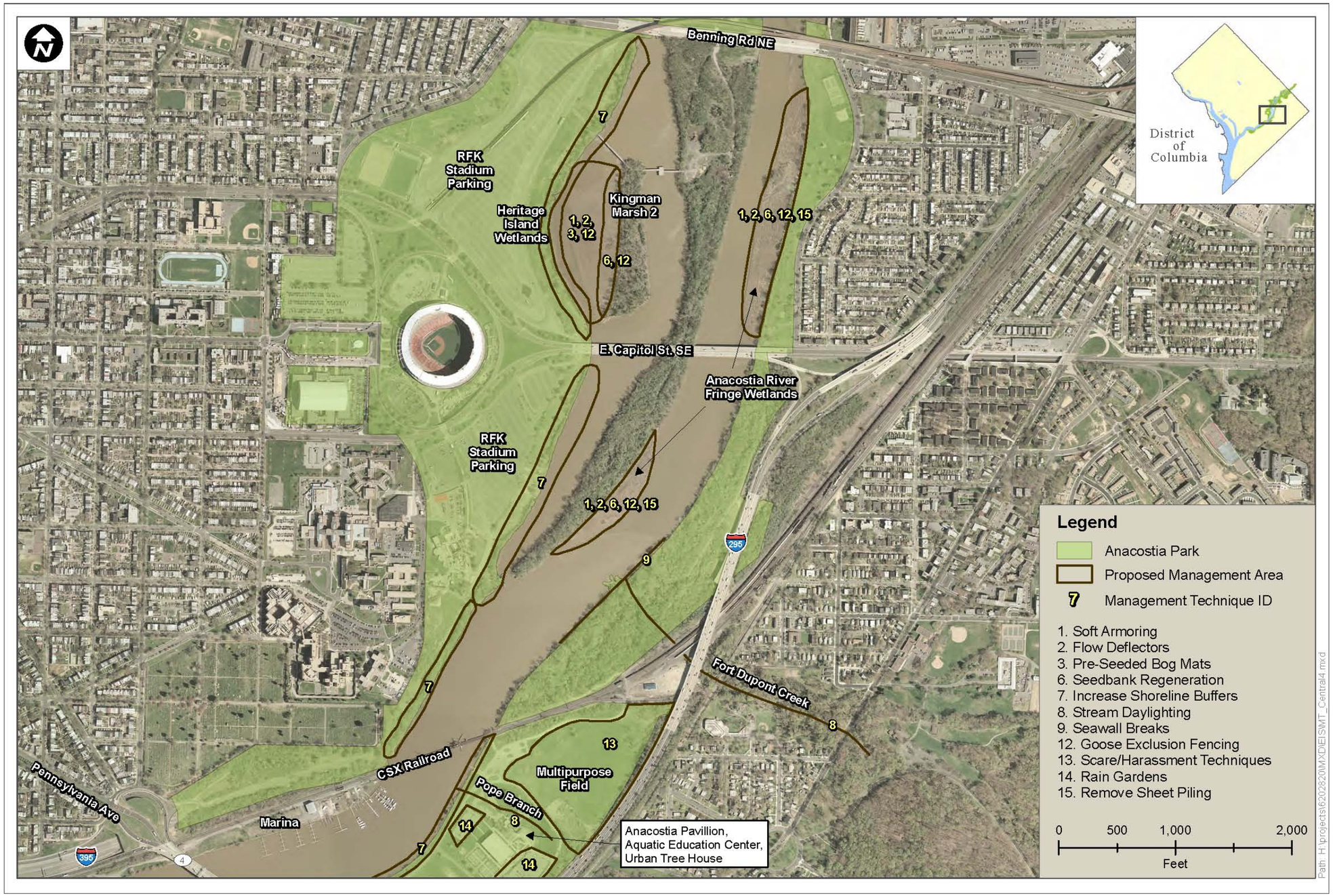

FIGURE 15: ALTERNATIVE E - LOCATIONS OF WETLAND AND RESIDENT CANADA GOOSE MANAGEMENT TECHNIQUES, CENTRAL AREA

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FIGURE 16: ALTERNATIVE E - LOCATIONS OF WETLAND AND RESIDENT CANADA GOOSE MANAGEMENT TECHNIQUES, SOUTH AREA

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Scare and Harassment—Under alternative E, an intensive program of scare and harassment techniques could be implemented and would be the same as alternative B. Scare and harassment techniques would be implemented in the spring to deter resident Canada geese from nesting at the park. Additional scare and harassment techniques may be implemented as new technologies become available.

Reproductive Control—Under alternative E, reproductive control management techniques would be the same as those of alternative B.

Cultural/Educational—Under alternative E, cultural/educational management techniques would be the same as those of alternative B.

All of the non-lethal resident Canada goose management techniques described above for alternative E would be implemented within the first 5 years of this plan/EIS with the exception of reproductive control management techniques.

IMPLEMENTATION COST

The total cost of implementing alternative E includes both wetland and resident Canada goose management techniques over the life of this plan/EIS. Estimates of these costs are included in the table below.

Alternative E Cost Estimate

#	Action	Assumptions	Implementation of Technique (one-time cost)*	Implementation of Technique (annual cost)	Cost for the 15-year Planning Period†
1	Vegetation monitoring and invasive plant species management	Same as alternative B	$30,125 (first year only)	$386,370 (labor + annual costs)	$5,825,675
2	Population Monitoring	Same as alternative B	$0	$10,000	$150,000
3	Hydrology techniques	Cost does not include design and permitting; some costs encompassed in salary of labor from #1 above	$2,968,750	$0	$2,968,750
4	Vegetation techniques		$2,002,384	$26,630	$2,401,834
5	Wetland restoration	Cost does not include design and permitting	$1,348,000	$0	$1,348,000
6	Park Operations and Maintenance		$268,820	$9,970	$418,370
7	Lethal Control	No techniques proposed	$0	$0	$0
8	Habitat modification		$3,151,102	$0	$3,151,102
9	Scare and harassment**	Includes year 1 cost only	$19,712	Unknown	$19,712

#	Action	Assumptions	Implementation of Technique (one-time cost)*	Implementation of Technique (annual cost)	Cost for the 15-year Planning Period†
10	Reproductive Control**	Includes year 1 cost only	$11,100	Unknown	$11,100
11	Cultural/Educational	Some costs encompassed in salary of labor from #1 above	$5,000 (signage)	N/A	$5,000
TOTAL COST FOR ALTERNATIVE E					**$16,299,543‡**

* Exact year of implementation unknown at this time; cost does not include maintenance or repair, if applicable.

** Includes cost for year 1 only; adaptive management would determine if technique would be required and to what extent in subsequent years.

† One-time cost + (annual cost*15 yrs)

‡ Total cost for 15 years assumes all proposed wetland and resident Canada goose management techniques would be implemented during the life of the plan/EIS.

HOW ALTERNATIVES MEET OBJECTIVES

As stated in the "Purpose of and Need for Action" chapter, the management alternatives selected for analysis should generally meet all project objectives. The management alternatives must also address the stated purpose of taking action and resolve the need for action. Therefore, the alternatives were individually assessed by how well they would meet the objectives of this plan/EIS. Alternatives that did not meet the objectives were not analyzed further and are discussed in the "Alternatives Eliminated from Further Consideration" section that follows. These specific objectives, and how they are addressed by each proposed alternative, are summarized in table 3.

SUMMARY OF IMPACTS

A summary of wetland management techniques and resident Canada goose management techniques is presented in tables 4 and 5. The "Environmental Consequences" chapter describes the effects of each alternative on each impact topic, including the impact on recreational values and visitor experience. These impacts are summarized in table 6.

ALTERNATIVES AND TECHNIQUES ELIMINATED FROM FURTHER CONSIDERATION

NO WETLANDS OR RESIDENT CANADA GOOSE MANAGEMENT ALTERNATIVE

During the deliberative process of alternative formulation for this plan/EIS, one alternative was dismissed. This alternative was no wetlands management and no resident Canada goose management. This alternative was dismissed because it would not meet the objectives of this plan/EIS and is therefore unreasonable. In addition, the park would likely always continue to do some management activities such as oiling eggs. Therefore, this alternative was considered but dismissed.

TABLE 3: THE DEGREE TO WHICH EACH ALTERNATIVE MEETS OBJECTIVES

Objective Areas	Specific Objectives	Alternative A – No Action	Alternative B – High Wetlands & High Resident Canada Goose	Alternative C – Moderate Wetlands, Moderate Resident Canada Goose	Alternative D - Low Wetlands & Low Resident Canada Goose	Alternative E – High Wetlands & Moderate Resident Canada Goose, with No Lethal Control
Overall	• Ensure actions are consistent with the laws, policies, and regulations that guide the NPS, as defined in chapter 1.	• Fully meets objectives.	• Fully meets objectives; permits would be required to implement lethal control.	• Fully meets objectives; permits would be required to implement lethal control.	• Fully meets objectives; permits would be required to implement lethal control.	• Fully meets objectives.
Wetlands	• Reduce adverse effects of resident Canada goose grazing pressure on current and future restored wetland sites to ensure plant regeneration sufficient to reach the desired condition of a functional wetland system.	• Fails to meet objectives because resident Canada goose management techniques including egg oiling and goose exclusion fences do not meet desired conditions.	• Fully meets objectives due to numerous resident Canada goose management techniques including intensive lethal control, increasing buffers, intensive scare and harassment program, and egg oiling.	• Fully meets objectives due to numerous resident Canada goose management techniques including lethal control, increasing buffers, scare and harassment program, and egg oiling.	• Partially meets objectives because of fewer resident Canada goose management techniques available. There would be no initial lethal control used. Shoreline buffers would be limited and no scare and harassment program would be initiated. Egg oiling would remain the same intensity as it is currently.	• Partially meets objectives because of no lethal control – lethal control would be more effective in reducing adverse effects of the resident Canada geese.
	• Maintain native wetlands vegetation and manage the encroachment of invasive and exotic plant species.	• Partially meets objectives due to the reliance on volunteers and partners to continue invasive plant species management.	• Fully meets objectives because invasive plant species would continue to be managed and native species would be restored due to buffering shorelines and executing a high-density planting effort with persistent, native species.	• Fully meets objectives because invasive plant species would continue to be managed and natives would be restored by planting shoreline buffers and executing a low-density planting effort with persistent native species.	• Partially meets objectives due to reduced wetland management. There would be a minor level of invasive plant species management. There would be no shoreline buffers planted or no new native species planted.	• Fully meets objectives because invasive plant species would continue to be managed and native species would be restored due to buffering shorelines and executing a high-density planting effort with persistent, native species.
	• Restore, protect, and maintain wetland functions.	• Fails to meet objectives due to limited wetland management. There is currently no wetland restoration or hydrology management at the park.	• Fully meets objectives due to high wetland management and new wetland restoration efforts. Techniques include preventing erosion and clogging of wetlands, creating tidal guts, daylighting, seawall breaks, and stormwater outfall energy dissipation.	• Partially meets objectives because of high wetland management but no new restoration efforts are proposed. Techniques include preventing erosion and clogging of the wetlands, and stormwater outfall energy dissipation. No tidal guts, daylighting, or seawall breaks would occur to restore wetlands.	• Partially meets objectives because of high wetland management but no new restoration efforts are proposed. Techniques include removing structures that clog wetlands. No erosion control, tidal guts, daylighting, or seawall breaks would occur to restore wetlands.	• Fully meets objectives due to high wetland management and new wetland restoration efforts. Techniques include preventing erosion and clogging of wetlands, creating tidal guts, daylighting, seawall breaks, and stormwater outfall energy dissipation.
Wildlife and Wildlife Habitat	• Manage the resident Canada goose population within the park such that a viable wetlands habitat can be sustained.	• Fails to meet objectives because the resident Canada goose population has limited management resulting in wetlands that are not pre-dominantly self-sustaining.	• Fully meets objectives because resident Canada goose population would be highly managed resulting in wetlands that would become pre-dominantly self-sustaining. Resident Canada goose population would be managed by intensive lethal control, modification of goose habitat, intensive scare and harassment program, and increased egg oiling.	• Fully meets objectives because resident Canada goose population would be highly managed resulting in wetlands that would become pre-dominantly self-sustaining. Resident Canada goose population would be managed by less intensive lethal control, modification of goose habitat, less intensive scare and harassment program, and increased egg oiling.	• Partially meets objectives because the resident Canada goose population would be managed but the wetlands may not become pre-dominantly self-sustaining. There would be no initial resident Canada goose population reduction. Lethal control would be used one time if the habitat modification and current egg oiling do not meet the resident Canada goose threshold. No scare and harassment techniques would be used.	• Partially meets objectives because the resident Canada goose population would be managed but the wetlands may not become pre-dominantly self-sustaining. No lethal control would be used to manage the resident Canada goose population. Management techniques would include habitat modification, intensive scare and harassment program, and increased egg oiling.
	• Manage the resident Canada goose population, consistent with the USFWS Resident Canada Goose Management Plan (USFWS 2005).	• Fails to meets objectives because inconsistent with USFWS 2005 and the Atlantic Flyway Resident Goose Management Plan (Atlantic Flyway Council 1999).	• Fully meets objectives because consistent with USFWS (2005) and Atlantic Flyway Council (1999). Management techniques were taken from USFWS 2005.	• Fully meets objectives because consistent with USFWS (2005) and Atlantic Flyway Council (1999). Management techniques were taken from USFWS 2005.	• Fully meets objectives because consistent with USFWS (2005) and Atlantic Flyway Council (1999). Management techniques were taken from USFWS 2005.	• Fully meets objectives because consistent with USFWS (2005) and Atlantic Flyway Council (1999). Management techniques were taken from USFWS 2005.

Objective Areas	Specific Objectives	Alternative A – No Action	Alternative B – High Wetlands & High Resident Canada Goose	Alternative C – Moderate Wetlands, Moderate Resident Canada Goose	Alternative D - Low Wetlands & Low Resident Canada Goose	Alternative E – High Wetlands & Moderate Resident Canada Goose, with No Lethal Control
	• Restore, protect, and maintain wetlands for native fish and wildlife populations.	• Fails to meet objectives because does not provide wetland habitat or wetland restoration efforts.	• Fully meets objectives because provides restored wetland habitat and includes new planting efforts. Wetlands restored by preventing erosion and clogging, planting native vegetation, creating tidal guts, and daylighting.	• Fully meets objectives because provides restored wetland habitat and includes new planting efforts. Wetlands restored by preventing erosion and clogging, and planting native vegetation.	• Partially meet objectives because of low wetland restoration and planting efforts. Techniques include removing item that clog wetlands. No new native species would be planted and no wetland restoration techniques.	• Fully meets objectives because provides restored wetland habitat and includes new planting efforts. Wetlands restored by preventing erosion and clogging, planting native vegetation, creating tidal guts, and daylighting.
Visitor Experience	• Enhance visitor experience by restoring, maintaining, protecting, and interpreting wetlands.	• Partially meets objectives due to limited education efforts by park programs. Currently no wetland restoration.	• Fully meets objectives because provides new cultural and educational elements. Wetlands would be restored and enhanced by increasing buffers, managing invasive plants, and planting native vegetation.	• Fully meets objectives because provides new cultural and educational elements. Wetlands would be restored and enhanced by increasing buffers, managing invasive plants, and planting native vegetation.	• Partially meets objectives due to limited education efforts by park programs. No new cultural or educational elements would be implemented.	• Fully meets objectives because provides new cultural and educational elements. Wetlands would be restored and enhanced by increasing buffers, managing invasive plants, and planting native vegetation.
	• Enhance public understanding of the value of wetland restoration and issues associated with the management of resident Canada geese.	• Partially meets objectives because of limited wetland education efforts, but no resident Canada goose management education and no goose signage.	• Fully meets objectives because of wetland education and resident Canada goose management education efforts, including goose signage.	• Fully meets objectives because of wetland education and resident Canada goose management education efforts, including goose signage.	• Partially meets objectives because of limited new wetland and resident Canada goose management education efforts, but includes goose signage.	• Fully meets objectives because of wetland education and resident Canada goose management education efforts, including goose signage.
	• During implementation of any management action, minimize disruption to visitor use and experience or adverse impacts to visitor and community safety.	• Fully meets objectives because visitor use and experience is not disrupted and safety is not compromised.	• Fully meets objectives because visitor use and experience is not disrupted and safety is not compromised.	• Fully meets objectives because visitor use and experience is not disrupted and safety is not compromised.	• Fully meets objectives because visitor use and experience is not disrupted and safety is not compromised.	• Fully meets objectives because visitor use and experience is not disrupted and safety is not compromised.
Park Operations	• Consider and plan for impacts from wetland and resident Canada goose management response activities on current park operations, including budget, workload, and visitor experience.	• Partially meets objectives because program relies on volunteers and partners.	• Fully meets objectives because plan/EIS identifies needed budget, impacts to workload and visitor experience.	• Fully meets objectives because plan/EIS identifies needed budget, impacts to workload and visitor experience.	• Fully meets objectives because plan/EIS identifies needed budget, impacts to workload and visitor experience.	• Fully meets objectives because plan/EIS identifies needed budget, impacts to workload and visitor experience.
Cooperation and Coordination	• Cooperate and coordinate with the District, USACE, and other government agencies, as well as other stakeholders currently implementing or interested in implementing a wetlands and resident Canada goose management strategy.	• Fails to meet objectives of the agencies and stakeholders because a strategy is not being implemented and agencies and/or volunteers may get discouraged.	• Fully meets objectives of the agencies and stakeholders due to active, aggressive programs.	• Fully meets objectives of the agencies and stakeholders due to active, aggressive programs.	• Partially meets objectives of the agencies and stakeholders due to less and minimal coordination.	• Fully meets objectives of the agencies and stakeholders due to active, aggressive programs.

TABLE 4: SUMMARY OF WETLAND MANAGEMENT ALTERNATIVES

Wetland Management Element	Management Technique	Alternative A – No Action	Alternative B –High Wetland, High Resident Canada Goose Management	Alternative C – Moderate Wetland, Moderate Resident Canada Goose Management	Alternative D – Low Wetland, Low Resident Canada Goose Management	Alternative E –High Wetlands, Moderate Resident Canada Goose Management with No Lethal Control
Hydrology	Erosion Control Techniques	--	F	F	--	F
	Remove Items that Clog Marsh	--	F	L	F	F
	Create Tidal Guts	--	F	--	--	F
	Upland Runoff	--	F	F	F	F
	No Wake Zones	--	F	F	--	F
	Water Level Change	--	F	L	--	F
	Wetland Elevations	--	F	--	--	F
Vegetation	Invasive Species	L	F	F	L	F
	Remove Sheet Piling		F	F	F	F
	Seedbank Regeneration	--	F	F	L	F
	Buffer Shoreline	--	F	F	--	F
	Planting Effort	--	F	L	--	F
Wetland Restoration	Daylighting	--	F	--	--	F
	Stream and Stormwater Outfall Dissipation	--	F	L	--	F
	Seawall Breaks	--	F	--	--	F
Cultural/ Educational	Education and Interpretation	L	F	F	L	F
	Boardwalks and Trails	--	F	--	--	F
Park Operations and Management	Rain Gardens	--	F	F	F	F
	Trash Management	L	F	F	--	F
	Impervious Areas	--	F	F	--	F

F=alternative includes a full effort

L=alternative includes a limited effort

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TABLE 5: SUMMARY OF RESIDENT CANADA GOOSE MANAGEMENT ALTERNATIVES

Wetland Management Element	Management Technique	Alternative A – No Action	Alternative B –High Wetland, High Resident Canada Goose Management	Alternative C – Moderate Wetland, Moderate Resident Canada Goose Management	Alternative D – Low Wetland, Low Resident Canada Goose Management	Alternative E –High Wetlands, Moderate Resident Canada Goose Management with No Lethal Control
Lethal Control	Round-up, Capture, Euthanasia	--	F	L	L	--
	Lethal Removal by Shooting	--	F	--	--	--
	Monitor population	--	F	F	F	F
	Maintain population	--	F	L	--	--
Habitat Modifications	Plant vegetative buffer	--	F	L	L	F
	Install/maintain new fencing	L	F	F	F	F
	Install Soft armoring	--	F	L	--	F
	Increase width of buffers	--	F	F	F	F
	New plantings unpalatable	--	F	F	F	F
	Application of repellents	--	--	F	--	--
Scare and Harassment	Scare and harassment techniques	--	F	L	--	F
Reproductive Control	Egg oiling	L	L	F	L	L
	Apply goose hatch control	--	L	F	--	L
	Implement scare techniques	--	F	--	--	F
Cultural/Educational	Signage	--	F	F	F	F
	Enforce NPS policy	--	F	F	F	F
	Technical brochure	--	F	F	F	F

F=alternative includes a full effort
L=alternative includes a limited effort

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TABLE 6: ALTERNATIVES COMPARISON TABLE AND SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Resource	Alternative A – No Action		Alternative B – High Wetland, High Resident Canada Goose Management		Alternative C – Moderate Wetland, Moderate Resident Canada Goose Management		Alternative D – Low Wetland, Low Resident Canada Goose Management		Alternative E –High Wetlands, Moderate Resident Canada Goose Management with No Lethal Control	
Soils	Long-term moderate adverse	Soil erosion and runoff would continue from lack of vegetative buffer, causing a change in soil character	Beneficial	Wetland improvement, herbivory reduction, and erosion control would stabilize soils	Beneficial	Vegetation planting and reduced herbivory would improve the soil	Long-term minor adverse	One-time resident Canada goose population reduction would lower herbivory but would not provide long lasting benefits to soils	Negligible	Vegetative buffers and wetland restoration would aid bank stabilization, but herbivory would continue to occur
Cumulative impacts	Long-term minor adverse cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts		Negligible cumulative impacts		Beneficial cumulative impacts	
Hydrology	Long-term minor adverse	Continued vegetation loss and wetland soil erosion would result in continued impacts on hydrology	Beneficial	Wetland restoration, revegetation, stabilization, and structure removal would all benefit hydrology, and stream flow	Beneficial	Wetland and resident Canada goose management would locally improve hydrology from better stormwater infiltration	Negligible	One-time resident Canada goose population reduction and no erosion control techniques would make no changes to hydrologic conditions	Negligible	Vegetative buffers and wetland restoration would trap pollutants, but herbivory would continue, resulting in no change to hydrologic conditions
Cumulative impacts	Beneficial cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts	
Water Quality	Long-term minor adverse	A continued loss of vegetation from herbivory, pathogen introduction, and continued erosion would cause turbidity and reduced water quality	Beneficial	Improved wetlands would reduce urban runoff and sedimentation, and reduced herbivory, fecal matter, and erosion control would improve turbidity and water quality	Beneficial	Reduction of urban runoff, a decrease in soil erosion, and a reduction in herbivory and fecal matter would improve water quality	Long-term minor adverse	One-time population reduction would cause short-term reduction in herbivory and fecal matter, but would result in no wetland restoration and long-term changes to water quality	Negligible	Wetland restoration would trap urban runoff, but goose herbivory and fecal matter addition would continue, resulting in no discernible change to water quality
Cumulative impacts	Negligible cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts		Negligible cumulative impacts		Beneficial cumulative impacts	
Floodplains	Long-term minor adverse	Herbivory and continued erosion would result in a further loss of the floodplain	Beneficial	Reconnection of wetland with river and wetland restoration would improve floodplain function	Negligible	Floodplain function would only be slightly improved by management techniques	Long-term minor adverse	Limited wetland management would result in localized benefits, but no overall improvement of floodplain function	Negligible to beneficial	Reconnection of wetland with river and wetland restoration would improve floodplain function
Cumulative impacts	Long-term minor adverse cumulative impacts		Beneficial cumulative impacts		Negligible cumulative impacts		Long-term minor adverse cumulative impacts		Negligible cumulative impacts	
Wetlands	Long-term moderate adverse	Herbivory, invasive plant species, erosion, and loss of wetland function would result in continued degradation of wetlands and water quality	Beneficial	Decreased herbivory would allow revegetation in wetlands, and wetland restoration and erosion control would improve functionality	Beneficial	A reduction in herbivory, and some wetland management techniques would improve wetland function	Beneficial (following resident Canada goose reduction activities)/Long-term minor adverse	A reduction in herbivory and some resident Canada goose management provide short-term benefit, but wetland functionality, abundance, and diversity would still be decreased	Long-term minor adverse	Benefits from wetland management on vegetation would be largely offset by large resident Canada goose population size, even with non-lethal resident Canada goose management measures
Cumulative impacts	Long-term minor adverse cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts		Negligible cumulative impacts		Negligible cumulative impacts	
Aquatic Resources	Long-term moderate adverse	Herbivory would continue to reduce wetland quality and quantity and lower water quality, resulting in further loss of aquatic habitat	Beneficial	Revegetation, stabilization, and hydrology changes would improve habitat and food sources for aquatic resources	Beneficial	Wetland improvements would have detectable improvements on food sources or aquatic habitats	Negligible	No wetland restoration techniques would result in no change or improvement of food sources or aquatic habitat	Negligible	No detectable or measureable improvements to food sources and habitat quality of macroinvertebrates
Cumulative impacts	Long-term minor adverse cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts		Beneficial cumulative impacts	

Resource	Alternative A – No Action		Alternative B – High Wetland, High Resident Canada Goose Management		Alternative C – Moderate Wetland, Moderate Resident Canada Goose Management		Alternative D – Low Wetland, Low Resident Canada Goose Management		Alternative E –High Wetlands, Moderate Resident Canada Goose Management with No Lethal Control	
Vegetation	Long-term minor adverse	Continued herbivory and increased coverage of invasive plant species would impact native vegetation	Beneficial	Wetland management, herbivory reduction, habitat modification, and new planting would improve native vegetation	Beneficial	Wetland management and reduced herbivory, and invasive plant species control would benefit native vegetation	Long-term minor adverse	Goose herbivory may increase the cover of invasive vegetation, and reduce the abundance and diversity of native vegetation	Negligible	Continued goose herbivory would offset native planting buffers, resulting in an immeasurable change in the vegetation
Cumulative impacts	Long-term minor adverse cumulative impacts		Negligible cumulative impacts		Negligible cumulative impacts		Long-term minor adverse cumulative impacts		Long-term minor adverse cumulative impacts	
Wildlife (not including resident Canada geese)	Long-term minor adverse	Vegetation loss and erosion in wetlands due to wildlife grazing (primarily resident Canada geese) negatively affects aquatic-dependent wildlife species that utilize wetlands, such as waterfowl and migrant Canada geese	Beneficial	Improvements to habitat (both terrestrial and wetlands) and food sources could positively affect population numbers/structure of wildlife species in the park	Beneficial	Improvements to habitat (both terrestrial and wetlands) and food sources could positively affect population numbers/ structure of wildlife species, including those listed by the District WAP	Long-term minor adverse	Food sources and habitat quality would be improved through plantings, but may be offset or reduced by the lack of lethal reduction activities; small changes to population numbers, structure, genetic variability, and other demographic factors might occur	Negligible	Food sources and habitat quality would be improved through plantings, but may be offset by the lack of lethal reduction activities, resulting in an immeasurable change to population numbers or structure of wildlife in the park
Cumulative impacts	Long-term minor adverse cumulative impacts		Negligible cumulative impacts		Negligible cumulative impacts		Long-term minor adverse cumulative impacts		Long-term minor adverse cumulative impacts	
Resident Canada Geese	Negligible impact	Intensive population reduction strategies are not proposed and the resident Canada goose population would remain above the recommended 54 resident Canada geese within the park	Long-term major adverse impact on resident Canada geese in the park	Population would be reduced and maintained at a lower level than current numbers throughout the life of the plan/EIS	Long-term moderate adverse impact on resident Canada geese in the park	Population would be reduced at a lower level than current numbers up to five times throughout the life of this 15-year plan/EIS	Short-term, major, adverse impacts on resident Canada geese in the park	A one-time, lethal population reduction could occur, but would not be maintained over the long-term	Negligible, impact on resident Canada geese in the park	Population reduction strategies would not occur under alternative E; the resident Canada goose population would likely remain above the recommended 54 resident Canada geese within the park
			Overall long-term moderate adverse impact	Impacts to the population of resident Canada geese within the park would be detectable, and these impacts would be perceptible at the Maryland or DC resident Canada goose population level, but not at the Atlantic Flyway resident Canada goose population levels	Overall long-term minor adverse impact	Impacts to the population of resident Canada geese within the park would be detectable, but these impacts would not be perceptible at the Maryland, DC, or at the Atlantic Flyway resident Canada goose population levels	Overall negligible impact	There would be no observable or measurable impacts to the population of resident Canada geese within the park or to the Maryland, DC, or Atlantic Flyway resident Canada goose populations	Overall negligible impact	There would be no observable or measurable impacts to the population of resident Canada geese within the park or to the Maryland, DC, or Atlantic Flyway resident Canada goose populations
Cumulative impacts	Long-term, major, adverse cumulative impacts		Long-term, major, adverse cumulative impacts		Long-term, major, adverse cumulative impacts		Long-term, major, adverse cumulative impacts		Long-term, major, adverse cumulative impacts	
Historic Districts and Structures	No Effect	Current and continued management practices would not result in any impacts to historic structures and districts.	Negligible to long-term moderate adverse*	Wetland and resident Canada goose management techniques would somewhat alter setting near Kenilworth Gardens, Langston Golf Course and Anacostia Park causing negligible impacts; future wetland management could have a long-term, moderate impact on the Anacostia River Seawall	Negligible	Wetland and resident Canada goose management techniques would somewhat alter setting in the vicinity of Kenilworth Gardens, Langston Golf Course and Anacostia Park causing negligible impacts	Negligible	Limited wetland and resident Canada goose management techniques would somewhat alter the setting in the vicinity of Kenilworth Gardens, Langston Golf Course and Anacostia Park causing negligible impacts	Negligible to long-term moderate adverse*	Wetland and resident Canada goose management techniques would somewhat alter setting near Kenilworth Gardens, Langston Golf Course and Anacostia Park causing negligible impacts; future wetland management could have a long-term, moderate impact on the Anacostia River Seawall

Resource	Alternative A – No Action		Alternative B – High Wetland, High Resident Canada Goose Management		Alternative C – Moderate Wetland, Moderate Resident Canada Goose Management		Alternative D – Low Wetland, Low Resident Canada Goose Management		Alternative E –High Wetlands, Moderate Resident Canada Goose Management with No Lethal Control	
Cumulative impacts	Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts	
Archeological Resources	No Effect	Current and continued management practices would not result in any impacts to archeological resources.	Long-term, minor to moderate adverse *	High effort wetland and resident Canada goose management techniques would require ground-disturbing activities that could impact known and unknown/undiscovered archeological resources	Long-term minor adverse*	High effort wetland and moderate effort resident Canada goose management techniques would require ground-disturbing activities that could impact known and unknown/undiscovered archeological resources	Long-term minor adverse	Goose herbivory may increase the cover of invasive vegetation, and reduce the abundance and diversity of native vegetation	Negligible	Continued goose herbivory would offset native planting buffers, resulting in an immeasurable change in the vegetation
Cumulative impacts	Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts	
Park Management and Operations	Long-term minor adverse	Maintenance requirements could increase if the resident Canada goose population in the park exhibits an overall increase	Long-term moderate adverse	Increased staff and resources would be necessary to implement new management techniques and measures required to ensure a safe and beneficial experience for park visitors	Long-term moderate adverse	Increased staff and resources would be necessary to implement new management techniques and measures required for the alternative	Long-term minor adverse	Food sources and habitat quality would be improved through plantings, but may be offset or reduced by the lack of lethal reduction activities; small changes to population numbers, structure, genetic variability, and other demographic factors might occur	Negligible	Food sources and habitat quality would be improved through plantings, but may be offset by the lack of lethal reduction activities, resulting in an immeasurable change to population numbers or structure of wildlife in the park
Cumulative impacts	Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts		Long-term moderate adverse cumulative impacts	
Visitor Use and Experience	Beneficial for visitors who enjoy Canada geese at the park Long-term minor adverse for visitors who do not enjoy Canada geese at the park	Visitors could continue to view goslings and adult resident Canada geese year round in large numbers Resident Canada goose population would not be drastically reduced; Some visitors may avoid the Langston Golf Course or this area because of the high number of resident Canada geese that utilize turf areas of the golf course.	Beneficial for visitors who enjoy Canada geese at the park Beneficial for visitors who do not enjoy Canada geese at the park	Visitors would continue to view goslings and adult Canada geese year round within the park Resident Canada goose population would be reduced; management techniques would make Langston Golf Course and other areas less attractive to resident Canada geese	Beneficial for visitors who enjoy Canada geese at the park Beneficial for visitors who do not enjoy Canada geese at the park	Visitors would continue to view goslings and adult Canada geese year round within the park Resident Canada goose population would be reduced; management techniques would make Langston Golf Course and other areas less attractive to resident Canada geese	Short-term, major, adverse impacts on resident Canada geese in the park Overall negligible impact	A one-time, lethal population reduction could occur, but would not be maintained over the long-term There would be no observable or measurable impacts to the population of resident Canada geese within the park or to the Maryland, DC, or Atlantic Flyway resident Canada goose populations	Negligible, impact on resident Canada geese in the park Overall negligible impact	Population reduction strategies would not occur under alternative E; the resident Canada goose population would likely remain above the recommended 54 resident Canada geese within the park There would be no observable or measurable impacts to the population of resident Canada geese within the park or to the Maryland, DC, or Atlantic Flyway resident Canada goose populations
Cumulative impacts	Beneficial cumulative impacts for visitors who enjoy Canada geese at the park Negligible cumulative impacts for visitors who do not enjoy Canada geese at the park		Beneficial cumulative impacts for visitors who enjoy Canada geese at the park Beneficial cumulative impacts for visitors who do not enjoy Canada geese at the park		Beneficial cumulative impacts for visitors who enjoy Canada geese at the park Beneficial cumulative impacts for visitors who do not enjoy Canada geese at the park		Beneficial cumulative impacts for visitors who enjoy Canada geese at the park Negligible cumulative impacts for visitors who do not enjoy Canada geese at the park		Beneficial cumulative impacts for visitors who enjoy Canada geese at the park Negligible cumulative impacts for visitors who do not enjoy Canada geese at the park	

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MODERATE LEVEL OF WETLANDS MANAGEMENT WITH HIGH LEVEL OF RESIDENT CANADA GOOSE MANAGEMENT

This alternative was removed from further consideration following a detailed analysis of the resources and following the roundtable discussion. It was determined that this alternative had the most controversial resident Canada goose management techniques and that the alternative in general was very similar to alternative B. This alternative retained the intensive resident Canada goose management techniques of alternative B, both lethal and non-lethal, and combined it with a less intensive wetlands management plan. This alternative assumed that less aggressive wetland management might be needed if the resident Canada goose population is highly controlled.

TECHNIQUES DISMISSED FROM FURTHER CONSIDERATION

Several techniques that were considered for the alternatives were also dismissed during the process of alternative formulation. The following techniques were eliminated from further consideration for the management of wetlands and resident Canada geese at Anacostia Park.

WETLAND MANAGEMENT TECHNIQUES

Maintenance Dredging—The alternatives described above include the creation of tidal guts in areas of the wetlands that do not continuously receive tidal water flow. These tidal guts would be created through a one-time dredging activity. The NPS has eliminated maintenance dredging of the existing and created tidal guts due to the high costs associated with the effort. This element is not economically feasible.

Hard Containment—Hard containment, including sheet piling and riprap would not be used to completely surround wetland areas. The purpose of containment is to temporarily hold sediment in place. Hard containment surrounding the entire wetland has been dismissed since sheet piling and riprap are typically permanent materials. This element is not technically or economically feasible.

RESIDENT CANADA GOOSE MANAGEMENT TECHNIQUES

Harassment Techniques—Harassment techniques that involve the use of pyrotechnics, propane cannons, distress calls, and lasers were dismissed. Due to the concerns discussed below, these types of harassment techniques were dismissed as reasonable alternative elements. In general, harassment techniques provide a short-term temporary relief. Success of harassment techniques varies depending on the size of the property, size of resident Canada goose population, and time of year the harassment techniques are used (Paulin and Drake 2004). Pyrotechnics, propane canons, and distress calls were dismissed because they conflict with and up-to-date or valid park plan, statement or purpose and significance, or other policy, such that a major change in the plan or policy would be needed to implement the elements. Specifically, the use of soundmaking devices does not assist the park in protecting natural sounds (NPS 2006a). The use of lasers and hazing with water spray would cause great environmental impacts. Below is a short description of harassment techniques that were dismissed.

Pyrotechnics—Pyrotechnics are devices that make a loud noise intended to scare geese away from an area. Pyrotechnics include screamers and banger shells (shot out of a starter-type pistol) and shell crackers (shot out of a 12-gauge shotgun). Detonating pyrotechnics would be loud and irritating to the surrounding communities.

Propane Cannons—Propane cannons are devices that ignite propane gas to produce a loud explosion at timed intervals. This technique is extremely loud. The park is urban and the use of propane cannons would disturb surrounding residences and communities.

*Distress C*alls—This element involves using a recording of distress calls of Canada geese. Distress calls are most effective when played back loud enough to be heard by geese at a distance. When using this element, geese quickly habituate to distress stimulus (French 2001).

Lasers—Lasers used as a harassment tool are relatively low power, long-wave length lasers that can disperse species under low light conditions. Lasers cannot be pointed directly at people, roads, and aircraft (French 2001). This technique may be an acceptable tool; however, public safety is a concern and this technique can be costly.

Hazing with Water Spray Devices—In public use areas, this is not a viable tool due to increased noise levels that could disturb the surrounding residences. In addition the use of a water spray device would likely create areas of ponding throughout the park, including the recreation fields.

Noisemaking devices—Noisemaking devices that could be mounted on vehicles, hand-held, or operated remotely such as emergency sirens, nautical horns, and electric whistles played at loud levels to scare geese were dismissed. Firing non-projectile blanks from firearms or starter guns and firing bangers, screamers, and whistle bombs from a 15-millimeter launcher are additional scare and harassment devices that were also dismissed from further consideration. It is likely that the resident Canada goose population would habituate to these noisemaking harassment techniques. While some of these devices are occasionally used in other parks, Anacostia Park's location within the metropolitan area and the public's close proximity to areas where these devices would be used makes these devices too disruptive. Visitors playing golf or on adjacent playing fields would be constantly disrupted by noise.

Nest Destruction—Landowners and local governments who intend to oil eggs or destroy nests must register and log these activities on the USFWS website. Registration must be completed before egg oiling and nest destruction activities are undertaken. Egg oiling and nest destruction can only be completed after registration between March 1 and June 30. Additionally, participants in the program must return to the USFWS website by October 31 to report the number of nests and eggs destroyed, even if no eggs or nests were destroyed. Registration is only valid for one season, and must be renewed each year before nests and eggs may be destroyed (USFWS 2009). Resident Canada geese typically nest within 150 feet of the water (Smith et al. 1999). When goose nests are destroyed, Canada geese may re-nest in or near the first or original nest. Re-nesting is more common when nest failure occurs early in the egg-laying period. If nest destruction occurs after more than one week of egg incubation, re-nesting is rare (Smith et al. 1999). Nest destruction was considered but dismissed from further analysis during the process of alternative formulation. When nests are destroyed resident Canada geese may re-nest in or near the first or original nest.

Tolerance Zones—NPS personnel considered establishing areas within the park that would be considered resident Canada goose nesting tolerance zones and non-tolerance zones. The purpose of the tolerance zone is to allow resident Canada geese to continue to reproduce and sustain a viable population. The purpose of the non-tolerance zone is to focus resident Canada goose management efforts in those areas identified for wetland management and restoration. The tolerance zones would include areas set aside where geese would be allowed and they would not be disturbed by the management techniques discussed in each alternative. These sites would be easily accessible and would offer the geese preferred habitat for foraging and nesting. The sites would include feeding areas, good sight lines, and access to bodies of water. The non-tolerance zones would not allow resident Canada geese to nest or forage in the selected areas. Nesting areas would be visited on a daily basis; those nests built within the no tolerance

zones would be removed and destroyed. This alternative was not considered technically viable since it would be impossible to keep geese from any given area because there is no fencing within the park and geese could move in and out of areas by flying. In addition, moving geese would shift the problems associated with the geese to other areas within the park or neighboring property, which would not meet the project objectives or resolve the need.

Exclusion Techniques (electric fencing)—There are many safety concerns associated with the use of electric fencing for goose management. Fences may need to be place in public areas since resident Canada geese are found throughout Anacostia Park. Other types of exclusion fencing do not pose the same harm to visitors and can be effective deterrents. Therefore, because of public safety concerns and other adverse environmental affects (Drake and Paulin 2003), this type of exclusion fencing was dismissed.

Capture and Relocation—This technique includes capturing resident Canada geese and relocating them to an area of sufficient distance from the park to ensure that they would not return. Capturing resident Canada geese within Anacostia Park and relocating them would be in violation of NPS Policy regarding translocation. Relocating resident Canada geese to a different area would require permits. In addition, if resident Canada geese were to relocate, they may ultimately cause similar problems within the new location. Due to the concerns discussed above relating to policy and feasibility, capture and release was dismissed as a reasonable alternative element. This would be in conflict with up-to-date and valid park plan, statement of purpose and significance, or other policy, such that a major change in the plan or policy would be needed to implement.

Introduction of Mute Swans—This technique involves the introduction of mute swans to Anacostia Park. Swans are characterized as aggressive birds and will defend their territory, especially during breeding seasons. Mute swans are more tolerant of other waterfowl and may only defend the immediate area around their nest. This is not a viable technique because mute swans may act as decoys and can attract geese to waterbodies (USDA 2002). In addition, it is against NPS policy to introduce a non-native species (NPS 2006a). This is not technically or economically feasible and would be in conflict with up-to-date and valid park plan, statement of purpose and significance, or other policy, such that a major change in the plan or policy would be needed to implement.

Lure Crops—This technique includes fields of grain that have been planted and purposefully left for geese to consume. Due to the need of the park to have to use a nearby agricultural field located outside of park boundaries, this technique was dismissed. In addition, this technique may lead to an increase in bird density locally because birds are attracted to the abundance of food (French 2001). This was dismissed because it is not technically feasible and it may lead to other adverse environmental impacts outside the park.

PREFERRED ALTERNATIVE

Alternative B fully meets all project objectives; alternative B is the preferred alternative.

The selection of the preferred alternative was accomplished during a roundtable meeting on March 8, 2010. Meeting attendees included the project team (Anacostia staff, NPS Regional Director, and representatives from CUE). During the roundtable meeting, the project team discussed how each of the alternatives fully meets, partially meets, or fails to meet the project objectives. The results of the roundtable discussion concluded that alternative B is the preferred alternative. Alternative B fully meets all the project objectives listed above due to the high number of resident Canada goose management techniques including lethal control, scare and harassment program, habitat alteration, and egg oiling. This alternative also proposes extensive wetland restoration opportunities including managing invasive plant

species, creating new shoreline buffers with native species, creating tidal guts, and daylighting. Other alternatives proposed did not fully meet each of the objectives.

In addition, to meeting the project objectives, all impacts to natural resources, (with the exception of resident Canada geese) are beneficial as a result of alternative B and include the following: soils, geology, water quality, floodplains, wetlands, aquatic resources, terrestrial vegetation, and wildlife (not including the resident Canada goose). These resources are described in more detail in the paragraphs that follow.

The majority of the wetland and resident Canada goose management techniques included under alternative B would not diminish the character-defining features or the overall integrity of historic resources and would have negligible impacts (*no adverse effect* for Section 106) on historic structures and districts. However, seawall breaks and daylighting, which are future wetland management techniques considered under alternative B, could have up to a long-term moderate adverse impact (*adverse effect* for Section 106) on the Anacostia River Seawall, which is potentially eligible for the NRHP. Future NEPA compliance would be necessary to assess possible impacts to the Anacostia River Seawall in the event that NPS implements the seawall breaks and daylighting associated with the alternative. Similarly, some of the management techniques under alternative B would require ground-disturbing activities that could result in direct, long-term minor to moderate adverse impacts (*adverse effect* for Section 106) to archeological resources. Additional documentation of archeological resources and NEPA compliance would be necessary to assess possible impacts to archeological resources as a result of alternative B. If impacts to cultural resources were found to be of such magnitude that a finding of *adverse effect* under Section 106 of the National Historic Preservation Act results, then NPS would consult with the District of Columbia State Historic Preservation Office and the Advisory Council. Adverse effects under Section 106 would be mitigated by context sensitive design or other measures developed during future Section 106 consultation as stipulated in a formal Memorandum of Agreement.

Although it is possible that adverse effects could occur to cultural resources as a result of alternative B, the following beneficial impacts to natural resources would occur:

- **Soils**—Beneficial impacts as a result of wetland and resident Canada goose management techniques proposed, which would improve the existing wetlands, create new wetlands, and reduce goose herbivory of wetlands which would increase wetland vegetation and rootmass, thus stabilizing soils adjacent to the river and reducing actual soil loss during rain events.
- **Hydrology**—Beneficial impacts as a result of the suite of potential techniques to improve the hydrology of the watershed including: erosion control techniques; removing/modifying structures that negatively affect the marsh; creating tidal guts; potential enforcement of no wake zones along the River; investigating the effects of extreme water level change; and considering altering water elevations; the combination of these techniques would infiltrate stormwater into soils, thus mimicking natural drainage processes and reducing the volume of stormwater runoff that enters the Anacostia River during rain events; stream and channel flow would also be improved by removing and/or modifying structures that impede flow.
- **Water Quality**—Beneficial impacts through reducing the resident Canada goose population in the park which would decrease the number of fecal droppings and decrease the amount of erosion from excessive grazing, thus improving water quality through decreased pathogens and sedimentation; new wetlands proposed or restored can serve as a trap for nutrients and sediment (and associated pollutants and pathogens binding to sediment) carried by runoff from surrounding uplands or contiguous wetlands, thereby improving water quality in the Anacostia River.
- **Floodplains**—Floodplain function would improve in localized areas of the park through improvements to wetlands; additional vegetative buffer plantings along the river; and the removal

of impervious surface in the watershed as well as potential flood attenuation through wetland restoration techniques.

- **Wetlands**—The high wetland and resident Canada goose management techniques proposed would enhance existing wetland areas at the park and restore or create new wetland areas resulting in beneficial impacts; it is expected that with rapidly reduced goose browsing pressure, the herbivory previously observed in wetland vegetation would start to reverse and may allow the vegetation to become more resilient (through increased rootmass and propagules) to goose herbivory the following spring.
- **Aquatic Resources**—For alternative B, improvements to wetland vegetation through restoration and resident Canada goose management would indirectly benefit aquatic resources, including finfish, benthic macroinvertebrates, and shellfish because revegetation, stabilization, and changes to hydrology would improve habitat and food sources for aquatic species.
- **Terrestrial Vegetation and Wildlife**—Alternative B would result in overall beneficial impacts on vegetation due to wetland management practices, new plantings, and a reduction in herbivory which would improve native vegetation communities; this alternative would also result in beneficial impacts on wildlife (not including resident Canada geese) because improvements to habitat and food sources would positively impact population structure and numbers in the park.

The only adverse impact to natural resources as a result of alternative B includes adverse impacts to resident Canada geese within the park due to lethal reduction activities. Alternative B proposes more intense management techniques, and therefore, has a long-term moderate to major adverse impact on the resident Canada goose in the park because the population would be lethally reduced and maintained at a lower level than current numbers throughout the life of the plan/EIS; impacts to the population of resident Canada geese within the park would be detectable, and these impacts would be perceptible at the Maryland or DC resident Canada goose population level, but not at the Atlantic Flyway resident Canada goose population levels.

For visitor use and experience, there would be different expectations for different users of the park. For alternative B, it is the intent of NPS to manage a population of, and not eradicate, the resident Canada geese. NPS recognizes some Canada geese would remain in the park and would include both resident geese and migratory geese. For this alternative, impacts to visitors who enjoy seeing resident Canada geese at the park would continue to be beneficial. Similarly, impacts to visitors who do not enjoy resident Canada geese at the park would be beneficial since the resident Canada goose population would be reduced under alternative B.

SUMMARY−CONSISTENCY WITH SECTIONS 101(B) AND 102(1) OF NEPA

The NPS requirements for implementing NEPA include an analysis of how each alternative meets or achieves the purposes of NEPA, as stated in sections 101(b) and 102(1). Each alternative analyzed in a NEPA document must be assessed as to how it meets the following purposes:

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
2. Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.
3. Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.

4. Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
5. Achieve a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities.
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Council on Environmental Quality (CEQ) Regulation 1500.2 establishes policy for federal agencies' implementation of NEPA. Federal agencies shall, to the fullest extent possible, interpret and administer policies, regulations, and public laws of the United States in accordance with the policies set forth in NEPA (sections 101(b) and 102(1)); therefore, other acts and NPS policies are referenced as applicable in the following discussion.

Fulfills the Responsibilities of Each Generation as Trustee of the Environment for Succeeding Generations

Alternatives B, C, D, and E provide increased protection to wetlands at Anacostia Park by establishing wetland and resident Canada goose management guidelines that reduce impacts on the restored wetlands from the resident Canada geese. Applying both resident Canada goose and wetland management techniques would not only benefit the restored wetlands in the park when compared to the no action alternative, but would also provide protection to other resources including soils, water quality, vegetation, and wildlife.

Alternative B provides the highest level of wetlands and resident Canada goose management by combining the most aggressive wetland techniques with intensive resident Canada goose management techniques including lethal control. Alternative B would reduce herbivory on wetland vegetation by implementing an intensive lethal control program, altering the preferred habitat of resident Canada geese, and establishing a scare and harassment program. Alternative B would also implement various wetland management techniques, including use of erosion control techniques, creating tidal guts, and considering daylighting and seawall breaks, that would restore, protect, and maintain wetland functions. Restoring wetlands would also benefit other wildlife within the area. Alternative B would fully meet the purpose of fulfilling the responsibilities of each generation as trustee for the environment.

Alternative C includes moderate wetlands management with moderate resident Canada goose management. This alternative assumes that more intensive wetland management would be needed to counteract the resident goose population that would remain in the area. Alternative C would include a variety of resident Canada goose management techniques including lethal control, increasing vegetative buffers, and implementing a scare and harassment program. Overall, these techniques would reduce the amount of herbivory by geese within the restored wetland areas. Wetland techniques would restore, protect, and maintain the wetland functions, including hydrology and vegetation. Techniques may include erosion control, planting efforts, and managing invasive plant species. Wetland restoration would also benefit other wildlife in the area. Consequently, alternative C would also fully meet the purpose of fulfilling the responsibilities of each generation as trustee of the environment.

Alternative D includes a plan for low wetlands management and low resident Canada goose management. Alternative D combines less aggressive wetland management techniques with lethal resident Canada goose management one time during the life of the plan if necessary. Wetland management techniques include managing invasive plant species, considering new rain garden areas, and removing or modifying structures that result in erosion or clogging the marsh. Resident Canada goose management techniques include minimal alteration of preferred habitat, and continuation of the park's egg oiling program.

Although, wetland and resident Canada goose management techniques would improve conditions when compared to the no action alternative, benefits would be short-term and wetland functionality would continue to decrease. Consequently, alternative D would only meet the purpose of fulfilling the responsibilities of each generation as trustee of the environment to a moderate degree.

Alternative E combines the most aggressive wetlands management technique with intensive non-lethal resident Canada goose management techniques. Alternative E restores, protects, and maintains wetland functions by using erosion control techniques, creating tidal guts, and considering daylighting and seawall breaks. Although resident Canada goose management techniques would not include lethal control, benefits to the wetlands could result from modifying preferred goose habitat, initiating an intensive scare and harassment program, and continuing reproductive controls. The benefits from wetland management would continue to be largely offset by the large size of the resident Canada goose population at the park. Therefore, alternative E would only meet the purpose of filling the responsibilities of each generation as trustee of the environment to a moderate degree.

Alternative A, the no action alternative, would not change the current wetland and resident Canada goose management at the park. The park would continue to maintain the current goose exclusion fencing and conduct yearly egg oiling. Goose herbivory, invasive plant species, erosion, and loss of wetland function would result in further degradation of wetlands, water quality, and wildlife habitat. Due to the continued degradation of the wetlands and wildlife habitat, alternative A would not fully meet the purpose of fulfilling the responsibilities of each generation as trustee for the environment.

Ensure for all Americans Safe, Healthful, Productive, and Aesthetically and Culturally Pleasing Surroundings

Alternatives B and C would fully meet the purpose of ensuring for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings. Alternatives B and C would include high to moderate resident Canada goose management techniques as described above. Minimizing the size of the resident Canada goose population at the park, would reduce the amount of goose feces throughout the park lands. This reduction would improve the health and safety of visitors at the park and the natural aesthetics of the park. The wetland and resident Canada goose management techniques would also improve the aesthetics of the area by restoring the wetlands and other vegetation throughout the park.

Alternatives D and E would meet the purpose of ensuring for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings, but only to a moderate level. Alternative E would include low wetland and resident Canada goose management as described above. If needed a one-time lethal control effort would be implemented. The reduction of the population would reduce the amount of goose feces throughout the park, which would benefit the health and safety of park visitors and natural aesthetics. However, since other resident Canada goose management strategies would be minimal, it is likely that the population may re-establish. Alternative E includes high wetland management and low resident Canada goose management as described above. Since no lethal control would be used in alternative E, it is likely that the large resident Canada goose population at Anacostia would continue to destroy wetlands and goose droppings throughout the park grounds would continue to be a problem. The wetland management techniques would restore and protect the wetlands; however, the benefits to the wetlands would be offset by the large resident Canada goose population size.

Alternative A would not fully meet the purpose of ensuring for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings. Alternative A includes minimal wetland and resident Canada goose management techniques. The resident Canada goose population would continue to destroy the wetlands throughout the park. In addition, goose feces throughout the park lands would

continue to be a problem, which would increase health and safety concerns and decrease the aesthetic and cultural landscape of the park.

Attain the Widest Range of Beneficial Uses of the Environment without Degradation, Risk of Health or Safety, or other Undesirable and Unintended Consequences

Alternatives B and C would fully meet the purpose of attaining the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences. Alternatives B and C would continue to allow a wide range of visitor use opportunities. The decrease in the resident Canada goose population would improve the health and safety of recreating at the park, by reducing the amount of goose feces throughout the park lands, including the playing fields which are used for multiple sporting events. These alternatives have been designed to allow multiple uses of the park without further degradation of water quality, vegetation, wildlife, and special status species. Alternative B offers additional uses of the park if new boardwalks and trails were constructed.

Alternatives D and E would meet the purpose of attaining the widest range of beneficial uses of the environment without further degradation, risk of health and safety, or other undesirable or unintended consequences, but only to a moderate level. Alternatives D and E would continue to allow a wide range of visitor use opportunities; however, the health and safety of individuals would continue to be an issue since, the large resident Canada goose population would most likely continue. Alternative D would only allow a onetime lethal control reduction and alternative E would not include lethal control. Goose feces throughout the park would continue to be high and reduce the river's water quality. In addition, it is likely that the resident Canada goose population would continue to destroy the wetland areas.

Alternative A would not fully meet the purpose of attaining the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences. Under the no action alternative, the park would continue minimal wetland and resident Canada goose management strategies including maintaining goose exclusion fencing, egg oiling, and removal of invasive plant species. The resident Canada goose population would continue to destroy the wetlands throughout the park. Goose feces would continue to be a problem throughout the park including the playing fields and Langston Golf Course. Visitors would continue to recreate at the park; however, health and safety of visitors would continue to be a concern.

Preserve Important Historic, Cultural, and Natural Aspects of our National Heritage and Maintain, wherever Possible, an Environment that Supports Diversity and Variety of Individual Choice

Alternatives B and E would meet the purpose of preserving important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice, but only to a moderate level. Alternatives B and E include a high level of wetland and resident Canada goose management techniques (no lethal control for alternative E). Some of the proposed techniques may adversely impact the historic and archeological resources throughout the park. The wetland and resident Canada goose management techniques may alter the historic setting in the vicinity of Kenilworth Gardens, Langston Golf Course, and Anacostia Park. Some techniques such as, daylighting, seawall breaks, and creating tidal guts may require ground disturbing activities that could impact known or undiscovered archeological resources. However, restoring the wetlands throughout the park would benefit the natural aspects of the park including water resources, vegetation, wildlife habitat, and special status species.

Alternatives C and D would meet the purpose of preserving important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity

and variety of individual choice, but only to a moderate degree. Alternatives C and D include wetland and management techniques that would benefit the overall natural environment, including water resources, vegetation, wildlife habitat, and special status species. The wetland and resident Canada goose management techniques proposed under alternative C and D would require a limited scope of ground disturbing activities that could impact known or unknown archeological resources. In addition, the limited techniques proposed would create negligible impacts to the historic setting of Kenilworth Gardens, Langston Golf Course, and Anacostia Park.

Alternative A would meet the purpose of preserving important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice, but only to a moderate level. Under alternative A, the park would continue to manage wetlands and resident Canada goose population through maintaining goose exclusion fencing, egg oiling, and managing invasive plant species. The continuation of the current management practices would not result in impacts to the historic structures and districts or to archeological resources. However, the natural aspects of the park would continue to degrade. The resident Canada goose population would continue to destroy the wetland areas throughout the park. In addition, water resources, vegetation, and wildlife habitat would continue to degrade.

Achieve a Balance between Population and Resource use that would Permit High Standards of Living and a Wide Sharing of Life's Amenities

Balancing population and resource use under the plan/EIS would include protecting the resources unimpaired for the enjoyment of present and future generations and providing access for visitors to experience the natural resources of the park. NPS *Management Policies 2006* states that the enjoyment that is contemplated by the *Organic Act* is broad; it is the enjoyment of all the people of the United States and includes enjoyment both by people who visit parks and by those who appreciate them from afar. It also includes deriving benefit (including scientific knowledge) and inspiration from parks, as well as other forms of enjoyment and inspiration. Congress, recognizing that the enjoyment by future generations of the national parks can be ensured only if the superb quality of park resources and values is left unimpaired, has provided that when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant. As discussed above, alternatives B and C would continue to provide a variety of visitor activities throughout the park. Alternatives B and C would implement a variety of wetland and resident Canada goose management techniques that would restore and protect the wetland areas throughout the park. In addition, alternatives B and C would reduce the resident Canada goose population using lethal control and maintain the population through the life of the plan. Alternatives B and C would have the greatest benefit to the natural resources of the park including water resources, vegetation, wildlife habitat, and special status species. Given this, alternatives B and C would fully meet this purpose because each action alternative would provide the public access to share the park's amenities and would protect the resources so that they would be available for future generations.

Alternatives D and E would meet the purpose of achieving a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities, but only to a moderate level. Alternatives D and E would implement a limited number of wetland and resident Canada goose management techniques described above. Since lethal control would be limited in alternative D and prohibited in alternative E, it is likely that the large size of the resident Canada goose population at the park would continue. Although portions of the wetlands throughout the park may be restored, it is likely that the benefit would only be short-term, due to the continuation of the large resident Canada goose population. Alternatives D and E would continue to offer a variety of visitor uses, however, portions of the park would continue to degrade.

Alternative A would not fully meet the purpose of achieving a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities. Under the no action alternative, the park would continue minimal wetland and resident Canada goose management techniques including maintaining goose exclusion fencing, egg oiling, and managing invasive plant species. The resident Canada goose population would remain in large numbers and goose herbivory would continue to threaten wetland vegetation. Resident Canada geese would continue to deplete the wetlands and cause adverse impacts to water resources and wildlife habitat. Although, visitors would have the opportunity to use the park for a variety of uses, resources would continue to degrade.

Enhance the Quality of Renewable Resources and Approach the Maximum Attainable Recycling of Depletable Resources

Action alternatives B, C, D, and E would fully meet the purpose of enhancing the quality of renewable resources and approach the maximum attainable recycling of depletable resources. For the reasons discussed above, each alternative would enhance the quality of and protect the park's biological and physical resources to some extent. Alternatives B and C would provide the greatest protection of these resources since it would allow for the most wetland and resident Canada goose management techniques and it would allow lethal control throughout the life of the plan. Alternatives D and E would protect the park's biological and physical resources, but to the least degree when compared to the other action alternatives. Alternative E would include the least amount of wetland and resident Canada goose management techniques. Lethal control could only be used one time throughout the life of the plan if necessary. Wetland management would also be minimal; however, the park would still plant and widen vegetated buffers, use passive seedbank restoration efforts, address upland runoff, and create new rain gardens. These techniques would benefit the park's resources. Although alternative E would not allow lethal control, this alternative would allow high wetlands management and moderate resident Canada goose management. Restoring the park's wetlands would enhance other resources including water resources, vegetation, and wildlife habitat.

Alternative A would not meet the purpose of enhancing the quality of renewable resources. Under the no action alternative, the resident Canada goose population would continue to thrive and deplete the wetlands throughout the park. Other resources including water resources, vegetation, and wildlife would also continue to degrade.

The second purpose, "approach the maximum attainable recycling of depletable resources," is less relevant to the wetland and resident Canada goose management plan, as it is geared toward a discussion of "green" building or management practices. Alternatives B and E may include the construction of new boardwalks and trails. Environmentally appropriate design standards and materials would likely be used to minimize impacts to depletable resources. There would be no construction related to the no action alternative (alternative A), so this purpose would not apply.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The NPS is required to identify the environmentally preferred alternative in its NEPA documents for public review and comment. The NPS, in accordance with the U.S. Department of the Interior policies contained in the Department Manual (515 DM 4.10) and CEQ's Forty Questions, defines the environmentally preferred alternative (or alternatives) as the alternative that best promotes the national environmental policy expressed in NEPA (section 101(b)) (516 DM 4.10). The CEQ's Forty Questions (Q6a) further clarifies the identification of the environmentally preferred alternative stating, "this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (CEQ 1981).

Alternative B has been selected as the environmentally preferred alternative because it is the alternative that would best protect the biological and physical environment by ensuring an immediate as well as a long-term reduction in resident Canada geese within the park that could be sustained over the life of the plan and allow the wetland vegetation to recover from goose herbivory. All impacts to natural resources, (with the exception of resident Canada geese) are beneficial as a result of alternative B and included the following: soils, geology, water quality, floodplains, wetlands, aquatic resources, terrestrial vegetation, and wildlife (not including the resident Canada goose). These resources are described in more detail in the paragraphs that follow. Although alternatives B and C are very close in meeting the goal that identifies the environmentally preferred alternative, alternative B was selected primarily because of its greater certainty in achieving the resident Canada goose goal through high wetland and high resident Canada goose management techniques and all of the beneficial impacts associated with alternative B for natural resources. Alternatives A, D, and E were not considered environmentally preferred because of their lack of effect on resident Canada goose numbers in the park through low resident Canada goose management or lack of lethal reduction activities, which would result in potential adverse effects on the biological and physical resources of the park over the life of the plan.

The majority of the wetland and resident Canada goose management techniques included under alternative B would not diminish the character-defining features or the overall integrity of historic resources and would have l negligible impacts (*no adverse effect* for Section 106) on historic structures and districts. However, seawall breaks and daylighting, which are future wetland management techniques considered under alternative B, could have up to a long-term moderate adverse impact (*adverse effect* for Section 106) on the Anacostia River Seawall, which is potentially eligible for the NRHP. Future NEPA compliance would be necessary to assess possible impacts to the Anacostia River Seawall in the event that NPS implements the seawall breaks and daylighting associated with the alternative. Similarly, some of the management techniques under alternative B would require ground-disturbing activities that could result in direct long-term minor to moderate adverse impacts (*adverse effect* for Section 106) to archeological resources. Additional documentation of archeological resources and NEPA compliance would be necessary to assess possible impacts to archeological resources as a result of alternative B. If impacts to cultural resources were found to be of such magnitude that a finding of *adverse effect* under Section 106 of the National Historic Preservation Act results, then NPS would consult with the District of Columbia State Historic Preservation Office and the Advisory Council. Adverse effects under Section 106 would be mitigated by context sensitive design or other measures developed during future Section 106 consultation as stipulated in a formal Memorandum of Agreement.

Although it is possible that adverse effects could occur to cultural resources as a result of alternative B, the following beneficial impacts to natural resources would occur, thus justifying alternative B as the environmentally preferred alternative:

- **Soils**—Beneficial impacts as a result of wetland and resident Canada goose management techniques proposed which would improve the existing wetlands, create new wetlands, and reduce goose herbivory of wetlands which would increase wetland vegetation and rootmass, thus stabilizing soils adjacent to the river and reducing actual soil loss during rain events. Alternative B is the most beneficial to soils compared all other alternatives because this alternative proposes the most hydrology techniques, greatest planting density effort, most wetland restoration projects in combination with lethal population reduction activities for geese to reduce grazing pressure of vegetation from resident Canada geese.
- **Hydrology**—Beneficial impacts as a result of the suite of potential techniques to improve the hydrology of the watershed including: erosion control techniques; removing/modifying structures that negatively affect the marsh; creating tidal guts; potential enforcement of no wake zones along the River; investigating the effects of extreme water level change; and considering altering water

elevations; the combination of these techniques would infiltrate stormwater into soils, thus mimicking natural drainage processes and reducing the volume of stormwater runoff that enters the Anacostia River during rain events; stream and channel flow would also be improved by removing and/or modifying structures that impede flow. Even though alternatives B and E propose the most intensive hydrology techniques, alternative E does not include lethal population reduction activities for geese to reduce grazing pressure of vegetation from resident Canada geese. Therefore, alternative B is the most beneficial alternative to hydrology.

- **Water Quality**—Beneficial impacts through reducing the resident Canada goose population in the park which would decrease the number of fecal droppings and decrease the amount of erosion from excessive grazing, thus improving water quality through decreased pathogens and sedimentation; new wetlands proposed or restored can serve as a trap for nutrients and sediment (and associated pollutants and pathogens binding to sediment) carried by runoff from surrounding uplands or contiguous wetlands, thereby improving water quality in the Anacostia River. Alternative B is the most beneficial to water quality compared all other alternatives because this alternative proposes the most hydrology techniques, greatest planting density effort, most wetland restoration projects in combination with lethal population reduction activities for geese to reduce grazing pressure of vegetation from resident Canada geese.
- **Floodplains**—Floodplain function would improve in localized areas of the park through improvements to wetlands; additional vegetative buffer plantings along the river; and the removal of impervious surface in the watershed as well as potential flood attenuation through wetland restoration techniques. Alternative B is the most beneficial to floodplains, because alternative C includes only limited removal of structures and least invasive stream/stormwater outfall modifications and no seawall breaks and no daylighting are proposed for alternative C to reconnect the floodplain with the Anacostia River. Although alternative E proposes similar techniques compared to alternative B, the floodplain benefits from a full suite of wetland management techniques proposed without a resident Canada goose population (lethal) reduction may be either completely offset or take longer to realize for alternative E.
- **Wetlands**—The high wetland and resident Canada goose management techniques proposed would enhance existing wetland areas at the park and restore or create new wetland areas resulting in beneficial impacts; it is expected that with rapidly reduced goose browsing pressure, the herbivory previously observed in wetland vegetation would start to reverse and may allow the vegetation to become more resilient (through increased rootmass and propagules) to goose herbivory the following spring. Compared to alternative B, which is the most beneficial to wetlands, alternative C would not include creating tidal guts and would not consider stream daylighting or seawall breaks and planting efforts would be at a lower density. Although alternative E proposes similar techniques compared to alternative B, the benefits to wetlands from a full suite of wetland management techniques proposed in alternative E without a resident Canada goose population (lethal) reduction would not have a beneficial impact on wetlands.
- **Aquatic Resources**—For alternative B, improvements to wetland vegetation through restoration and resident Canada goose management would indirectly benefit aquatic resources, including finfish, benthic macroinvertebrates, and shellfish because revegetation, stabilization, and changes to hydrology would improve habitat and food sources for aquatic species. Alternative B is the most beneficial to aquatic resources compared all other alternatives because this alternative proposes the most wetland techniques in combination with a lethal population reduction activities for geese to reduce grazing pressure of wetland vegetation from resident Canada geese.
- **Terrestrial Vegetation and Wildlife**—Alternative B would result in overall beneficial impacts on vegetation due to wetland management practices, new plantings, and a reduction in herbivory which would improve native vegetation communities; this alternative would also result in

beneficial impacts on wildlife (not including resident Canada geese) because improvements to habitat and food sources would positively impact population structure and numbers in the park. Alternative B is the most beneficial to terrestrial resources compared all other alternatives because this alternative proposes the most techniques that would benefit vegetation and wildlife in combination with a lethal population reduction activities for geese to reduce grazing pressure of vegetation from resident Canada geese.

The only adverse impact to natural resources as a result of alternative B includes adverse impacts to resident Canada geese within the park due to lethal reduction activities. Alternative B proposes more intense management techniques, and therefore, has a long-term moderate to major adverse impact on the resident Canada goose in the park because the population would be lethally reduced and maintained at a lower level than current numbers throughout the life of the plan/EIS; impacts to the population of resident Canada geese within the park would be detectable, and these impacts would be perceptible at the Maryland or DC resident Canada goose population level, but not at the Atlantic Flyway resident Canada goose population levels.

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Chapter 3: Affected Environment

CHAPTER 3: AFFECTED ENVIRONMENT

This "Affected Environment" chapter describes the existing environmental resources of the areas that would be affected if the Proposed Action were implemented. The descriptions, data, and analyses focus on the specific conditions or consequences that may result from implementing the Proposed Action as required by Director's Order #12: *Conservation Planning, Environmental Impact Analysis, and Decision Making,* which sets forth the policy and procedures by which NPS will comply with NEPA (NPS 2011).

A description of existing environmental conditions provides a better understanding of planning issues and establishes a benchmark by which the magnitude of environmental effects of the proposed action, the no action alternative, and other alternatives can be compared. The information in chapter 3 is organized by the same environmental topics used to organize the impact analysis in chapter 4. Figures 17 through 19 present a general location map of Anacostia Park.

PHYSICAL RESOURCES

This section discusses soils within the study area.

SOILS

The Anacostia Watershed has seen major alterations to its soil from the past 150 years of development. Major alterations of the tidal portion of the Anacostia River by the USACE began in the 1920s and left fill materials (Udorthents soils) along much of the riparian buffer in the District portion of the Anacostia River. The majority of the soils within Anacostia Park are considered Udorthents (USDA NRCS 2006). Udorthents are comprised of very heterogeneous earth fill material that has deposited on poorly drained to somewhat excessively drained soils. Udorthents are composed of approximately 80 percent earthy material and 20 percent of other matter which may include bricks, or pieces of concrete or stone. The fill is a mixture of organic and inorganic waste materials, as well as sandy, gravelly, clayey, or silty soil materials. The thickness of the fill is variable, but is typically more than 20 inches. Permeability, available water capacity, runoff, and internal drainage are also quite variable (DCDOT 2006a). Most areas adjacent to the Anacostia River contain udorthents. In addition, udorthents are located at Poplar Point, park headquarters, RFK shoreline, Anacostia pavilion, picnic areas, ball fields, and Langston Golf Course (figures 20 through 22). Soils surrounding the park headquarters also contain urban lands (USDA NRCS 2006). The urban land mapping unit consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces (DCDOT 2006a). Soils considered urban lands are also located around the RFK stadium and on the west bank of the Anacostia River near the 11th Street Bridge (figure 20 through 22).

Other soil classifications throughout Anacostia Park include Iuka sandy loam, Matapeake silty loam, Bibb sandy loam, Fluvaquents, Galestone, and Rumford soils, Fallsington sandy loam, Christiana silt loam, Keyport fine sandy loam, Sassafras gravelly sandy loam, Woodstone sandy loam, and Melvin silt loam (figures 20 through 22). The Iuka series consists of deep, moderately well drained, moderately permeable soils that formed in stratified loamy and sandy alluvial sediments. These soils are on nearly level flood plains. They are saturated with water at depths of 1 foot to 3 feet below the surface during wet seasons and are subject to flooding. Slopes range from 0 to 2 percent. These soils are located at the tennis courts and picnic area just south of Pennsylvania Avenue and at the Langston Golf Course (in Kingman Marsh). Small pockets of Iuka soils are located throughout Kenilworth Marsh (USDA NRCS 2006) (figures 20 through 22). Iuka soils are considered hydric soils in the District (USDA NRCS 2008). The definition of a hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils are one of the required

criteria for a site to be characterized as a wetland and include soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation.

The Matapeake series consists of very deep, well drained, moderate to moderately slow permeable soils that formed in silty eolian sediments underlain by coarser fluvial or marine sediments. Slopes range from 0 to 8 percent. These soils are located at the basketball courts just south of Benning Road (USDA NRCS 2006) (figures 20 through 22).

The Bibb series consists of very deep, poorly drained, moderately permeable soils that formed in stratified loamy and sandy alluvium. These soils are on floodplains of streams in the Coastal Plain. Runoff for this soil is very slow and permeability is moderate with the water table within eight inches of the surface most of the year. Slopes range from 0 to 2 percent and the erosion hazard is none to slight. This soil is limited in use for building, gardens, lawns, and recreational uses because of the high water table and potential of flooding. These soils can provide suitable habitat for many wildlife species. These soils are located within the small islands and Langston Golf Course at Kingman Marsh and the wetland areas on the west bank of the Anacostia River just south of the Baltimore Washington Parkway. The Bibb series also make up the majority of the soils within the Kenilworth Marsh area (USDA NRCS 2006) (figures 20 through 22). Bibb soils are also considered hydric soils in the District (USDA NRCS 2008).

Fluvaquents are typically found in floodplains and have a slope of 0 to 2 percent. These soils have a high potential for flooding and a high water table. Because of these characteristics, these soils have severe limitations for buildings, gardens, lawns, and recreational uses. Although they have these limitations, these soils do provide suitable habitat for many wildlife species and can be used as natural areas and habitat. A small area of fluvaquent soils is located in the Anacostia River Fringe Wetlands adjacent to the Anacostia River just south of Benning Road. Additionally, small pockets of fluvaquent soils are located throughout Kenilworth Marsh (USDA NRCS 2006) (figures 20 through 22). Fluvaquents are also considered a hydric soil in the District (USDA NRCS 2008).

Small areas Galestone and Rumford soils and Fallsington sandy loam are located near the entrance to the Kenilworth Aquatic Gardens (USDA NRCS 2006) (figure 20). Galestone and Rumford soils consist of very deep, somewhat excessively drained, moderately rapid permeable soils that formed in marine deposits. Slopes range from 0 to 15 percent. The Fallsington soils consist of very deep, poorly drained, moderate to moderately slow permeable soils that formed in loamy marine and old alluvial sediments. Slopes range from 0 to 2 percent.

Small areas of Beltsville silt loam, Sassafras gravelly silt loam, Sunnyside fine sandy loam, Muirkirk variant complex, and Woodstown sandy loam are located on the west bank of the Anacostia River just north and south of the Maryland line (USDA NRCS 2006) (figure 20). The Beltsville silt loam and Woodstown sandy loam are very deep, moderately well drained soils with moderate permeability. The Sunnyside fine sandy loam and Sassafras gravelly silt loam are very deep, well drained soils with moderate permeability. The Muirkirk series consists of very deep, well drained to somewhat excessively drained, moderately slow to slowly permeable soils on uplands.

An area of Christiana silt loam and Keyport fine sandy loam soils are located within the Langston Golf Course (USDA NRCS 2006) (figure 20). These soils are considered very deep and moderately well drained. Permeability is very slow to slow in the Keyport series and moderate to moderately slow in the Christiana series.

FIGURE 17: ANACOSTIA PARK, NORTH AREA

FIGURE 18: ANACOSTIA PARK, CENTRAL AREA

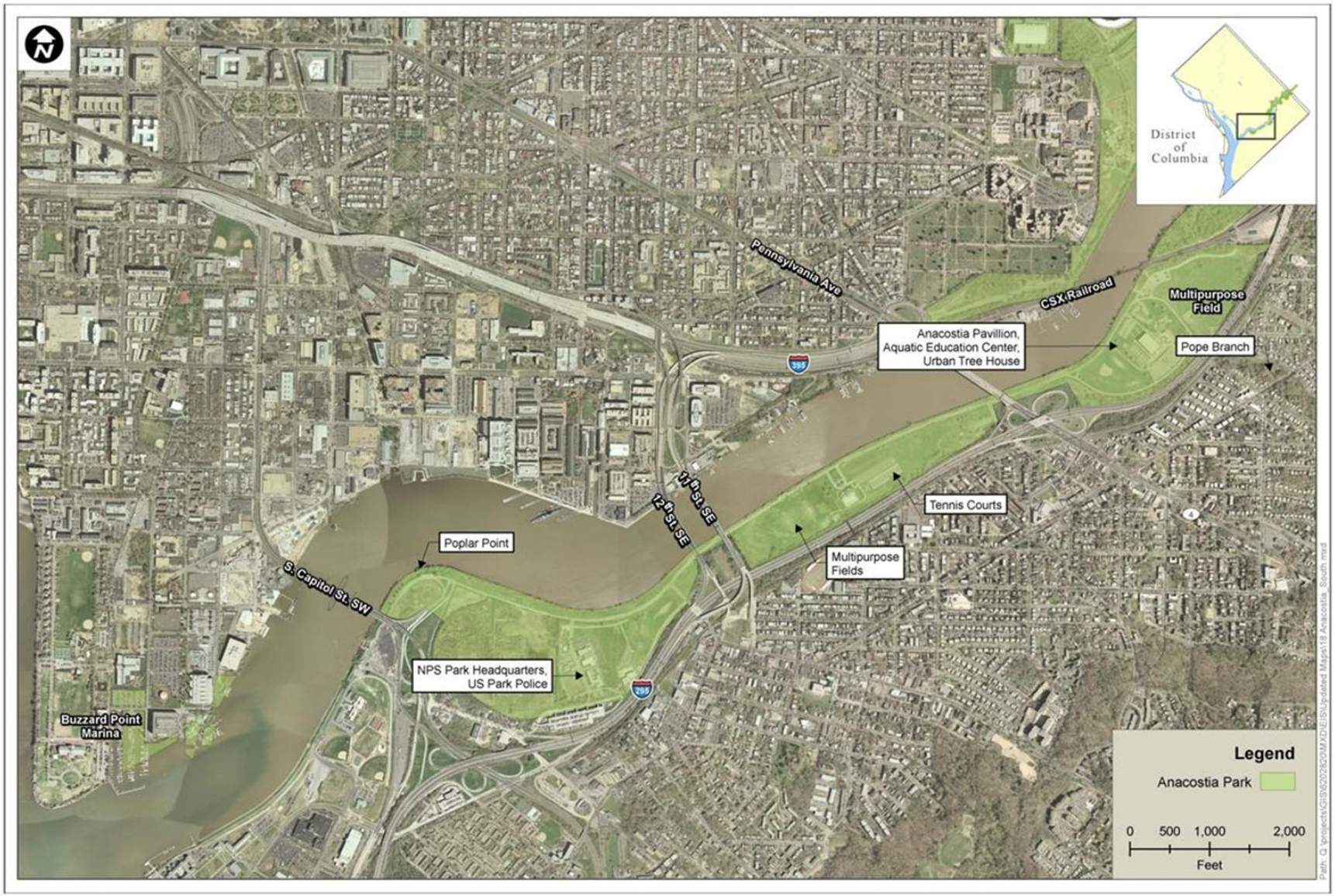


FIGURE 19: ANACOSTIA PARK, SOUTH AREA

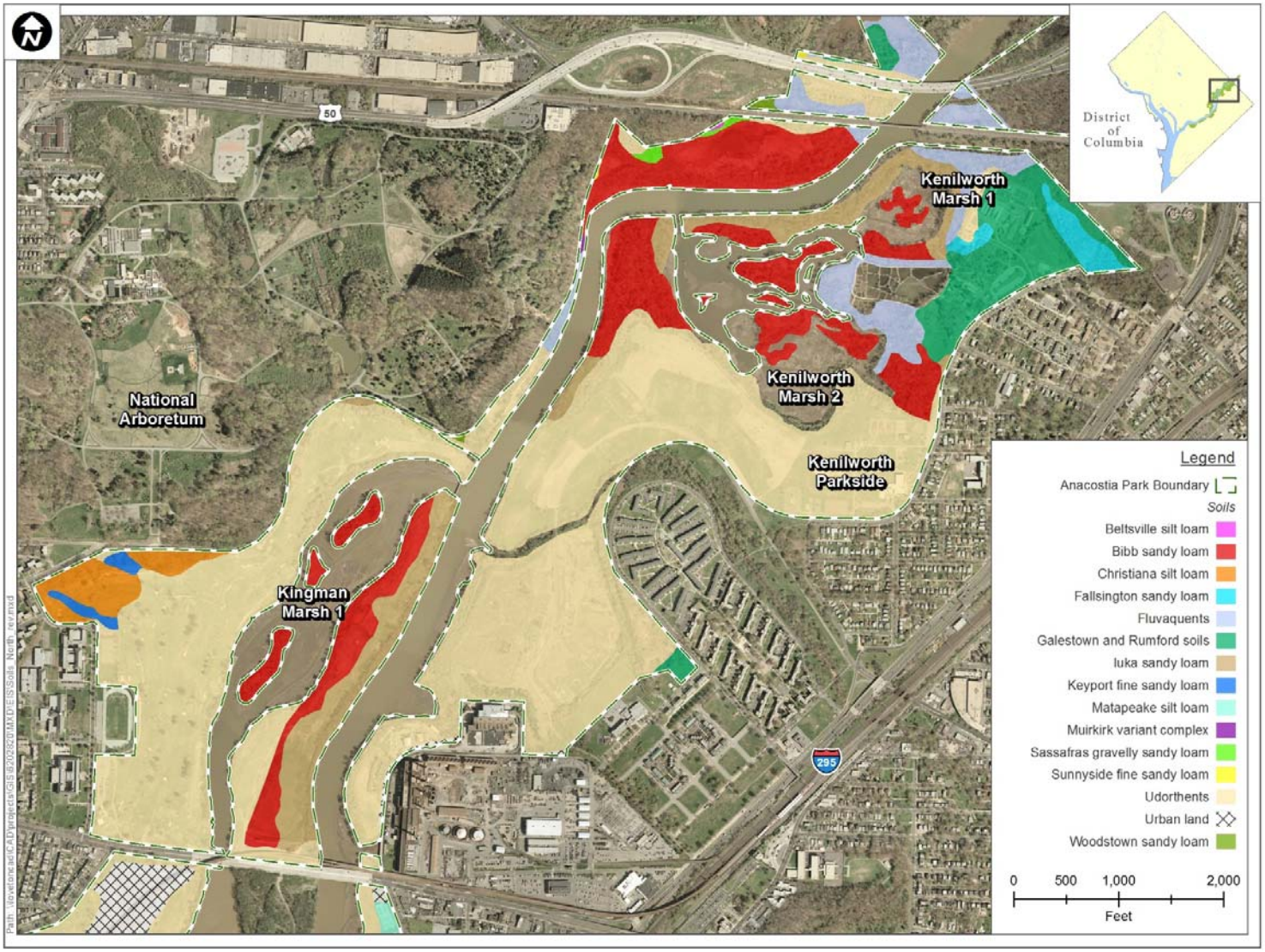


FIGURE 20: SOILS MAP OF ANACOSTIA PARK, NORTH AREA

FIGURE 21: SOILS MAP OF ANACOSTIA PARK, CENTRAL AREA

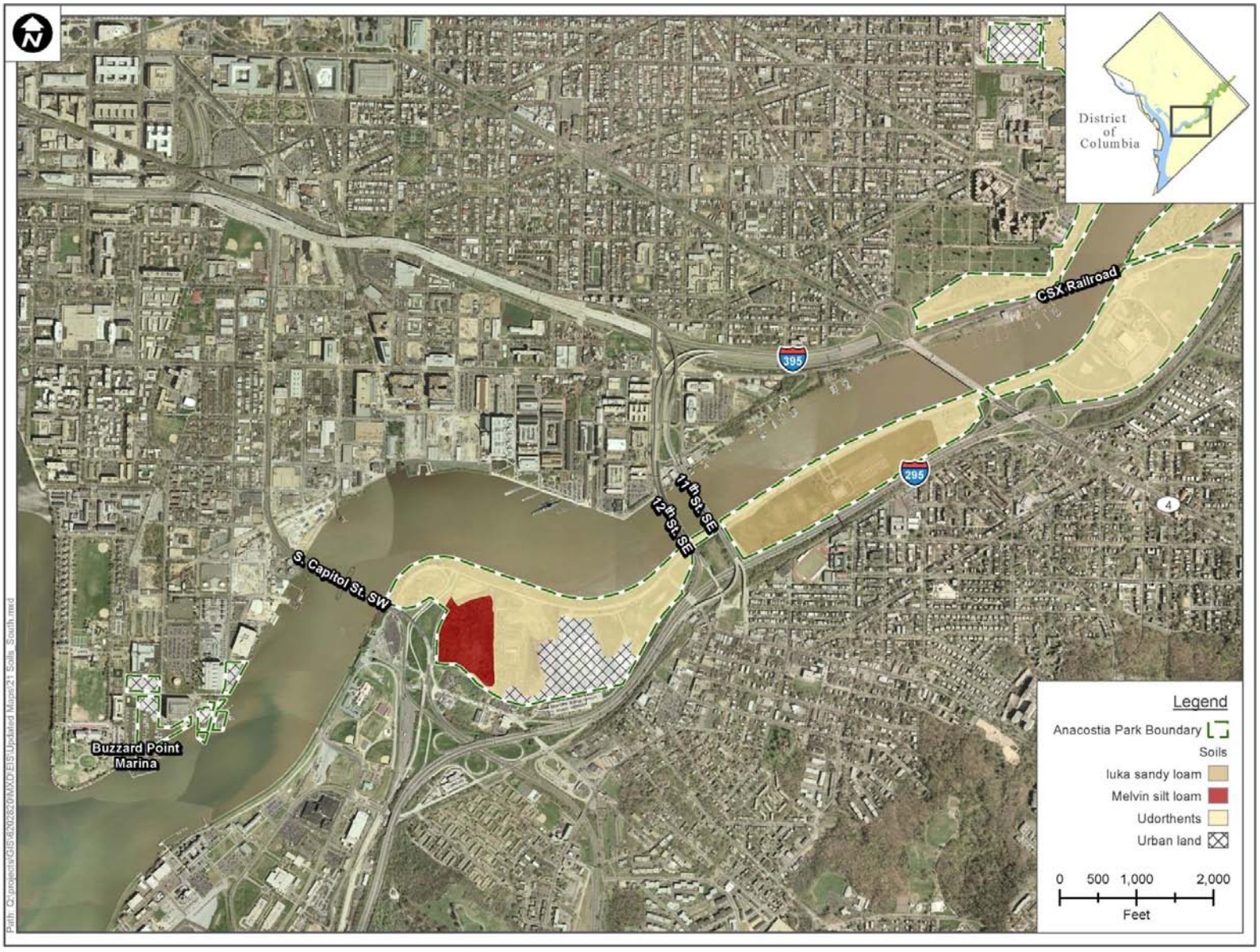


FIGURE 22: SOILS MAP OF ANACOSTIA PARK, SOUTH AREA

A small area of Melvin silt loam is located just east of the South Capitol Street Bridge near the park headquarters (USDA NRCS 2006) (figure 22). The Melvin series consists of very deep, poorly drained soils formed in silty alluvium on flood plains and in upland depressions. Slopes range from 0 to 2 percent.

Soil erosion occurs along the Anacostia River and its tributaries from the large amounts of stormwater rushing over the concrete and spilling out of stormwater pipes. Erosion has occurred in the tributaries from urban runoff and flash floods. Soil surrounding the outfall pipes along the seawall has eroded away due to the high velocity of the water spilling into the river. The seawall runs along the east and west bank of the Anacostia River. The seawall has failed in various areas, due to concrete stones falling out and water flow washing out the soil from behind the seawall. The loss of soil has created large scour holes behind the seawall, particularly in areas along the river bank below the CSX railroad tracks near the park headquarters. Construction along the river has also resulted in erosion of soils. Some small-scale erosion occurs due to the tidal action on the mud flats.

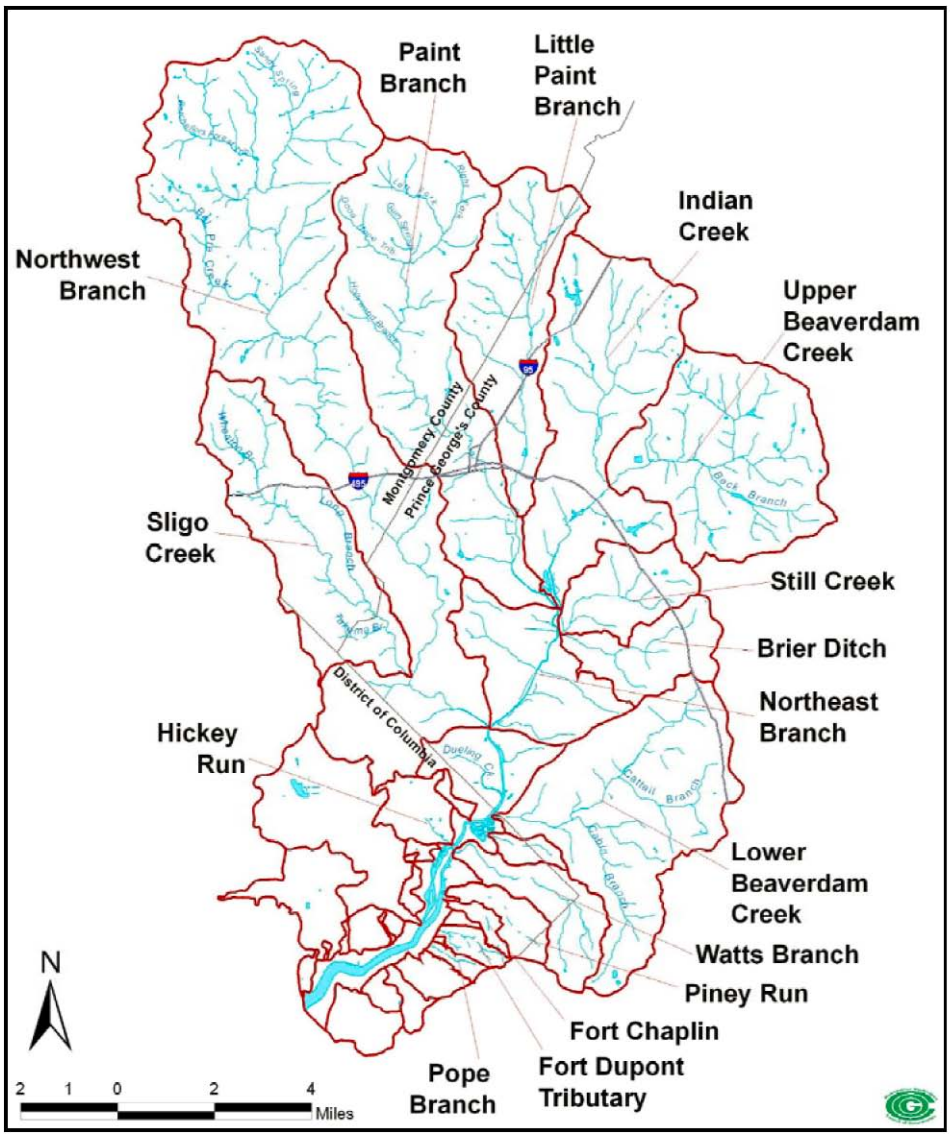
WATER RESOURCES

This topic includes hydrology, water quality, and floodplains.

HYDROLOGY

Anacostia Park is located within the greater Anacostia Watershed (figure 23), estimated at approximately 170 square miles, and drains portions of Montgomery and Prince George's Counties in Maryland as well as the eastern portion of the District. The Anacostia River is formed by the confluence of the free-flowing (non-tidal) Northeast and Northwest Branches at Bladensburg, Maryland in Prince George's County. The tidal influence in the Anacostia River extends approximately 1,000 feet upstream of this confluence in both Branches; therefore, the entire tidal Anacostia River from Bladensburg to the Potomac River contains only freshwater. The salt wedge from the ocean and the Chesapeake Bay does not persist past the District. Below the confluence in Bladensburg, the Anacostia River flows in a southwesterly direction for approximately 2.0 miles in Maryland and for approximately 6.7 miles through the eastern portion of the District. The Anacostia River joins the Potomac River at Hains Point in DC, approximately 108 miles upstream of the Chesapeake Bay near Point Lookout, Maryland. The NPS owns approximately 16 miles of shoreline along the Anacostia River. Overall, the morphology of the tidal Anacostia River system has been dramatically altered. This condition reflects the impacts of seawall construction, mainstem navigational dredging and associated filling, which collectively led to the destruction of the river's once-thriving riverine fringe wetlands (DCOP 2003).

The Anacostia River receives drainage from Hickey Run, Lower Beaverdam Creek and Watts Branch subwatersheds (figure 23). Tributaries of the Anacostia River within Anacostia Park and the District of Columbia include Watts Branch, Hickey Run, Fort Dupont Creek, and Pope Branch (figure 23). Most of the lateral tributaries of the Anacostia River have been modified, to varying degrees, through enclosure within storm drain systems, and some are contained in combined storm/sanitary sewers (DCOP 2003). Watts Branch is the largest tributary to the Anacostia River and is partially in the District jurisdiction; the mainstem of Watts Branch is classified as a perennial stream by the USGS. The USGS maintains a stage recorder in the lower portion of Watts Branch and provides real-time stage data on line (DCDOH 2005). Hickey Run is a western tributary of the Anacostia River and discharges into the river just north of Kingman Marsh, near the southern border of the USDA National Arboretum (DCDOH 2003a). The mouth of the tributary is a broad tidal area and runs through the national arboretum to New York Avenue (DCDOH 2005). Fort Dupont Creek is located south of the East Capital Street Bridge and its confluence is located along the eastern shoreline of the Anacostia River. Pope Branch is located south of Fort Dupont Creek and its confluence is located along the eastern shoreline of the Anacostia River.



Source: AWRP and MWCOG 2009

FIGURE 23: ANACOSTIA WATERSHED AND SUBWATERSHEDS

Kenilworth Park and Aquatic Gardens is located within the upper, northeastern section of Anacostia Park and constitutes approximately 700 acres. This portion of the park includes the historic aquatic gardens, Kenilworth Marsh, ball fields, and other recreational facilities. Kenilworth Marsh is a restored freshwater tidal marsh on the Anacostia River located adjacent to the Kenilworth Aquatic Gardens. This area is a tidal wetland that was restored in 1993 by depositing dredged material onto existing mudflats. The current marsh has a direct hydrologic connection to the Anacostia River via a breach in the seawall along the Anacostia River. Kenilworth Aquatic Gardens is a 14-acre historic site dedicated to the cultivation and display of exotic aquatic plants located along the east bank of the Anacostia River.

Kingman Marsh is located along the Anacostia River, and separated from the river by Kingman Island; the island is intersected by both the Benning Road Bridge and the East Capital Street Bridge. Kingman Marsh is a 110-acre tidal freshwater impoundment that was created during the 1920s and 1930s to provide a recreational boating area for the District residents. The marsh is hydrologically connected to the tidal

Anacostia River by two inlets located at the northern and southern portions of Kingman Island (historically known as Burnham Barrier). The upper section of the lake is characterized by a dendritic tidal canal system, and during a low tide consists primarily of barren mudflats and areas with shallow water (DCDOH 2003b). The lower section of the lake has an average depth of 3 feet at low tide, with fewer mudflats and no tidal canal system. During a rising tide, water enters the lake through the inlets. The range between mean low and mean high tide is approximately 3.0 feet. Mean high tide elevation is 2.09 feet NGVD (DCDOH 2003b). The majority of sources of water entering the lake include tidal flow, sheet flow from periods of heavy rain, and stormwater outfalls. The lower and upper portion of the lake is connected by a 30-foot culvert located under the Benning Road Bridge (USACE 1994). In 2000, the USACE initiated the restoration of 42 acres of a freshwater tidal emergent wetland in Kingman Marsh.

The Kingman and Kenilworth tidal marshes experience on average a 3.0-foot tidal exchange twice daily such that portions of marsh area that are too low to support vegetation become exposed mudflat at low tide. Both marshes are low energy in that they lie behind island/berm structures that protect them from the energies of the main Anacostia channel (USGS 2004).

Generally, the Anacostia River Basin receives approximately 40 inches of precipitation annually, and this precipitation is fairly evenly distributed throughout the seasons of the year. Therefore, high river flows can occur during any month. Water slows as it leaves the Piedmont Plateau and enters the Coastal Plain physiographic province (DCFWD 2001). In this location, the Anacostia River acts like a lake or sink due to slow water movement. Because time flushing in the Anacostia is dependent upon the tide, water may reside in the river for extended periods of time before reaching the downstream Potomac River (DCFWD 2001). The average flush time for the Anacostia River is 20 days, but a 40-day flush time is not uncommon during the fall season (DCFWD 2001). Under periods of extremely low flow, this residence time can be as long as 100 to 110 days (MWCOG 2007). Flow in many segments of the tidal of the river can move either upstream or downstream, depending on tidal conditions. In the downstream portions of the river, hydrodynamics are dominated by the direction and magnitude of the tidal surge. The mean annual stream flow for the Anacostia, as measured at the upstream flow gages, is 139 cubic feet per second (DCDOH 2003a).

HYDROLOGY AND THE ROLE OF CLIMATE CHANGE

Hydrology is currently being affected by and would continue to be affected by climate change. The most relevant known and predicted impacts of climate change on hydrology at the park include mean sea level rise, coastal flooding, drought, and the increase in extreme weather events such as intense precipitation and storm events. Hydrology would be affected by climate change through alterations in base flow and depth (Erwin 2009). However, no large annual change to streamflow is expected in the mid-Atlantic region, due to the offset of seasonal changes (NPS 2010c). While mean annual changes in streamflow are uncertain, winter and spring flows and the potential for winter and spring flooding would likely increase (NPS 2010c). Diminished summer/early fall flows are also expected as a result of climate change, partially due to increased evaporation associated with higher warm season temperatures (NPS 2010c). Climate change could also alter hydrology through changes to the hydroperiod (Erwin 2009). A hydroperiod is the number of days per year that an area of land is dry or the length of time that there is standing water at a location. The hydroperiod of a wetland is the length of time and portion of year the wetland holds ponded water. Therefore, changes in hydroperiod as a result of climate change could affect the productivity, diversity, and distribution of wetlands as a function of hydrology. Climate change could also cause increased flooding and increased flood runoff, resulting in a decrease in recharge of some floodplain aquifers (Erwin 2009). Generally, climate change could affect the hydrology of individual wetland ecosystems through changes in precipitation and temperature regimes (Erwin 2009).

Sea levels provide an important key to understanding the impact of climate change. By combining local rates of relative sea level change for a specific area based on observations with projections of global sea level rise (IPCC 2007), coastal managers and engineers can analyze and plan for the impacts of sea level rise for long-range planning. Tide stations are therefore used to measure local sea level, which refers to the height of the water as measured along the coast relative to a specific point on land. In the district, a mean sea level trend has been developed from data collected at tide station (8594900) in the district (NOAA 2012). Based on monthly data collected from 1924 to 2006, the mean sea level trend is 3.16 millimeters/year (with a 95% confidence interval of +/- 0.35 mm/yr), which is equivalent to a change of 1.04 feet in 100 years (NOAA 2012). Using this trend, it is possible that the mean sea level of the Anacostia River could increase by a total of 1.872 inches during the life of this project (15 years). The science team for this project considered climate change and predicted that the Anacostia River could rise approximately 2 inches during the 15-year life of this plan. In addition, shoreline armoring (such as the sheet piling at the Anacostia River Fringe Wetlands along the River) would influence the ability of both habitats and biota to adapt to sea level rise (Strange et al. 2008). Specifically, shoreline protection structures can block inland migration of wetlands and the placement of hard structures reduces sediment inputs from upland sources and increases erosion waterward of a structure (Strange et al. 2008). Tidal elevations, even changes as small as inches, are extremely important parameters to consider in wetland restoration and management as well as long-term planning for this project.

It is also very likely that the frequency, intensity and duration of coastal flooding would increase as mean sea levels rise and affect hydrology. Changes in coastal storms are uncertain, but it is very unlikely that coastal storm systems would weaken to such a large extent as to offset the effects of higher mean sea levels (NPS 2010c). It is expected that the 1 in 10 year flood event may occur more than twice as often as today based on conservative IPCC-based sea level rise projections (NPS 2010c). It is predicted that short-term (monthly to seasonal) droughts would increase in frequency, intensity, and duration during summer and fall. Changes in long-term (multi-year) droughts are unknown (NPS 2010c). Intense precipitation events are likely to increase across a range of time scales (sub-hourly to daily), leading to more severe flooding which can ultimately affect hydrology (NPS 2010c).

WATER QUALITY

Although the designated use of the Anacostia River has been a Class A Water (Primary Contact Recreation) by Federal Water Quality Standards, it has been recognized for many years that water quality in the Anacostia River are highly degraded due to point source, non-point source pollution, and refuse (USEPA and NOAA 2009) from historic toxic contamination, sewer overflows and leaks, and urban stormwater runoff. The Chesapeake Bay Program (CBP) designated the Anacostia River as one of the three most polluted watersheds in the Chesapeake Bay (CBF 2006). The lower Anacostia River is essentially an embayment of the Potomac River with very low flow. Even though the lower portion of the Anacostia River located within the District is tidally influenced and exhibits a 3.0 foot average tide height twice daily, the river has a very slow flushing rate, which prevents flushing that might otherwise remove some of the contamination (USEPA and NOAA 2009). Therefore, heavy siltation, accumulation of toxic metals and organic chemicals in sediments, and sewage overflows all contribute to poor water quality in this section of the river (NPS 2004a). The District Water Quality Standards (WQS), Title 21 of the District of Columbia Municipal Regulations (DCMR) specifies the categories of beneficial uses of waterbodies. Class A and Class B waters must achieve or exceed water quality standards for specified pollutants. The waters are classified on the basis of current use and designated beneficial uses as described below in table 7.

TABLE 7: WATERBODY CLASSIFICATION AND DESIGNATED USE

Waterbody Name	Current Use	Designated Use
Anacostia River	B, C, D, E	A, B, C, D, E
Hickey Run	B, C, D	B, C, D
Watts Branch	B, C, D	B, C, D
Other Anacostia River Tributaries	B, C, D	A, B, C, D

Source: DCDOH 2003a

NOTES: Class A - primary contact recreation
Class B- secondary contact recreation
Class C- protection and propagation of fish, shellfish, and wildlife
Class D- protection of human health related to consumption of fish and shellfish
Class E- navigation

Water quality conditions in the tidal Anacostia River have historically been poor. Generally, low dissolved oxygen (DO) concentrations, suspended solids, and high fecal coliform bacteria counts are characterized as major water quality issues (USACE 2002). The water quality of (Kingman) Marsh has also been characterized as poor due to high water temperatures, low DO concentrations, and pollution (USACE 1994). Total suspended solids (TSS) have been listed by the USEPA for total maximum daily loads (TMDLs) as a pollutant in the Anacostia River which directly affects water quality. TSS reduces water clarity, blocks sunlight necessary for SAV, reduces oxygen levels, clogs fish gills, and smothers fish eggs and aquatic insects (CBF 2006). Other specific contaminants of concern in the Anacostia River include lead, mercury, PCBs, PAHs, dichlorodiphenyltrichloroethane (DDT) and chlordane (NPS-USGS 2007). Many water quality parameters that are monitored violate the District's water quality standards to support aquatic life, including DO concentrations. Specifically, the Anacostia River and Kingman Marsh continue to receive nonpoint discharges derived from the intensively developed (impervious) adjacent areas as well as impacts from combined sewer overflows (CSOs) along the river. These CSOs cause high fecal coliform concentrations in violation of the District standards for swimming and elevated levels for nutrients (USACE 1994). The existing poor water quality in the Anacostia has led to fish advisories and consumption restrictions and has severely limited recreational fishing. Stormwater runoff from RFK and the surrounding parking lots is discharged into Kingman Marsh. Overall, poor water quality in Kingman Marsh and the Anacostia River contributes to aquatic ecosystem issues including low numbers of tolerant fish and macroinvertebrate species (USACE 2002).

The water quality of the Anacostia River is being affected by the resident Canada geese due to herbivory on wetland plants and as a result of fecal droppings.

The water quality of the Anacostia River is being affected by the resident Canada geese as a result of both herbivory on wetland plants and fecal droppings, but it is unknown whether the Anacostia River is measurably affected by fecal droppings from geese since this has not been studied at the park. Wetlands are generally considered nitrogen- or nitrogen and phosphorus limited, which results in the rapid uptake of nitrogen and phosphorus from the water column. The herbivory on wetland plants by the resident Canada goose population decreases the function of the wetlands, which ultimately increases the amount of nutrients within the Anacostia River. In addition, fecal droppings from the geese can degrade overall water quality, particularly in areas where the pathogens can concentrate (USFWS 1999). Fecal droppings increase the amount of fecal coliform, nitrogen, and phosphorus levels, and can carry pathogens such as *Cryptosporidium* species, *Giardia* species, *Salmonella* species, and *Escherichia coli* bacteria (Rutgers 2004). Fecal matter

from geese has not been demonstrated to affect water quality or human health at Anacostia Park. Fecal matter is described as a contributing factor to water quality in combination with other factors such as effects of goose herbivory. Additionally, the impact of this fecal matter has not been studied at Anacostia Park, and it is likely that the contribution of fecal droppings from resident Canada geese is small when compared to other sources of pollution.

In addition to these water quality issues, the lower tidal section of the Anacostia as well as Kingman Marsh and tributaries to the Anacostia River within Anacostia Park have been classified by the District as an Impaired Segment under Section 303(d) of the Clean Water Act. Section 303(d) of the Federal Clean Water Act and regulations developed by USEPA require states to prepare a list of waterbodies or waterbody segments that do not meet water quality standards even after all the pollution controls required by law are in place. Waterbodies or waterbody segments not meeting the appropriate water quality standards are considered to be impaired. Impaired segments are waters that do not or are not expected to meet water quality standards as given in the Clean Water Act. The law requires that states place the impaired waterbody segments on a list referred to as the 303(d) list and develop TMDLs for the waterbodies on the list. The USEPA has established TMDLs, which limit the amount of pollutants that can enter a waterbody, and a high priority has been placed on controlling these factors along the lower Anacostia River (NPS 2004a). As a result of the impairment of the Anacostia River, human fish consumption advisories have been placed by the District and Maryland due to PCB, methlymercury, and pesticide contamination. This issue is discussed in more detail in *Visitor Health and Safety*.

The pollutants causing impairment have been listed through the Section 303(d) Program in a draft 2008 document for the lower Anacostia River and Kingman Marsh (DCDE 2008). Additional tributaries to the Anacostia River that also have pollutants on the 303(d) list include the following: Watts Branch, Hickey Run, Fort Dupont Creek, and Pope Branch (DCDE 2008). The 2008 list included the following pollutants causing impairment in the waterbodies mentioned above: bacteria, organics, TSS, metals, oil & grease, biological oxygen demand (BOD), total PCBs, Bis(2-ethylhexyl) phthalate, total residual chlorine, and trash (DCDE 2008). Table 8 presents the pollutants causing impairment for each waterbody within Anacostia Park as well as the TMDL establishment date and the priority ranking for TMDL development. The 2008 list includes for the first time trash as a pollutant causing impairment. Recent estimates from the Metropolitan Washington Council of Governments (MWCOG) indicate that approximately 20,000 tons of trash and debris enter the Anacostia River annually. The main source of this trash problem is litter and illegal dumping (AWRP and MWCOG 2007).

Additionally, the 2008 list includes bacteria (fecal coliform bacteria). The Anacostia is affected by high levels of bacteria, due to leaking sewers, sewer overflows, pet waste and wildlife (MWCOG 2007). The majority of the fecal coliform bacteria enter the Anacostia River through CSO outfalls that are typically found in older cities such as the District. These systems were designed to collect rainwater runoff, domestic sewage, and industrial wastewater all in the same system. Most of the time, combined sewer systems transport all of their wastewater to a sewage treatment plant. However, during periods of heavy rainfall or melting snow the volume of wastewater going into the sewers can exceed the capacity and excess wastewater empties directly into nearby streams, rivers, or other water bodies (USEPA 2007). There are 15 CSO outfalls located on the Anacostia River (DCWASA 2008). The two largest CSO outfalls include the Northeast Boundary CSO, which drains into the Anacostia River near RFK Stadium and East Capitol Street, and the "O" Street Pump Station, which drains into the Anacostia River just below the Washington Navy Yard. DCWASA estimates that combined sewers overflow into the Anacostia and Potomac Rivers about 75 times annually, and spill approximately 1.5 billion gallons per year into the Anacostia River alone (DCWASA 2008). This combination of untreated sewage and stormwater has negative effects on water quality and aquatic life and is the main reason for the bacteria TMDL for the Anacostia River. As a result of a consent decree that the USEPA signed with the DCWASA in 2004 to improve water quality in the Anacostia and Potomac Rivers and Rock Creek, a 20-

year Long-Term CSO Control Plan has been drafted. This plan includes three deep underground storage tunnels, including side tunnels to reduce flooding rehabilitation of existing pumping stations and the elimination of 14 overflow outfalls, four of which are located in the Anacostia Watershed (DCWASA 2008). When the project is fully implemented, CSO discharge would be reduced by a projected 98 percent along the Anacostia River (DCWASA 2010).

TABLE 8: IMPAIRED DISTRICT WATERS AND POLLUTANTS WITHIN AND ADJACENT TO ANACOSTIA PARK

303(d) Listing Year and Category	Waterbody or Segment Name	Pollutants or Pollutant Categories Causing Impairment	TMDL Establishment Date	Priority Ranking for TMDL Development
1998, Category 4A	Lower Anacostia River (Segment 1)	• BOD	December 2001	High
		• Bacteria • Organics • Metals • Oil & Grease	October 2003	High
		• TSS	July 2007	High
		• PCBs	October 2007	High
1998, Category 5	Lower Anacostia River (Segment 1)	• Trash	December 2012	High
1998, Category 4A	Kingman Marsh	• Bacteria • Organics • Metals • Oil & Grease	October 2003	High
Tributaries to the Anacostia River Adjacent to Anacostia Park				
1998, Category 4A	Lower Watts Branch (Segment 1)	• Bacteria • Organics • TSS	October 2003	High
1998, Category 4A	Hickey Run	• Bacteria • Organics	October 2003	High
2002, Category 5	Hickey Run	• Bis(2-ethylhexyl) phthalate • Chlorine (total residual)	December 2012	High
1998, Category 4A	Fort Dupont Creek	• Bacteria • Metals	October 2003	High
1998, Category 4A	Pope Branch	• Bacteria • Organics • Metals	October 2003	High

Source: DCDE 2008

Category 4A: Waterbody or segment of a waterbody for which TMDLs for pollutants causing impairments have been approved or established by USEPA may be placed in this category.

Category 5: Waterbody or segment of a waterbody with at least one designated use not attained or threatened and a TMDL is needed. A waterbody or segment of a waterbody may be placed in this category even if TMDLs have been approved for some of the pollutants/pollution identified as causing non-attainment. All necessary TMDLs for a waterbody or segment of a waterbody must be approved or established by USEPA in order to be placed in category 4A. The chemicals for which the Organics TMDL have been approved include chlordane, DDD, DDE, DDT, Dieldrin, Heptachlor Epoxide, PAH1, PAH2, PAH3, and Total PCBs. The chemicals for which the metals TMDL have been approved include arsenic, copper, lead, and zinc. Bacteria TMDLs have been approved for fecal coliform bacteria.

FLOODPLAINS

EO 11988, "Floodplain Management," issued May 24, 1977, directs all federal agencies to avoid both long- and short-term adverse effects associated with occupancy, modification, and development in the 100-year floodplain, when possible. Floodplains are defined in this order as "the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to a one percent greater chance of flooding in any given year." Flooding in the 100-year zone is expected to occur once every 100 years, on average.

NPS has adopted guidelines pursuant to EO 11998 stating that NPS policy is to restore and preserve natural floodplain values and avoid environmental impacts associated with the occupation and modification of floodplains. The guidelines also require that, where practicable alternatives exist, Class I actions should be avoided within a 100-year floodplain. Class I actions include the location or construction of administration, residential, warehouse, and maintenance buildings, non-excepted parking lots, or other man-made features that by their nature entice or require individuals to occupy the site. In addition, NPS proposed actions that may adversely affect floodplains must comply with Director's Order #77-2: *Floodplain Management*. *Floodplain Management* states that flood conditions and associated hazards must be quantified; appropriate actions (an alternative site, or effective mitigation and/or warning and/or evacuation planning) must be taken to manage floodplain conditions and flood hazards; and a formal statement of findings (SOF) must be prepared. In addition, NPS must protect and preserve the natural resources and functions of floodplains; avoid the long- and short-term environmental effects associated with the occupancy and modification of floodplains; and avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks; and restore, when practicable, natural floodplain values previously affected by land use activities within floodplains.

The study area for floodplains includes all portions of the park within the park boundary. Generally, the 100-year floodplain extends several hundred feet from the river in the park boundary. Exceptions include the areas surrounding estuaries and tributaries of the Anacostia River. Figures 24 through 26 show the 100-year and 500-year floodplains along the Anacostia River.

The study area for floodplains includes all portions of the park within the park boundary.

A flood protection levee is located along the east bank of the Anacostia River and extends from Poplar Point to the southwest corner of the Naval District Washington (NDW) Anacostia Annex, approximately 9,700 feet (1.84 miles) (figure 26). The majority of the levee is an earthen berm, but approximately 1,100 feet of the levee is constructed of concrete. The concrete floodwall is located along the bulkhead of the NDW Anacostia Annex Marina (DCOP 2003). Additionally, a seawall stabilizes portions of both the western and eastern banks of the Anacostia River. Conditions of the seawall vary; some portions of the seawall are deteriorating due to vegetation growth, age, soil erosion, and leaking stormwater systems and other portions of the seawall are currently being replaced (DCOP 2003).

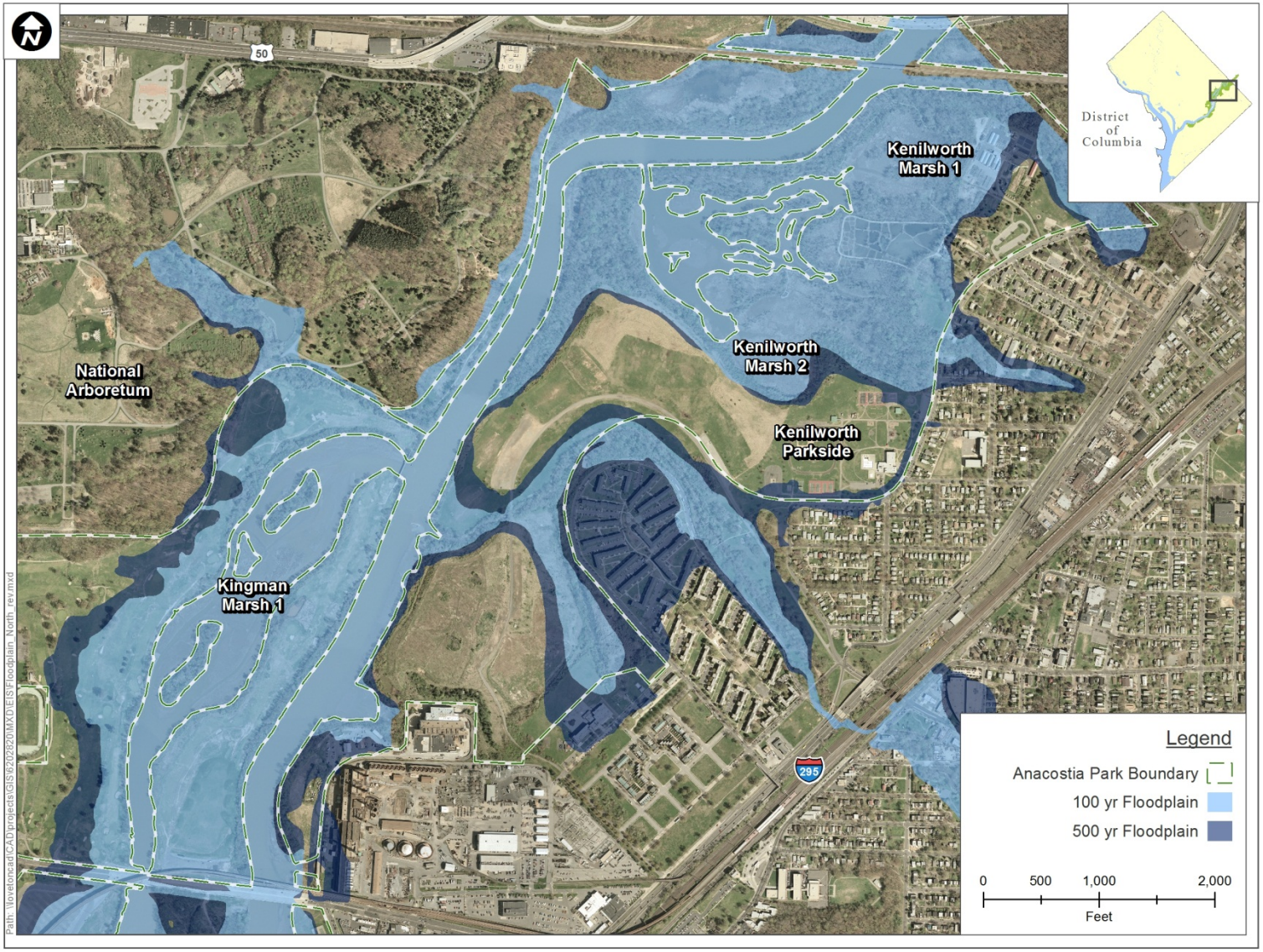


FIGURE 24: FEMA FLOODPLAIN MAP OF ANACOSTIA PARK, NORTH AREA

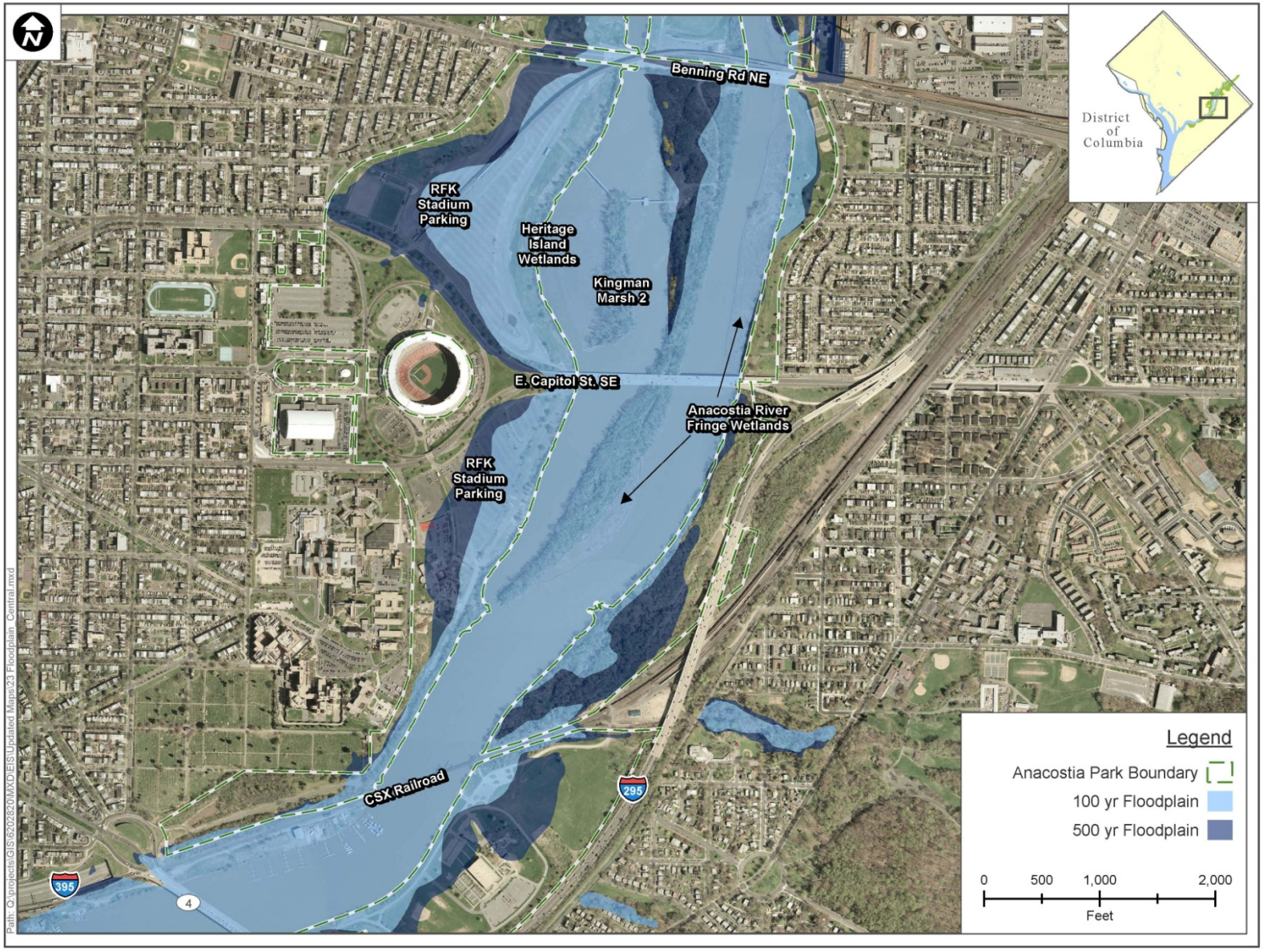


FIGURE 25: FEMA FLOODPLAIN MAP OF ANACOSTIA PARK, CENTRAL AREA

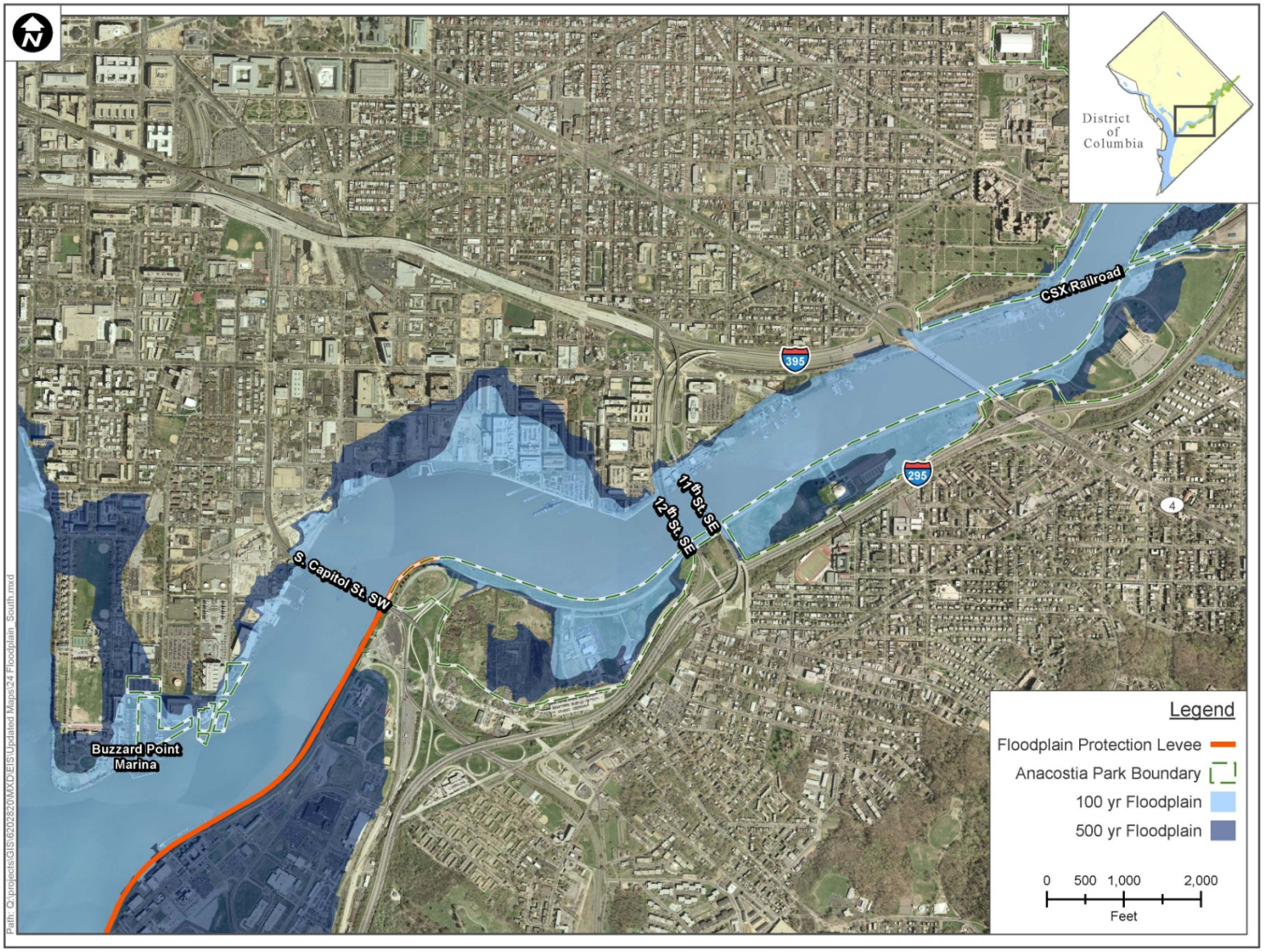


FIGURE 26: FEMA FLOODPLAIN MAP OF ANACOSTIA PARK, SOUTH AREA

WETLANDS

The NPS has adopted a goal of "no net loss of wetlands."

Under Director's Order #77-1: *Wetland Protection,* the NPS has adopted a goal of "no net loss of wetlands" as well as established the policies, requirements, and standards through which the NPS will meet its responsibilities to protect and preserve wetlands. The Order states that "Where natural wetland characteristics or functions have been degraded or lost due to previous or ongoing human activates, the NPS will, to the extent appropriate and practicable, restore them to pre-disturbance conditions." Additionally, "Where appropriate and practicable, the NPS will not simply protect, but will seek to enhance natural wetland values by using them for educational, recreational, scientific, and similar purposes that do not disrupt natural wetland functions." EO 11990, "Protection of Wetlands," directs all federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. In the absence of such alternatives, parks must modify actions to preserve and enhance wetland values and minimize degradation.

For the NPS, any area that is classified as a *wetland* according to the USFWS *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) is subject to NPS Director's Order #77-1: *Wetland Protection.* Under the Cowardin definition, a wetland must have one or more of the following three attributes:

1. At least periodically, the land supports predominantly hydrophytes (wetland vegetation);
2. The substrate is predominantly undrained hydric soil; or
3. The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

The Cowardin wetland definition encompasses more aquatic habitat types than the definition and delineation manual used by the USACE for identifying wetlands subject to Section 404 of the Clean Water Act. The 1987 *Corps of Engineers Wetlands Delineation Manual* requires that all three of the parameters listed above (hydrophytic vegetation, hydric soil, wetland hydrology) be present in order for an area to be considered a wetland. The Cowardin wetland definition includes such wetlands, but also adds some areas that, though lacking vegetation and/or soils due to natural physical or chemical factors such as wave action or high salinity, are still saturated or shallow inundated environments that support aquatic life.

The District DOE has established the Water Quality Division (WQD) to restore and protect the surface and ground waters of the District. The Program was established under the authorities of the District Water Pollution Control Act and the federal Clean Water Act. The Water Quality Control component fulfills the function of policy planning as well as regulatory control of surface water, groundwater, and wetlands. Program components of the WQD include water quality monitoring functions that encompass the bioassessment of wetlands and river fringes. The WQD does not have their own set of specific wetland criteria, but the WQD must review projects prior to permit issuance when the waters of the District are impacted.

HISTORY OF ANACOSTIA WETLANDS

The Anacostia River was historically flanked with nearly 2,500 acres of tidal marsh. However, in the early 20th century the USACE was charged with a major "reclamation" effort designed to improve navigation by channeling and containing the river within a stone seawall. The Anacostia River was

engineered into a channeled city river from a meandering river with extensive wetlands (figure 27). Tidal flats and wetlands were drained and filled to help rid the city of mosquito-borne diseases and stench along the river. Most of the areas known today as Anacostia Park, including Kingman Marsh, Kingman Island, and Kenilworth Marsh, were created or enlarged by the USACE during the reclamation work.

Benning Road Bridge 1927 across Anacostia River with dredged portion downstream (right side) and still intact freshwater tidal wetlands upstream (left side of photograph). Photo shows complete conversion of wetlands to fastland and tidal water below Benning Road (USGS 2006b).

FIGURE 27: HISTORIC PHOTOGRAPH OF THE ANACOSTIA RIVER

Public and government interests in restoring wetlands in the Anacostia River watershed grew in the 1980s when the NPS began working in collaboration with others concerned about the health of the watershed to restore nearly 100 acres of tidal wetlands along the Anacostia River. The restoration of tidal marshes was completed to improve the water quality of the Anacostia River, improve native plant and animal diversity, and provide a more natural recreation experience for park visitors along the river, as well as meet the Department of the Interior agreement to the Chesapeake Bay Recovery Program.

Even with the restoration of Kenilworth Marsh, Kingman Marsh, Heritage Island Wetlands, Anacostia River Fringe Wetlands, Bladensburg Marina and the Anacostia East Wetland Mitigation Project referred to as ANA-11 (representing approximately 120 acres), less than 180 acres of tidal emergent wetlands currently exist in the Anacostia between Bladensburg and the confluence with the Potomac River. (AWRP and MWCOG 2009).

PREVIOUS WETLAND RESTORATION EFFORTS

Numerous efforts by various federal, local, and community organizations have been completed, are currently underway or are scheduled for the restoration of the Anacostia River and its tributaries. Many of these restoration efforts are located either within or adjacent to Anacostia Park, including Kenilworth Marsh, Kingman Marsh, Anacostia River Fringe Wetlands, Heritage Island Wetlands, Pope Branch, Hickey Run, Watts Branch, and Poplar Point (figures 28 and 29). Although wetland habitats are being restored within Anacostia Park, some are being damaged in part by resident Canada geese that are overgrazing the wetland plants. The emergent and submerged aquatic vegetation that comprise the tidal marshes and fringe wetlands cannot sustain viable seasonal growth due to the intense grazing pressures from resident Canada geese, reducing the survival of the plantings. Besides grazing pressures from resident Canada geese, other wetland restoration issues that have been observed at Anacostia Park include incorrect hydrologic regimes (too much inundation to vegetation or too little submersion of vegetation); planting methods including species selection and existing seed bank; insects and disease; engineered marsh soils; and removal of invasive plant species.

The District Department of Health (DOH), Environmental Health Administration (EHA) is the lead agency implementing many wetland and watershed restoration projects in the Anacostia within the District. Key partners for these restoration projects include the USACE-Baltimore District, NPS, USDA-NRCS, the USEPA, the USGS Patuxent Wildlife Research Center, District DOE, MWCOG, and the USFWS. One of the restoration goals of the Anacostia Watershed is to increase wetland acreage, and many wetland restoration projects have already been completed or are scheduled for completion (MWCOG 2007).

The following is a brief summary and the status of each project either completed or currently planned for implementation by the District DOH EHA (DCDOH undated):

Kenilworth Marsh—Kenilworth marsh is a 77-acre restored freshwater tidal marsh on the Anacostia River located adjacent to the Kenilworth Aquatic Gardens (figure 28). The area was originally drained during past dredging operations, which created mudflats. In 1993, 32 acres of emergent wetland were created by the USACE in cooperation with the MWCOG and the NPS (Syphax and Hammerschlag undated). The marsh was created by depositing dredged material back onto the existing mudflats to create fill areas of higher elevation separated by tidal guts (Syphax and Hammerschlag n.d.). The fill areas were planted with approximately 350,000 plants of 18 species to re-establish marsh vegetation as part of the restoration effort. The current marsh has a direct connection with the Anacostia River via a breach in the seawall along the river and supports diverse plant and animal communities. A walking trail (River Trail) borders the northern wetland and makes its way to the breach in the seawall, while a boardwalk extends from the Kenilworth Aquatic Gardens to the southern portion of the marsh. The boardwalk and adjacent River Trail currently provide opportunities for visitors to interact with the environment. Public access to this type of habitat is rare, especially in the context of a large metropolitan city.

Kingman Marsh—The goal of this project was to restore over 40 acres of freshwater tidal wetlands in the Kingman Marsh area (figure 28) in order to increase plant and animal diversity and improve the filtering capacity of the Anacostia (USACE 1999). This project was completed in 2000. Monitoring efforts are continuing in connection with other wetlands that have been restored in Kenilworth Park.

Kingman Island—The goal of this project was to restore the southern half of Kingman Island (figure 28) as a natural recreational area (DCDOH undated). Habitat restoration efforts focused on enhancement of vernal pool habitat on Heritage Island, the creation of varied habitat niches, the removal of trash, and the creation of a meadow on Kingman Island. The U.S. Navy completed the reconstruction of the pedestrian bridges in August 2001. Construction of this project has not yet been scheduled (DCDOH undated).