SECTION 3 STUDY METHODS AND ASSESSMENT RESULTS

A thorough assessment of both the stream corridor and the upland conditions in a watershed is critical to a holistic approach to watershed management and restoration.

This section details the results of the fieldwork associated with the Centennial and Wilde Lake Restoration Plans, which includes the Unified Stream Assessment (USA), Unified Subwatershed and Site Reconnaissance (USSR), subwatershed retrofitting, and lake shoreline assessments. Detail includes the areas assessed, a summary of data findings, and associated mapping.

3.1 STREAM ASSESSMENT

Field teams conducted a physical stream assessment and teams documented stream corridor conditions for more than 14 linear miles of both perennial and intermittent streams in the Centennial and Wilde Lake sub-watersheds the week of September 29–October 1, 2004. Crews conducted the USA—a comprehensive stream walk protocol for evaluating the physical riparian and floodplain conditions in small urban watersheds. Methods of conducting fieldwork and evaluating collected data can be found in Kitchell and Schueler (2004). The USA integrates qualitative and quantitative components of various stream survey and habitat assessment methods and is used to identify the locations of suspected illicit connections, impacted buffer, severe stream bank erosion, excessive trash accumulation and dumping, and affected stream crossings. While the USA helps to identify high-quality streams for protection, its main benefit is in identifying restoration opportunities for discharge prevention, stream restoration, stormwater retrofits, and riparian reforestation. In the Centennial and Wilde Lake sub-watersheds, the focus was on verifying riparian buffer conditions, characterizing stream bank stability and overall stream habitat condition, and identifying outfall locations that are suspected illicit discharges in need of maintenance or potential retrofit opportunities.

CWP and Tetra Tech staff conducted the USA employing two- or three-person teams. Teams generally covered 2 miles of stream per day. Stream miles in each of the subwatersheds were delineated into 18 individual stream reaches. Within each perennial reach, teams evaluated overall reach habitat using a scoring system based on the U.S. Environmental Protection Agency's (EPA) Rapid Bioassessment Protocol. Teams also identified and recorded basic information on outfall locations, severely eroded stream banks, utility crossings, impacted riparian buffers, trash dumping, and stream crossings. In total, field crews performed the following activities:

- Evaluated more than 30 outfalls, of which 14 were identified for repair, discharge investigation, or retrofitting
- Evaluated three utility crossings, of which two were identified for follow-up inspection or repair
- Identified five areas for buffer reforestation
- Identified 10 sites for stream restoration/bank stabilization
- Identified two locations for trash removal and/or prevention of dumping

A comparative analysis of overall reach habitat scores highlighted 11 reaches in "poor" condition. Reaches were classified as "excellent, "good," "fair," or "poor" based on the average habitat conditions over the length of the reach compared to percentiles of the highest scoring reach in the Centennial subwatershed, Reach B (145 points). Reaches with total scores within the 90th percentile were considered "excellent," while scores that fell below the 65th percentile were considered "poor." The 75th percentile was used as the threshold between "good" and "fair." Table 3.1 summarizes the point breakdown. Tables 3.2 and 3.3 provide a listing of the reaches within each subwatershed (Centennial and Wilde Lake, respectively), their total habitat scores, and a summary of the general characteristics observed. Figures 3.1 and 3.2 show reach locations in the Centennial and Wilde Lake subwatersheds, respectively.

Table 3.1 Reach Overall Habitat Score Percentiles

Score	Percentile	Classification
145	High score	
>130	90%	Excellent
>109	75%	Good
>94	65%	Fair
<93	Less than 65%	Poor

Table 3.2 Centennial Lake Reach Characterization

Reach ID	Total Score	Reach Characterization
A	134 excellent	Reach A is the mainstem of the tributary draining to Centennial Lake. The reach was generally stable through agricultural and forested lands. The stability was compromised in places by invasive species that have overwhelmed replanted and protected buffer areas.
B	145 excellent	This is a generally stable reach that drains low-density residential and institutional land uses. The lower portion of the reach contains additional replanted stream buffers that are compromised by invasive species.
C	141 excellent	The generally stable reach has isolated areas where construction activities are affecting the stream.
D	110 good	This unstable reach drains a residential area that feeds into a small in-stream pond that is used for stormwater management before it enters the lake.
E	82 poor	This stream runs through a neighborhood area that drains to the Little Patuxent below the lake. There are a number of locations in the reach where homeowners have encroached upon the stream buffer and several untreated outfalls.
F	93 poor	The upper portion of the reach is very incised through a forested area.
G-1	102 fair	This segment of Reach G passes through a forested area where there is some localized erosion occurring primarily along meander bends.
G-2	113 good	This stable portion of the Reach G contains a stream buffer that is suffering from invasive species dominance and lack of forest growth. A beaver dam and a small constructed dam are located in this portion of the reach.

Table 3.3 Wilde Lake Reach Characterization		
Reach ID	**Total Score**	**Reach Characterization**
A	95 fair	The upper section of this reach, near Cedar Lane Park off of Route 108, is experiencing channel instability, especially where it enters the forest and begins downcutting and eroding its banks. Some of the development upstream is relatively recent, and the stream is likely adjusting to the change in hydrology. The reach between Elliotts Oak Road and Hesperus Drive appears to be a transport reach for sediment, and the portion below Hesperus Drive down to the lake is largely depositional as the slope of the stream is relatively flat. There are a number of locations where localized erosion is associated with a poor riparian buffer.
B	70 poor	This is a very unstable reach upstream of Durham Road West that traverses through residential backyards. Many homeowners have taken piecemeal measures to attempt to reduce loss of property.
C-1	74 poor	The upper portion of this reach is very unstable and contains high- and medium-density residential neighborhoods and some commercial development. Reach C-1 and a tributary to C-3 are the most unstable locations, though there is still active erosion in the upper portion of C-2, particularly just below Harper's Farm Road.
C-2	88 poor	
C-3	81 poor	
D	46 poor	Reach D is a degraded incised intermittent urban channel that transports a considerable amount of sediment according to Heil and Johnson (1995) and staff observations of eroding outfall infrastructure and active bank erosion. A stream rehabilitation project was completed on this reach in the spring of 2005 and has improved stream stability within this reach.
E	82 poor	Reach E is a stable urban channel that drains the Beaverbrook pond, which likely has a moderating effect on the stream. Much of this reach of the stream is unbuffered, and considerable algae is likely evidence of high nutrients from the Beaverbrook pond and/or lawn care practices.
F	Intermittent flow	Reach F is a relatively stable urban stream with two small locations where there is erosion caused by an inadequate stream buffer and channel instability.
G	83 poor	This enlarged urban stream is still somewhat erosive and relatively straight.
I	Intermittent flow	This badly eroding upper section (~100-ft) is undermining drainage infrastructure; it ultimately flows into a concrete channel and down to the lake.

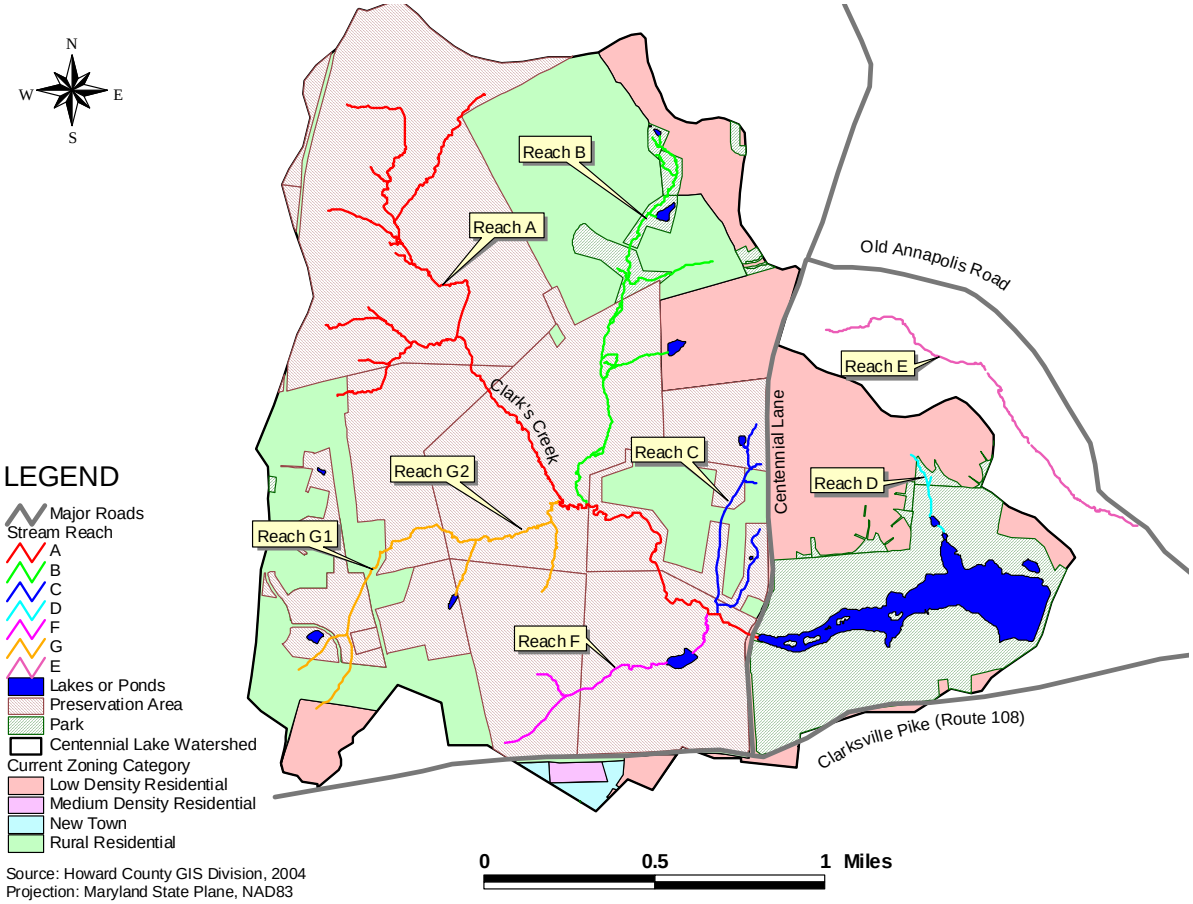

Figure 3.1 Centennial Lake reach map.

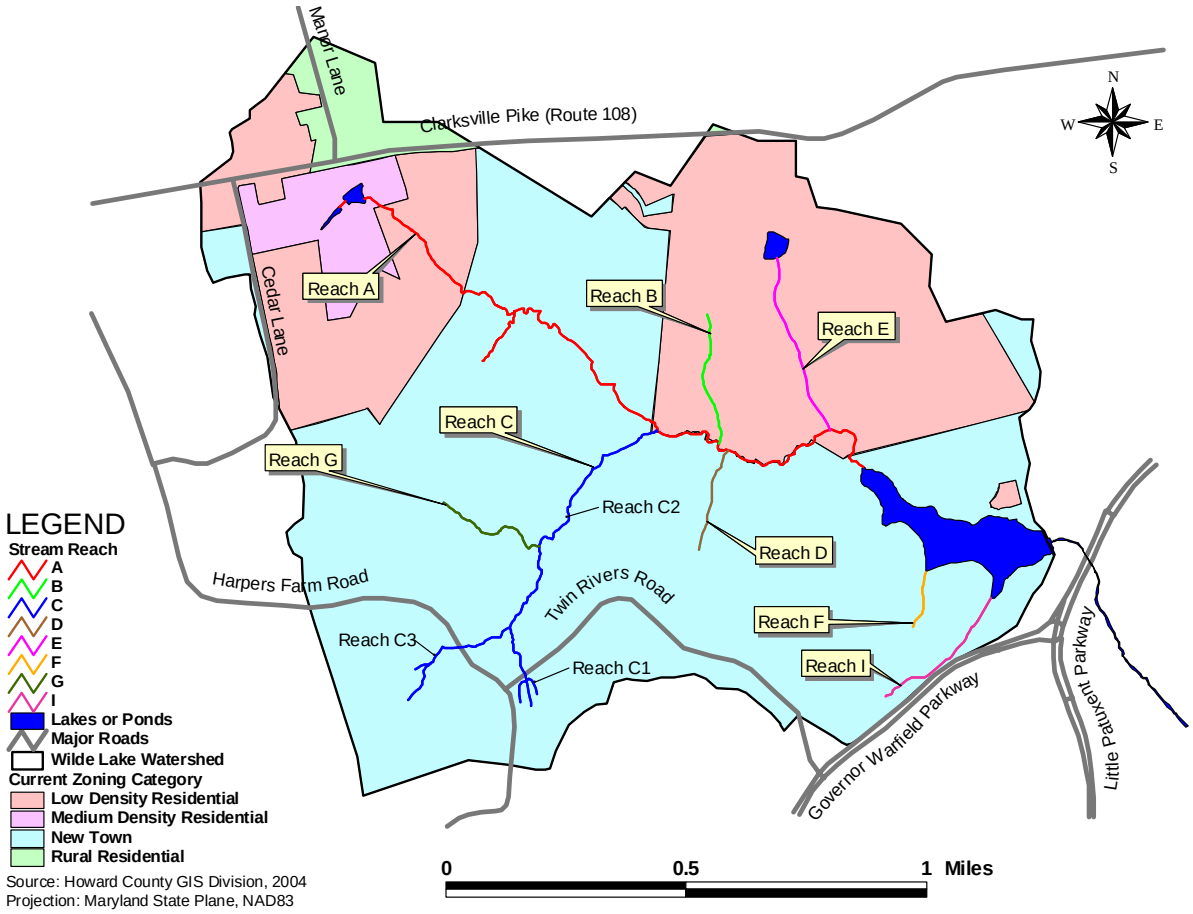

Figure 3.2 Wilde Lake reach map.

Centennial Lake

The Centennial Lake subwatershed has more limited development, much of which was built with stormwater management, except for most of the park infrastructure. These existing stormwater controls, however, do not provide the level of water quality treatment of more up-to-date practices. Agricultural uses still make up a significant portion of the upper watershed, and though well-managed, there are a number of important opportunities to reduce the impacts to the lake. Table 3.4 and Figures 3.3 and 3.4 provide additional details and locations of specific conditions found in the Centennial Lake sub-watershed.

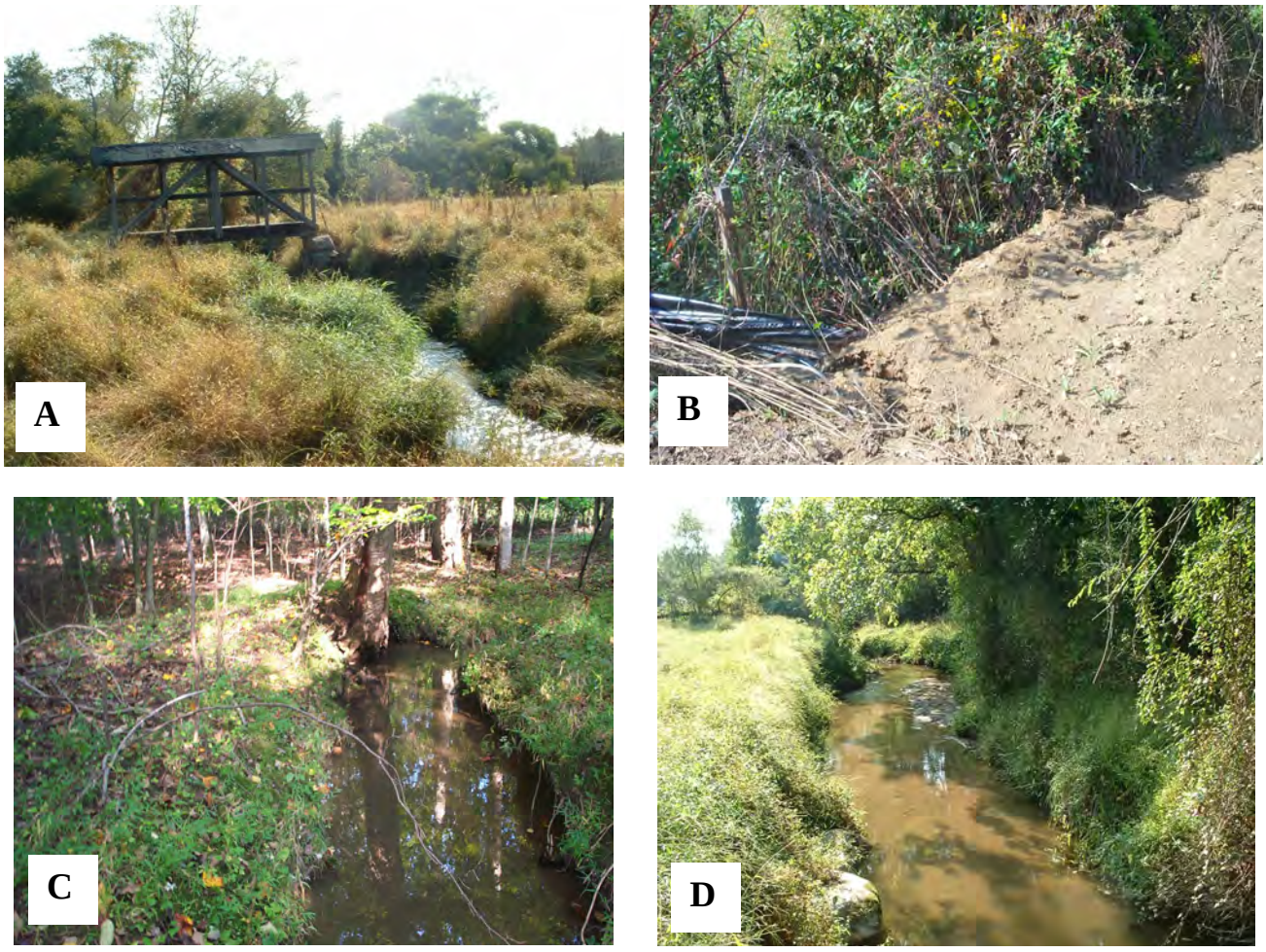

Figure 3.3 The Centennial Lake USA findings were characterized by generally stable streams in agricultural areas with a few notable areas for improvement. (A) an inadequate buffer site where invasive species have prevented the regrowth of forest resulting in unstable stream banks, (B) a location where erosion and sediment control was inadequate, (C) a typical section of stable stream in the upper portion of the watershed, and (D) some of the in-stream sediment deposition in a reach with unstable stream banks.

Table 3.4 Centennial Lake Watershed USA Results			
Subwatershed	**Reach ID**	**Problem ID**	**Condition**
Centennial Lake	A and F	IB-1/ER-1	Inadequate riparian buffer, lack of stream shading, and eroding stream
	A	OT-1	Outfall conveyance through floodplain creating a headcut beginning at stream; consider use of a level spreader
	A	IB-4	Inadequate riparian buffer due in part to invasive species
	F	IB-2	Inadequate riparian buffer
	G	IB-3	Inadequate riparian buffer due in part to invasive species
	G	ER-2	Small eroding reach through forested section below Manor Lane
	E	OT-2/3	Outfalls that drain directly to stream; consider for retrofit OT-2 almost fully submerged with sediment

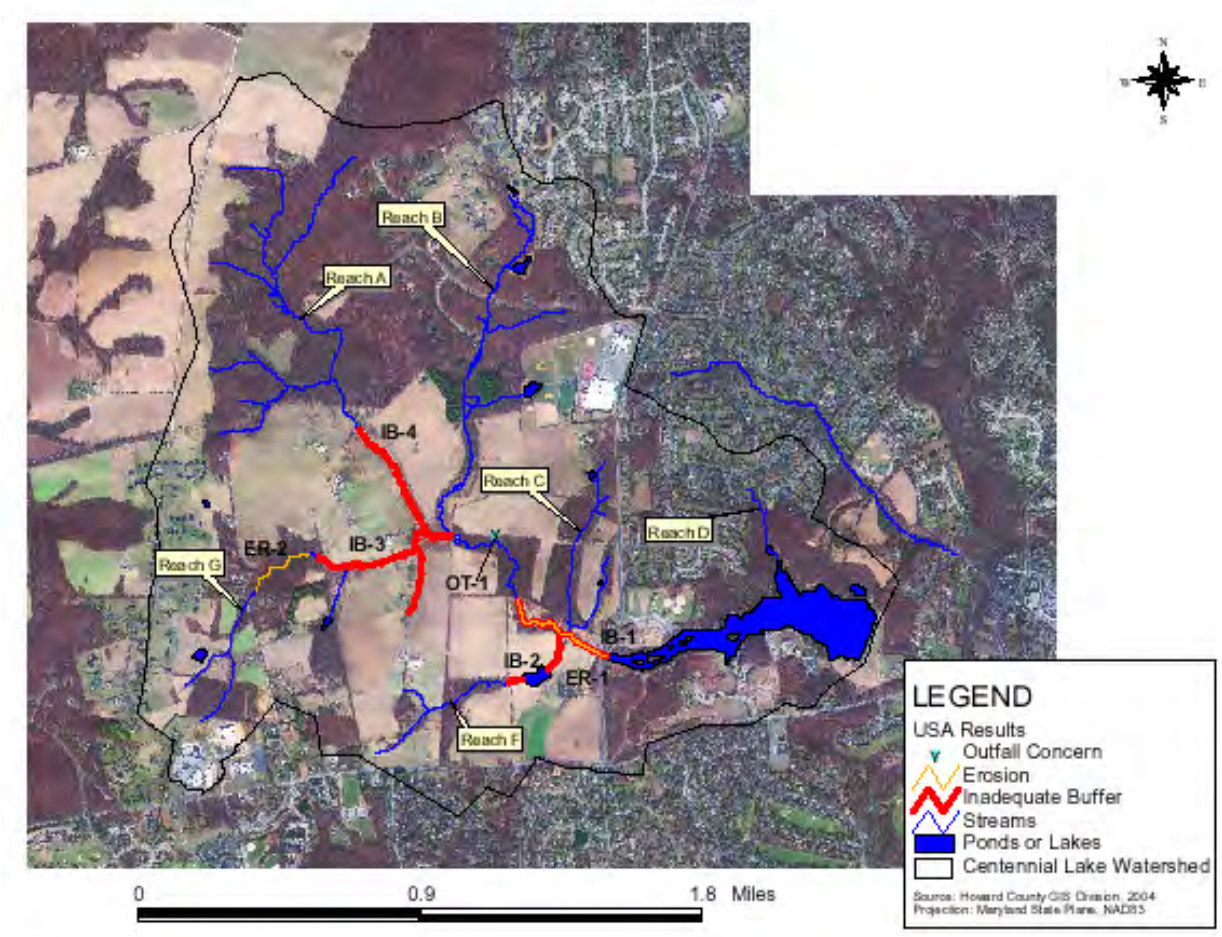

Figure 3.4 USA results for Centennial Lake sub-watershed.

Wilde Lake

Wilde Lake is characterized by stream instability and infrastructure problems resulting from a lack of stormwater runoff management when much of the area was constructed in the 1970s. Typical problems identified in Wilde Lake are shown in Figure 3.5, and maps illustrating the locations of restoration opportunities are provided in Figure 3.6. Table 3.5 lists the problems that were found in Wilde Lake, including those with evidence of illicit discharges. Priority restoration projects are identified as part of the implementation plan provided in Section 4. Wilde Lake, which is a much more developed watershed, has the majority of restoration needs and opportunities when compared to Centennial Lake.

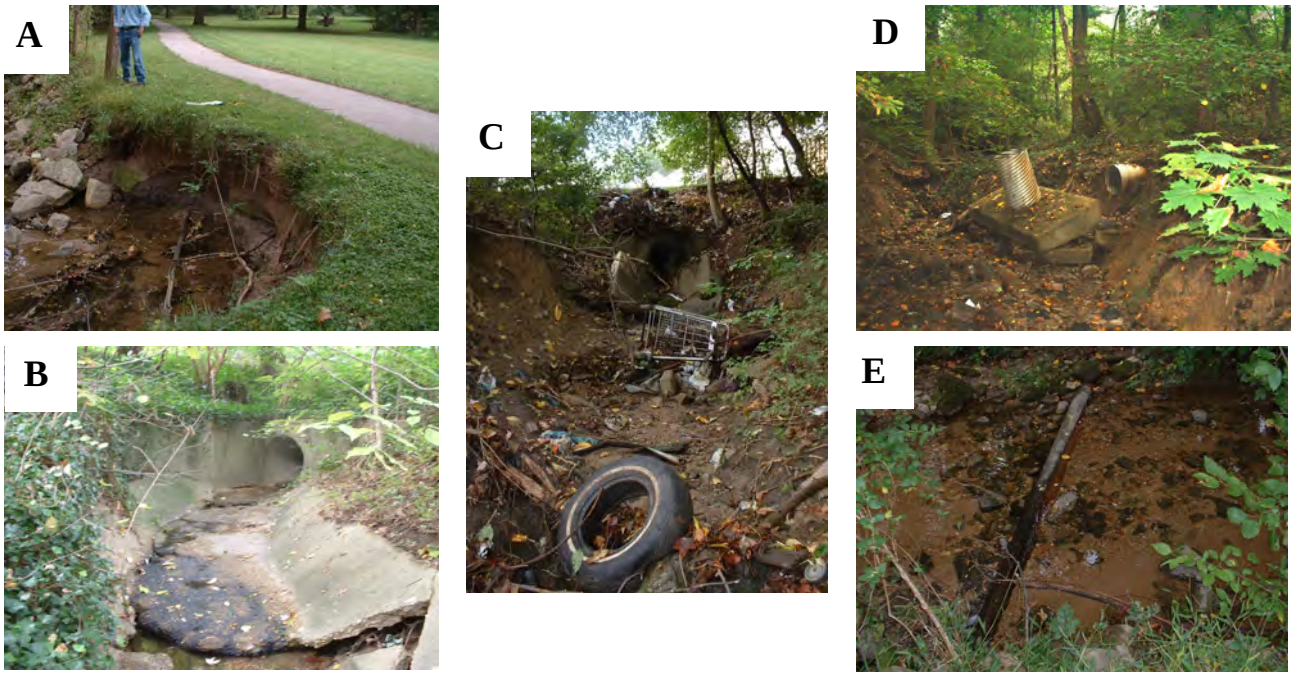

Figure 3.5 Typical problems identified in the USA assessment of Wilde Lake: (A) erosion and inadequate buffer, (B) potential illicit discharge, (C) trash dumping site, (D) broken outfall with stream erosion, and (E) exposed infrastructure.

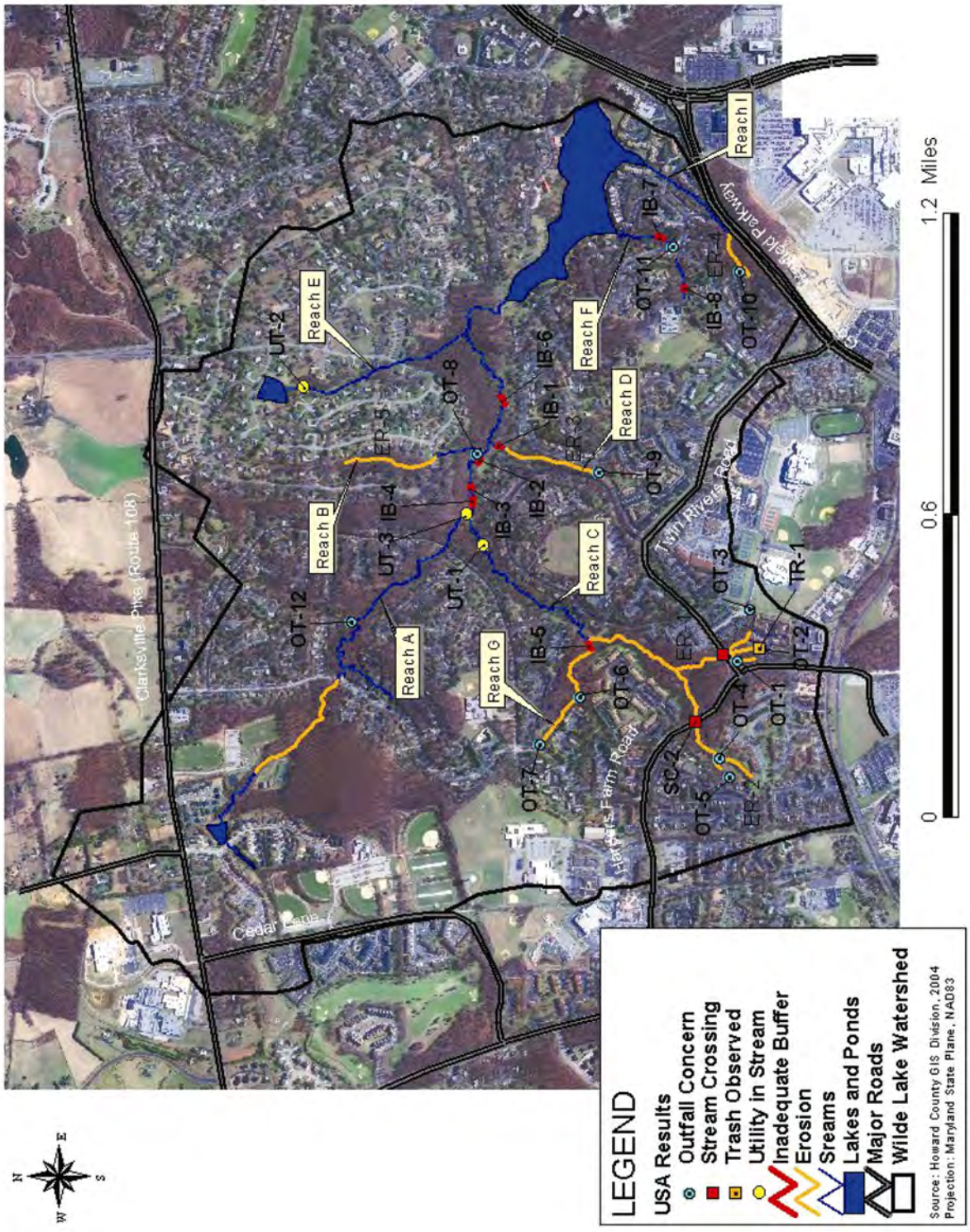

Figure 3.6 USA results for the Wilde Lake sub-watershed.

Table 3.5 Wilde Lake Watershed USA Results			
Subwatershed	**Reach ID**	**Problem ID**	**Condition**
Wilde Lake	WL-C1	OT-1	18 in outfall in need of stabilization
	WL-C1	OT-2, TR-1	18 in outfall potential stormwater retrofit location
	WL-C1	OT-3	18 in outfall potential retrofit location
	WL-C3	OT-4	42 in outfall potential retrofit location
	WL-C3	OT-5	36 in outfall potential retrofit location
	WL-G	OT-6	24 in outfall 2- to 3-ft drop undermining outfall
	WL-G	OT-7	27 in possible illicit discharge—yellowish discoloration
	WL-G	OT-8	27 in outfall infrastructure extends into stream
	WL-D	OT-9	48 in possible illicit car wash at gas station and reddish benthic growth, apron subsiding, recently fixed with stream rehabilitation project
	WL-D	OT-10	21 in end of outfall broken, headwall detached and in stream, recently fixed with stream rehabilitation project
	WL-I	OT-11	42 in black oily discharge possible evidence of illicit connection on concrete channel
	WL-A	OT-12	30 in outfall undercut and hanging in air
	WL-C2	ER-1	30 ft of erosion stemming from headcut from small parking lot fronting Twin Rivers Road.
	WL-C3	ER-2	200 ft of intermittent channel to the east of the mainstem of C3 behind the apartment complex; headcut migration will continue for another 200-ft
	WL-D	ER-3	400 ft of erosion high severity—stream restoration underway
	WL-I	ER-4	100-ft eroding reach where several outfalls and urban runoff areas come together
	WL-B	ER-5	600 ft of unstable banks affecting homeowner yards, fences, and trees in the Beaverbrook community
	WL-C2	UT-1	14 ft exposed water line in stream bottom
	WL-B	UT-2	Remnants of old sewer pipe; need to ensure no longer in use
	WL-A	UT-3	Exposed sanitary sewer located at the confluence of two streams
	WL-C1	TR-1	Trash cleanup estimated at five pickup truck loads
	WL-D	IB-1	40 ft left bank inadequate buffer and erosion
	WL-A	IB-2	20 ft inadequate buffer and erosion
	WL-A	IB-3	20 ft inadequate buffer and erosion
	WL-A	IB-4	70 ft inadequate buffer and erosion
		IB-5	40 ft left bank inadequate buffer and erosion
	WL-A	IB-6	60 ft around corner inadequate buffer and erosion
	WL-H	IB-7	30 ft inadequate buffer and erosion
	WL-H	IB-8	20- to 30-ft inadequate buffer and erosion
	WL-C1	SC-1	2-ft drop undermining headwall; fix with proposed stream restoration
	WL-C3	SC-2	1-ft drop, large scour hole, and downstream erosion resulting in part from misaligned culvert; fix with proposed stream restoration

3.2 UPLAND ASSESSMENT

This section summarizes the findings from CWP's (September 2004) residential and hotspot assessments. Approximately 30 residential neighborhoods and 14 potential hotspot locations within the Wilde Lake and Centennial Lake sub-watersheds were evaluated for pollution prevention and restoration potential. Identification of hotspots, municipal operations, and residential pollution-producing behaviors that contribute to nutrient loading was the focus of this effort. For a detailed description USSR used during this survey, consult Wright et al. (2004).

The USSR is a field survey that evaluates potential pollution sources and restoration opportunities within urban subwatersheds. The USSR is a "windshield" survey where field crews drive every road in the watershed to determine specific pollution sources and identify areas outside of the stream corridor where pollution prevention possibilities exist. The concept behind the USSR is to provide a quick but thorough characterization of all upland areas to identify major sources of pollutants and restoration opportunities for source controls, pervious area management, and improved municipal maintenance (e.g., education, buffer plantings, downspout disconnections).

Neighborhood Source Assessment (NSA)

The NSA profiles pollution source areas, stewardship behaviors, and restoration opportunities within individual neighborhoods, looking specifically at yards and lawns, rooftops, driveways, sidewalks, curbs, and common areas. When neighborhoods are found to have similar characteristics in these areas, they are grouped together and assigned a single unique site ID. Table 3.6 shows which neighborhoods were assessed, assigned to groups, and given unique site IDs. Figures 3.7 and 3.8 show the locations of the neighborhoods in Centennial and Wilde Lake watersheds.

CWP grouped the 30 neighborhoods into 23 assessment areas, specifically assessing lot size, tree cover, drainage, lawn size, general upkeep, and stewardship. Each neighborhood assessment area was assigned a pollution severity of "severe," "high," "moderate," or "none," using a set of benchmarks set forth in Wright et al. (2004). Pollution severity is an index of how much nonpoint source pollution a neighborhood is likely generating based on easily observable features (lawn care practices, drainage patterns, oil stains). Factors that are assessed during the NSA include over fertilization, extensive pesticide and herbicide application, car washing, use of salts and deicer, rooftop runoff to impervious surfaces, pet waste issues and buffer encroachment. Additional detail and the weighting methods used for the various factors can be found in Wright et. al., 2004. The restoration potential was also determined for each neighborhood type, with rankings of "high," "moderate," or "low" depending on the feasibility of on-site retrofits or behavior changes, which in turn depend on available space, number of opportunities, presence of a strong Home Owners' Association (HOA), and the like. Table 3.6 summarizes the NSA results.

Table 3.6 Neighborhood Pollution Severity and Restoration Potential

Watershed	Site ID	Neighborhood*	Pollution Severity	Restoration Potential	Specific Recommendations
Centennial Lake	CL-N1	Woodland Road	Moderate	Low	Reforestation
	CL-N2	Oak Hill			Buffer planting/ education
	CL-N3	Centennial Estates			
	CL-N4	O'Donnell (Carillon Drive)			
	CL-N5	Chateau Valley			
	CL-N6	Centennial Lake	Moderate	Low	
	CL-N7	The Preserve	Moderate	Low	
	CL-N8	Chateau Ridge	Low	Low	
	CL-N9	Gaither Hunt	Moderate	Low/ Moderate	Lawn care education
Wilde Lake	WL-N1	Cedar Manor	Moderate	Low/ Moderate	Lawn care education Buffer planting/ education Wet pond maintenance (County is studying***) Cleanup
	WL-N2	Beech Creek			
	WL-N3	Hobbitts Glen	Low	Low	
	WL-N4	Bryant Woods, The Cove, Watermark Place, Windstream Drive, Bryant Square	Moderate	Low/ Moderate	Pet waste education Buffer planting around lake
	WL-N5	Green Mountain Circle	Moderate	Low/ Moderate	Downspout disconnection
	WL-N6	Faulkner Ridge, Fall River Terrace	Low	Low	Buffer education
	WL-N7	Cross Fox, Faulkner Station, Harpers Forest Apts., Deering Woods	Low	Low	Buffer education
	WL-N8	Ranleagh Court	Low	Low	
	WL-N9	Merion Station, Settler Place**	Moderate	Low/ Moderate	Lawn care education Buffer planting/ education Wet pond maintenance Cleanup parking lot retrofit
	WL-N10	Longfellow Harper's Choice	Low	Low	Pet waste education
	WL-N11	Beaverbrook (Durham Rd.)	Moderate	Moderate	Pond maintenance Lawn care education
	WL-N12	Longfellow (Mystic Ct.)	Moderate	Low	General housekeeping and dumping education
	WL-N13	Running Brook	Low	Low	
	WL-N14	The Birches	Moderate	Low	Need buffer around lake

Shading indicates higher-priority neighborhoods based on pollution severity and actions needed; includes those neighborhoods that were found as having "moderate" pollution severity and a restoration potential on the upper half of the "low" guidelines, which can be found in Wright et al. (2004).

*Neighborhoods with similar characteristics are occasionally grouped together in the field. If more than one neighborhood/subdivision is listed, each of those listed was included on one field sheet. Where names were not known, the main road name(s) have been included.

**Included on field sheet for WL-N4, though assigned a different unique ID for different retrofit options.

*** The County has conducted a bathymetric survey of the Beech Creek pond.

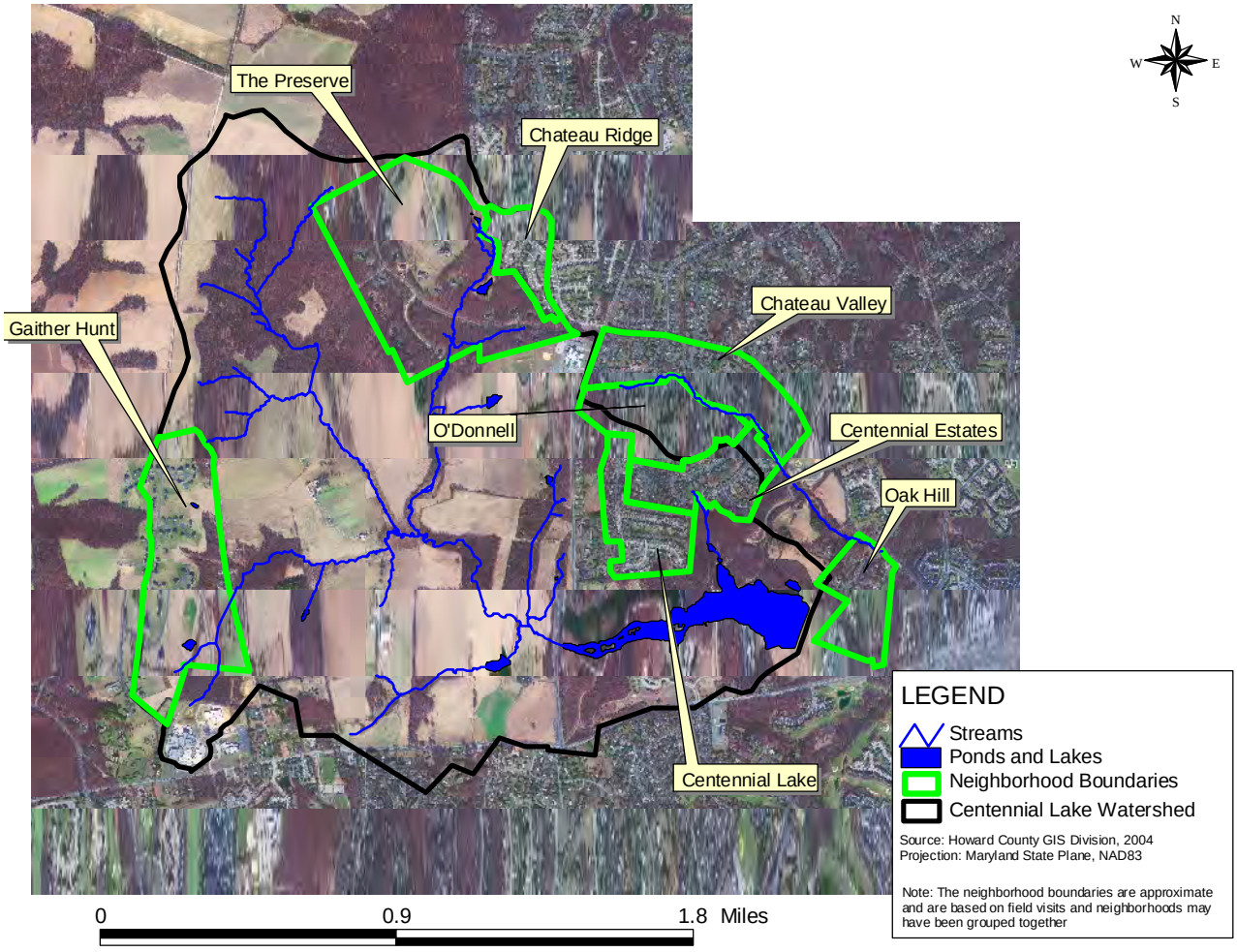

Figure 3.7 Neighborhoods in Centennial Lake Watershed.

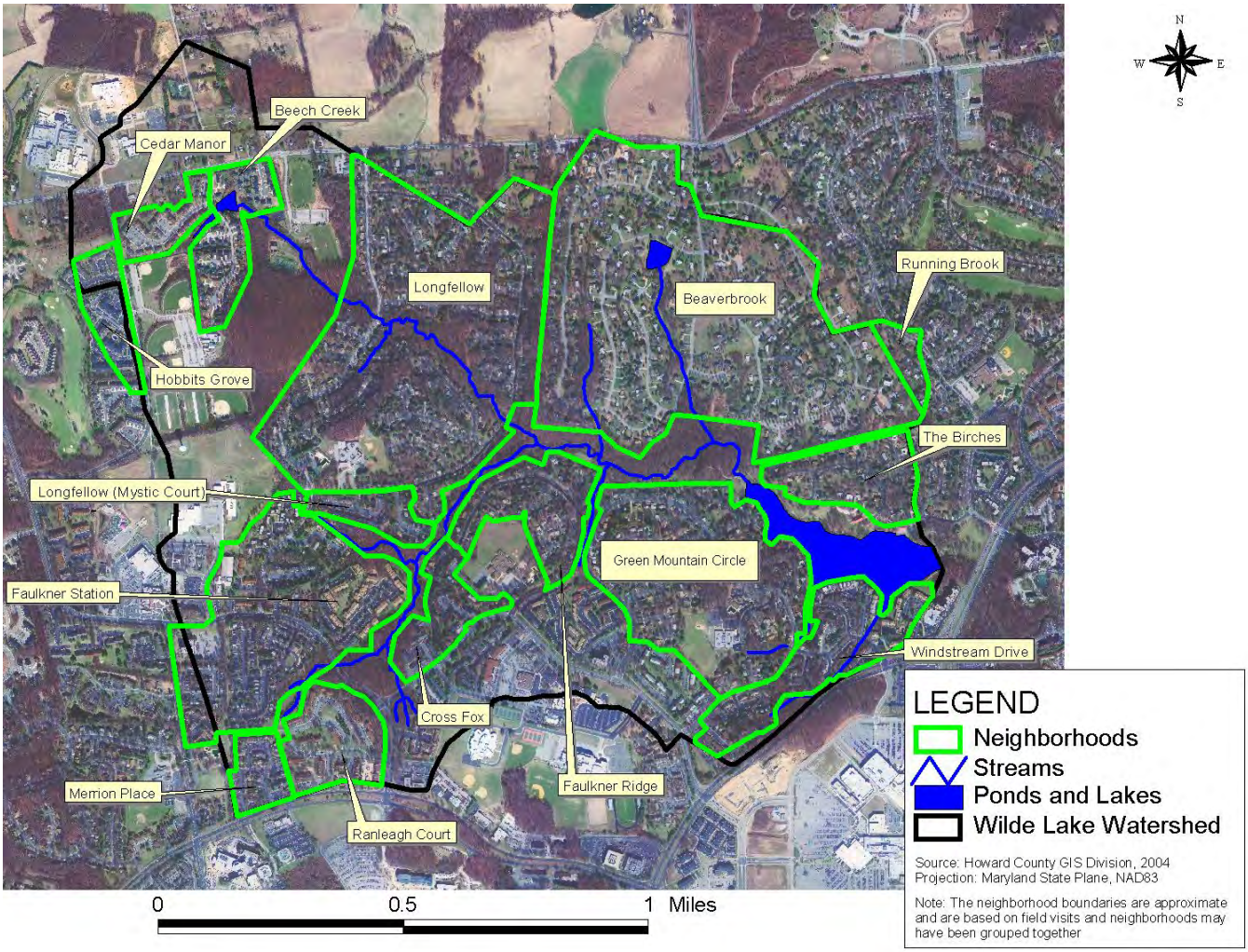

Figure 3.8 Neighborhoods in Wilde Lake Watershed.

Although the restoration potential was determined to be "low" or "moderate" for most neighborhoods, a watershed wide public education campaign is still considered to be a cost effective use of County funds. Statistics compiled for the Chesapeake Bay watershed reveal that 50% of residents who fertilize their lawns will over-fertilize (Swann, 2000). As a result, in urban watersheds lawns are a significant potential contributor to water quality degradation. The public education campaign would provide information to new residents, remind current residents of actions they can take to protect the lakes and would provide information regarding new practices and techniques that residents can adopt to reduce the runoff from their yards.

As shown in Table 3.6, the three recurring recommendations found in these two watersheds were downspout disconnection, buffer planting/education, and lawn care education. Frequently, downspouts were found to be connected to impervious areas; in some of these areas, rain barrels or rain gardens were often feasible (Figure 3.9). A second observation was the lack of buffer and/or buffer encroachment along stream reaches and Wilde Lake, in particular (Figure 3.10). Finally, many lawns were identified as being highly managed. This determination was made by observing bright green grass that is all one height with few to no weeds appearing frequently fertilized, mowed, and/or watered (Figure 3.11).

Figure 3.9 One of the more extreme downspout connections. Connection (see arrow) shown here has worn a small channel across the footpath that surrounds Wilde Lake.

Several other observations were made throughout both watersheds. These are not specifically addressed on an area of the NSA field sheet, but are worth noting. Figure 3.12 shows some of these observations.

Figure 3.10 Several streams as well as lakesides in both watersheds (A) and Wilde Lake (B) displayed a lack of buffer and/or buffer encroachment (C). Buffer education and plantings are two strategies to combat these problems.

Figure 3.11 The house on the left shows tell-tale signs of high turf management, including lack of weeds and evidence of fertilizer (bright green grass). The house on the right also shows signs of high turf management, but contains a rain barrel and compost bin, which is evidence of a conservation ethic in the watershed.

Single lot construction sites can discharge sediment to the streets, which may have an impact on downstream receiving waters.

Permeable pavement used in this parking area at Centennial Park off Old Annapolis Road may potentially have more widespread application.

Pet waste pick-up stations were numerous around Wilde Lake and are an inexpensive way to improve water quality and educate residents.

Pervious cul-de-sac islands were frequently found throughout Wilde Lake. While these already slightly reduce impervious cover in the watershed, there may be opportunities to use some of them to treat stormwater.

Figure 3.12 Miscellaneous observations observed throughout the sub-watersheds.

Hotspot Site Investigation (HSI)

The HSI ranks the potential severity of each commercial, industrial, municipal, or transport-related hotspot found within a subwatershed by looking specifically at vehicle operations, outdoor materials storage, waste management, building conditions, turf and landscaping, and stormwater infrastructure. For the purposes of this study, stormwater "hotspots" are defined as commercial, industrial, institutional, municipal, or transport-related operations that produce higher levels of stormwater pollutants, and/or present a higher potential risk for spills, leaks, or illicit discharges. Each location is rated as a "confirmed" hotspot or a "potential" hotspot, or is found to have "no evidence" of recent illicit discharge. No evidence – refers to locations that had less than five potential pollution sources and no "observed pollution sources" – therefore the area was characterized as having no evidence that it was a hotspot for pollutants (that is not to say that there may not be room for follow up and perhaps business outreach education) (Wright et. al., 2004). As shown in Table 3.7, 13 potential hotspot sites were surveyed in both watersheds.

Table 3.7 Hotspot Status Based on HSI Data

Hotspot	Site ID	Location	Select Pollution Indicators
Confirmed	WL-H3	Wilde Lake Village Shopping Center (Giant)	Poor dumpster management Poor loading/unloading practices (Giant)
Potential	CL-H1	Park maintenance facility on south side of Centennial Lake	Gas sheen from uncovered fueling station Poor dumpster management
	CL-H3	Centennial High/Burleigh Manor Middle School	Nontarget irrigation/landscaping near storm drain
	CL-H4	Homewood School/Board of Education Admin. Building	Poor dumpster management
	CL-H5	Harpers Choice Middle School/Cedar Lane School	Poor dumpster management
	WL-H5	Cedar Lane Park maintenance	Poor outdoor material storage
	WL-H6	Longfellow Elementary School	Poor dumpster management
No Evidence	CL-H2	Tennis court pavilion/building on north side of Lake	Poor dumpster management Uncovered storage
	CL-H6	Adult care facility	Downspouts directly connected to storm drain
	WL-H1	Bryant Woods Elementary School	Poor dumpster management Extensive turf coverage; medium management
	WL-H2	Faulkner Ridge Center	Poor dumpster management Extensive turf coverage; medium management
	WL-H4	Columbia Athletic Club	Downspouts directly connected to storm drain
	WL-H7	Parking lot of Running Brook Elementary School	Three of the storm drain inlets do not get treated by grass filter

According to Table 3.7, only one site was found to be a confirmed hotspot—Wilde Lake Village Shopping Center. The primary reason for this was the fact that there was no stormwater treatment was visible, and several businesses had poor dumpster management. The storm drain in the loading area of the Giant Supermarket was completely covered over with organic matter

and trash. The stream survey also identified a possible illicit discharge downstream of the shopping center at the outfall adjacent to Green Mountain Circle where suds were visible that may have originated from the outdoor carwash located at the gas station (OT-9).

The single biggest observation at each of the potential hotspots surveyed was poor dumpster management. Frequently, dumpsters were in a state of disrepair and were located on an impervious area without any runoff control practices in place (Figure 3.13).

Figure 3.13 Dumpsters throughout both watershed were frequently located on concrete or asphalt and had no secondary containment present.

Uncovered storage or loading/unloading areas were a frequent problem as well. The loading area at the Giant store in Wilde Lake Village Shopping Center (Figure 3.14) was a particular problem. At the Centennial Lake Park maintenance building, unlabeled storage drums were found situated on an asphalt parking lot with no secondary containment (Figure 3.14), and an uncovered fueling area had noticeable sheen spreading downgradient.

Figure 3.14 Poor loading/unloading practices were found at Giant Supermarket in Wilde Lake, while unlabeled storage drums without secondary containment were found at Centennial Lake Park (right).

3.3 STORMWATER RETROFIT INVENTORY

Retrofitting is the art and science of identifying stormwater treatment opportunities in developed areas where stormwater control is currently absent or poorly provided. A thorough analysis of subwatershed retrofitting potential is crucial to understanding and achieving the full restoration potential in watersheds and streams. As a restoration practice, retrofits are best implemented at a watershed or subwatershed level where, on a cumulative basis, meaningful improvements can be made to the conditions of receiving waters.

The goals of retrofitting are twofold. The first is to establish a stable, predictable hydrologic regime that regulates the volume, duration, frequency, and rate of stormwater flows, allowing other restoration strategies such as bank stabilization, riparian reforestation, and aquatic habitat enhancement to be successful. The second is to improve the pollutant filtering and groundwater recharge capacity of the drainage area through a variety of projects that either directly filter the runoff, detain it where pollutants can be removed through settling and biological processes, or modify the paved landscape to increase the natural filtering capability of developed lands. The art and practice of retrofitting is finding the appropriate mix of projects that can provide enough control to maximize this potential in small drainage areas where the effects can actually be seen.

To these ends, CWP and Tetra Tech conducted a stormwater retrofit inventory in the Centennial Lake and Wilde Lake subwatersheds on October 13–15, 2004. More than 55 candidate sites were initially identified using updated orthophotos and information gathered during the stream and upland assessments. Candidate sites located upstream of affected stream reaches, at failing or inadequate existing stormwater facilities, and at uncontrolled hotspots were considered priorities for visiting in the field. Candidate sites for investigation also included large open tracts of land typically associated with institutional uses and other public lands such as parklands and recreational facilities.

Field crews visited 51 sites and developed initial concepts for 51 retrofits, with 35 located in the Wilde Lake subwatershed and 16 in the Centennial drainage. Multiple concepts were developed at a few individual sites. Tables 3.8 and 3.9 describe each site visited in the field for Centennial and Wilde Lakes, respectively, and Figure 3.15 and 3.16 show the locations of these sites within the subwatersheds.

Table 3.8 Centennial Lake Retrofit Sites

Site Number	Site Name	Existing Conditions	Potential Retrofit	Obvious Constraints	Property Owner
CL01	Tributary G Lab School Wet Pond Expansion	Untreated stormwater near existing wet pond between the Tech. and Homewood Schools	Wet pond expansion to add treatment for adjacent school site	Cost	Board of Education
CL02	Centennial Park Bioretention #1	Untreated runoff from parking area flowing into lake	Bioretention—single or multi-cell facility to treat untreated stormwater	Divert runoff from upslope pipe elevation to gain adequate head	Public Rec & Parks
CL03	Tributary G Maintenance	Existing wet pond/sediment trap	Maintenance—convert sediment trap to stormwater facility, muck out sediment, remove stand pipe, plant wetland fringe	Identification of responsible party	HOA or developer
CL04	Tributary E Centennial Park Ballfield	Sediment plume extending from ballfield across parking area to stormdrain	Bioretention—construct small facility to treat ballfield runoff	Loss of several parking spots, pedestrian flow	Public Rec & Parks
CL05	Tributary E	Wetpond with clogged orifice	Maintenance—unclog	None	HOA
CL06	Tributary E Hermitage Bioretention	Two untreated outfalls	Bioretention—create bioretention facility	Private ownership	Private Landowner
CL07	Tributary E Knobs End	Large cul-du-sac serves two homes	Impervious cover reduction—create grassed island or shared driveway	None	County
CL08	Tributary D Pond Maintenance	Frequent rain events cause flow spill over riser	Maintenance—lower orifice or create low-flow orifice and increase storage as pond has likely filled in significantly—check for possible submerged utility	Cost to increase storage	Parks and Recreation
CL09	Tributary B Burleigh Manor Bioretention	Parking lot runoff causing erosion	Bioretention Demo Project	None	Board of Education
CL10	Tributary B Burleigh Manor Loading Dock Bioretention	Spill would be transported downstream	Bioretention Demo Project (for spill containment)	Trees, excavation	Board of Education
CL11	Tributary A Covenant Park	Parking lot with grassed island	Bioretention Demo Project—Easy conversion in landscaped island	Private property—possible	Church
CL101	Lake Maintenance Yard Option #1	Untreated maintenance yard (flows to Lake)	Sandfilter or bioretention	None	Parks and Recreation
CL102	Lake bioretention	Untreated parking area	Bioretention near tennis courts	None	Parks and Recreation
CL103	Centennial Lake Boat Ramp Impervious reduction	Untreated road and boat ramp runoff	Sea Streets—sloped area application or permeable pavers to treat a portion of the runoff	Limited space and cost issues	Parks and Recreation
CL104	Lake Maintenance Yard Option #2	Untreated impervious area	Option 2 soil amendments	Ensure not a wetland	Parks and Recreation
CL105	Tributary B Centennial HS Bioretention	Unused parking lot island	Bioretention demo	None	Board of Education

Table 3.9 Wilde Lake Retrofit Sites					
Site Number	**Site Name**	**Existing Conditions**	**Potential Retrofit**	**Obvious Constraints**	**Property Owner**
WL01a	Reach C Bioretention Option #1	Untreated parking area and entrance drive	Bioretention	Private property	Private Property/ HOA
WL01b	Reach C Bioretention Option #2	Untreated parking area and entrance drive	Bioretention	Some movement of utilities required	Columbia Association (CA)
WL02	Reach C Century 21 Bioretention	Uncontrolled commercial building and parking lot	Bioretention to treat rooftop and parking lot runoff (0.5")	Loss of approximately 12 parking spaces	Private commercial
WL03	Reach C Shallow Marsh Wetland	Uncontrolled apartment complex	Shallow Marsh Wetland	Possible wetlands impacts (low quality) and loss of community open space	CA
WL04	Reach C Harpers Forest Apts. Rain Garden	Unmanaged runoff from apartment complex (rooftops and parking)	Rain garden "fingerprinted" around existing mature trees with flow splitter in existing storm-drain to divert flow	Mature trees would require careful site management protection measures	Private
WL05	Reach C Rideout Heath Apts. Rain Garden	Existing 12" RCP outfall discharges runoff from streets to open forested area	Provide rain garden at end of existing outfall	Existing forest area; however, poor quality	Private
WL06	Reach C Harpers Forest Rain Garden #2	Unmanaged flow from townhouses west of Harpers Forest	Rain garden with flow splitter in existing storm-drain to divert flow into it; bioretention system that ties flow back into storm-drain	Use of Columbia Association open space may be an issue	CA
WL07	Reach C High Tide Ct. Rain Garden	Unmanaged street runoff around existing turf circle within court	Rain garden with curb cuts to divert street drainage into it	Existing trees; adjacent residents may use turf area for recreation	County Right-of-way
WL08a	Reach C Deering Woods Rain Garden	Open area/park access area adjacent to an existing storm-drain	Provide flow splitter to divert runoff into a rain garden, sited carefully adjacent to sewer; relocate footpath	Removal of three trees and relocation of footpath	CA and HOA
WL08b	Reach C Deering Woods Infiltration Trench	Existing storm-drain through green space with yard inlets	Convert green space to shallow infiltration with underdrains to attenuate flow volume	Need soil tests; residents may use open space for recreation	Private
WL09	Reach C Longfellow ES Dry Pond Retrofit	Existing dry pond with brick riser provides quantity control for portion of school site	Improve water quality treatment with modifications to pond bottom to provide rain garden area with overflow into infiltration trench. Good education opportunity	None	Public-school
WL10a	Reach D Plunge Pool /Step Pool	Existing uncontrolled high-density residential and commercial areas	Create plunge pool and step pool to dissipate energy	Stream stabilization project has been constructed Spring 2005	CA
WL10b	Reach D Wet-Pond Retrofit	Existing uncontrolled high-density residential and commercial areas	Create a large wet-pond to provide flow attenuation and water quality treatment	Limited space/sewer line	CA

Table 3.9 Wilde Lake Retrofit Sites (continued)					
Site Number	**Site Name**	**Existing Conditions**	**Potential Retrofit**	**Obvious Constraints**	**Property Owner**
WL12a	Reach I Thicket Lane	Townhomes and parking discharge to existing storm-drain (downstream channel erosion)	On-line infiltration/detention in surface sand filter with level spreader	Proximity of townhomes	Private
WL12b	Reach I May Wind Ct. Outfall Treatment	Damaged outfall and eroded stream channel	Pervious pavement for overflow parking; roof leader disconnection; velocity reduction measures and outfall repair; stabilize downstream channel	Possible sanitary sewer line	Private
WL13	Reach H Twin Rivers Rd. Bioretention	Open landscaped area between uncontrolled parking and road runoff	Bioretention with curb cuts from parking area and roadway; grass filter strip along edge of parking; relocate path if necessary	Several medium-sized landscaping trees and footpath	Private or CA
WL14	Reach D Faulkner Ridge	Uncontrolled runoff from two parking areas	Provide bioretention and infiltration in a combination of three locations: convert existing swale below playground to bioretention; provide infiltration trench between parking and Marble Fawn Ct.; create vegetated island in Ct.	Existing utilities, street lights	Private
WL15	Reach G Harpers Choice Middle School Dry Pond Retrofit #1	Existing dry pond providing quantity control for school	Convert dry pond to provide QL treatment in micropool with berm and two forebays; divert additional flow to pond	Possible safety concerns from school and downstream homes; possible dam safety permitting issue	Public
WL16	Reach G Harpers Choice Middle School Dry Pond Retrofit #2	Existing dry pond (smaller drainage area with no potential for additional flow)	Convert dry pond to bioretention/rain garden or sand filter combination to improve QL treatment; provide forebay, add trash rack, and stabilize inlet and outlet structures	Minimal; may be safety concerns if design includes extended detention	Public
WL17	Reach G CA Sports Complex Dry Pond Retrofit	Existing unmaintained dry pond	Convert dry pond to improve QL treatment; provide forebay, micropool. Remove trees from embankment and extend roof leaders to pond. Alternative design: convert to bioretention for QL and divert runoff to school dry pond for CPv (QN) treatment	Proximity to existing homes may create aesthetic concerns	CA
WL18	Reach C Produce Galore Outfall Retrofit	Severely eroded outfall and channel downstream of parking area	Potential bioretention at edge of parking area and plunge pool/velocity dissipater at outfall	Adjacent forest and steep slopes adjacent to channel	Private or CA
WL101	Reach E Durham Rd. East Pond Retrofit #1	Existing dry pond quantity control with extensive marsh bottom; severe short-circuiting	Reduce short-circuiting w/berm and add small storm control	Small size of existing facility and proximity of homes; existing wetlands	HOA or Private

Table 3.9 Wilde Lake Retrofit Sites (continued)					
Site Number	**Site Name**	**Existing Conditions**	**Potential Retrofit**	**Obvious Constraints**	**Property Owner**
WL102a	Reach B Lake Circle Dr. Streetscape	30”-wide existing roadway serving small number of homes draining to stream reach with documented erosion problems	Combination or curb cuts to create small rain gardens, and street edge alternatives/ impervious reduction measures	Locations of utilities and mature landscaping will drive design options	Private/ public
WL102b	Reach B Durham Rd. W. Streetscape	30”-wide existing roadway serving small number of homes draining to stream reach with documented erosion problems	Combination or curb cuts to create small rain gardens, and street edge alternatives/ impervious reduction measures	Locations of utilities and mature landscaping will drive design options	Private/ public road
WL103	Reach E Beaverbrook Farm Pond	Existing farm pond, mowed to edge; high levels of nutrient enrichment/algal growth apparent; wildfowl management issue	Establish aquatic fringe and landscaping to improve shade along shallow edges; develop wildfowl management program	Aesthetics—resident preference for mowed edge	HOA/ private
WL104	Reach A Cedar Lane Park Retrofit Options	Existing park with facilities on both sides of stream channel. Storm-drain outfall just above stream crossing	1. Parking lot bioretention in expanded parking islands and a curb-cut in the NE corner of lot 2. Tennis court bioretention along NE corner of tennis courts in low-lying area 3. Storage retrofit to provide floodplain storage using stormflow diversion from stream channel onto floodplain 4. Small bioretention/rain barrels at bathrooms 5. Entrance road rain garden to intercept runoff and convey through a new grassed swale	Primarily minor conflicts with current park uses; need to reconfigure some parking. Storage option will require coordination with maintenance access.	Public
WL105	Reach A Cedar Lane Park Ballfields Existing Pond Retrofit	Existing dry pond with marsh bottom; no riser—quantity control provided by outlet pipe directly through embankment	Provide riser control structure to improve water quality, by increasing the residence time; provide a forebay to improve ease of maintenance	Existing wetland developed in pond bottom; ability to expand pond footprint limited	Public
WL106	Reach A Cedar Lane Park Entrance Bioretention	Parking lot and entrance road runoff enters storm-drain, bypassing a grassed open area that could be utilized for small treatment area	Close off inlets at edge of parking area and allow runoff to flow through a curb cut and grassed swale into a bioretention cell	Primarily aesthetic considerations	Public

Table 3.9 Wilde Lake Retrofit Sites (continued)					
Site Number	**Site Name**	**Existing Conditions**	**Potential Retrofit**	**Obvious Constraints**	**Property Owner**
WL107	Reach A Olde Woods Way	Upstream of Beech Creek Rd., road embankment and undersized culvert forming partial dam along stream channel	Enhance stream valley storage through weir wall or new control structure and/or minor excavation in stream valley to form pocket wetlands	Existing stream with perennial baseflow and wetlands; proximity of houses	Public/ private
WL109	Lake Direct Hyla Brook Rd. Lakeside Demo Project #1	Open grassed area with several trees adjacent to lake with potential space to accommodate adjacent road drainage prior to entering storm-drain	Divert roadway runoff through curb cuts into a bioretention cell	Avoidance of critical root zones around mature trees; primarily aesthetic and maintenance issues	Public
WL110	Lake Direct Hyla Brook Rd. Catchbasin Diversion	Road runoff conveyed directly to outfall into lake	Divert runoff from catchbasin into an excavated area forming a micropool/wetland	Inadequate space—mature trees, paths	Public
WL111/ 112	Multiple Cul-de-sacs	Large paved cul-de-sacs suitable for landscaped islands (e.g., Snowy Brook throughout Beaverbrook)	Provide a landscaped island with curb cuts to divert runoff into center; either with or without structural underdrain bioretention system	Minor aesthetic considerations; many cul-de-sacs in the area are already landscaped—need to fill in the gaps	Public
WL113	Reach A Board of Ed. Dry Pond Retrofit	Dry pond built for quantity control with concrete channel—short circuiting	Add small storm control and extended detention; convert to stormwater wetland or other wet pond design if hydrology permits. Add manhole and extend storm-drain to far end of pond; create circuitous flowpath through pond bottom	Sewer line may limit pond expansion.	Public
WL114	Reach F Bryant Woods	Portion of parking lot treated with infiltration practice	Add a bioretention facility to provide additional treatment for the school site	Limited space	Public
WL115	Reach F Bryant Gardens Apartments	Untreated existing development	Underground infiltration system	Adjacent to sewer	Public
WL116	Lake Direct High Rise Apartments	Untreated parking lot	Add a bioretention system to treat parking lot	Loss of parking spaces	Private
WL117	Reach A Longfellow	Untreated existing residential development	Add a bioretention system next to existing “tot lot “	Limited space	CA or private

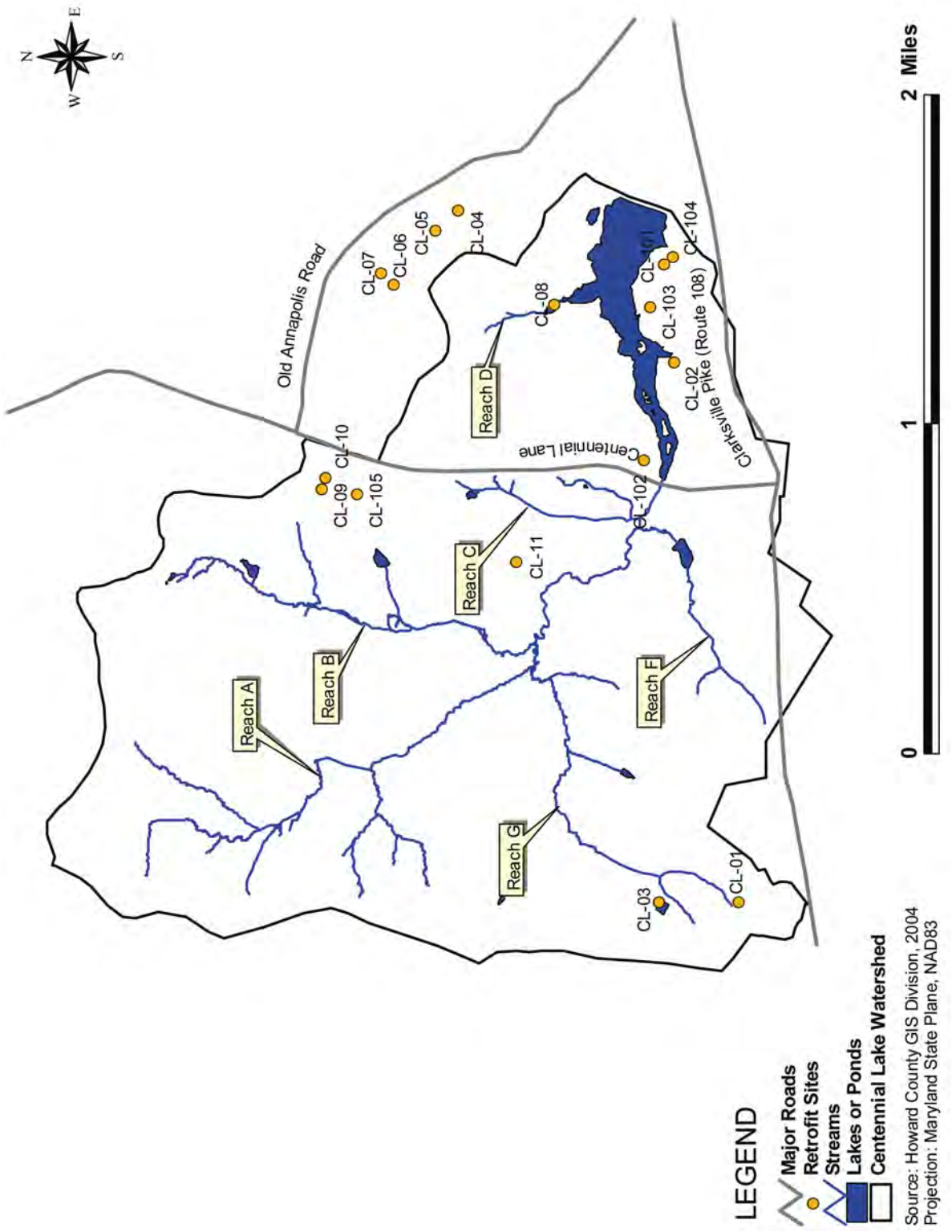

Figure 3.15 Stormwater retrofit inventory concept locations in Centennial Lake.

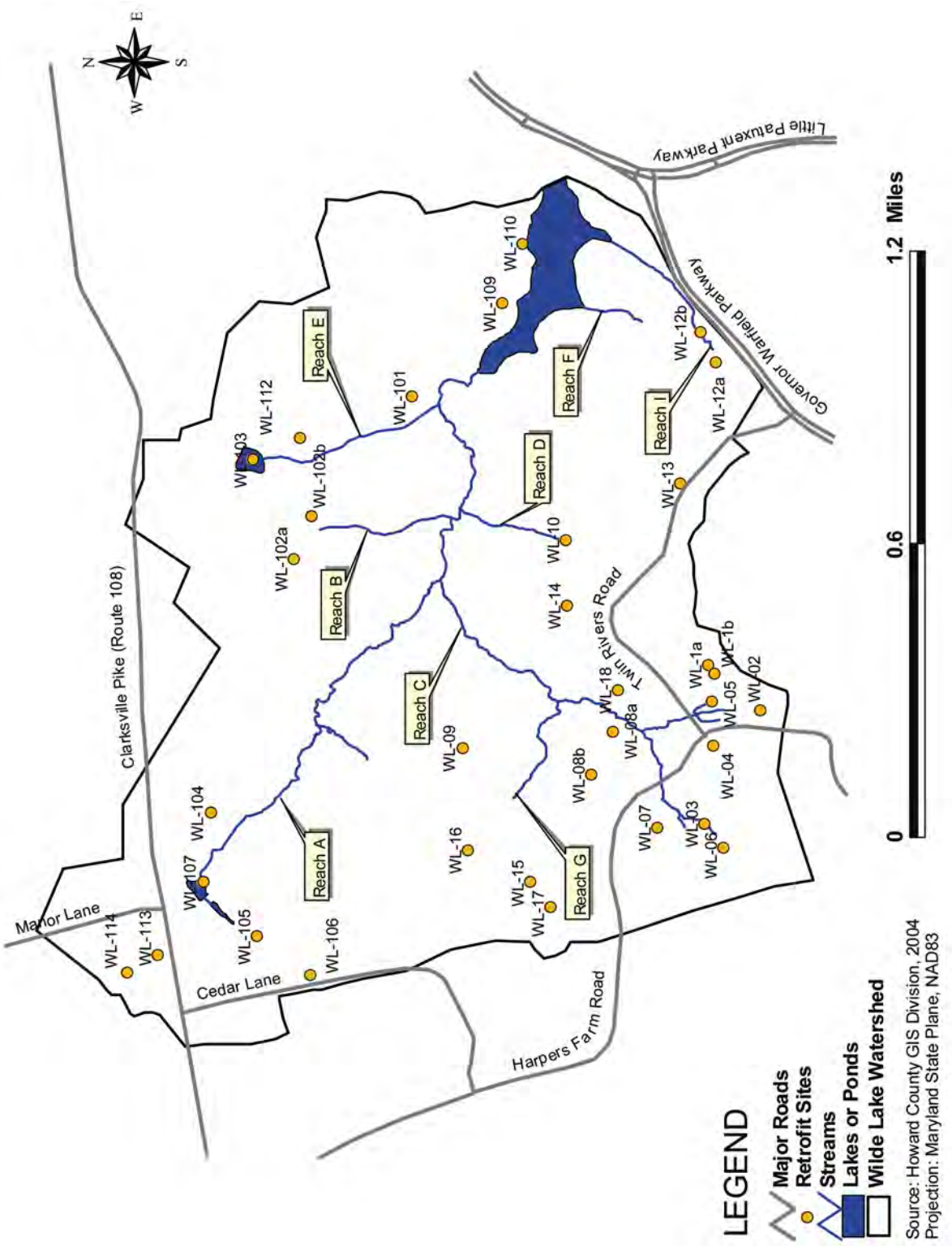

Figure 3.16 Stormwater retrofit inventory concept locations in Wilde Lake.

Potential retrofit projects were ranked "high," "medium," and "low," based on a suite of factors including water quality treatment, channel protection benefits, educational impact, cost, and feasibility. Feasibility includes such factors as access, ownership, and environmental site constraints such as existing wetlands. In the Wilde Lake subwatershed, 8 candidate sites received a "high" ranking and 20 received a "medium" ranking. In the Centennial subwatershed, 3 sites were ranked "high," and 10 were ranked "medium." Based on a review of stakeholder goals and priorities, 14 sites have been recommended for further study at this time and have representative concepts provided to help inform subsequent design and implementation, as described in Section 4.

In the Wilde Lake subwatershed, eight existing storage facilities were identified for retrofits consisting primarily of dry pond conversions. Many of these existing facilities were constructed for 2- or 10-year storm control, so they may be inadequate for protecting streams from erosion from the more frequent small storms and provide few water quality improvements. An additional five potential sites for new storage projects were identified (WL-03, WL-10b, WL-104, WL-107, and WL-110).

Potential project sites for improving infiltration and filtering of pollutants covered a wide array of possibilities. Twenty-seven sites were identified treating approximately 40 acres of existing impervious area. The total drainage area covered by the combination of existing ponds proposed for retrofit, new storage sites, and new water quality treatment sites covers 357 acres of the subwatershed, or 29% of the drainage area.

In the Centennial Lake subwatershed, four existing storage facilities were identified for retrofits, all of which are wet-ponds proposed for additional storage or improved channel protection. Twelve sites were identified for potential water quality retrofits, treating approximately 13 impervious acres. The total drainage area covered by the combination of existing pond retrofits and new water quality treatment projects covers 172 acres or 8% of the drainage area. These projects, although representing a small portion of the overall drainage area, would result in treatment for the majority of the developed area in conjunction with other existing controls not identified for retrofitting.

Figure 3.17 shows an example of a cul-de-sac retrofit location. Figure 3.18 shows an example of short-circuiting at a stormwater pond.

3.4 LAKE SHORELINE ASSESSMENTS

A shoreline assessment was conducted for both Centennial and Wilde Lakes to evaluate the potential for direct water quality impacts from the adjacent lands. The assessment was conducted using modified USA forms. The shorelines were evaluated for shoreline stability, areas of shoreline encroachment, direct water quality sources, and the effects of resident waterfowl. Also discussed are other problems observed, such as unintended trails and sediment buildup.

Figure 3.17 Example of a cul-de-sac retrofit location for the installation of a landscaped island.

Figure 3.18 Short-circuiting at Beaverbrook stormwater pond.

3.4.1 Centennial Lake

Centennial Lake is located on parkland owned by the County and is part of Centennial Park. The lake is a man-made reservoir and is used for boating and fishing only; swimming is not allowed except for the Columbia Triathlon, held once a year. The Howard County Department of Recreation and Parks is responsible for management of the lake and associated park environment. At this time there is no written lake or shoreline management plan, although shoreline management activities have been conducted, including management of the waterfowl population and the installation of riprap along the shoreline to prevent erosion.

Shoreline Stability

Centennial Lake has had problems with shoreline stability in the past. Efforts have been made to protect the shoreline from erosion by installing riprap along the shoreline in numerous locations, shown in Figure 3.19.

Shorefront Encroachment

Maintaining a natural setting within the park has resulted in an adequate buffer zone around a majority of the lake. An inadequate buffer was observed in three specific locations, shown in Figure 3.19. At these locations, mowing to the lake edge was observed in 3 specific locations. At each of the locations, some form of lake buffer is recommended although, because of the need for public access and the fact that one of the locations serves as an emergency spillway, a grass buffer or native nonwoody plantings may be warranted. The reduction in the size and quality of the buffer allows runoff to sheet flow directly to the lake.

Direct Water Quality Sources

Three storm drain outfalls flow directly to the lake. All three convey stormwater runoff from parking lots or park roads. A fourth outfall is likely located on the north side of the lake draining the existing parking areas near the tennis courts, although it was not located in the field because of heavy vegetation and the potential that the outfall is submerged in the lake. An attempt was made to evaluate all three outfalls to determine the condition; their locations are shown in Figure 3.19.

The first outfall was located on a small inlet near the boat rental station. This outfall drains the parking lots and a portion of the road leading to the lots. The actual outfall structure could not be located because of the extensive riprap and vegetation located along the shoreline. This area was also fenced to prevent access to the shoreline by park visitors. There was a storm drain inlet just outside the fencing. It was assumed that this inlet was installed to drain the grassed area between the walking path and the lake. At the time of the shoreline assessment in September 2004, no standing water was observed but the area was saturated and showed signs of erosion. It was assumed there were no structural defects to the outfall and that the significant man-made buffer around the outfall was installed to arrest erosion problems. This outfall is a direct drain to the lake and can convey pollutants deposited on the parking lot directly to the lake.

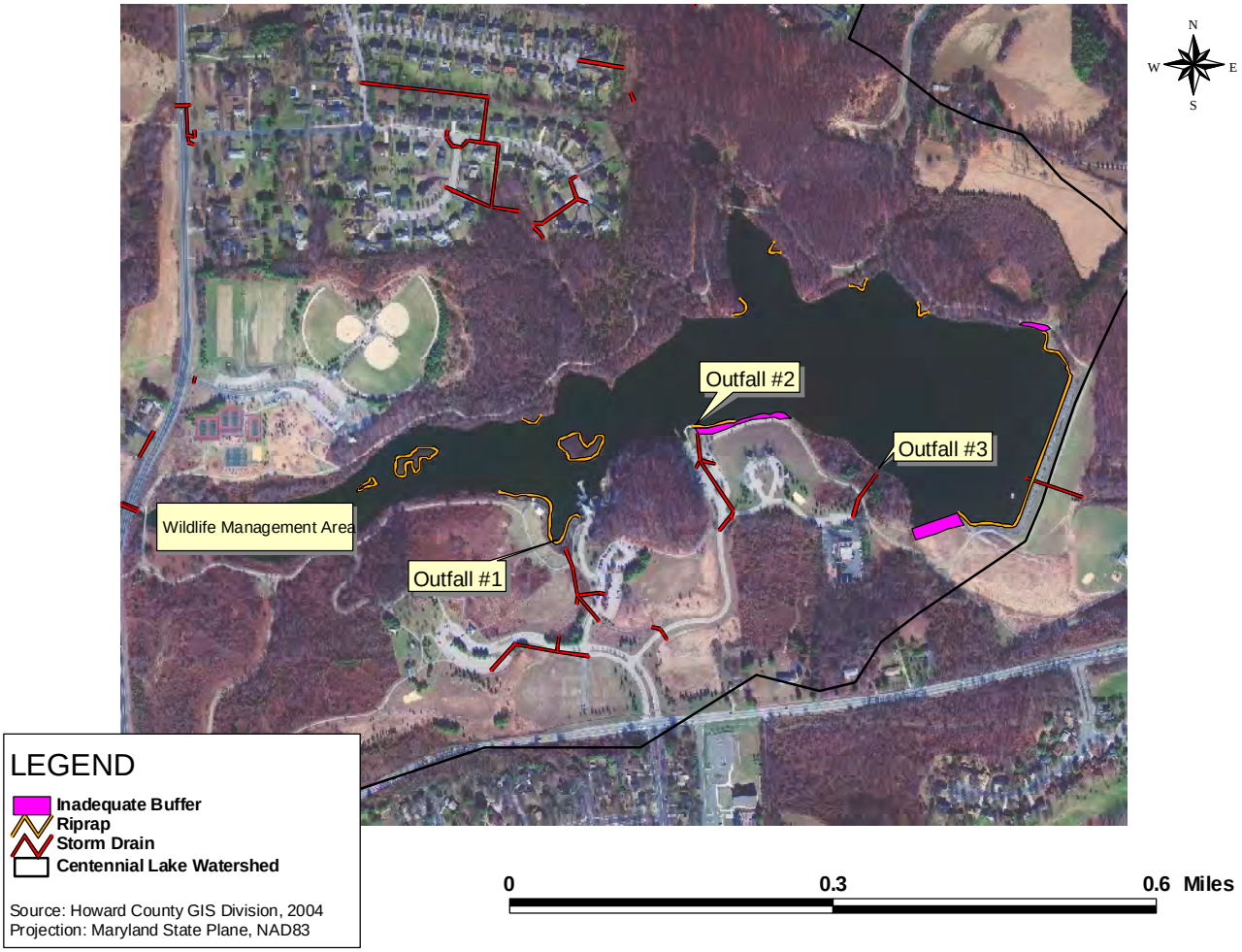

Figure 3.19 Results of the Centennial Lake shoreline assessment.

The second outfall was located next to the boat launch. This outfall drains the boat launch parking lot and a portion of the road leading to the lot. The outfall was in good condition but is a direct drain to the lake. Pollutants deposited on the parking lot and park roads can be washed directly to the lake through the storm drain system.

The third outfall was located near the park maintenance yard. The outfall drains the parking lot located next to the maintenance yard and a portion of the road leading to the parking lot. The actual outfall structure could not be located because of the heavy vegetation located along the shoreline. It was assumed that the outfall structure was in good condition. This outfall is a direct drain to the lake and can convey pollutants deposited in the parking lot and possible contaminated runoff from the vehicle maintenance yard.

The fourth outfall (assumed) would be located on the north side of the lake in close proximity to the tennis courts. Again, pollutants deposited on the parking areas and runoff from the adjacent sports fields are likely draining directly to the lake without any treatment.

Resident Waterfowl Management

The presence of Canada geese and other resident waterfowl has become a problem on Centennial Lake as more waterfowl become full-time residents of the lake. According to Brenda Belensky from the Howard County Department of Recreation and Parks, approximately 50 breeding pairs of Canada geese are in residence at Centennial Lake. During the summer the Canada goose population ranges from 100 to 300 birds and during the fall migratory season the population can climb to between 700 and 1,000 birds. To manage the resident Canada goose population, the County conducts an egg-addling program to restrict the number of chicks hatched during each breeding season.

The presence of large numbers of waterfowl can negatively affect both the lake water quality and the quality of the shoreline buffer, as many waterfowl trample and feed on the shoreline vegetation. Waterfowl droppings on the shoreline are washed directly into the lake, contributing to the excessive nutrient loading. The County has made numerous efforts to encourage waterfowl to migrate elsewhere or to exclude them from certain areas of the park. Fencing, such as that shown in Figure 3.20, has been relatively successful in excluding waterfowl from portions of the shoreline buffer. The remaining exception to this is the large hill tract adjacent to the boat ramp areas (parallel to outfall #2) on the south side of the lake that is managed in turf grass and contains extensive evidence of goose fecal matter.

Unintended Trails

Although there is a paved walking path around the entire perimeter of the lake, unintended paths were observed leading from the paved walking path directly to the shoreline. Figure 3.21 gives an example of the type of unintended path observed. Note that repeated use of this path has resulted in the loss of grass and other vegetation, allowing soil and other debris to be washed off directly to the lake. These areas are not expected to be serious contributors to sedimentation in the lake because of limited size and disturbance.

Figure 3.20 Goose exclusion fencing.

Figure 3.21 Example of an unintended path.

Sediment Buildup
Sediment buildup has been a problem in the upper reach of the lake. The excessive sediments washed into the lake are a concern for possible phosphorus release in the summer when shallow, slow-moving waters may be become anoxic and release phosphorus from the sediment. Currently there are not sufficient data to document the release of phosphorus in Centennial Lake though it is common in other urban lakes.

3.4.2 Wilde Lake
The Columbia Association owns Wilde Lake and is responsible for all management of the shoreline. A majority of the property around Wilde Lake is privately owned but is considered open space from the hours of 6 a.m. to 10 p.m. A paved walking path around most of the lake is open to the public.

Shoreline Stability
Wilde Lake is relatively urbanized with instances of seawalls along two southern portions of the lake. Two instances of shoreline erosion were observed that also had inadequate buffers. It was also clear that mowing to the lake edge was conducted in these locations, as shown in Figure 3.22.

Shorefront Encroachment
The majority of the shoreline along the southern shore of the lake is privately owned property. Instances of mowing up to the lake edge were observed. Also observed were instances of extensive landscaping near the lake, as shown in Figure 3.22.

Direct Water Quality Impacts
Eight storm drain outfalls drain directly to the lake. These outfalls provide a direct conduit for contaminated runoff to reach the lake. In addition, numerous downspouts were observed to flow directly to the lake. Most of the outfalls were not accessible because they were underwater or hidden by dense vegetation; thus they could not be evaluated. The only outfall to be inspected was outfall #1, located on the northern side of the lake, shown in Figure 3.22. This outfall drains the residential area above the lake and appeared to be in good condition. There was evidence of some subsidence behind the endwall, allowing the soil behind the endwall to be washed directly to the lake.

Resident Waterfowl Management
The upper portion of Wilde Lake is designated a swan refuge, and fishing is not allowed in this area, shown in Figure 3.22. In addition to resident swans (nonnative mute swans were observed), Canada geese and other waterfowl were observed during the shoreline assessment. Population estimates for Wilde Lake were not available for resident geese, ducks, and swans.

Sediment Buildup
Sediment buildup has been a problem in the upper reaches of the lake, and a sediment plume is visible in the aerial photos of the lake (Figure 3.22). The excessive sediment washed into the lake has resulted in the formation of islands in the Swan Refuge Area in the upper portion of the lake. Excessive sediment can be expected to be slowly washed further downstream into the lake, reducing its useful depth.

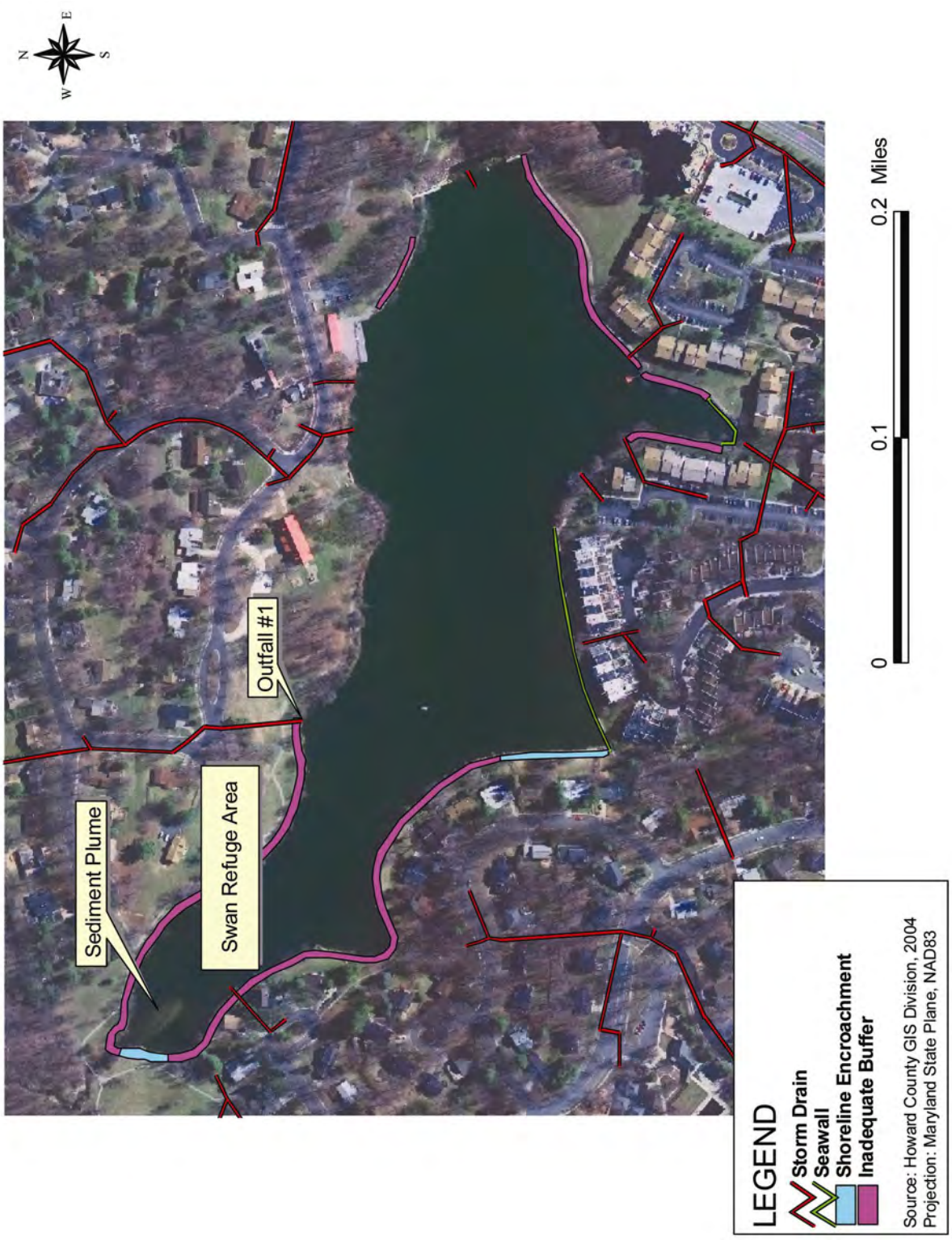

Figure 3.22 Results of Wilde Lake shoreline assessment.