Description	Drainage Areas (Hydrologically Combined)
MILES 1	33.3	Concentrated flow in tree-lined ditch along property line. Discharges into tidal floodplain area of Miles River. Located northeast of Rt. 33 and Solitude Road intersection.	6, 7, 8
MILES 2	16.5	Concentrated flow in a diagonal open swale w/ riprap bottom. Discharges into Miles River via culvert. Located on 4 properties northeast of Rt. 33 and Royal Oak Road intersection.	5, 9
MILES 3	11.6	Concentrated flow in a narrow 2' deep ditch. Discharges into Miles River via culvert. Located behind eastern properties of Beach Road.	4, 10
MILES 4	9.0	Sheet flow into Miles River along approx. 1/3 mile of hardened shoreline. Located along Rt. 33 across from Station Road.	1, 2, 3
OAK 1	1.9	Parking area at boat ramp drains into storm drain inlet and then discharges into Oak Creek via a storm drain pipe.	32, 33
OAK 2	3.7	Sheet flow into Oak Creek from areas southeast of Station Road, north of River Road.	31, 34
OAK 3	5.4	Concentrated flow into northern cove of Oak Creek. Impacted by tide.	11, 30
OAK 4	104.8	Concentrated flow into northern cove of Oak Creek. Runoff from area between Station Road and Royal Oak Road.	12, 13, 14, 15, 16, 17, 29

OAK 5	7.5	Concentrated and sheet flow into northern cove of Oak Creek. Runoff drainage from River Road.	26, 27, 28
OAK 6	6.5	Sheet flow into southern cove of Oak Creek.	23, 25
OAK 7	9.2	Concentrated flow into approximately 0.65 wetland area in southern cove of Oak Creek.	24
OAK 8	21.4	Sheet flow into Oak Creek along approx. 1/2 mile of shoreline.	18, 19, 21, 22
OAK 9	4.3	Eroded swale along property line.	20

<u>MILES 1</u>

Miles-1 is a 660' long, tree-lined trapezoidal-ditch that flows northeast from St. Michaels Road towards the Miles River *(Photos P39 – P41)*. Twin culverts crossing St. Michaels Road, in which are 50% clogged, pass the runoff from the south *(Photo P38)*. The ditch transforms into a wide floodplain channel before discharging into the river *(Photos P42 – P44)*. The floodplain is a tidal area. The ditch is approximately 2' deep and appears stable. However, as evidenced from a fallen tree that was identified along the ditch, it appears the ditch cannot handle the volume of water from large storm events.

Photo 38

Photo 39

Photo 42

Photo 44

All photos provided on enclosed CD

<u>MILES 2</u>

Miles-2 is a series of three different channels. The first channel is a 290' long, stable, trapezoidal grass channel which receives runoff via roadside ditches from both sides of St. Michaels Road *(P027 – P031)*. A large riprap apron is located on the downstream side of the culvert cross Rt. 33 and prior to the grass channel. The grass channel leads into a wide riprap channel with a grade stabilizing wall on one side *(P037)*. After the vertical walls ends, the riprap channel continues towards the river. Riprap is evident on the channel's bottom. Side slopes are mild with grass cover *(P034 – P035)*. The runoff is discharged into the river via culvert through the timber bulkhead *(P036)*. All channels appeared to be stable.

Photo 31

Photo 29

Photo 37

Photo 35

Photo 34

Photo 36

All photos provided on enclosed CD

<u>MILES 3</u>

MILES 3 is a 750' long, narrow and shallow trapezoidal ditch that bisects residential properties near Beach Road. Standing water was noticed at the upstream end of the ditch where it crosses Rt. 33 (*P021 – P023)*. A residential house was being constructed at the time of the investigation. The house is within 6' of the ditch. Several roof drains discharge into the ditch. The ditch flows into a culvert and then through the bulkhead into the river *(P024 – P026)*. There were some signs of scouring on the side slopes of the ditch. The outfall pipe and bulkhead are in disrepair.


Photo 23


Photo 24


Photo 25


Photo 24

All photos provided on enclosed CD

OAK 1

OAK 1 is a storm drain outfall directly into Oak Creek. It receives runoff from a portion of the Rt. 33 roadside ditch and the boat ramp's parking lot *(P069 – P071)*.


Photo 70


Photo 71

All photos provided on enclosed CD

OAK 3

OAK 3 is a 270' long tidal channel that receives concentrated runoff from Back Street and the northern portion of Station Road. The channel bottom has no vegetation, but is heavily vegetated on its side slopes. *(P077 – P079A)*.


Photo 78


Photo 78A


Photo 79


Photo 79A

All photos provided on enclosed CD

OAK 4

OAK 4 is a 1,180' long drainage channel that begins at Royal Oak Road and continues to Station Road. As listed in Table 1, OAK 4 is the focal drainage point of approximately 102 acres. A cross culvert discharges runoff into the channel from the western side of Royal Oak Road. The channel begins in a wooded area *(P135 – P138)* and then continues into an open space *(P097 – P098)*. After the open space, the channel turns sharply northeast and then east towards Station Road. After crossing Station Road in a 30" CMP culvert, it discharges into a large tidal channel off of Oak Creek. The channel has consistent cross section for its entire length between Royal Oak and Station Roads, including a 5' bottom width, 3-4' deep, and 1:1 side slopes. Some trees and limbs have fallen into the channel. After Station Road, the channel passes the historic cemetery and two private sheds that are constructed right upon the banks of the channel *(P081 – P089)*.

Photo 136

Photo 98

Photo 83

Photo 95

Photo 83

Photo 82A

Photo 84

Photo 86A

All photos provided on enclosed CD

<u>OAK 5</u>

OAK 5 is an outfall culvert that receives runoff from River Road. Two culvert pipes and a roadside swale drain towards the outfall culvert. Although the downstream of the pipe was identified, the upstream side was not visible *(P103 - P104)*. The outfall pipe discharges through a deteriorated timber bulkhead *(P105)* where significant washout is evident *(Photo 105A)*. In observing the elevations of the pipe's downstream invert compared to the estimated upstream invert, it appears the pipe has a negative slope. Outfall pipe and bulkhead are in disrepair.

Photo 103

Photo 104

Photo 103

Photo 105A

All photos provided on enclosed CD

<u>OAK 9</u>

Oak-9 is a naturally created v-ditch along a property line due to erosion *(PW10 – PW13)*.

Photo W10

Photo W13

All photos provided on enclosed CD

MILES 4, OAK 1, OAK 2, OAK 6, OAK 7, OAK8
These drainage groups represent the areas where sheet flow enters the Miles River and Oak Creek directly without becoming concentrated flow.

SEDIMENT AND NUTRIENT LOADING

Sediment and pollutant loading from upland runoff has been determined to be significant detriment to the overall health of the Chesapeake Bay and its many tributaries. Sediment loading in streams and rivers is caused by upland soil and bank erosion. Sediment loading increases the turbidity in a waterway, thereby causing a decline in Submerged Aquatic Vegetation, which limits spawning and feeding areas for fish. Pollutant loading comes from many different sources in urban, residential, and agricultural runoff. The two primary pollutants of concern are Phosphorous (Total) and Nitrogen. These two elements promote algae blooms in waterways which results in degraded oxygen levels. Reducing the levels of upland sediment and pollutant loading has become a primary goal in a wide scale effort to improve the quality of the Chesapeake Bay.

The Simple Method is a tool used to determine annual phosphorus loading levels. However, the same equation can be used to approximate the sediment and nitrogen levels as well. The Simple Method equation is as follows:

$$L = P\ Pj\ Rv\ C\ A\ 0.2266$$

where

L = Total Pollutant Loading (lbs.)
P = Annual precipitation depth (inches)
Pj = Fraction of rainfall events that produce runoff = 0.9
Rv = Runoff coeficient
C = Average pollutant runoff concentration (mg / L)
A = Watershed area (acres)
0.2266 is a conversion factor

and

- Pj = 0.9
- Annual precipitation depth = 45.85 inches

Different land covers will produce different average pollutant runoff concentrations of phosphorus, nitrogen, and sediments. Table 4 lists the values of ‘C’ for this study

TABLE 4

Land Use	Total Suspended Solids (mg/l)	Total Phosphorus (mg/l)	Total Nitrogen (mg/l)
Impervious (Driveways & Roads)	145	0.44	0.43
Lawn	125	1.30	0.35
Rooftop	20	0.11	0.45
Woods	30	0.30	0.25
Trees / Landscaping	55	0.40	0.33

Using the Simple Method equation, concentration levels from Table 4, and the measured land cover, the annual pollutant loadings was determined for each Drainage Group. Table 5 lists these values.

TABLE 5

Drainage Group	Total Drainage Area (Ac.)	Annual TSS (lbs.)	Annual TP (lbs.)	Annual TN (lbs.)
MILES 1	33.3	4,742	22.3	16.6
MILES 2	16.5	3,392	15.3	12.3
MILES 3	11.6	2,545	11.5	10.6
MILES 4	9.0	1,972	8.6	7.2
Total for Miles River	70.4	12,651	57.8	46.7
OAK 1	1.9	1,468	4.8	4.5
OAK 2	3.7	1,375	5.4	5.2
OAK 3	5.4	1,070	5.3	4.5
OAK 4	104.8	9,608	49.7	41.1
OAK 5	7.5	1,786	7.5	6.9
OAK 6	6.5	964	5.0	4.2
OAK 7	9.2	771	4.4	4.1
OAK 8	21.4	2,563	14.4	10.2
OAK 9	4.3	643	3.4	2.8
Total for Oak Creek	164.6	20,248	99.8	83.4

PEAK FLOWRATES AND VELOCITIES

Erosion in upland areas is usually caused by concentrated flow with excessive velocities in an earthen channel or ditch. The rate of erosion is dependent on the velocity, the slope of channel/ditch and the soil properties. Excessive velocities are caused by infrequent storm events with tremendous rainfall. A value greater than 3.0 feet per second (fps) is generally considered a potential erosive condition. By determining the area, ground cover, and slopes within a watershed, peak flowrates, and resultantly peak velocities, can be determined for a given area of concentrated flow. On the Eastern Shore of Maryland, the typical rainfall event used to determine peak flowrates is the 2-year storm. For Talbot County, the 2-yr storm rainfall event is 3.4”. The resulting peak flowrates and corresponding velocities for each Drainage Group is listed in Table 6. A hydrologic flowchart of the drainage areas, ditches/ channels, and Drainage Groups are provided in ***Exhibit 5***.

TABLE 6

Drainage Group	Component	2-Yr. Peak Flowrate (cfs)	Max. Velocity (fps)	Avg. Velocity (fps)
MILES 1	Trap. Ditch	12.4	3.2	1.3
	Floodplain Ditch		4.5	1.5
MILES 2	Grass Channel	8.8	2.3	0.9
	Riprap Ch - Vertical Wall		2.0	0.7
	Riprap Channel - Open		1.7	0.6
MILES 3	Trap. Ditch	9.0	2.2	0.8
MILES 4	N/A – Sheet Flow	--	--	--

OAK 1	Outfall Pipe	3.8	--	--
OAK 2	N/A – Sheet Flow	--	--	--
OAK 3	Tidal Channel	4.5	2.0	0.6
OAK 4	Tidal Channel	35.1	4.0	1.3
OAK 5	Outfall Pipe / Overflow	4.1	--	4.0
OAK 6	N/A – Sheet Flow	--	--	--
OAK 7	N/A – Sheet Flow	--	--	--
OAK 8	N/A – Sheet Flow	--	--	--
OAK 9	Eroded V-ditch	2.4	3.7	1.6

SEA LEVEL RISE AND UPLAND INUNDATION

The implications of a rise in the sea level, and the area of impact, are very much a concern to the waterfront towns and communities on the Eastern Shore. The concern is for potential loss of upland areas, shorelines, beaches and environmental habitat including protective marsh areas and beds of submerged aquatic vegetation. As is the case with most of the Delmarva Peninsula, Talbot County is a coastal plane with low lying elevations generally less than +10' feet above sea level. Scientists, politicians, planners and other parties are studying and planning for an increase in the water levels around Talbot County by implementing new policies for future development and possible retrofit/ improvement projects for coastal towns, like Newcomb.

The Maryland Department of Natural Resources has developed an online tool, named *Merlin*, which uses spatial data to map vulnerable areas to possible sea level inundation in the 0-2', 2-5' and 5-10' range. This study investigated the impact area of the 0-2' inundation level for the Town of Newcomb.

According to the Merlin data, the impact along the Miles River appears to be minimal. This data can be confirmed by reviewing the contours along the shoreline. Plus, the majority of the shoreline in this area is hardened with either bulkhead or stone revetment which indicates a significant variation in elevation between water level and upland elevation. The average elevation along the Miles River shoreline is at +6.0' except near the Rt. 33 bridge over Oak Creek. This area has an average elevation of +4.0' with a smaller area at +2.0'. This hardened shoreline continues along the western shore of Oak Creek into the most northern cove of Oak Creek, where OAK3, OAK 4 and OAK 5 are located. According to the Merlin spatial data, this area is most vulnerable to inundation from a sea level rise of 0-2'. Similar to the northern cove, the wetland area of OAK 7 would be susceptible also. The remaining area of the southern cove is naturally elevated above the 0-2' inundation range. ***Exhibit 6*** shows the 0-2' inundation area along the Newcomb shoreline.

COMMUNITY INPUT

During the course of gathering information for this study, residents of Newcomb were invited to provide feedback on the conditions of the Village, specifically any problem areas of flooding or erosion. A majority of the residents interviewed mentioned the biggest problem is the flooding that occurs at the intersection of Station Road and Royal Oak Road. There are roadside ditches on both sides of the two roads; however, the problem occurs, according to the residents, in the downstream ditch along Royal Oak Road. There is a residence located 190' to the north where their driveway culvert is clogged. This blocked culvert causes backup to the intersection and further up Station and Royal Oak Road. The residents state that flooding regularly encroaches the road, creating a driving hazard. One resident, Mrs. Julie Imirie, stated the problem causes a residual effect of flooding her property. This roadside ditch (on the northbound side) receives runoff from as far south as Acorn Road. In all, the area draining to this roadside ditch is roughly 17 acres (DA14 and DA17). The 2-year storm produces approximately 12.8 cfs. If the roadside ditch was free and clear of debris, it would be able to contain this flowrate with a peak velocity of 2.4 feet/second. The following are pictures provided by Ms. Imirie and AMA.

Station Road, Facing Northeast

Station Road, Facing Southwest

Imirie Property - 7305 Station Road

Photo 118A – Facing Intersection

Photo 119 – Royal Oak Road, Northwest (Note Blocked Culvert Downstream)

Photo 119A – Facing Intersection

Many residents also stated that the County should regularly maintain the roadside ditches removing leaves and sediments. As previously mentioned, most of the driveway culverts are clogged up to 75%. The residents state if the culverts were clear, the drainage system within Newcomb would probably work sufficiently.

On the other side of the Village, Mr. Frank Cavanaugh provided information regarding the riprap swale that travels diagonally through his property and into the Miles River (MILES 2). Since a majority of the runoff entering the swale is from St. Michaels Road, Mr. Cavanaugh has expressed concerns to the Maryland State Highway Administration for years to get the channel stabilized and/or upgraded. According to Mr. Cavanaugh, the State has not assisted in the upkeep of the swale and thus Mr. Cavanaugh and his neighbors have stabilized it with riprap and an outfall pipe through a recently constructed bulkhead.

Some residents expressed their frustration with the outfall pipe on River Road (OAK 5). They state that since the outfall pipe is blocked, runoff fills the small roadside ditch and then overflows approximately 60’ into the river. This is the probable reason why washout exists behind the bulkhead at the pipe’s discharge point.

RECOMMENDED PROJECT LOCATIONS

To achieve the greatest benefit of water quality treatment for any retrofit projects, the locations of the recommended Best Management Practices (BMP) projects are located in areas of concentrated flow near tidal outfalls. With the exception of two parcels located on Rt. 33 and a small public park near the boat ramp, all the land is private property. Thus, all retrofit projects will require either property acquisition or drainage easements. It is believed that the strongest possibility of implementing any retrofit BMP projects within Newcomb would be in the form of linear applications. Ideally, the BMPs should be constructed ‘offline’ of the primary drainage system. Offline projects are where a BMP is constructed adjacent to a flow area. The ‘first flush’ of most storms would be directed to the BMP. Larger storm events would bypass the BMP in the original, or modified, drainage swale or ditch. Although offline systems are preferable, this would require additional land and thus additional property acquisition or easements. In this study, only one (MILES 1) of the seven recommended projects are proposed to be offline of the main drainage system. The locations of the recommended projects are Drainage Groups MILES 1, MILES 2, MILES 3, OAK 3, OAK 4, OAK 5 and OAK 9 as described in Table 3. Table 7 provides a list of Drainage Groups where a retrofit project is not proposed.

TABLE 7

Drainage Group	Reason
MILES 4	Sheet flow
OAK 1	Storm drain pipe under paved parking area
OAK 2	Sheet flow
OAK 6	Sheet flow
OAK 7	Wetland area in place.
OAK 8	Sheet flow

RECOMMENDED RETROFIT PROJECTS

The recommendations for water quality and quantity improvements are all linear applications, taking place in, or next to, the original drainage system. There are a several factors which influence the recommendations made herein. First being the soil type of the area. According to National Resource Conservation Service (NRCS) website, the soil conditions for the Newcomb area consists mostly of silt loams (*Soil Report provided on enclosed CD*). These soils are generally found in low lying areas, drain poorly, and have a Hydrologic Soil Group (HSG) rating of C or D. The HSG is an estimate of the soils runoff potential. A HSG of ‘A’ means the soil has a high infiltration rate. Conversely, a rating of ‘D’ means the soil has a minimal infiltration rate. According to the Soil Report, the majority of the subsurface near the waterfront areas has a HSG of ‘C’. As you go further inland, the soil becomes a ‘D’ type.

A second factor in determining the best BMP for a site is the groundwater elevation. The low lying elevations in the Newcomb area result in a groundwater elevation that may be only 1-3’ below the surface. This presents a problem for any type of infiltration system, since there is minimum vertical distance requirement between the bottom of a BMP and the groundwater elevation.

Several BMPs use the combination of a filter media and retention (i.e. bioretention, bioswales, sand filters) to treat runoff. The runoff would enter the BMP and then filter down through a substrate material that absorbs the pollutants. In soils with an HSG of A or B, these BMPs can be constructed without and underdrain system. In C and D soils, an underdrain system is recommended to withdrawal any water that does not infiltrate into the subsurface soil. The problem for implementing these types of BMPS in any of the existing drainage ditches or swales is that the low lying elevations would prevent an underdrain system with an adequate outfall. These BMPs systems can be constructed without the underdrain system; however over time the filter media may become permanently saturated which may reduce its performance capabilities of removing pollutants.

A BMP’s rate of pollutant removal is also a strong factor in determining where it should be used. Wetlands and filtering systems tend to have a higher removal rate of phosphorus and nitrogen due to their aerobic zones. BMP’s with a capability of reducing the volume of runoff from exiting the system tend to have a larger rate of TSS removal. Table 8 lists pollutant removal rates of various BMP devices.

TABLE 8 – BMP Pollutant Removal Rates (%)

	TSS	TP	TN
Dry Pond	49	20	24
Wet Pond	80	52	64
Wetland	72	48	24
Filtering	86	59	32

Bioretention	59	5	46
Infiltration	89	65	42
Open Channel	81	24	56

The BMP that is recommended for most of the retrofit projects in Newcomb is a Submerged Gravel Wetland (SGW). These systems are recommended for areas with a high groundwater table and poorly drained soils (HSG of C/D). The system contains a 2-4' layer of stone media covered by 6" of a planting substrate like mulch or compost. Wetland plants are then planted over the substrate material. Pollutant removal is achieved through biological uptake of the wetland plants. A large drainage area is recommended for these systems to ensure an adequate water supply for the wetlands. However a high groundwater table can compensate for a smaller drainage area.

The concern for implementing a SGW into existing channels and ditches is the possibility of excessive velocities that would be detrimental to the wetland plants. By implementing a series of low-profile, stone check dams to diffuse the velocity, and specifying plants with a strong root system (i.e. River Bulrush), a SGW could sustain an area of concentrated flow.

Based on factors such as community input, drainage area, pollutant loading, peak flowrates, and location, the recommended retrofit projects have been prioritized, as shown in Table 9.

TABLE 9

Recommended Project Priority	Drainage Group	Drainage Area (Ac.)	Total Impervious Area (Ac.)	Annual TSS Loading (lbs.)	Annual TP Loading (lbs.)	Annual TN Loading (lbs.)
1	OAK 5	7.5	1.5	1,786	7.5	6.9
2	MILES 1	33.3	3.2	4,742	22.3	16.6
3	OAK 4	104.8	7.2	9,608	49.7	41.1
4	MILES 2	16.5	2.6	3,392	15.3	12.3
5	MILES 3	11.6	2.3	2,545	11.5	10.6
6	OAK 3	5.4	1.0	1,070	5.3	4.5
7	OAK 9	4.3	0.6	643	3.4	2.8

OAK 5

OAK 5 is a location where the drainage area is relatively small (7.5 ac.), however the existing pipe that is the outfall for the upland area is buried and needs to be replaced. A small 80' long Submerged Gravel Wetland (SGW) is proposed in-line with the existing roadside ditch. This concept plan proposes to remove, replace, and relocate the old outfall pipe with a new one. The new outfall pipe would discharge into a stone plunge pool as part of a living shoreline concept proposed at this location (see *Shoreline Improvement Recommendations)*. According to the residents, a 50' wide County Right-Of-Way exists on the north side of River Road near the River Road/ Woodside Road intersection. This ROW was established to allow fire trucks to access Oak Creek for water withdrawal. The new outfall pipe would be located in this unpaved ROW area. ***Exhibit 7*** shows a conceptual plan view and profile of OAK 5.

MILES 1

The recommended retrofit project MILES 1 presents the greatest opportunity to reduce upland pollutants from entering a tidal area, in this case the Miles River, and a minimal imposition to private property. The existing ditch runs along a property line near the northwest corner of Newcomb. Facing downstream, to the left is a grass buffer area for the adjacent farm. The concept plan for MILES 1 recommends expanding the existing ditch into this buffer strip. The expansion area would be excavated lower than the existing ditch invert. A linear wetland is proposed in the expansion area. A linear wetland was chosen over a Submerged Gravel Wetland because of the potential length (~500') of the project. The cost of a 500' long SGW would make the project infeasible for the area it treats (33 ac.). By creating a wetland, a less amount of planting substrate would have to be imported and placed as opposed to bank run gravel, thereby reducing the costs.

Runoff from smaller storms would be directed into the SGW. During large storm events, the wetland area would be filled, thus the runoff would overflow into the original ditch. The northern side slope of the linear wetland would be restored to a meadow, similar to existing conditions. ***Exhibit 8*** shows a conceptual plan view and profile of MILES 1.

OAK 4

The outfall location of OAK 4 receives approximately 45% of the drainage runoff from the Village of Newcomb and beyond. It is evident that this area of concentrated flow receives a large volume of runoff due to the channel's configuration. Beginning at Royal Oak Road and continuing to Station Road, the channel has an average 5' bottom width and a depth of 3.5'. It is a dry bed, thus it is only active during storm events. According to the HydroCAD Stormwater Management program, the 2-year storm produces 34.6 cubic feet per second (cfs) in the channel, but only has a 3.7 feet per second (fps) peak velocity and a 1.4' depth of water.

The large drainage area of OAK 4 presents an ideal scenario for a water quality project, however site constraints limit any expansion of the channel. Near the downstream end, a residence is located to the north and a historical cemetery is located to the south. The cemetery contains the burial site of General Perry Benson, a commander of local militia in the Revolutionary War and War of 1812. Further, both the property owners to the north and south have constructed sheds right along channels banks.

The concept plan for OAK 4 includes placing three (3) stone check dams downstream of the culvert crossing Station Road to reduce the runoff velocity. The check dams would be placed at a minimum height to retain runoff from small storms and dissipate the velocity for larger storms. A SGW is proposed in between the check dams to provide water quality. River Bulrush (Scirpus fluviatilis) would be planted along the channel bottom in the SGW, creating a wetland area. This plant is typically used as a shoreline stabilizer and can withstand up to 0.5 ppt of salinity. The side slopes of the channel would be planted with various upland shrubs (i.e. Tussock Sedge, Red Chokeberry, Square Stemmed Monkey Flower, Sweet Flag and Swamp Milkweed) that can withstand temporary inundation, thrive in wet soil conditions, and are salt tolerant. An additional set of three check dams would be placed further upstream for additional velocity reduction. This recommended plan would tie directly into a living shoreline project located at the mouth of the channel (see *Shoreline Improvement Recommendations)*. ***Exhibit 9*** shows a conceptual plan view and profile of OAK 4.

Due to site constraints of the area, the amount of pollutant removal for OAK 4 would be minimal, although it is a reduction from a large drainage. This study focused on the downstream portion of the channel (~ 170'). If funding was available, it is conceivable that the project could be extended further upstream with more check dams and planting areas. The upstream open area is a realistic location for a possible project expansion.

The development the OAK 4, or one of similar concept, should incorporate a maintenance plan by the County. Since the channel can receive large volumes of water, debris can travel down the channel and possibly get backed up in the wetland plants and/ or at the check dams. To ensure the longevity and effectiveness of OAK 4, it would be necessary to periodically inspect the channel and remove any debris.

MILES 2

MILES 2 presents a favorable situation to treat runoff from a State Road. The County could consider approaching SHA to acquire supplemental funds for this project. MILES 2 proposes to maintain the flow path of the swale, however implement a water quality SQW under the riprap channel. An overflow pipe could be constructed through the existing timber bulkhead. Wetland plantings would be installed along the channel bottom. The existing swale side slopes are relatively flat. The slopes are a part of the property owner's maintained lawn. So as not to obstruct any more of the water view than necessary, no upland plantings are proposed on the side slopes. ***Exhibit 10*** shows a conceptual plan view and profile of MILES 2.

MILES 3

The location of MILES 3 is such that it would not only provide water quality treatment for approximately 11.6 acres, but also improve a drainage ditch where the outfall is in a state of disrepair. The development area for MILES 3 is very narrow. A residential house is only 30' from the project site. However, as mentioned, two services can be improved with this project. A 100' long SGW is proposed in-line with the existing ditch. In order to upgrade the existing outfall, a storm drain yard inlet and outfall pipe would be constructed at the downstream end of the SGW. A 10' long section of the deteriorating bulkhead would have to be replaced as part of the outfall construction. Considering the condition of the existing ditch, it is believed that the adjacent property owners would approve of the project in order to improve the condition of the ditch. ***Exhibit 11*** shows a conceptual plan view and profile of MILES 3.

OAK 3

The configuration of OAK 3 is similar to that of OAK 4, where a wide drainage channel discharges into a mud flat of tidal waters. The difference is that OAK 3 has a 95% smaller upland drainage area than OAK 4. Thus is the reason why OAK 3 is the fifth recommend priority for project retrofit within Newcomb. The residents on both sides of the tidal channel grow and promote vegetation on the channel side slopes (*Photo 78A*). The vegetation along the channel is very stable and healthy. Although OAK 3 has a smaller drainage area, the concept plan is similar to OAK 4. The result is a larger percentage of upland pollutants can be treated with the proposed improvements. A series of three stone check dams are proposed in the channel with a Submerged Gravel Wetland constructed in between the dams. Also similar to OAK 4, a living shoreline would be constructed in the tidal area downstream of the channel (see *Shoreline Improvement Recommendations)*. ***Exhibit 12*** shows a conceptual plan view and profile of OAK 3.

Similar to OAK 4, a maintenance schedule should be set up with the development of OAK 3.

OAK 9

OAK 9 is conceptual project to rectify a drainage problem between two residential properties. Apparently, runoff coming from further upland makes it way between the houses. Since there is no ditch to receive the runoff, erosion has occurred where the runoff is draining to the river. The eroded ditch is shallow and winding. A SGW is proposed along the eroded ditch area to provide water quality management for the runoff. Further, two small check dams are placed in the SGW to reduce any erosive velocities that may occur. ***Exhibit 13*** shows a conceptual plan view and profile of OAK 9.

Using Table D.4.6 from the Maryland Department of Environment Stormwater Management Manual and the removal rate for a wetland as shown in Table 8, the amount of pollutant load removed can be determined. Table 10 lists the percentage and load amount of pollutant removed for each concept plan listed above.

TABLE 10

Project	TSS Removed as % of Total Annual Load	Estimated TSS Load Removed (lbs./yr.)	TP Removed as % of Total Annual Load	Estimated TP Load Removed (lbs./yr.)	TN Removed as % of Total Annual Load	Estimated TN Load Removed (lbs./yr.)
OAK 5	3	48	2	0.1	1	0.1
MILES 1	14	663	9	2.1	5	0.8
OAK 4	4	366	3	1.3	1	0.5
MILES 2	12	391	8	1.2	4	0.5
MILES 3	11	281	7	0.9	4	0.4
OAK 3	15	159	10	0.5	5	0.2
OAK 9	22	143	15	0.5	7	0.2

OAK 3 AND OAK 4 ALTERNATE

The recommendation for OAK 3 and OAK 4 incorporates a Submerged Gravel Wetland and upland wetland vegetation in the concept design. Depending on the design elevations within the channel, the upland wetland plantings could be replaced with tidal or inter-tidal vegetation. Further, a sand media would replace the bank run gravel media. However, there would be a concern of how the fresh water runoff would impact the tidal/ inter-tidal vegetation. These factors should be investigated prior to any project implementation.

HISTORIC SHORELINES

The Merlin website also provides data on historical shorelines from 1847, 1942, 1994, and 2010. ***Exhibit 14*** overlays these shorelines on an aerial photograph. Areas of a receding and ascending shoreline are clearly visible along Miles River and Oak Creek. Along the Miles River, the shoreline has receded between 40 and 100' since 1847. It is expected that this recession occurred prior to the installation of the bulkheads and stone revetments. In observing the comparison between the 1994 and 2010 shorelines, there is no change indicating a stable shoreline. In Oak Creek, from the bridge south to the northern cove, the shoreline appears to be stable through the years. The northern cove of Oak Creek had shoreline loss in the areas of OAK 4 (~80' receded length) and OAK6 (~50' receded length). These locations, as previously mentioned, are points of concentrated flow, thus the cause of shoreline loss is from upland storm runoff rather than wave/ wind activity. Continuing south around the peninsula, the shoreline has recessed slightly (~20'). However, this shoreline has been stabilized with a stone revetment and is currently stable. The southern cove has experienced both recession and accession of shoreline. The floodplain of OAK 7 was previously a open water area (1942 shoreline) that has apparently filled in with sediment (2010 shoreline) creating a wetland area. As the shoreline continues south along the western coast of Oak Creek, the shoreline has changed very little since 1942.

SHORELINE FIELD INSPECTION

The shoreline within the Village of Newcomb is about 1.7 miles long. This includes 0.7 miles along the Miles River and 1.0 miles along Oak Creek. This area was visually inspected by boat to determine unstable areas possible causes of any unstable areas. The investigation started on the southeast edge of Newcomb, near Acorn Lane, continued under the Rt. 33 Bridge, and along the Miles River up to the limits of Newcomb. Table 11 is a summary of the shoreline investigation. Sections 1 through 14 are on located on Oak Creek and Section 15 through 17 are on the Miles River. A location map of the 17 sections is provided on ***Exhibit 15***.

TABLE 11

Section	Length	Structure	Condition	
1	600'	Minor Stone Revetment	Stable	
Photos: W03 – W17 Remarks: Revetment is a minor structure protecting low lying residential properties. Minor erosion in isolated areas. Single concrete boat ramp. This section is where OAK 9 is located, but shoreline is not erosive.				
2	945'	Stone Revetment	Stable	
Photos: W18 – W30 Remarks: Revetment is a tall structure protecting mostly one residence. Higher upland elevations result in taller structure.				

<table>
<tr><td>3</td><td>315’</td><td>Natural - Wooded</td><td>Unstable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W31 – W34

Remarks: Natural shoreline is mud flat beach with sparse trees and heavy vegetation. Some scouring and tree roots apparent. Area is secluded thus it is anticipated that erosion is caused by either rainfall or refracted waves from adjacent bulkhead.</td></tr>
<tr><td>4</td><td>170’</td><td>Bulkhead / Stone Revetment</td><td>Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W35, W38

Remarks: Combination of timber bulkhead and stone revetment protecting single property.</td></tr>
<tr><td>5</td><td>200’</td><td>Natural - Floodplain</td><td>Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W36 – W37, W39 – W45

Remarks: Natural floodplain area (OAK 7).</td></tr>
<tr><td>6</td><td>685’</td><td>Stone Revetment</td><td>Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W46 – W54

Remarks: Stone revetment for protecting two properties. Storm drain pipe daylights through revetment (Photo W48). Upstream end of pipe unknown. No erosion evident. Apparent fill outboard of revetment for approximately 125’ (Photo W49).</td></tr>
<tr><td>7</td><td>315’</td><td>Minor Stone Revetment</td><td>Mostly Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W55 – W62

Remarks: Minor stone revetment that is non-linear and non-uniform in height and width. Revetment area mostly stable. Last 30’ of revetment is concrete rubble in disrepair (Photo 62). Undercutting of rubble revetment is evident. Rubble revetment located adjacent to OAK 5.</td></tr>
</table>

<table>
<tr><td colspan="4">Photo 62</td><td></td></tr>
<tr><td>8</td><td>120’</td><td>Old Timber Bulkhead</td><td>Moderately Unstable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W63 – W67

Remarks: Aged bulkhead in need of replacement. Openings between timber sheeting boards evident. At time of investigation, water was draining from hole in bulkhead (shown in picture). Pipe visible in hole (Photo 67). OAK 5 daylights through bulkhead. Area behind OAK 5 is washed out (Photo 103 & 105A).</td></tr>
<tr><td>9</td><td>265’</td><td>Natural - Vegetation</td><td>Moderately Unstable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W68 – W73

Remarks: Small peninsula and mud flat area with a natural shoreline. Broken piles are evident around perimeter of peninsula, indicating possible bulkhead existed here at one time. Elevations on peninsula are high enough to support upland evergreen trees. Peninsula transforms into a mud flat area which is the outfall of OAK 4 (Photo 73).</td></tr>
<tr><td>10</td><td>75’</td><td>Make Shift Bulkhead</td><td>Moderately Unstable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W74 – W75

Remarks: Make shift bulkhead made from various sized and located boards. Sheds/buildings located directly behind bulkhead.</td></tr>
<tr><td>11</td><td>280’</td><td>Natural - Wooded</td><td>Unstable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W76 – W77

Remarks: Natural shoreline covered with sparse vegetation and trees. Limbs and minor scouring are evident on northwest side of cove. Mud flat outfall of OAK 3 is located before scoured shoreline. Area is secluded thus it is anticipated that erosion is caused by either rainfall or refracted waves from nearby bulkhead.</td></tr>
</table>

<table>
<tr><td>12</td><td>640’</td><td>Bulkhead / Stone Revetment</td><td>Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W78 – W85

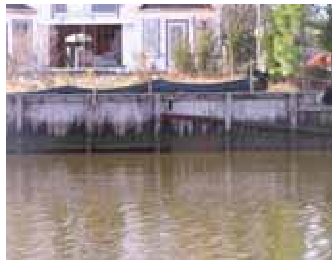
Remarks: Mostly stone revetment shorelines with small section of timber bulkhead. With the exception of one area at the before timber bulkhead begins (Photo 81), all structural shoreline appears stable.</td></tr>
<tr><td>13</td><td>400’</td><td>Steel / Timber Bulkhead</td><td>Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W86 – W91

Remarks: Steel then timber bulkhead on County property. Timber bulkhead continues along Rt. 33 bridge.</td></tr>
<tr><td>14</td><td>330’</td><td>Natural – Beach / Armor stone</td><td>Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W92 – W95

Remarks: Beach located on south side of bridge. Armor stone protects bridge abutment abutment.</td></tr>
<tr><td>15</td><td>1,250’</td><td>Stone Revetment</td><td>Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W92 – W95

Remarks: Stone revetment with high elevation (~ +6.0’).</td></tr>
<tr><td>16</td><td>1,665’</td><td>Timber Bulkhead</td><td>Mostly Stable</td><td rowspan="2"></td></tr>
<tr><td colspan="4">Photos: W96 – W109

Remarks: Timber bulkhead of various ages. Appears bulkheads have been sporadically replaced over the years. Some sections are recent construction. 165’ of bulkhead fronting new construction at end of Beach Av. is in state of disrepair (Photos W106). This is the outfall location of MILES 3 (Photo 105). Sand accretion is apparent in front of some bulkhead sections.</td></tr>
</table>

Photos W106 (Bulkhead) and W105 (Outfall of MILES 3).				
17	380’	Stone Revetment	Stable	
Photos: W110 – W111 Remarks: Tall stone revetment protecting two residences. Stone revetment ends at outfall of MILES 1.				

SHORELINE IMPROVEMENT RECOMMENDATIONS

The shoreline along the Miles River and Oak within Newcomb is mostly stable and hardened. Most of the the waterfront property owners with stone revetments or bulkheads have a lasting, non-eroding shoreline. There are exceptions where a bulkhead is aged and deteriorating such Section 8 and the newly constructed house in Section 16 (at MILES 3 outfall). The two shoreline areas that are considered ‘unstable’ are naturally vegetated and have signs of undercutting (Section 3 and 11). For Section 3, a rapid progression of shoreline erosion is not expected due to its protected location. The waterfront property owners along the Miles River have a continual line of shoreline protection of revetments or bulkhead, leaving no area exposed to possible lateral shoreline erosion. The condition of the shoreline along Oak Creek varies from property to property. Table 12 provides a summary of the inspected shoreline sections and their stability classification.

TABLE 12

Shoreline Condition	Length (ft.)	Percentage of Total Length
Stable	5,600	64.9
Mostly Stable	1,980	22.9
Moderately Unstable	460	5.3
Unstable	595	6.9

Stable:	Shoreline shows no sign of erosion and is good condition.
Mostly Stable:	Majority of shoreline is in good condition. Some isolated repair/replacement areas are recommended.
Moderately Unstable:	Shoreline is near the end of its service life or has a possibility of failing or eroding over the next 5-10 years.
Unstable:	Shoreline shows signs of undercutting, sediment seepage, or washout.

SECTION 7

Section 7 has approximately 30’ of a concrete rubble revetment (Photo 62) that should be removed (see Table 11). Instead of replacing the revetment, a living shoreline is proposed. This could be tied into the OAK 5 project. The outfall pipe would discharge into a stone plunge pool to dissipate the velocity. Tidal wetlands would be planted behind coir fiber logs. The logs would provide protection from any minor wave activity that enters the cove. A plan view of the living shoreline is shown on ***Exhibit 7***.

SECTION 8
Section 8 is a bulkhead that has reached the end of its service life. As mentioned in Table 11, the openings between the sheeting boards have expanded over the years. This expanded opening is an avenue for sediment loss. The County can provide recommendations and guidance to the property owner for bulkhead replacement.

SECTION 9
The shoreline along Section 9 provides the greatest opportunity for a living shoreline. The remnant of a small peninsula is an ideal location to restore upland area and also create a tidal wetland. A combination of low-profile stone sills and coir logs could be installed around the peninsula. The elevation within the living shoreline could easily be designed to vary between upland and wetland. This living shoreline would also provide protection to the historical cemetery located directly upland of the peninsula. As stated in OAK 4, a living shoreline located at the small peninsula could be tied into the water quality project in the existing channel (OAK 4). It is recommended that the Section 9 and OAK 4 be considered one project. The OAK 4 project reduces the exiting velocities that approach the peninsula. The low-profile stone sill proposed with Section 9 provides a defined channel into open waters. ***Exhibit 9*** provides a conceptual site plan of the living shoreline located at the outfall of OAK 4. The living shoreline was not continued further north due to presence of a moored boat located approximately 65' from the mouth of the existing channel.

SECTION 10
Section 10 is a make-shift bulkhead which is directly outboard of three small buildings. Although the bulkhead currently appears stable, it is expected that this structure will not endure. It is recommended that this structure be replaced with a typical bulkhead structure of pilings and sheeting.

SECTION 11
Similar to Section 9, a living shoreline is proposed in connection with improvements to a drainage channel (OAK 3). However, unlike Section 9, the upland drainage area is not large and the velocities exiting the channel are not considered erosive. The primary purpose for a living shoreline at this location is to stabilize and improve the existing northern shoreline. As mentioned in Table 12, there are some minor signs of undercutting and fallen trees. The cause of the eroding shoreline is not known, although it is anticipated that refracted waves are the cause. A living shoreline would prevent further erosion. ***Exhibit 12*** shows the living shoreline in respect the water quality project (OAK 3).

SECTION 16
The 165' of bulkhead located near Beach Avenue is in state of disrepair and should be replaced. It is recommended that this project coincide with the implementation of MILES 3. The remaining 1,500' of bulkhead is in good condition.

EFFECT OF SEA LEVEL RISE ON RECOMMENDED UPLAND AND SHORELINE PROJECTS

As previously stated, the areas where sea level rise would cause inland inundation are primarily in the northern and southern coves of Oak Creek. Three upland projects (OAK 3, OAK 4, OAK 5) and three shoreline projects (Section 7, Section 9, Section 11) are proposed in the northern cove area. Two of the upland projects (OAK 3 & OAK 4) are proposed in existing drainage channels. The long term effect of sea level rise at these two locations is that the channels would slowly become a full tidal area as opposed to upland or inter-tidal areas. This would result in a slow degeneration of the wetland plants being proposed. For the OAK 4 project, the proposed improvements could be moved further upstream to elevate it above the 0-2' inundation range. Since the drainage area to a relocated SGW would become smaller, the project could potentially be a longer project in the upstream channel, thereby maintaining the same level of pollutant removal as currently proposed.

Site constraints prohibit OAK 3 from moving inland. A rise in sea level is not expected to impact OAK 5.

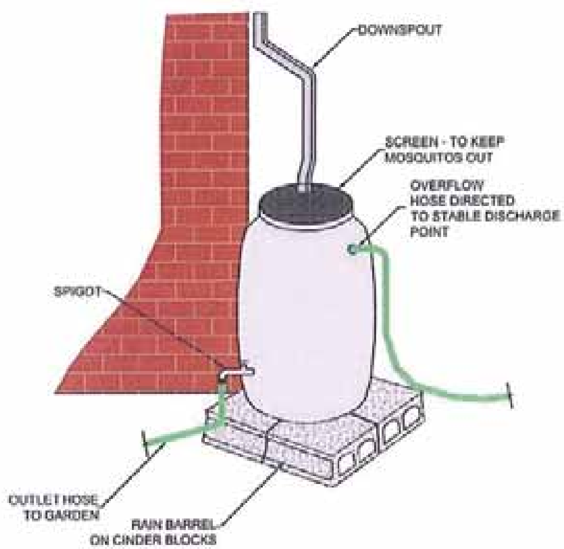
In a living shoreline, a low-profile or a coir log is installed around an area to protect it from low-energy wave activity and to contain the imported planting material. In order to account for a rise in sea level, the top of the containment structures should be elevated 6-9” above the current spring tide line. With a raised wetland area, less inter-tidal and more upland plants would be placed. Over time, the inter-tidal plants would adjust to the different tide levels, while the upland plants will slowly degenerate. The down side of an elevated containment structure is that it might meet resistance from nearby property owners because they would consider an eyesore.

The elevations at the remaining recommended projects (MILES 1, MILES 2, MILES 3, OAK 9) are all above the 2’ inundation range, therefore it is not anticipated that a rise in sea level will affect these areas.

RECOMMENDATIONS FOR THE INDIVIDUAL PROPERTY OWNER

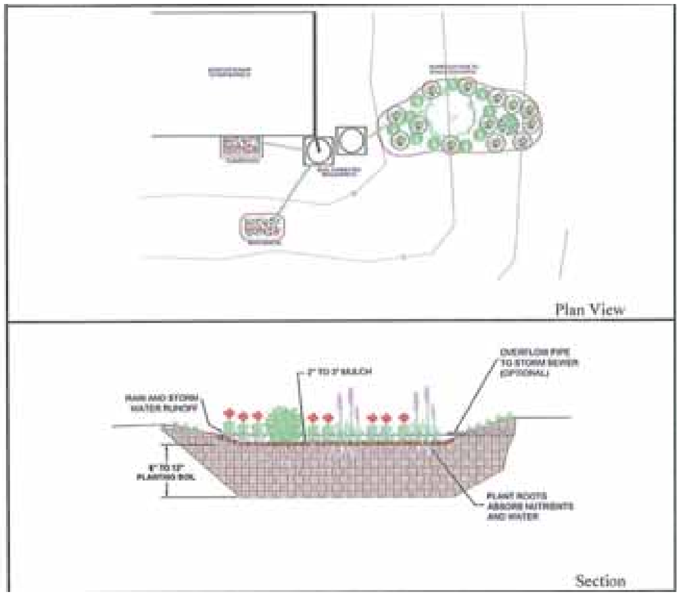
RAIN BARREL

Apart from County Capital projects, there are small scale projects that can be suggested to the individual property owners to improve the water quality from their home. One individual practice is to install Rain Barrels at their downspouts. Rain barrels capture and temporarily store rainfall from a home’s rooftop area. The stored water can be used for watering gardens, landscaping, or any other non-potable use. Any pollutants that are present from rooftop runoff is captured and then distributed over a pervious area during a non-storm event. This promotes infiltration of the runoff rather than it possibly becoming part of a concentrated flow into a nearby waterway. A typical rain barrel detail obtained from the MDE SWM Manual is shown below.



RAIN GARDEN

In a similar fashion, a Rain Garden can be implemented at a downspout or some other location of shallow concentrated flow in a yard. As defined in the MDE SWM Manual, a rain garden is a “shallow, excavated landscape feature or a saucer-shaped depression that temporarily holds runoff for a short period of time.” The excavated area is filled with planting soil, then a 2-3” layer of mulch, and then a variety of shrubs, grasses, and flowers are planted in the depressed area. Runoff from small storms will drain into the garden and then filter down through the planting material. The garden is designed such that it will hold a small amount runoff. Any significant rainfall will simply fill and then overflow the garden. This practice is usually used for small impervious area such as a rooftops or driveways. The plan view and detail shown below is obtained from the MDE SWM Manual.



GRASS FILTER STRIP

A 5-10 foot wide grass filter strip is a practice that waterfront property owners can implement to promote pollutant removal before runoff enters a waterway. The filter strip would receive runoff in the form of sheet flow. Allow the grass to grow 9-12" would increase the capability of removing pollutants more so than if the area is regularly maintained. The area should be mowed 2-3 times a year in order to prevent unwanted growth of trees, shrubs, or other vegetation.

SCHEDULED MAINTENANCE OF COUNTY ROADS

The biggest concern that the residents expressed was the lack of maintenance on the roadside ditches and driveway culverts. As previously mentioned, the ditches and culverts have become filled/ clogged with leaves, sediment, and other debris. Over time, some of the driveway culverts become fully blocked. As the culverts remain blocked, sediment builds up in the ditch causing the flow line (bottom) to rise. The end result, as stated by the residents, is that water overflows from the ditches and backups into the yards.

Residents stated they have contacted the County about maintaining the ditches and culverts. Due to budget shortfalls, this maintenance item is typically postponed or eliminated from the County's maintenance programs. The County may consider requesting a volunteer from Newcomb to coordinate an effort once or twice a year to clean out the ditches and culverts. If the County could possibly provide the machinery and trucks to remove the debris, the residents could possibly perform the work of debris removal. This is just one possibility that could be initiated by the County. It is recommended that the County investigate other possibilities of a joint effort for ditch and culvert maintenance because it is a very important and frustrating issue to the residents of Newcomb.

INTERSECTION OF ROYAL OAK ROAD AND STATION ROAD

The issue of the Royal Oak Road / Station Road intersection flooding during storm events is discussed in the section *Community Input*, above. Due to the pressing concern that this flooding is currently a driving hazard, the County should promptly proceed with installing a new driveway culvert at the residential property located on Royal Oak Road. The field inspection revealed that the remaining culverts leading to the large channel are free of debris. Installing this single culvert should rectify the flooding problem at the intersection.

PROJECT CONSTRUCTION COSTS

Estimated construction costs have been developed for each of the seven recommended projects. The costs were developed using the latest unit costs for similar type projects. The listed figures should be used for budgetary reasons only and should not be considered final. The costs provided in Table 13 do not include any consultant services such as permitting, design, survey, or construction administration.

TABLE 13

Recommended Project Priority	Drainage Group	Estimated Construction Costs	Includes Living Shoreline	Living Shoreline Section	Exhibit
1	OAK 5	$27,700	Y	Part of 7	7
2	MILES 1	$39,200	N	--	8
3	OAK 4	$59,100	Y	9	9
4	MILES 2	$15,800	N	--	10
5	MILES 3	$34,800	N	--	11
6	OAK 3	$28,500	Y	11	12
7	OAK 9	$4,600	N	--	13

SUMMARY

The Village of Newcomb presents several opportunities to develop a pollutant reduction and water quality improvement project through Environmental Site Design. The locations of the seven recommended retrofit projects were chosen because they are areas of concentrated flow where maximum treatment can be obtained for an upland area. All projects propose work on private property, thus an open line of communication should be established with the residents of Newcomb in the possible implementation of the above concept projects. The field investigation and above report also identify areas where the drainage system within the Village should be improved and/ or replaced due to its age and neglect over the years. These failed/ neglected systems are critical factors in current driving hazards, upland flooding, or threats to historical areas within the Village.

For the most part, the coastal shoreline in Newcomb is stable due to property owners implementing various types of shoreline protection over the years. There are some isolated natural shorelines that show signs of eroding (i.e. undercutting, fallen trees and scouring). The recommendations listed above attempt to combine a shoreline stabilization project with an upland water quality project to maximize their overall effect.

The Village of Newcomb is a quiet community with several features that make it attractive to its residents. It is the intent that the recommended projects provided herein can not only improve the water quality of runoff entering the Miles River and Oak Creek, but also add an aesthetic environmental feature that compliments the community.

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Google Earth.

Mr. Frank Cavanaugh, Resident, Village of Newcomb.

Mr. and Mrs. Pete Imirie, Residents, Village of Newcomb.

TALBOT COUNTY - VILLAGE OF NEWCOMB

Legend

- Village of Newcomb
- Contours
- Parcels

AERIALS MAP

Exhibit 1

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.

0 500 1,000 Feet

N W E S

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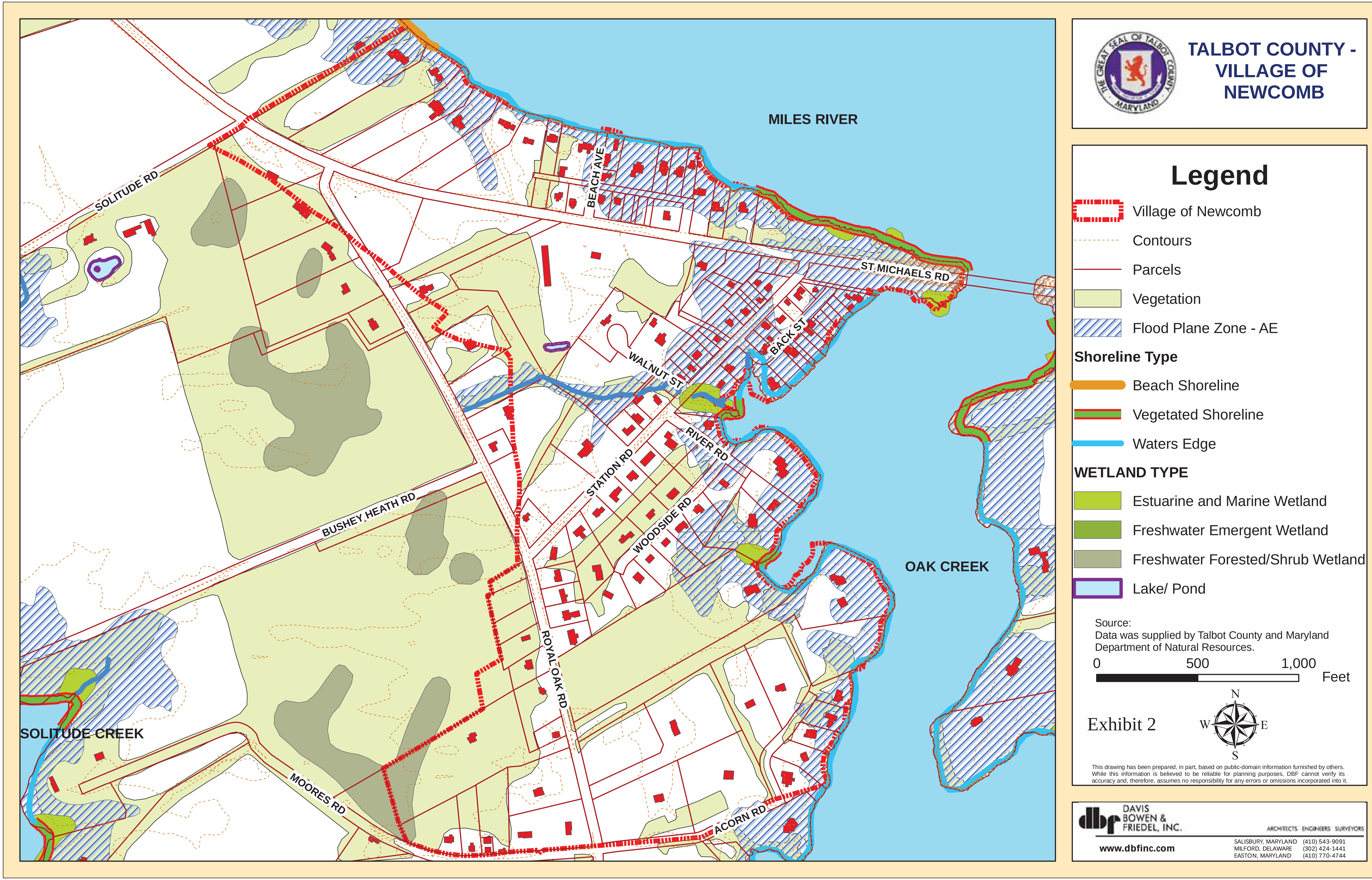

TALBOT COUNTY - VILLAGE OF NEWCOMB
THE GREAT SEAL OF TALBOT COUNTY MARYLAND
MILES RIVER
OAK CREEK
SOLITUDE CREEK
SOLITUDE RD
BEACH AVE
ST MICHAELS RD
WALNUT ST
BACK ST
RIVER RD
STATION RD
BUSHEY HEATH RD
WOODSIDE RD
ROYAL OAK RD
MOORES RD
ACORN RD
Legend
Village of Newcomb
Contours
Parcels
Vegetation
Flood Plane Zone - AE
Shoreline Type
Beach Shoreline
Vegetated Shoreline
Waters Edge
WETLAND TYPE
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Lake/ Pond
Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.
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Exhibit 2
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TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Drainage Area Map

Exhibit 3

Source:
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0 200 400 FEET

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TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Photo Locations #1

Legend

- Village of Newcomb
- P21 Photo Location - Upland
- P-W101 Photo Location - Water
- Existing Culvet/Pipe
- Existing Contours
- Shoreline

Exhibit 4

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resourses.

0 200 400 FEET

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TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Photo Locations #2

Legend

- Village of Newcomb
- P21 Photo Location - Upland
- P-W101 Photo Location - Water
- Existing Culvet/Pipe
- Existing Contours
- Shoreline

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.

0 200 400 FEET

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TALBOT COUNTY- VILLAGE OF NEWCOMB

Photo Locations #3

Legend

- Village of Newcomb
- P21 — Photo Location - Upland
- P-W101 — Photo Location - Water
- Existing Culvet/Pipe
- Existing Contours
- Shoreline

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resourses.

0 200 400 FEET

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TALBOT COUNTY-
VILLAGE OF
NEWCOMB

SWM Hydrocad Flow Chart

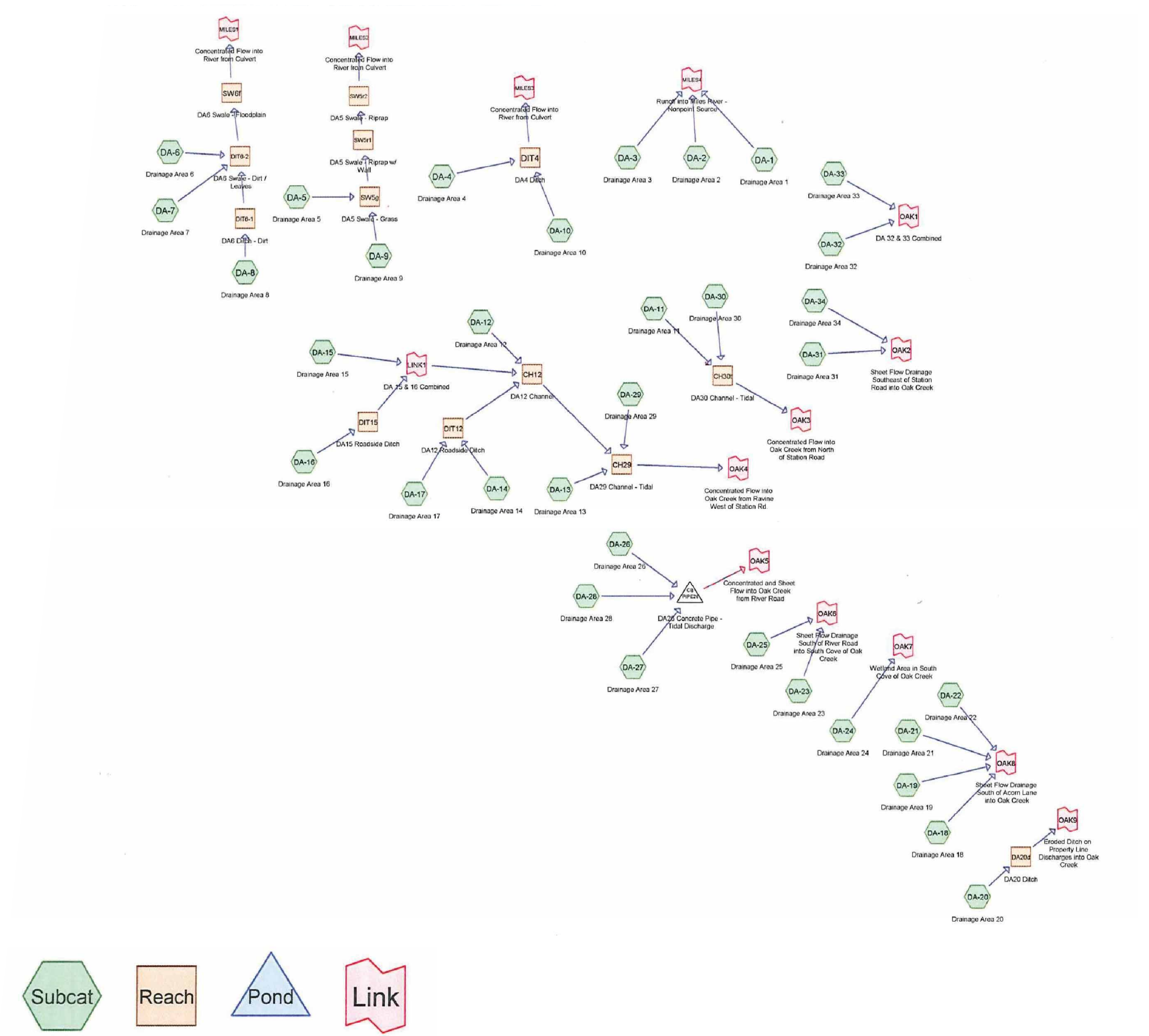

Exhibit 5

Source:
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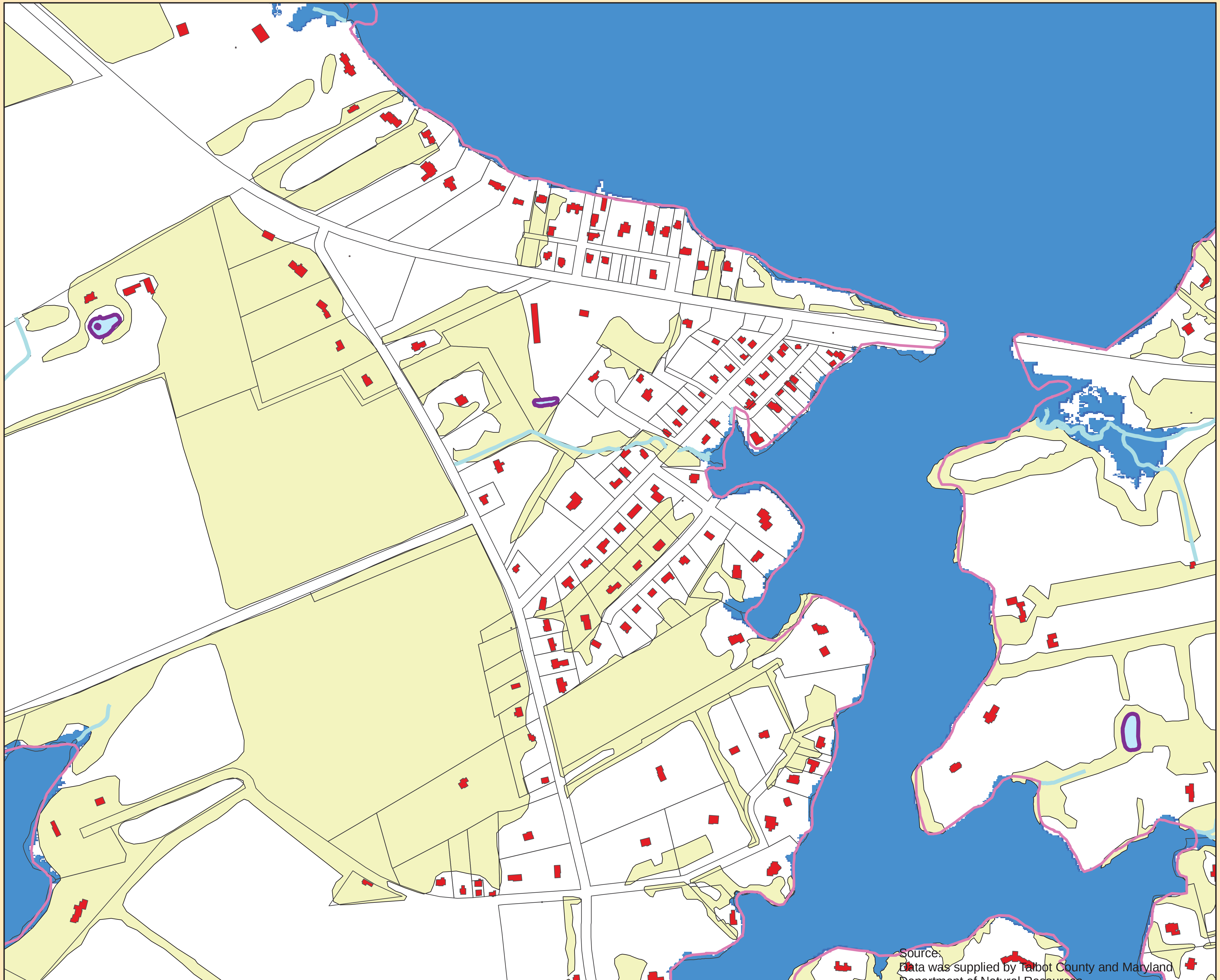

TALBOT COUNTY - VILLAGE OF NEWCOMB

Projected 0-2' Sea Level Rise Inundation Areas

Legend

0- 2ft Inundation

- 0
- 0-2' Sea Level Rise Inundation Areas
- Shoreline
- Buildings
- Parcels
- Vegetation
- Lake/ Pond

Exhibit 6

N W E S

0 600 1,200 Feet

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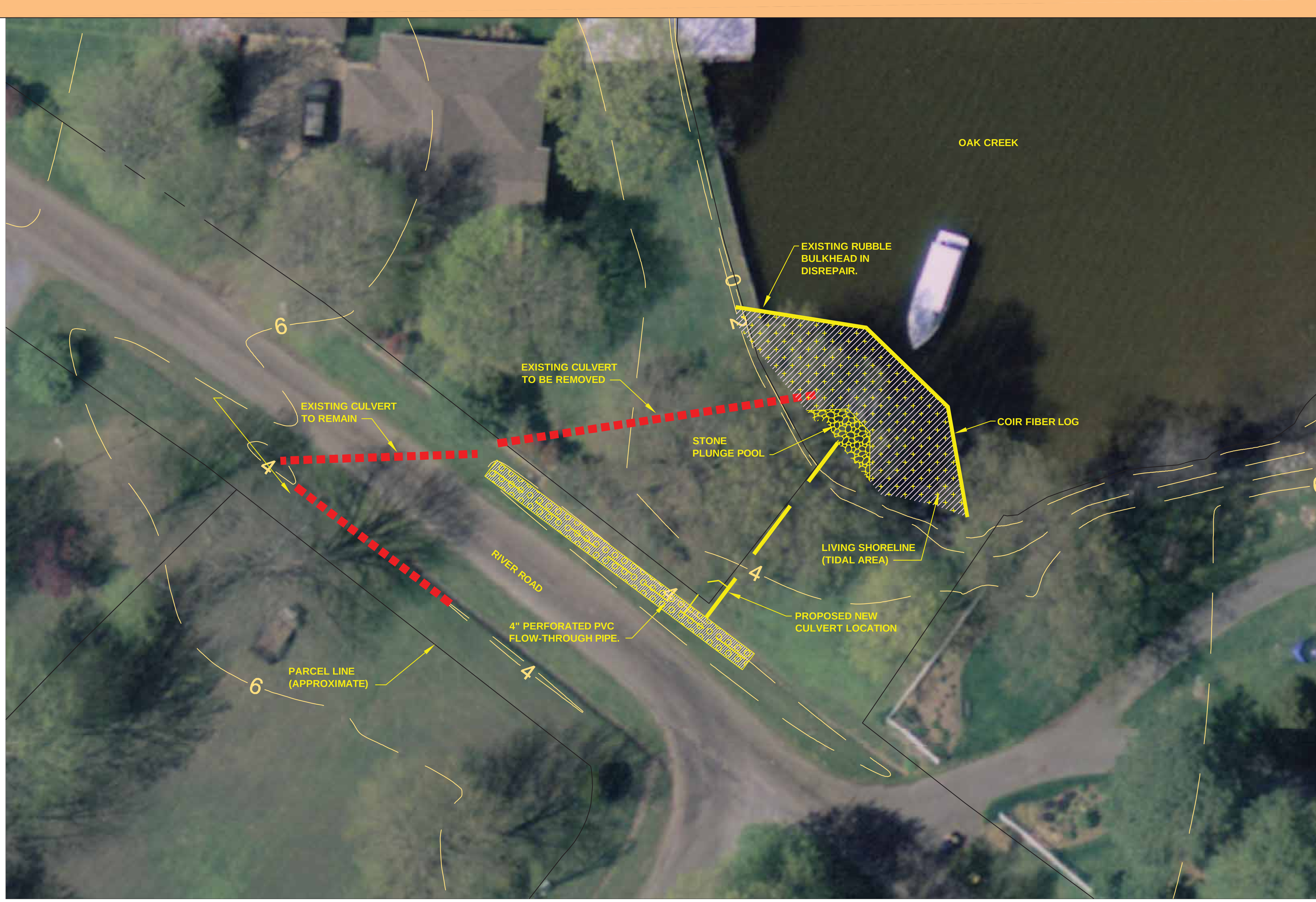
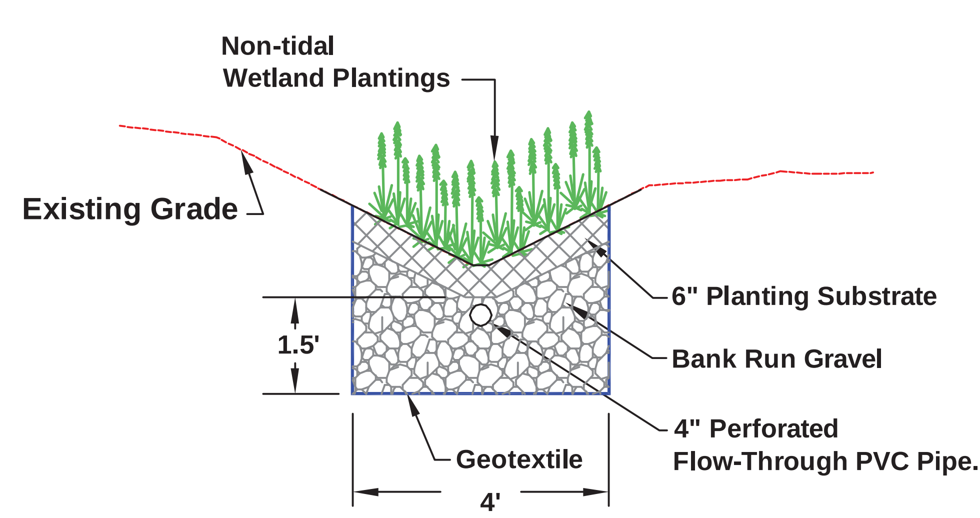
TALBOT COUNTY- VILLAGE OF NEWCOMB

Recommended Retrofit Site "OAK 5"





Legend

- Non-Tidal Wetland Planting Area
- Upland Planting Area
- Tidal Wetland Planting Area
- Meadow Restoration

Exhibit 7

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.

0 200 400 FEET

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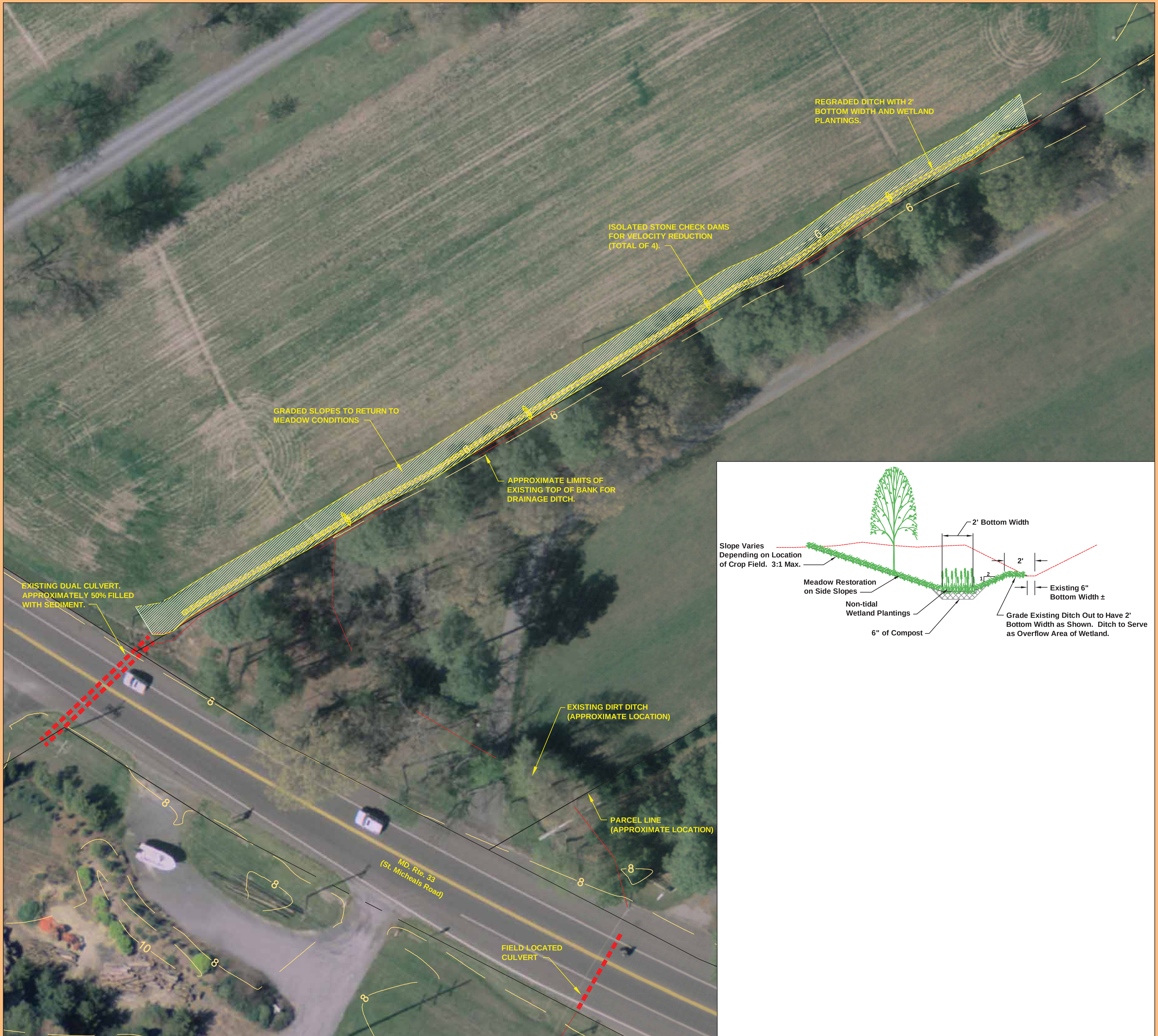
TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Recommended Retrofit Site "MILES 1"



Legend

- Non-Tidal Wetland Planting Area
- Upland Planting Area
- Tidal Wetland Planting Area
- Meadow Restoration

Exhibit 8

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.

0 200 400 FEET

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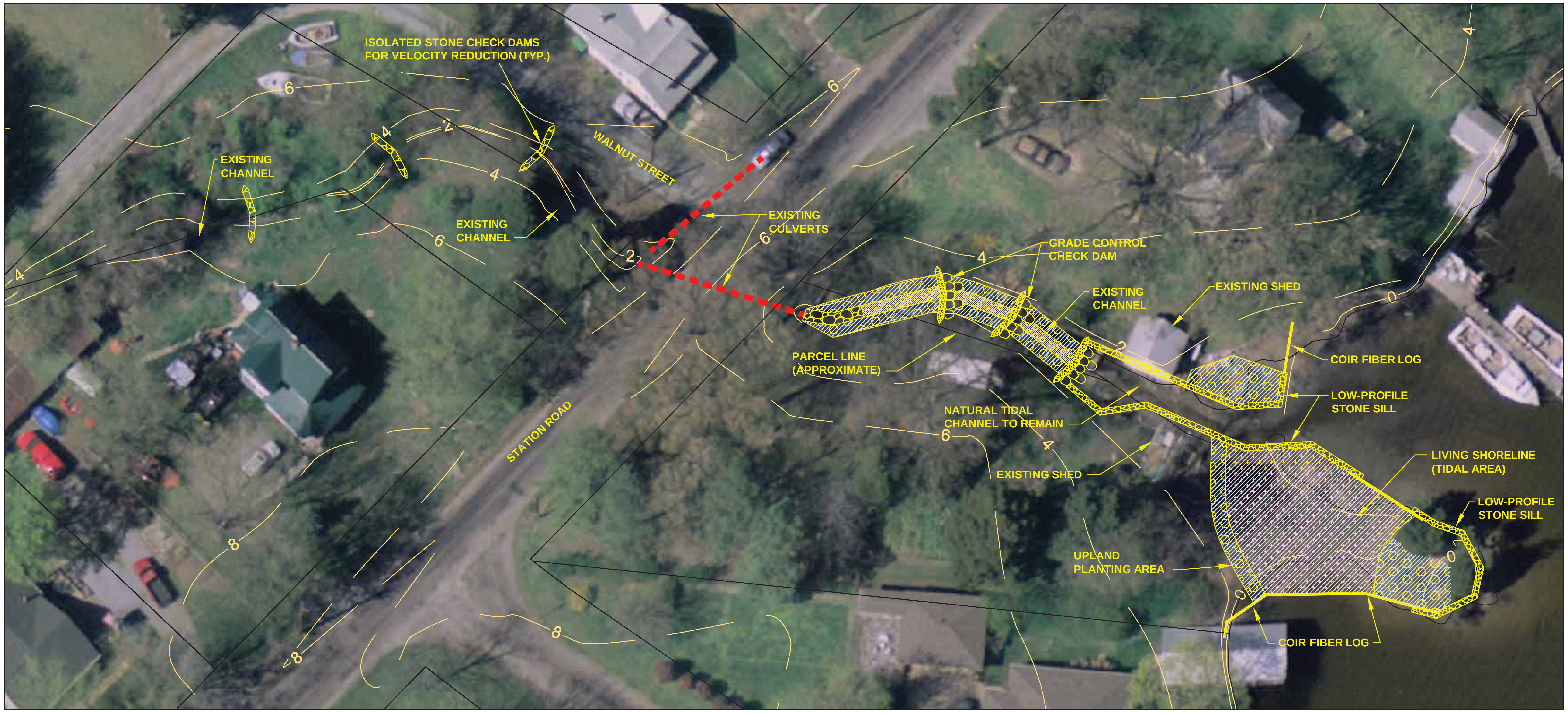
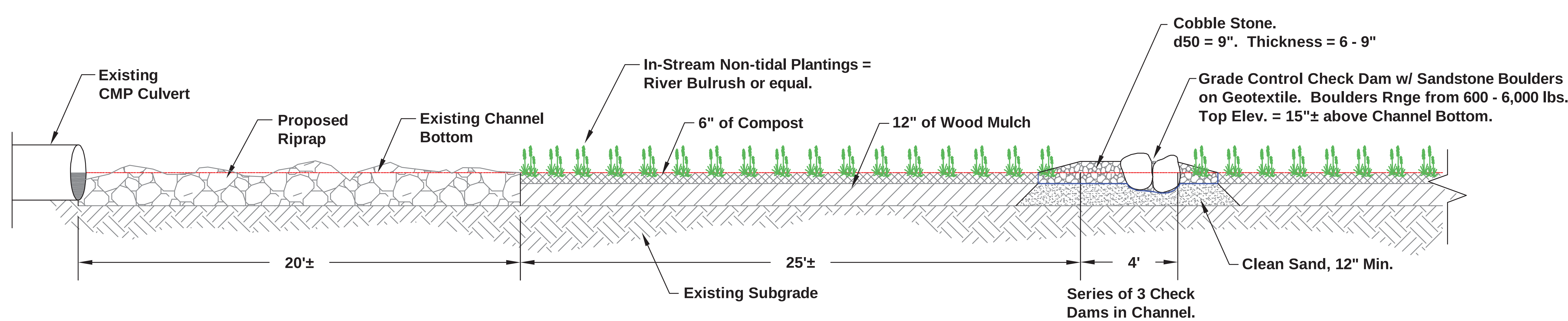
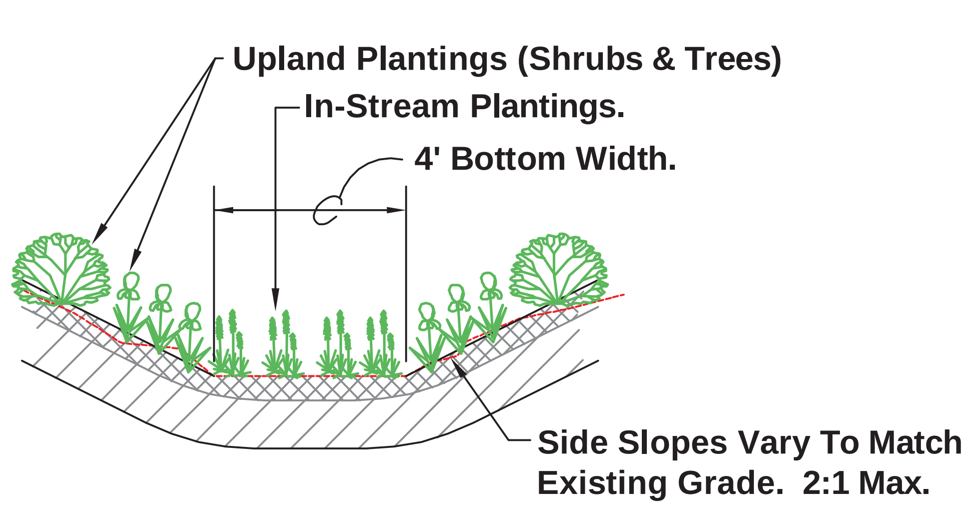
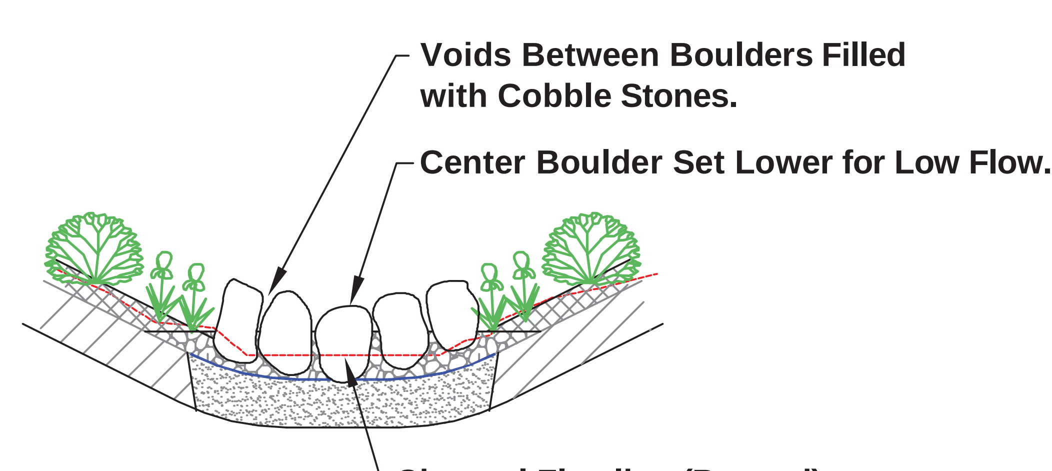
TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Recommended Retrofit Site "OAK 4"









Legend

- Non-Tidal Wetland Planting Area
- Upland Planting Area
- Tidal Wetland Planting Area
- Meadow Restoration

Exhibit 9

Source:
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0 200 400 FEET

N E S W

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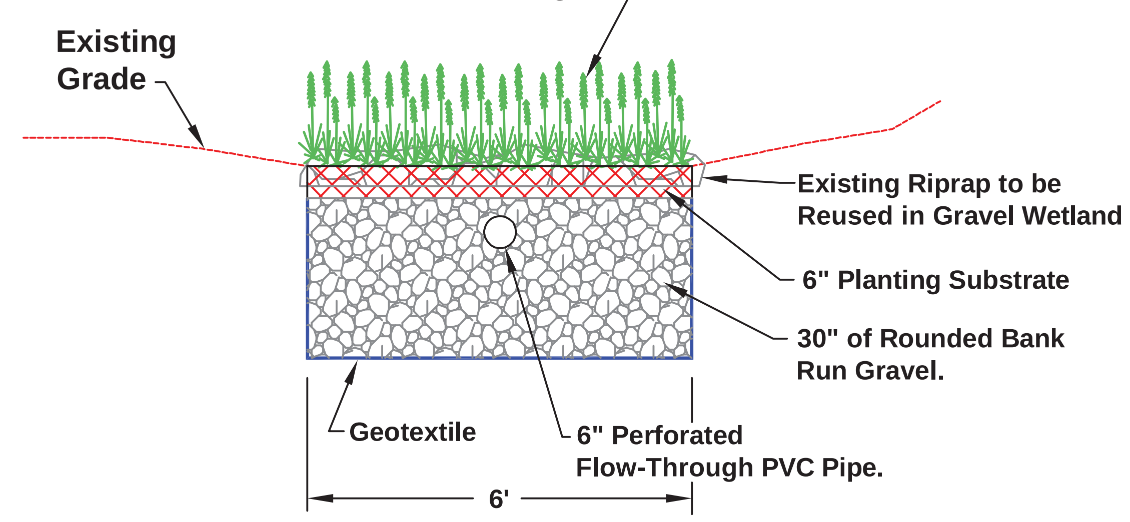
TALBOT COUNTY-VILLAGE OF NEWCOMB

Recommended Retrofit Site "MILES 2"



Legend

- Non-Tidal Wetland Planting Area
- Upland Planting Area
- Tidal Wetland Planting Area
- Meadow Restoration

Exhibit 10

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.

0 200 400 FEET

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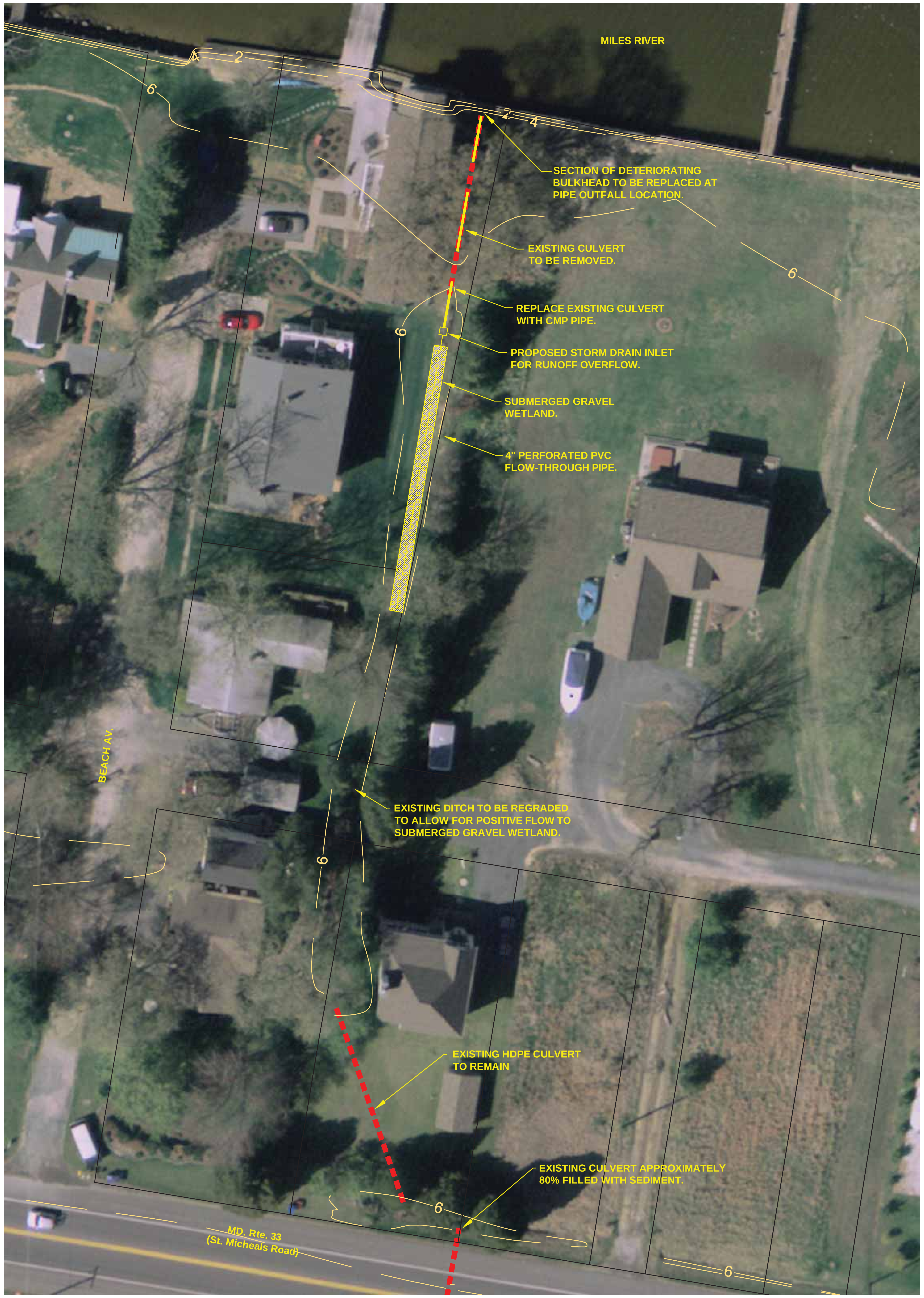

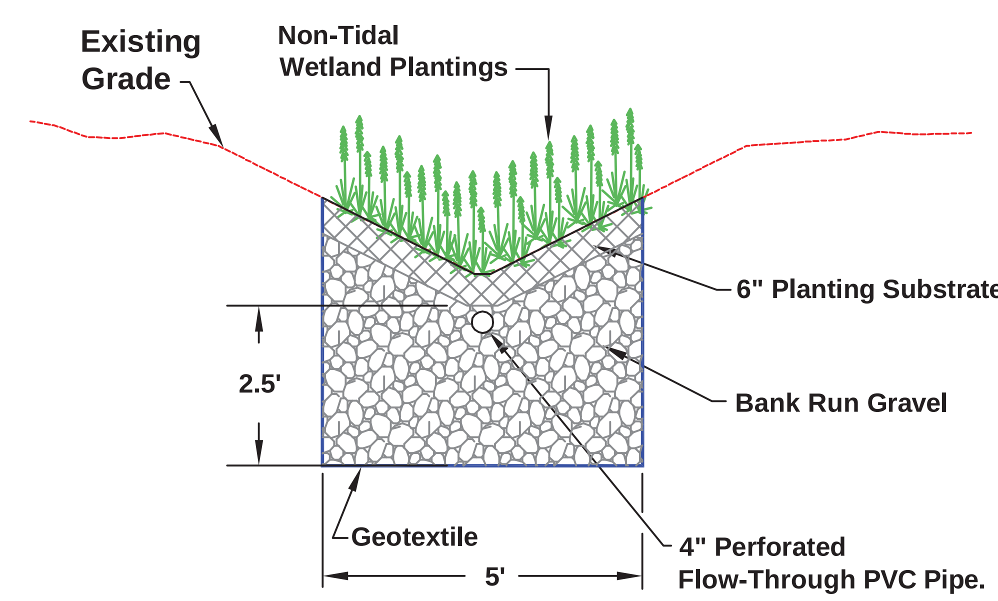

TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Recommended Retrofit Site "MILES 3"

Legend

- Non-Tidal Wetland Planting Area
- Upland Planting Area
- Tidal Wetland Planting Area
- Meadow Restoration

Exhibit 11

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.

0 200 400 FEET

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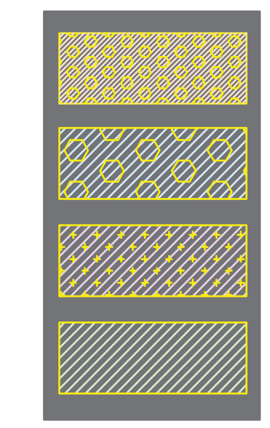
TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Recommended Retrofit Site "OAK 3"

Legend



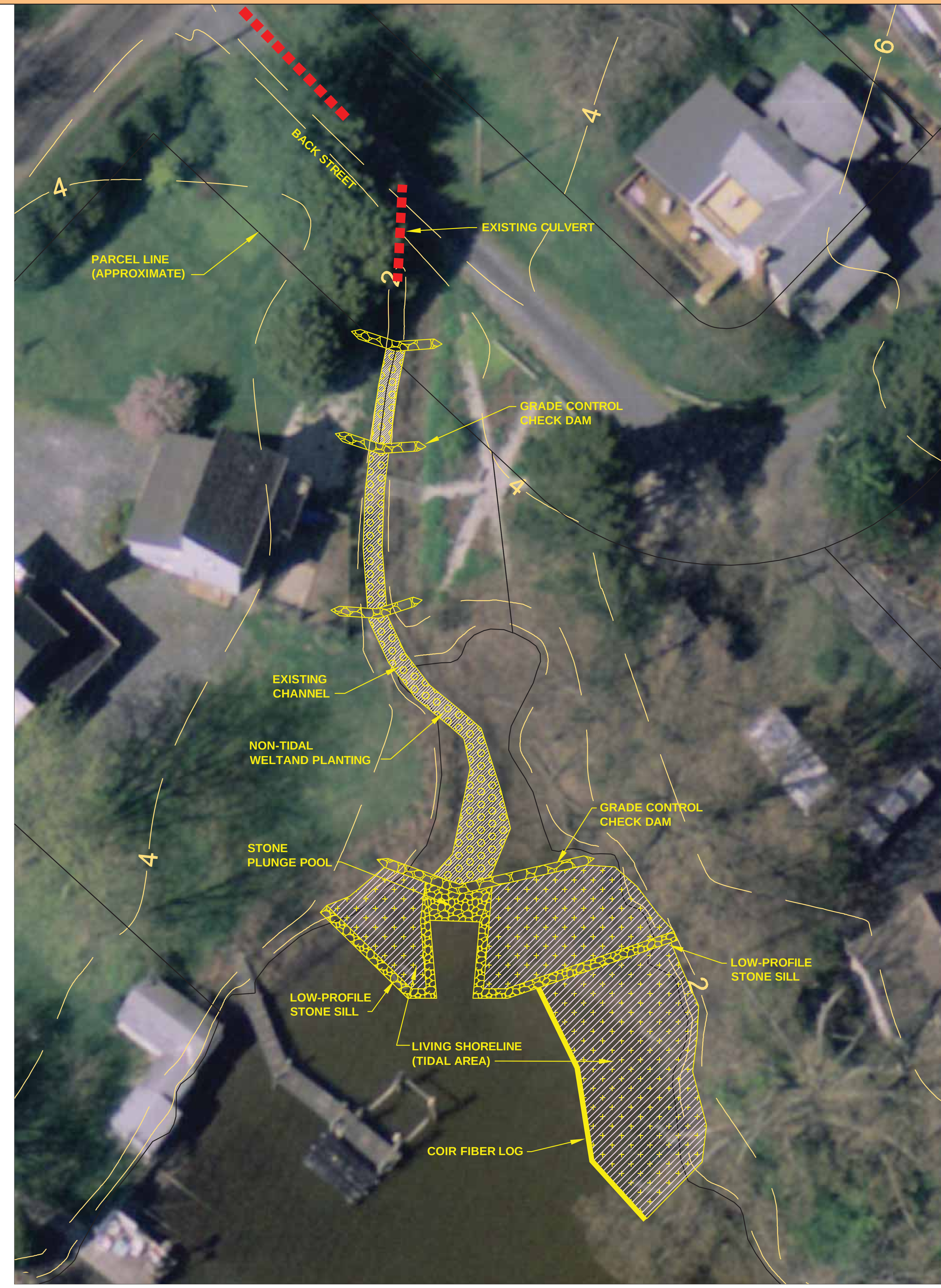
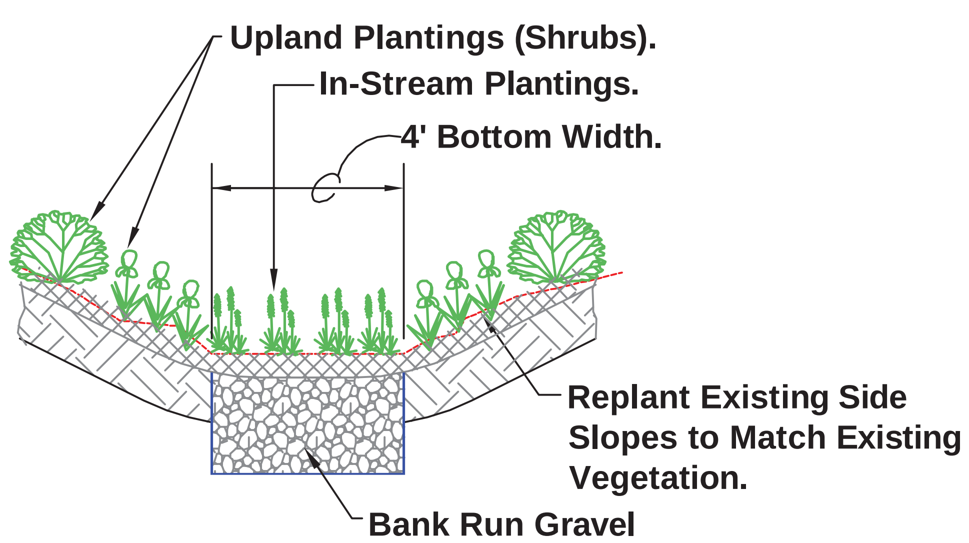
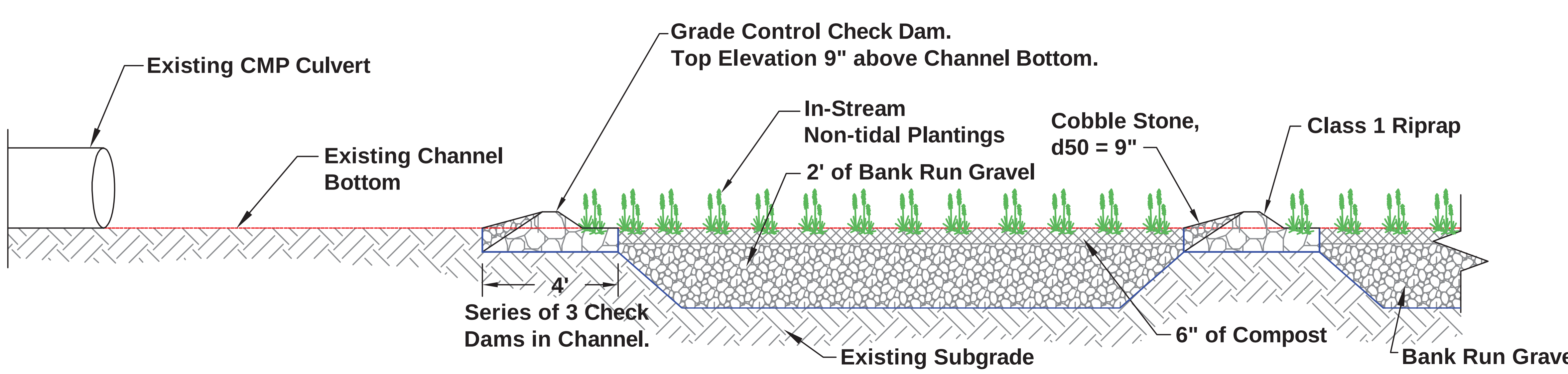
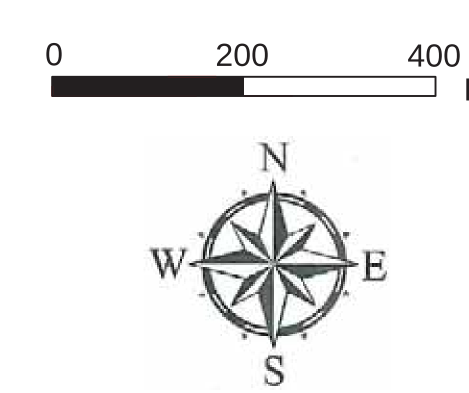


Exhibit 12





Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.



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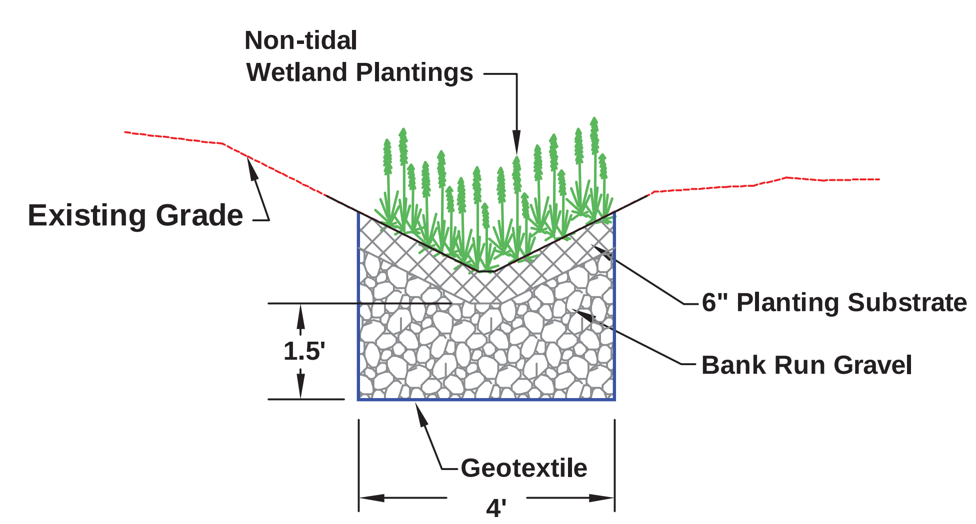
TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Recommended Retrofit Site "OAK 9"



Legend

- Non-Tidal Wetland Planting Area
- Upland Planting Area
- Tidal Wetland Planting Area
- Meadow Restoration

Exhibit 13

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.

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TALBOT COUNTY-
VILLAGE OF
NEWCOMB

Legend

- 1847 Shoreline
- 1942 Shoreline
- 1994 Shoreline
- 2010 Shoreline

Exhibit 14

Historic Shoreline Map

Source:
Data was supplied by Talbot County and Maryland Department of Natural Resources.

0 200 400 FEET

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TALBOT COUNTY-
VILLAGE OF
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Shoreline Inspection

Exhibit 15

Source:
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