2 ALTERNATIVES

This chapter documents the process used to develop improvement concepts for Broad Branch Road and describes the resulting project alternatives, which were developed in accordance with the goals established to meet the project purpose and need. ***This Final Environmental Assessment (EA) expands on the discussions presented in the initial EA published on October 9, 2013 and the Revised Draft EA published on October 15, 2020, and addresses comments received.*** In the initial EA, a No Action Alternative and three Build Alternatives were considered for the rehabilitation of Broad Branch Road. The Revised Draft EA identified the Preferred Alternative, which is a modified version of Build Alternative 3 from the initial EA. ***This Final EA identifies an option as part of the Preferred Alternative for including a shared use path for a portion of the project corridor within the DDOT right-of-way.*** For ease of review and comparison, the discussion of alternatives is presented in the same order as the previous documentation.

2.1 ALTERNATIVES DEVELOPMENT PROCESS

While the main purpose of the project is to rehabilitate Broad Branch Road and control stormwater runoff, other elements are also being studied for inclusion within the roadway cross-section, including bicycle and pedestrian facilities. With regard to the latter, DC legislation (see Section 1.2.4) has prompted the need for pedestrian accommodations within the corridor. Furnishing sidewalks along Broad Branch Road would also conform to the District's Complete Streets Program, a policy that encourages the provision of sidewalks along DC streets.

Alternatives development consisted of a multi-step collaborative process with the study team, stakeholders, and the public to develop a range of alternatives that incorporate elements to address each of the project's needs:

- Roadway elements
- Stormwater and drainage elements
- Bicyclist and pedestrian elements

The first step in the process was project scoping, which included an agency coordination meeting (March 24, 2011), a public scoping/concept development meeting (July 13, 2011), and an alternatives development meeting with federal and local agency representatives (August 25, 2011). At these three meetings, input was gathered from the stakeholders and public on the perceived deficiencies and problems within the roadway corridor. In addition, the study team collected information on desirable roadway, stormwater management and drainage, and pedestrian and bicyclist elements that would improve roadway operations and safety. The meetings also provided the stakeholders and public an opportunity to mix-and-match the various roadway, stormwater management, and pedestrian and bicycle elements to develop roadway cross-section concepts. The concepts were developed using a series of "building blocks" that

included various roadway widths, sidewalks, bike lanes, and stormwater management elements (curbs, swales, and rain gardens), as shown in **Figure 2-1**.

The concepts that were developed at the meetings were placed in a scaled tray that reported the width of the resulting concept. The width of the concepts was then compared to existing District Department of Transportation (DDOT)-owned right-of-way along the entire roadway corridor. The existing right-of-way ranges from approximately 33 feet to 120 feet wide. This part of the exercise demonstrated what concepts could be constructed within the existing DDOT right-of-way and which would require right-of-way acquisition. Seven different concepts were developed at the public meeting ranging in width from 22 to 33 feet. In addition, 22 concepts were developed by agency representatives, ranging in width from 22 to 41 feet. Each of the concepts is presented in **Appendix A**.

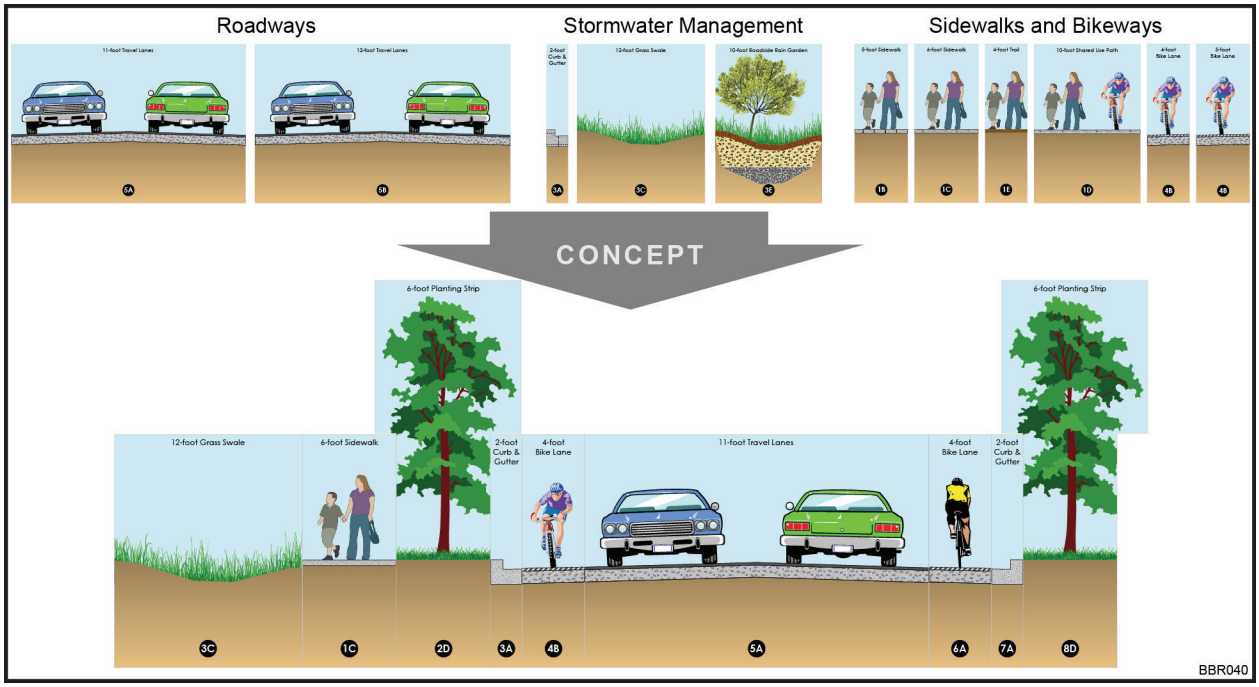

Figure 2-1. "Building Blocks" to Roadway Concepts

These concepts served as the foundation for the next step in the process: the development of three Build Alternatives that considered agency and public input as well as met the project's purpose and need. The three alternatives, described in detail in Section 2.3.2, were developed for the purposes of identifying topographic constraints and cut/fill needs, footprint, and environmental impacts, as discussed further in Chapter 4. The alternatives were formally presented at a Public Alternatives Meeting on November 8, 2012.

Along its 1.5-mile length, Broad Branch Road varies in terms of its topography and roadway cross-section. As noted above, the DDOT-owned right-of-way ranges from approximately 33 to 120 feet in width along Broad Branch Road. The narrowest width (33 feet) is generally located at the southern end of the corridor, south of Brandywine Street, which limits the types of improvements at this end of the corridor. While the DDOT-owned right-of-way width generally increases north of Grant Road and Davenport Street, the proximity of Broad Branch stream and Rock Creek Park

presents design constraints along the east side of the roadway up to where the Broad Branch stream crosses the road approximately 1,000 feet from the northern terminus of the project.

Given these varying features, one cross-section may not be appropriate for the full length of the roadway and the project considered variable cross-sections based on the project purpose and need and the available right-of-way. Each of the Build Alternatives that were identified for evaluation in the initial EA, as well as the Preferred Alternative, are described in the following sections.

2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative (Alternative 1), the improvements to Broad Branch Road would include minor restoration activities (safety and routine maintenance) that maintain the continuing operation of the existing roadway.

The existing roadway is located within DDOT right-of-way, with minor exceptions. These exceptions occur in six short sections along the project corridor where the existing roadway was constructed outside DDOT-owned property. These small areas account for a total area of 923 square feet. All but one location are located on the east side of the roadway where the northbound lane encroaches on National Park Service (NPS)-owned property in Rock Creek Park. The single encroachment on the west side of the roadway occurs where a curve in the southbound lane enters private property owned by a Sovereign Nation (the Republic of Peru). The location of the roadway, outside of the DDOT-owned right-of-way, may be due to inconsistencies in survey bounds that existed when the current Broad Branch Road was constructed or may be the result of previous repaving projects. ***DDOT may undertake future actions to correct these right-of-way exceptions, which may include an easement or land transfer.***

It was determined in the initial EA that the No Action Alternative does not meet the established purpose and need of the project; however, it provides a basis for comparing the environmental consequences of the proposed action.

2.3 PROPOSED ACTION

The proposed action will address deficiencies in the existing roadway infrastructure and stormwater management systems; improve the safety of motorists, pedestrians, and bicyclists; and enhance linkages with respect to serving pedestrian and bicycle travel.

Prior to any land disturbance activities, tree protection measures, protective fencing, and other best management practices (BMPs) would be installed. The existing roadway infrastructure within the project area would be removed including pavement, curb and gutter, inadequate stormwater drainage systems, as well as debris and trees that present a hazard. DDOT would include in the contractor specifications that all removed materials be disposed of or recycled in accordance with the DDOT *Standard Specifications for Highways and Structures*. Additional measures for the protection of cultural resources (e.g., historic retaining walls, culvert headwalls, stone boundary markers along the park boundary) would also be incorporated in the contractor specifications.

The proposed action would be designed to accommodate widths and weights of utility maintenance vehicles and emergency response vehicles. Grading and placement of clean fill

would be necessary to prepare a stable bed for the roadway and to provide adequate drainage conveyance. Existing profile elevations would be raised or lowered in steeper areas to minimize blind crests and improve sight distances along the roadway.

Inadequate stormwater inlets and culverts would be reconstructed and resized to appropriately convey water. Specifically, a new culvert is proposed for the roadway over Soapstone Creek toward the southern end of the project area. As discussed in Section 1.2.1, the emergency replacement of the Soapstone Creek Culvert was performed as a separate action independent of the proposed action; however, design plans for the permanent replacement structure for the culvert are analyzed in this EA. In addition, existing culverts at other locations may need to be extended to accommodate a wider corridor with additional roadway elements under some alternatives.

Both travel lanes of the roadway will be paved with a normal cross slope so that all roadway runoff would be directed to the curb and gutter on each side of the roadway. Stormwater management would be accomplished through a closed, underground system, which would collect and treat the runoff and direct it to the existing outfall locations along the corridor. Existing pipes in those outfalls with structural elements will be replaced with reinforced concrete pipes. Replacement of these pipes will require reconstruction of stone surrounds in portions of the stone retaining wall and stone headwalls. Improvements to pipes and outfalls located within DDOT-owned right-of-way as well as those on NPS property will be conducted as part of the proposed drainage improvements. ***DDOT would obtain a Special Use Permit for temporary activities related to the rehabilitation of existing structures that support DDOT infrastructure on NPS property, including access, construction and site restoration.***

Cross culverts will be used along the Broad Branch Road, where it is necessary and feasible, to prevent the offsite runoff from entering the roadway and to divert it to the existing outfalls. Concrete ditches behind the retaining walls would direct the offsite runoff to the proposed drainage system. Water quality catch basins will be used, wherever feasible, to screen debris and filter sediment before discharging runoff to the existing outfalls.

Stormwater management will be improved by providing bio-swales/rain gardens where space is available along with water quality catch basins. Rain gardens will be incorporated on the west side of the roadway at the north end of project area and at the intersection with Brandywine Street using Low Impact Development (LID) techniques (see Section 2.3.1 for a detailed description). The following features will be included in the rain gardens:

1. A bioretention area will be located adjacent to the roadway to act as a filter, applying BMPs. Runoff from the roadway would flow to the bioretention area as sheet flow, where it would filter through the 2.5- to 4-foot thick layer of sand media and into perforated underdrain pipes surrounded by aggregate and geotextile to filter material before being discharged to the existing storm drain system through an inlet structure connected to the existing drain system.
2. The inlet structure will also serve as an overflow structure to divert excess water out of the rain garden.

Stormwater management at the north end of the project area would be coordinated with the "daylighting project" undertaken by NPS and the District Department of Energy & Environment

(DOEE), which was completed in 2014. The project unearthed the pipe carrying an unnamed tributary of Broad Branch and restored the stream to a more natural system. The "daylighting" is intended to remove pollutants from the stream by exposing it to sunlight, air, soil, and vegetation and to reduce nutrient and sediment pollution from erosion caused by fast-moving stormwaters. The combined effects of both projects are expected to relieve downstream erosion of banks and gullies.

Coping and retaining walls would be incorporated where feasible to minimize the limits of disturbance and footprint of the roadway. Retaining walls would be designed with context sensitive materials to complement the setting of Rock Creek Park and the surrounding area as well as incorporate construction methods to minimize intrusion into the Rock Creek Park properties. Potential methods for constructing walls on the east side include reinforced concrete walls faced with stone or dry-stacked gravity walls constructed of local quarried stone (where feasible). Compatible materials may also be brought to the site to supplement existing materials. Walls on the west side would be reinforced concrete faced in stone. The type and depth of wall footers on both the east and west sides will be contingent on the results of geotechnical analysis to be conducted during the final design phase of the project. Designs and construction methods would be developed in close coordination with NPS.

Following construction, additional restoration along Broad Branch Road would include replanting of native tree species and vegetation, including restoration of landscaped areas in front of adjacent property owners on the west side of the road with commensurate landscaping. Species would be selected in consideration of the natural and cultural landscapes, as well as the aesthetics of Rock Creek Park and residential and institutional areas.

Where feasible, sidewalk treatments will be in keeping with the context of the project setting. Treatments include trail-like designs or the use of colored concrete or pavers. The selection of treatment types will take place during final design.

The rehabilitated roadway would be properly signed and marked in accordance with standards of the American Association of State Highway and Transportation Officials (AASHTO) and DDOT, and the *Manual on Uniform Traffic Control Devices* (MUTCD). Features such as signage and lighting would be incorporated into more detailed design plans.

Three options were considered for each of the Build Alternatives and presented as such in the initial EA. These options included:

- Option A – an expanded retaining wall along a portion of the west side of the roadway, which reduced the amount of cut required for roadway side slope;
- Option B – an extended sidewalk between Soapstone Creek and the NPS parking lot north of Beach Drive to improve linkages between Rock Creek Park and the roadway; and
- Option C – a new T-intersection at Brandywine Street which improves vehicular and pedestrian safety and provides green space for rain gardens.

Each of these options received positive responses from both agencies and the general public and were incorporated into the Build Alternatives as applicable, including the Preferred Alternative.

The following subsections describe the Preferred Alternative and the three Build Alternatives considered for the rehabilitation of Broad Branch Road. Alignment plans for the Preferred Alternative are presented in **Appendix B** and detailed cost estimates are presented in **Appendix C**. Comparable plans and cost estimates for each of the original Build Alternatives are presented in Appendices B and C of the initial EA.

2.3.1 PREFERRED ALTERNATIVE/ ALTERNATIVE 3 MODIFIED

To minimize encroachments outside of the existing right-of-way while still meeting the project's purpose and need, DDOT is recommending a modified version of Build Alternative 3 (as presented in the initial EA and described in Section 2.3.2 below).

Five properties along Broad Branch Road right-of-way are owned by foreign countries for use as residences for their ambassadors to the United States (see **Figure 2-2**). The potentially affected embassies requested the U.S. Department of State adopt measures necessary to protect the principle of inviolability of diplomatic missions as guaranteed by international law. Therefore, in order to avoid any encroachment upon land of any of the Sovereign Nations, all widening of the roadway adjacent to these properties between 27th Street and Beach Drive is proposed on the east side of the existing roadway. As a result, there would be minor encroachments onto Rock Creek Park, which is owned ***by the federal government*** and administered by NPS. Conceptual designs for the modified alternative indicate seven locations where the minor encroachments could occur. These are shown in **Figure 2-3** and described in more detail below. The majority of the park property adjacent to the roadway consists of steep grades leading from the roadway down to Broad Branch. In many sections, the steep grade along the roadway is maintained with retaining walls, which are in various stages of disrepair. The NPS was consulted throughout the design modification process and agreed in principle to the minor encroachments. ***Additionally, the Department of the Interior (DOI), which includes the NPS, reviewed the Revised Draft EA and Section 4(f) evaluation and, in a letter dated October 22, 2020, concurred that there are no feasible or prudent avoidance alternatives and that the Preferred Alternative is the alternative that causes the least overall harm (see Appendix Q). Acquisition of seven parcels of NPS land will be conducted via Transfer of Jurisdiction (TOJ) between NPS and DDOT to implement the project as there is no other feasible alternative.*** The formal request for the need for the federal land will commence following the completion of the NEPA process.

Alternative 3 Modified would be identical to the original Build Alternative 3 with the exception of the width of sidewalks on the west side of the roadway in front the Sovereign Nations' lands. To minimize encroachments onto NPS lands on the east side of the roadway at these locations, the sidewalks along the properties of Sovereign Nations would be reduced to a 5-foot width (see second and third cross-sections in Figure 2-3). These reduced-width sidewalks are consistent with Americans with Disabilities Act (ADA) standards. Renderings of the proposed improvements adjacent the Italian and Malaysian diplomatic residences are shown in **Figures 2-4, 2-5, and 2-6**.

Note that the graphics shown in this Final EA are intended to be illustrative representations of the typical cross-sections and elements; however, the elements will vary slightly depending on the physical features along the roadway corridor. Efforts to further minimize or eliminate potential impacts will occur during future phases of final design.

Figure 2-2. Sovereign Nation Properties along Broad Branch Road

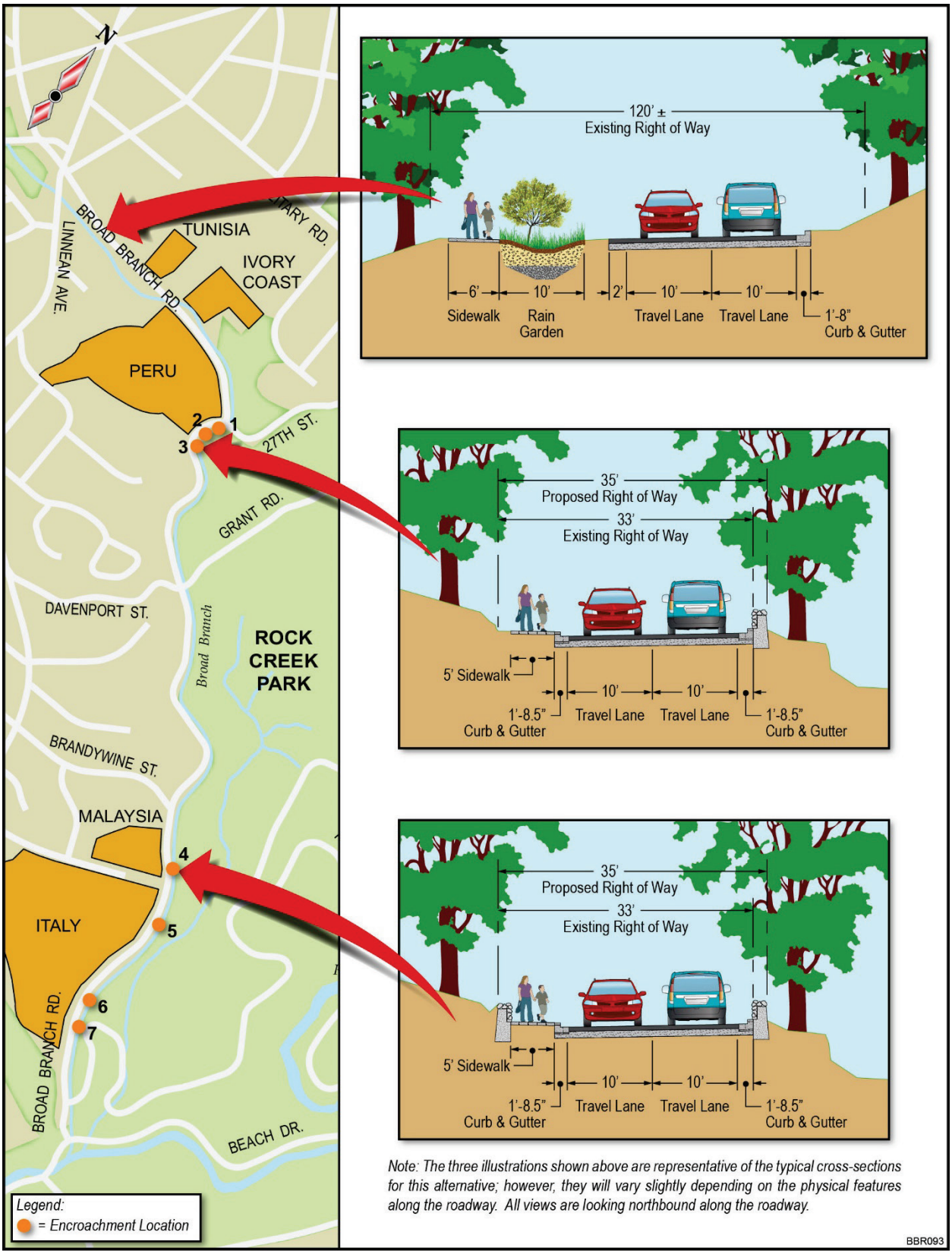

Figure 2-3. Alternative 3 Modified

Figure 2-4. Proposed Improvements Near the Entrance to the Italian Diplomatic Residence

Figure 2-5. Proposed Improvements Near the Entrance to the Malaysian Diplomatic Residence

Figure 2-6. Proposed Retaining Wall Along the Edge of the Malaysian Diplomatic Residence

Alternative 3 Modified consists of two 10-foot travel lanes; a 6-foot-wide sidewalk on the west side of the roadway, with the exception of the seven locations in front of the lands of the Sovereign Nations; and standard curb and gutter, as shown in the top cross-section in Figure 2-3. The alternative has a cross-section width ranging from approximately 35 to 44 feet.

A 10-foot-wide linear rain garden would be provided between the sidewalk and the roadway for approximately 1,000 feet southward of Linnean Avenue where the curb and gutter would be located only along the east side of the roadway. South of that to 27th Street, a 4-foot-wide planting strip would separate the sidewalk and roadway for the length of the project and the curb and gutter would be located on both sides. ***Based on comments received on the Revised Draft EA, the Preferred Alternative provides an option for a shared use path, in lieu of the aforementioned sidewalk and with a reduced-width rain garden, between Linnean Avenue and 27th Street. The intent of the shared use path is to accommodate two-way traffic of all non-motorized users, including bicyclists and pedestrians, and would be designed in accordance with DDOT and FHWA design criteria and guidance for such facilities. The shared use path option would remain within the same footprint and would remain in the DDOT right-of-way.***

The proposed curb is intended to prevent the edge of the new roadway from unraveling and discourage tree roots from disturbing the roadway base, as well as protect side slopes from stormwater runoff. In addition, curbs would provide the additional benefit of traffic calming. Finally, Alternative 3 Modified also extends the proposed sidewalk from the end of DDOT right-of-way into a 6-foot-wide sidewalk that reaches the Rock Creek Park parking lot entrance just north of Beach Drive. ***The design, construction, and maintenance of the continuation of sidewalk***

for the Preferred Alternative outside of the DDOT right-of-way to the parking lot entrance would be coordinated with the NPS.

In addition to the areas where the current roadway exceeds existing DDOT right-of-way as noted in Section 2.2, additional right-of-way would need to be acquired from NPS at the seven locations identified in Figure 2-3 for the permanent construction of the roadway, sidewalks, and associated retaining walls, as summarized in **Table 2-1**. As shown in Table 2-1, most of the encroachment areas are less than 1 foot in width. As agreed upon by NPS, these encroachments would not alter the function or use of the affected park property, and therefore represent a minimal use of the NPS park land (see Section 4.12 for a more detailed description of the potential impacts to this Section 4(f) resource). Temporary encroachments would be required for excavation as well as replacement of stormwater outfall pipes. Once construction is complete, the ground surface would be restored to its original elevation and re-vegetated as appropriate.

Table 2-1. Encroachment on Rock Creek Park

ENCROACHMENT AREA*	ROADWAY ENCROACHMENT		
	LENGTH (LINEAR FEET)	AVERAGE WIDTH (LINEAR FEET)	AREA (SQUARE FEET)
Location 1	32.33	0.36	11.52
Location 2	30.78	1.57	48.33
Location 3	12.52	0.85	10.63
Location 4	17.55	0.26	4.50
Location 5	32.43	0.47	15.12
Location 6	125.51	1.08	136.09
Location 7	22.58	0.43	9.64
Total	273.70	NA	235.83

* Locations are shown in Figure 2-3.

Intersection Improvements. As part of Alternative 3 Modified, the intersection of Broad Branch Road and 27th Street would be modified to split the right and left turn lanes for southbound motorists on Broad Branch Road, allowing for improved turning movements at the intersection – see Figure B-2, Sheet 3 in Appendix B. A new T-intersection is proposed at Brandywine Street to replace the existing forked Y-intersection (see Figure B-2, Sheet 6 in Appendix B). This improvement was described as Option C in the initial EA. The landscaped island at the center of the intersection is a "triangle park" maintained by the District Department of Parks and Recreation (DPR) in partnership with DDOT. The reconfiguration of this intersection was proposed to reduce the paved area and incorporate additional LID techniques in the roadway design with rain gardens in the interior corners of the new intersection. The reconfigured intersection would also improve roadway safety by minimizing crash risk for northbound drivers on Broad Branch Road turning left onto Brandywine Street. Requiring drivers to stop at a stop sign at the T-intersection, instead of yielding as with the existing Y-intersection, would also reduce speeds at the intersection. Sidewalks would be added on both sides of Brandywine Street to connect to the sidewalks proposed for the western side of Broad Branch Road. The design also includes wheelchair accessible ramps/aprons and a crosswalk that are compliant with Americans with Disabilities (ADA) requirements.

Retaining Walls. Some sections of roadway would require retaining walls (or coping walls) to minimize right-of-way requirements and stabilize slopes. Runoff from uphill areas behind the walls would be collected in concrete ditches behind the retaining walls and conveyed to existing outfalls via channels or storm sewers. ***On the east side of the roadway along the banks of Broad Branch, 9 segments of retaining walls, totaling 2,695 feet would be required. The walls would be designed to extend 3.5 feet above the top of the curb, as viewed from within the roadway, to meet DDOT safety standards*** (see **Figure 2-7**). ***The total wall height would range from 4.7 to 16.25 feet due to the slope down to Broad Branch. Much of this height would occur below ground surface so the portion of the wall visible from the stream side would be limited to 3.0 to 10.9 feet high (see Table 2-2). The 15 retaining walls on the west side of the roadway would range from 1.85 to 16.0 feet high and total over 3,830 feet in length. Final wall heights would be determined during final design based on soil stability analysis.*** Walls may be eliminated or reduced in height based on this analysis. The locations of these walls are shown in **Figure B-2 in Appendix B**.

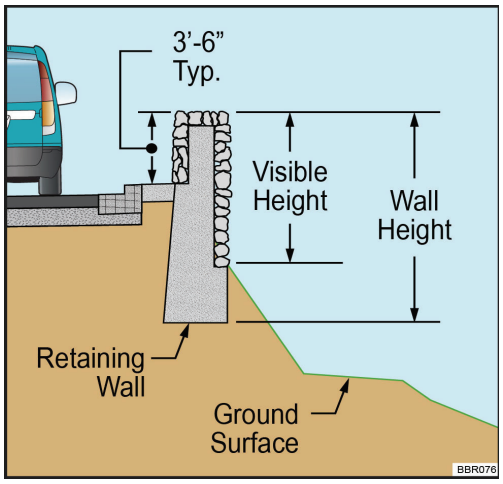

Figure 2-7. Typical retaining wall, east side of road, facing north

Table 2-2. Retaining Walls – Alternative 3 Modified (measurements in feet)

WEST SIDE						EAST SIDE					
SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH	SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH
R1W	26+20	27+55	5.50	5.50	135	R1E	29+60	30+50	14.50	6.25	90
R2W	28+20	30+40	8.50	8.50	220	R2E	32+70	34+10	10.75	3.00	140
R3W	33+00	34+65	7.50	7.50	165	R3E	37+00	39+80	14.25	4.00	280
R4W	39+70	40+20	3.00	3.00	50	R4E	44+20	44+40	11.50	3.25	20
	40+20	41+65	9.80	9.80	145						
	41+65	42+70	16.00	16.00	105						
	42+70	44+20	8.40	8.40	150						
	44+20	45+45	4.20	4.20	125						
R5W	46+45	48+65	8.00	8.00	220	R5E	45+75	46+45	16.25	5.00	70
R6W	51+20	52+60	12.50	12.50	140	R6E	47+65	49+90	15.75	8.25	225
R7W	52+75	54+20	8.50	8.50	145	R7E	53+45	53+60	11.50	3.50	15
	54+20	55+70	11.50	11.50	150						
	55+70	56+70	7.00	7.00	100						
R8W	60+30	61+35	4.50	4.50	105	R8E	68+75	69+15	7.00	7.00	40
							69+15	71+15	7.50	7.50	200
							71+15	71+45	4.70	4.70	30

▶ Continued.

Table 2-2. Retaining Walls – Alternative 3 Modified (measurements in feet)

WEST SIDE						EAST SIDE					
SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH	SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH
R9W	62+20	64+00	6.00	6.00	180	R9E	74+40	75+20	4.80	4.80	80
							75+20	79+25	7.10	7.10	405
							79+25	80+25	4.80	4.80	100
	64+00	65+20	11.00	11.00	120		80+25	81+25	9.40	9.40	100
							81+25	82+20	10.90	10.90	95
	65+20	65+80	7.00	7.00	105		82+20	87+15	7.40	7.40	495
							87+15	87+60	9.20	9.20	45
							87+60	90+25	5.75	5.75	265
R10W	67+65	68+70	6.25	6.25	105						
R11W	69+65	71+15	3.25	3.25	150						
R12W	71+15	72+65	5.20	5.20	150						
R13W	77+70	80+25	1.85	1.85	255						
R14W	83+20	86+15	5.00	5.00	295						
R15W	86+85	88+20	3.50	3.50	135						
	88+20	89+40	7.25	7.25	135						
	89+40	91+10	12.5	12.5	170						
	91+10	91+85	6.00	6.00	75						
Total Length					3,830						2,695

The majority of walls proposed on the east side of the roadway would be located within several feet of or partially overlap the footprint of existing stone walls. Several of these walls are contributing resources to the Rock Creek Park Historic District and traverse both DDOT and NPS property. DDOT would conduct necessary engineering studies, including stability analysis and wall crash rating analysis, to assess the condition of existing walls. The information would be used to determine whether new walls would need to be constructed to replace existing walls or whether existing walls could be restored and stabilized in their existing location to meet design standards. Where replacement structures are required, DDOT would construct the new walls within the existing wall's footprint reusing stones from the existing walls and supplementing with architecturally compatible materials as required. DDOT would also examine feasible methods to tie new walls into existing walls while ensuring structural stability and safety. Where existing walls cannot be restored, stones from the original walls would be retained for potential reuse in the construction of new walls. ***Restoration, replacement, and stabilization of architectural elements of historic properties would be in accordance with the stipulations set forth in the executed Section 106 Memorandum of Agreement (MOA) (see Appendix O), as concurred upon by the DC State Historic Preservation Office (SHPO).***

Drainage and Stormwater Management. In general, the roadway would have a normal cross slope and runoff would be directed toward the curbs and collected in water quality catch basins to be installed on the east and west sides of the roadway. These catch basins would screen debris and filter sediment before discharging runoff to the 21 existing outfall locations along the east side of the roadway. The locations of all outfalls are depicted in Figure B-2 in Appendix B. Cross

culverts would be used where it is necessary and feasible to prevent the offsite runoff from entering the roadway and divert it to the existing outfalls. Although no new outfalls would be added, existing outfalls would be improved with the installation of new reinforced concrete pipe (RCP) in locations where there are existing pipes, some of which are collapsed or broken, or silted in. Replacement of stormwater pipes would require work at outfalls exiting through headwalls or retaining walls.

Several of the retaining walls and outfalls, many of which are contributing resources to the Rock Creek Park Historic District, are existing DDOT infrastructure and occur on NPS property. It is necessary that DDOT obtain a Transfer of Jurisdiction to implement this project as there is no other feasible alternative. Additionally, DDOT would obtain a Special Use Permit from NPS for all temporary activities related to the rehabilitation of existing structures that support DDOT infrastructure on NPS property, including access, construction and site restoration. Walls surrounding existing pipes would be reconstructed after old pipes are removed, existing trenches are minimally excavated to accommodate new pipes, and new pipes are installed. Original stones or architecturally compatible materials will be used for the reconstruction of the outfalls and associated structures. All construction activities will follow DDOT construction standards. A linear rain garden would be incorporated on the west side, between the sidewalk and the roadway, at the north end of the project to incorporate LID techniques into the roadway redesign by reducing the amount of impervious surface in the project area and increasing green space. The rain garden would include a bioretention area adjacent to the roadway where runoff from the roadway would flow and be filtered through a layer of sand and into perforated underdrain pipes surrounded by aggregate and geotextile. Filtered stormwater would then be discharged to the existing storm drain system through an inlet structure connected to the existing drain system. The inlet structure would also serve as an overflow structure to divert excess water out of the rain garden.

Soapstone Creek Culvert Replacement. A major component of the stormwater management system improvements to be accomplished in the rehabilitation of Broad Branch Road includes replacement of the historic Soapstone Creek Culvert. The existing Soapstone Creek Culvert, a six-foot-wide stone arch culvert constructed in 1898, is to be replaced with a 16 feet by 9 feet high precast concrete arch culvert with an opening 16 feet wide by 4 feet high (**Figure 2-8**). The new structure is designed to reduce the frequency of stormwater overtopping the roadway and the extent of flooding.

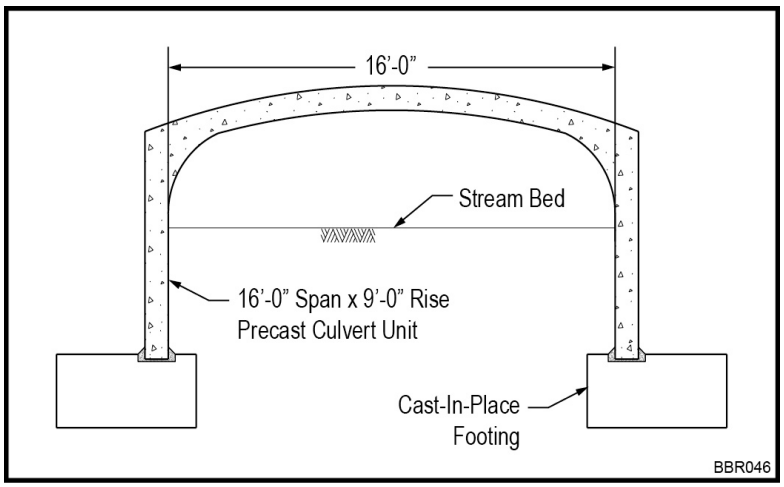

Figure 2-8. Soapstone Creek Culvert Replacement Design

The new culvert will consist of a precast concrete arch segment placed on concrete strip footing foundations alongside Soapstone Creek. It will measure 41 feet long. Headwalls above the culvert on both upstream and downstream sides will be constructed of concrete panels clad in stone salvaged from the historic culvert. If insufficient quantities of stone from the historic culvert are not available, the cladding may be constructed of a mix of existing stone and matching new stone.

The headwalls will extend from the top of the culvert opening to above the road surface level to form parapets. Two wingwalls constructed of precast concrete panels will be attached to the culvert and the headwall on each elevation and will run parallel to the roadway. The wingwalls will also extend above the roadway level, forming parapets, and will be clad in stone, similar to the headwall. Both the headwalls and wingwalls will serve a dual purpose of retaining earth fill and providing crash protection for the roadway. The inside surface of the arch will be smooth concrete. The resulting structure will resemble the existing historic culvert in form and visible materials with the exception of the inner surface of the arch, which will be smooth concrete. For functional reasons, the arch opening will be larger than the existing structure and the position and angle of the replacement structure with respect to the roadway (skew angle) will be slightly altered to accommodate improved constructability. The stonework will match the existing material and irregularly coursed rough-cut/uncut pattern to the maximum extent possible. Finalization of form, patterns, and materials would be determined in consultation with the SHPO and the NPS cultural resources specialist during final design. The road deck over Soapstone Creek will match the proposed elements along the rest of the roadway and be approximately 29 feet in width.

Restoration, replacement, and stabilization of architectural elements of historic properties would be in accordance with the stipulations set forth in the executed Section 106 MOA (see Appendix O), as concurred upon by the DC SHPO.

Project Cost and Duration. The total estimated project cost for Alternative 3 Modified is $56.3 million. The approximate construction duration is 30 months.

2.3.2 Build Alternatives

The proposed action originally consisted of Build Alternatives 2, 3, and 4 and consideration of design Options A, B and C. The most viable design options were incorporated into each of the final Build Alternatives as appropriate. Descriptions of each of the Build Alternatives evaluated in the initial EA are presented in the following sections. Based on comments received on the initial EA and subsequent coordination efforts with the affected Sovereign Nations, US Department of State, and the NPS, Alternative 3 was modified to create the Preferred Alternative.

2.3.2.1 Build Alternative 2

Build Alternative 2 is the minimum width alternative that generally meets the purpose and need of the project. It consists of two 10-foot travel lanes with standard curb and gutter on the east side with either a standard curb and gutter or a linear rain garden (bio-swale) to capture stormwater runoff on the west side, as shown in **Figure 2-9**.

The proposed curb is intended to prevent the edge of the new roadway from unraveling and discourage tree roots from disturbing the roadway base, as well as protect side slopes from stormwater runoff. In addition, curbs would provide the additional benefit of traffic calming.

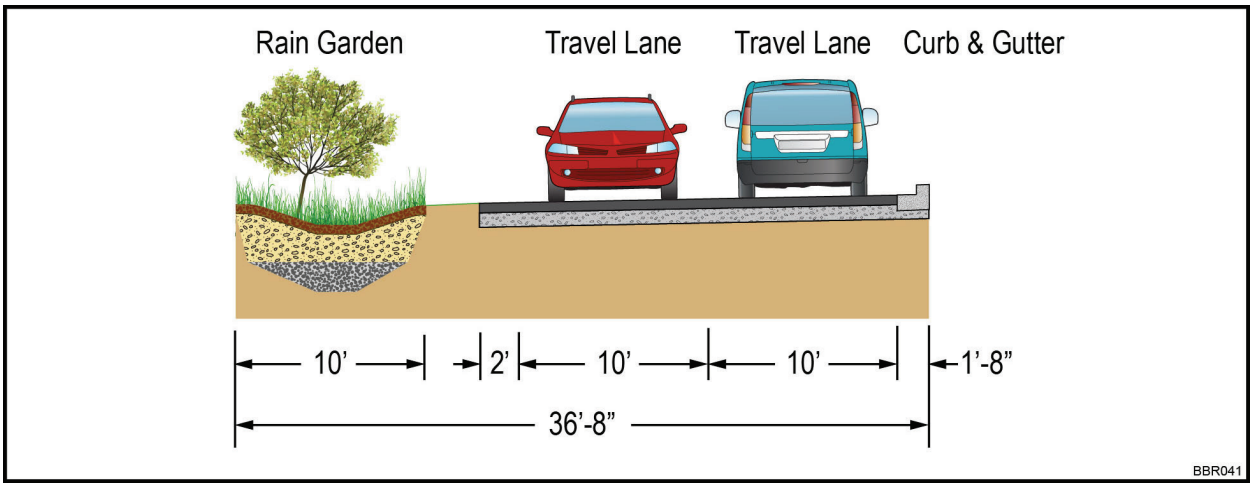

Figure 2-9. Build Alternative 2

The 10-foot-wide linear rain garden would be provided along the west side of the roadway for approximately 1,000 feet southward of Linnean Avenue. This alternative has a cross-section width ranging from approximately 23 to 37 feet. This alternative allows all elements of the rehabilitated roadway to be located within existing DDOT right-of-way, as shown in **Figure 2-10**, with minor exceptions as detailed in Section 2.2. (Note: the full alignment plan for Build Alternative 2 is presented in Appendix B of the October 2013 EA).

Notwithstanding these exceptions, there are no physical components proposed under Build Alternative 2 that would require acquisition of additional right-of-way from NPS or from private property. Areas requiring cut-and-fill activities outside the existing right-of-way are limited to nine discrete locations totaling 249 square feet (91 square feet on the east side and 157 on the west side) and would be accomplished through easements.

Sidewalks. To maintain the minimal width of right-of-way, Build Alternative 2 does not include sidewalks or any other form of pedestrian improvements.

Intersection Improvements. The intersection of Broad Branch Road and 27th Street would be modified under Build Alternative 2. The locations of stop bars are set back from the roadway curve and the bar is parallel for both left and right turns for southbound motorists on Broad Branch Road. The triangular roadway paint and barriers would be removed.

A new T-intersection at Brandywine Street would replace the existing forked Y-intersection. The intersection design is very similar to that described under Alternative 3 Modified; however, this alternative would not add sidewalks on both sides of Brandywine Street to connect to the sidewalks proposed for the western side of Broad Branch Road or the wheelchair accessible ramps/aprons and crosswalk.

Retaining Walls. Some segments of the roadway would require new or replacement retaining walls (or coping walls) to minimize cut-and-fill areas and to limit improvements to the DDOT-owned right-of-way. As previously noted, runoff from uphill areas behind the walls would be collected in concrete ditches behind the retaining walls and conveyed to existing outfalls via channels or storm sewers.

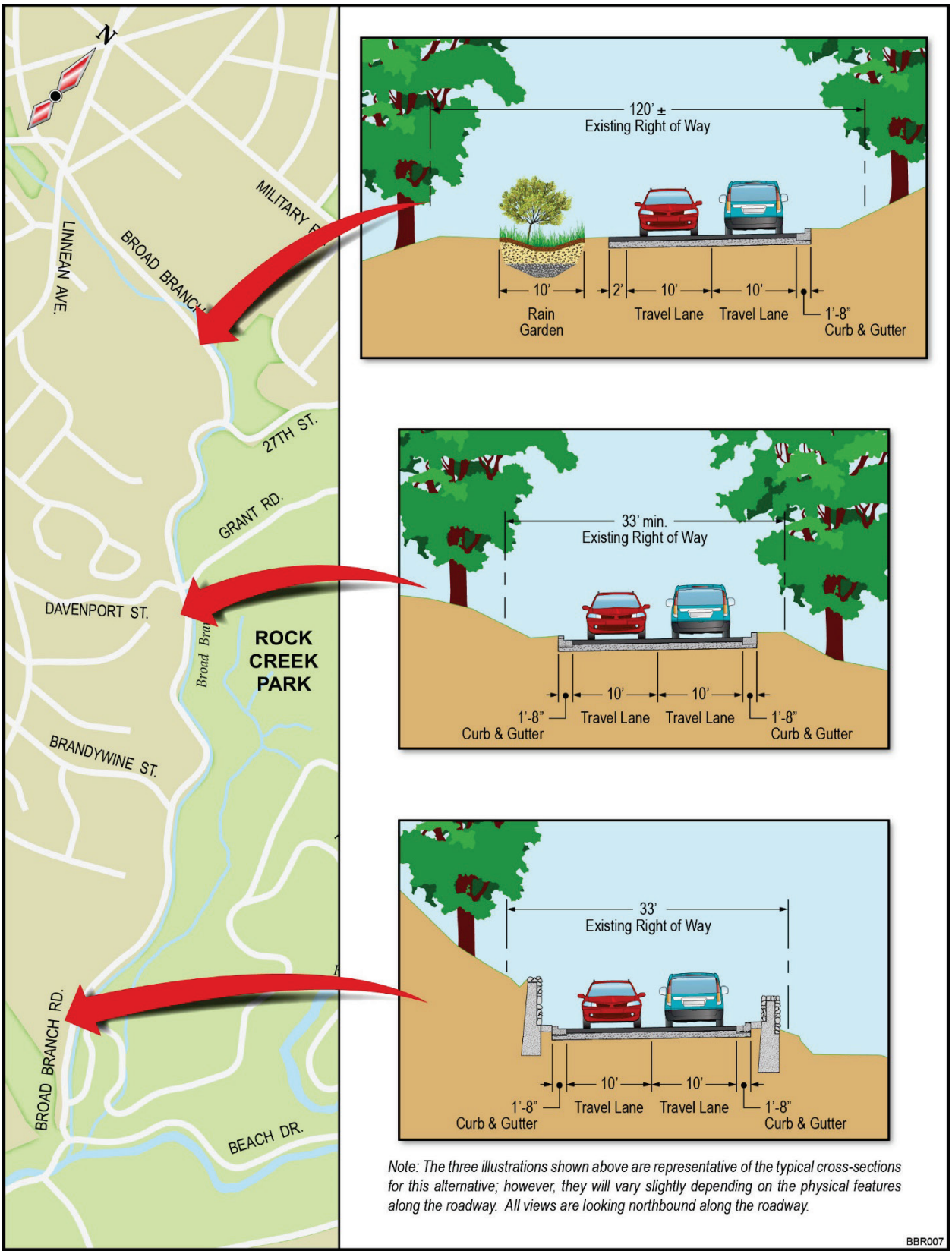

Figure 2-10. Build Alternative 2 – Typical Sections

On the east side of the roadway along the banks of Broad Branch, 9 segments of retaining walls, totaling over 1,750 feet in length, would be required. Similar to Alternative 3 Modified, the walls would be designed to extend 3.5 feet above the top of the curb, as viewed from within the roadway, to meet DDOT safety standards. To meet these standards and accommodate the steep slope along the edge of the roadway, the total wall height would range from 8 to almost 15 feet (see **Table 2-3**). Much of this height would occur below ground surface so the portion of the wall visible from the stream side would be limited to 4.5 to 6.5 feet high. The 12 retaining walls proposed on the west side of the roadway would range in height from 3 to 7 feet above the top of the curb and total more than 3,000 feet in length. Slope stability analysis would be conducted during final design to confirm the requirement for walls on the west side; walls may be eliminated or reduced in height based on this analysis.

Table 2-3. Retaining Walls – Build Alternative 2 (measurements in feet)

WEST SIDE						EAST SIDE					
SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH	SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH
R1W	28+30	30+00	4.50	4.50	169	R1E	29+64	30+40	13.50	6.00	79
R2W	33+15	35+60	3.50	3.50	244	R2E	32+74	33+05	9.00	3.75	31
R3W	39+45	45+11	4.00	4.00	560	R3E	33+90	34+15	11.00	4.25	25
R4W	46+58	49+07	3.00	3.00	252	R4E	38+54	38+73	13.25	4.00	18
R5W	51+39	55+36	6.00	6.00	392	R5E	45+90	46+34	14.25	5.50	44
R6W	63+81	65+13	3.50	3.50	129	R6E	47+75	49+95	14.75	6.75	220
R7W	65+18	65+75	5.00	5.00	58	R7E	53+53	53+68	8.00	3.25	15
R8W	69+25	72+61	5.00	5.00	336	R8E	69+34	70+15	10.50	4.50	81
R9W	78+02	80+66	4.50	4.50	266		77+03	80+25	11.00	4.50	325
R10W	83+37	86+35	7.00	7.00	302	R9E	80+25	88+50	8.75	4.00	815
R11W	86+92	87+48	5.00	5.00	56		88+50	89+49	10.50	4.00	98
R12W	88+12	91+34	4.00	4.00	322						
Total Length					**3,030**						**1,751**

Note: the location and height of these walls are shown in detailed alignment maps contained in Appendix B of the October 2013 EA.

The majority of walls proposed on the east side of the roadway would be located within several feet of or partially overlap the footprint of existing stone walls. Several of these walls are contributing resources to the Rock Creek Park Historic District and traverse both DDOT and NPS property.

The wall segments are required to meet design criteria. DDOT would conduct necessary engineering studies, including stability analysis and wall crash rating analysis, to assess the condition of existing walls. The information would be used to determine whether new walls would need to be constructed to replace existing walls or whether existing walls could be restored and stabilized in their existing location to meet design standards. Where replacement structures are required, DDOT would construct the new walls within the existing wall's footprint. DDOT would also examine feasible methods to tie new walls into existing walls while ensuring structural stability and safety. Where existing walls cannot be restored, stone from the walls would be retained for potential reuse in the construction of new walls. Several coping walls (walls less than 18 inches in height) would also be incorporated along the roadway within DDOT right-of-way.

Drainage and Stormwater Management. Stormwater management upgrades are similar to those described in Alternative 3 Modified and would include improvements to existing outfalls. Like Alternative 3 Modified, Build Alternative 2 includes replacement of the Soapstone Creek Culvert. The replacement of the Soapstone Creek Culvert would be the same in form, pattern, and materials as identified for Alternative 3 Modified; however, the structure would be slightly narrower over Soapstone Creek. The concrete strip footing foundations on which the precast concrete arch rests would be approximately 32 feet long and the road deck over Soapstone Creek for Build Alternative 2 would be approximately 23 feet in width to match the roadway elements along the rest of the alternative.

Project Cost and Duration. The total estimated project cost for Alternative 2 is $37.4 million. The approximate construction duration is 24 months.

2.3.2.2 Build Alternative 3

Build Alternative 3 consists of two 10-foot travel lanes, a 6-foot-wide sidewalk on the west side of the roadway for the entire length, and standard curb and gutter as shown in **Figure 2-11**. A 10-foot-wide linear rain garden would be provided between the sidewalk and the roadway for approximately 1,000 feet southward of Linnean Avenue where the curb and gutter would be located only along the east side of the roadway. South of that, a 4-foot-wide planting strip would separate the sidewalk and roadway for the length of the project and the curb and gutter would be located on both sides.

Build Alternative 3 extends the proposed sidewalk from the end of DDOT right-of-way into a 6-foot-wide sidewalk that reaches the Rock Creek Park parking lot entrance just north of Beach Drive. As noted previously, the proposed curb is expected to prevent the edge of the new roadway from unraveling, discourage tree roots from spreading underneath the roadway base, and control runoff. In addition, the curb would provide the added benefit of traffic calming. This alternative has a cross-section width ranging from approximately 33 to 43 feet from curb to outer edge of sidewalk. The typical cross-sections along the entire length of the roadway are shown in **Figure 2-12.** (Note: the full alignment plan for Build Alternative 3 is presented in Appendix B of the October 2013 EA).

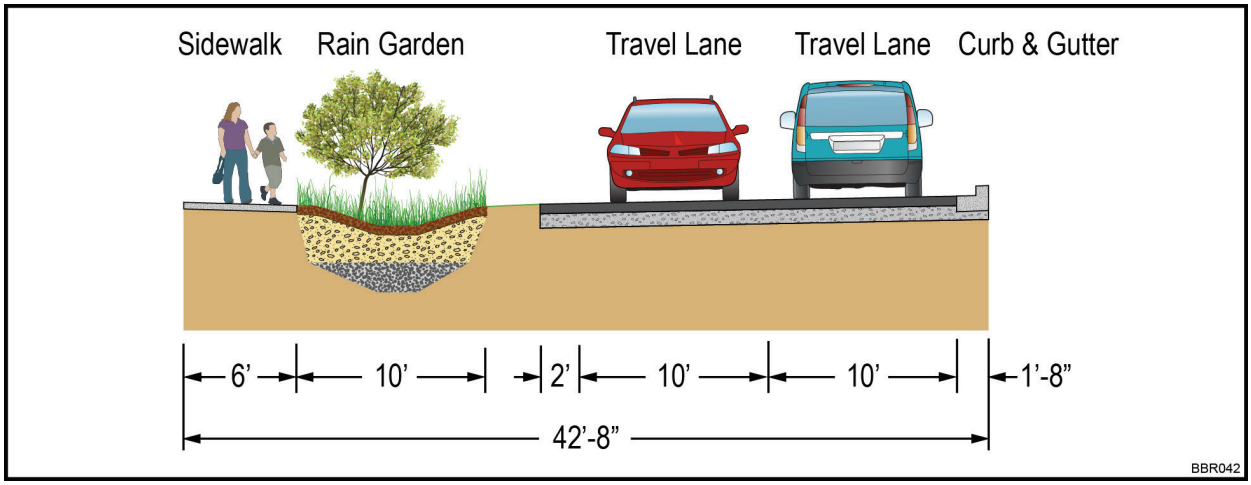

Figure 2-11. Build Alternative 3

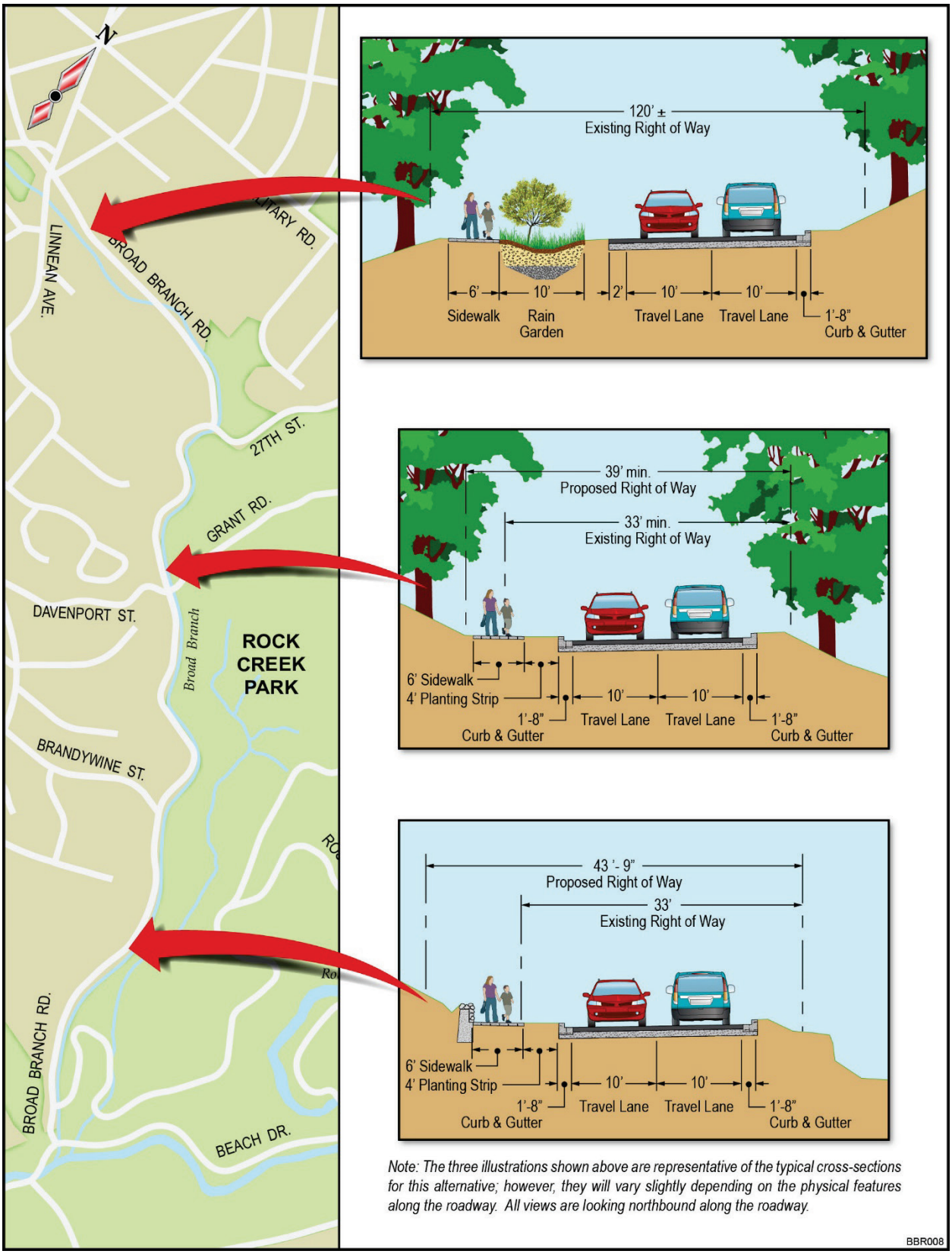

Figure 2-12. Build Alternative 3 – Typical Sections

In addition to the areas where the current roadway exceeds existing DDOT right-of-way as noted in Section 2.2, new right-of-way would be required on the west side along narrow portions of the roadway to accommodate the new sidewalk. Limited right-of-way, approximately 39 square feet, may be required along the east side of the roadway on NPS land to accommodate the construction of proposed new retaining walls; however, the final locations of new retaining walls and additional right-of-way, as needed, would be determined after completion of engineering studies to assess the condition of existing walls. In addition to the potential for right-of-way acquisition, narrow areas proposed for grading (fill) occur along the right-of way, the largest of which is approximately 2 feet wide by 50 feet long at the southern end of the project area south of Ridge Road (Station 91+00). Any grading outside the existing DDOT right-of-way would require a temporary construction easement.

Intersection Improvements. The intersection of Broad Branch Road and 27th Street would be modified to split the right and left turn lanes for southbound motorists on Broad Branch Road, allowing for improved turning movements at the intersection. A new T-intersection is proposed at Brandywine Street to replace the existing forked Y-intersection. The intersection design is the same as that described in Alternative 3 Modified and includes the same ADA compliant features.

Retaining Walls. Some sections of roadway would require retaining walls (or coping walls) to minimize right-of-way requirements and stabilize slopes. Similar to Alternative 3 Modified, runoff from uphill areas behind the walls would be collected in concrete ditches behind the retaining walls and conveyed to existing outfalls via channels or storm sewers. On the east side of the roadway along the banks of Broad Branch, 13 segments of retaining walls, totaling over 1,700 feet would be required.

Also similar to Alternative 3 Modified, the walls on the east side of the roadway would be typically designed to extend 3.5 feet above the top of the curb, as viewed from within the roadway, to meet DDOT safety standards. The total wall height would range from 8 to 16 feet due to the slope down to Broad Branch. ***Much of this height would occur below ground surface so the portion of the wall visible from the stream side would be limited to 3 to 8.25 feet high (refer to Table 2-4). The 16 retaining walls on the west side of the roadway would range from 2.5 to 13 feet high and total over 4,500 feet in length.*** Final wall heights would be determined during final design based on soil stability analysis. Walls may be eliminated or reduced in height based on this analysis. Although there is an increase in the number of retaining walls compared to Build Alternative 2, the average length of each retaining wall is shorter.

The majority of walls proposed on the east side of the roadway would be located within several feet of or partially overlap the footprint of existing stone walls. Several of these walls are contributing resources to the Rock Creek Park Historic District and traverse both DDOT and NPS property. DDOT would conduct necessary engineering studies, including stability analysis and wall crash rating analysis, to assess the condition of existing walls. The information would be used to determine whether new walls would need to be constructed to replace existing walls or whether existing walls could be restored and stabilized in their existing location to meet design standards. Where replacement structures are required, DDOT would construct the new walls within the existing wall's footprint. DDOT would also examine feasible methods to tie new walls

into existing walls while ensuring structural stability and safety. Where existing walls cannot be restored, stone from the walls would be retained for potential reuse in the construction of new walls.

Drainage and Stormwater Management. Stormwater management upgrades are the same as those described for Alternative 3 Modified.

Project Cost and Duration. The total estimated project cost for Build Alternative 3 is $43.7 million. The approximate construction duration is 30 months.

Table 2-4. Retaining Walls – Build Alternative 3 (measurements in feet)

WEST SIDE						EAST SIDE					
SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH	SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH
R1W	26+17	27+53	5.50	5.50	135	R1E	29+64	30+50	14.50	6.25	89
R2W	28+18	30+41	8.50	8.50	220	R2E	32+73	34+06	10.75	3.00	135
R3W	33+00	35+65	7.50	7.50	262	R3E	38+50	38+68	14.25	4.00	18
R4W	36+60	39+58	3.00	3.00	315	R4E	44+25	44+50	11.50	3.25	20
R5W	39+63	40+28	3.25	3.25	65	R5E	45+83	46+54	16.25	5.00	69
R6W	44+29	45+12	6.00	6.00	94	R6E	47+74	49+94	15.75	8.25	220
R7W	46+53	48+78	8.00	8.00	231	R7E	53+55	53+65	11.50	3.25	10
R8W	51+25	52+66	12.50	12.50	136	R8E	57+83	58+11	10.00	4.50	27
R9W	52+86	54+30	8.50	8.50	141	R9E	69+30	70+25	12.50	4.50	95
	54+30	55+82	11.50	11.50	144	R10E	77+21	77+41	10.25	5.00	24
	55+82	56+69	7.00	7.00	87	R11E	77+71	78+64	8.00	5.50	96
R10W	60+35	61+47	4.50	4.50	112	R12E	79+01	79+12	9.75	4.00	11
R11W	62+23	64+09	6.00	6.00	158	R13E	81+27	82+76	10.00	4.50	145
	64+09	65+29	11.00	11.00	117		82+76	87+50	8.25	4.25	470
	65+29	65+92	7.00	7.00	63		87+50	90+31	11.50	4.00	278
R12W	67+84	68+89	6.25	6.25	105						
R13W	69+23	70+07	4.00	4.00	84						
	70+07	70+87	7.00	7.00	84						
	70+87	71+81	10.75	10.75	91						
	71+81	73+15	5.75	5.75	131						
R14W	73+50	78+04	2.50	2.5	434						
	78+04	81+02	8.00	8.00	301						
	81+02	83+21	3.00	3.00	224						
	83+21	85+26	13.00	13.00	212						
	85+26	86+41	8.25	8.25	116						
R15W	86+84	87+45	5.00	5.00	62						
R16W	87+70	89+50	7.25	7.25	185						
	89+50	91+16	12.50	12.50	163						
	91+16	91+95	6.00	6.00	79						
Total Length					4,549						1,707

Note: the location and height of these walls are shown in detailed alignment maps contained in Appendix B of the October 2013 EA.

2.3.2.3 Build Alternative 4

Build Alternative 4 is the widest of the project alternatives and consists of two 10-foot travel lanes, a 6-foot-wide sidewalk on the west side, a 4-foot-wide bike lane on the east side, and standard curb and gutter, as shown in **Figure 2-13**. A 10-foot-wide linear rain garden would be provided between the sidewalk and the roadway for approximately 1,000 feet southward of Linnean Avenue. The curb and gutter would be located only along the east side of the roadway in this location. South of that, a 4-foot-wide planting strip would separate the sidewalk and roadway for the length of the project and the curb and gutter would be located on both sides. Build Alternative 4 extends the proposed sidewalk from the end of DDOT right-of-way into a 6-foot-wide sidewalk that reaches the Rock Creek Park parking lot entrance just north of Beach Drive. As described previously, the proposed curb is expected to provide improved runoff control, as well as prevent the edge of the new roadway from unraveling and discourage tree roots from disturbing the roadway base. In addition, the curb would provide the added benefit of traffic calming.

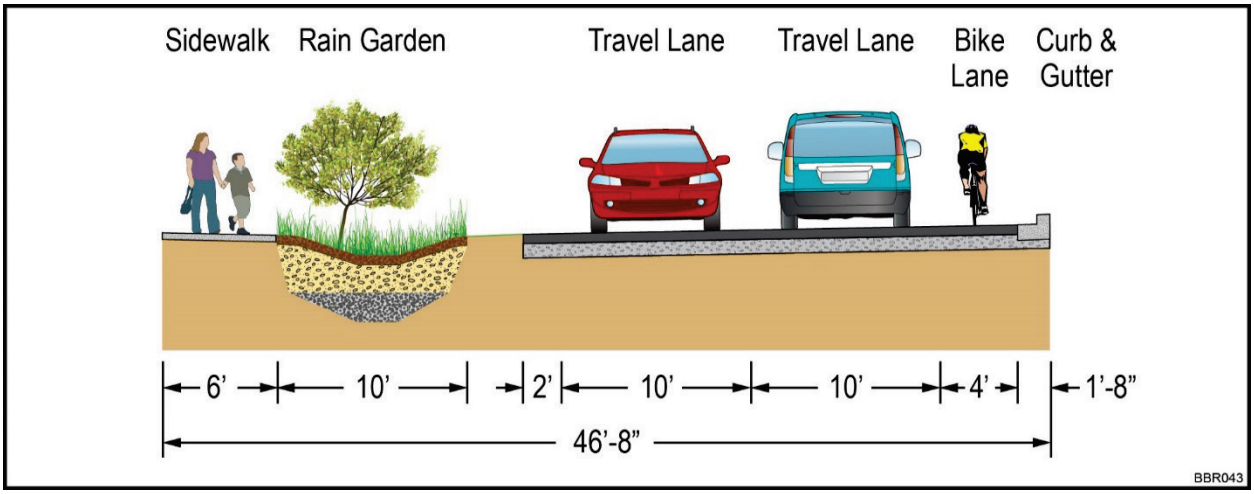

Figure 2-13. Build Alternative 4

This alternative has a cross-section width ranging from approximately 37 to 47 feet from curb to outer edge of sidewalk. The typical cross-sections along the entire length of the roadway are shown in **Figure 2-14**. (Note: the full alignment plan for Build Alternative 4 is presented in Appendix B of the October 2013 EA).

In addition to the areas where the current roadway exceeds existing right-of-way as noted in Section 2.2, new right-of-way would be required on both sides of the roadway to accommodate the sidewalk and planting strip on the west side and retaining walls on the east side. Like Alternative 3 Modified, Build Alternative 4 may also require additional right-of-way, approximately 2,200 square feet, along the east side of the roadway on NPS land to accommodate the construction of proposed new retaining walls (pending engineering studies to assess the condition of existing walls). Areas proposed for grading (fill) occur along both the east and west sides of the right-of way. Any temporary construction activities on NPS properties would require a Special Use Permit and permanent acquisition of NPS land will require a Transfer of Jurisdiction (TOJ).

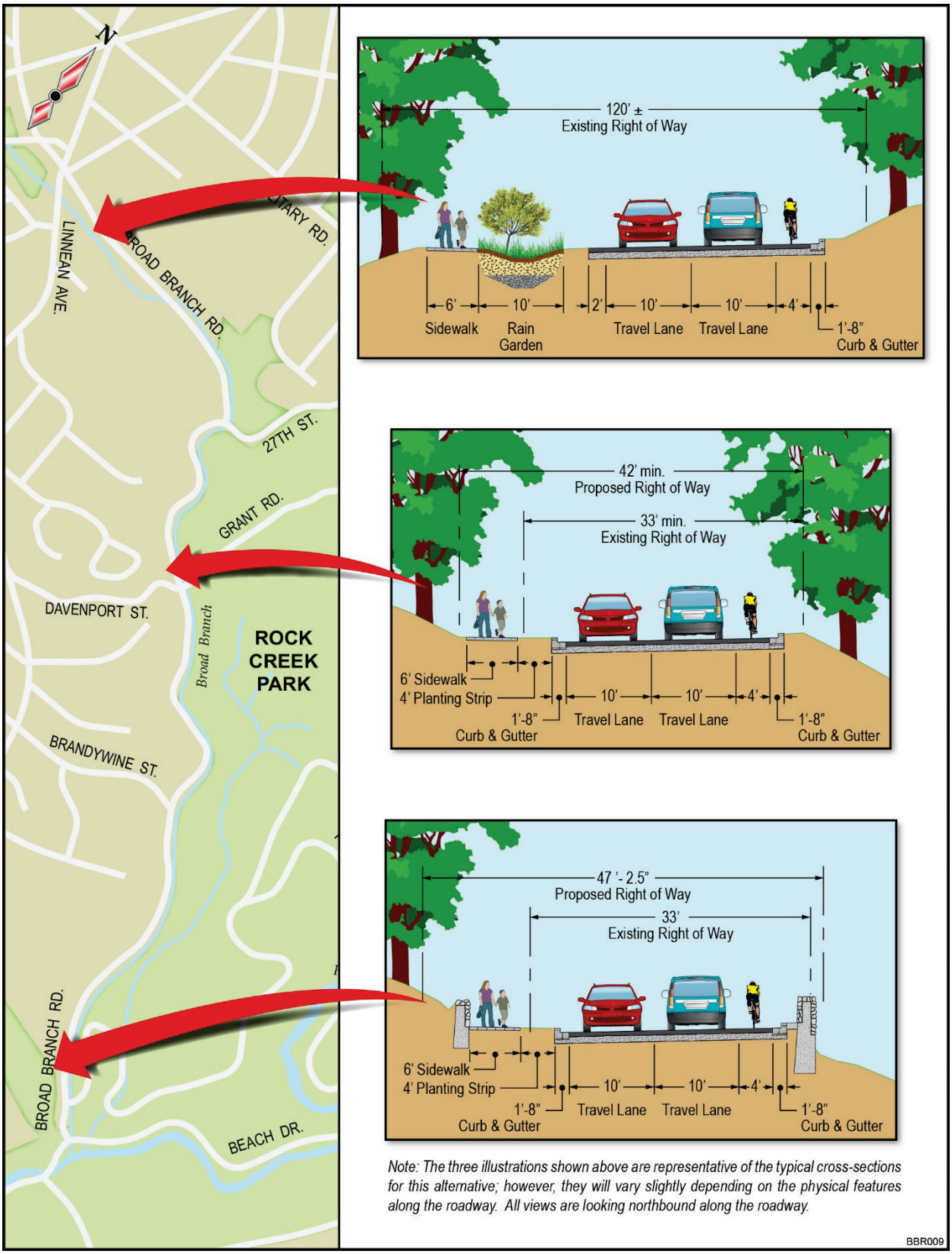

Figure 2-14. Build Alternative 4 – Typical Sections

Intersection Improvements. Similar to Alternative 3 Modified, the Broad Branch Road intersection with 27th Street would be modified to split the right and left turn lanes for southbound motorists on Broad Branch Road, allowing for improved turning movements at the intersection. The intersection would also be wider to accommodate the northbound bike lane.

A new T-intersection is proposed at Brandywine Street to replace the existing forked Y-intersection. The intersection design is very similar to that described for the Preferred Alternative 3 Modified. Proposed sidewalks on both sides of Brandywine Street in this alternative would connect to the sidewalks proposed for the western side of Broad Branch Road. The design also includes ADA-compliant wheelchair accessible ramps/aprons and a crosswalk.

Retaining Walls. Some sections of roadway would require retaining walls in order to minimize right-of-way requirements and stabilize slopes. Like Build Alternatives 2, 3, and 3 Modified, runoff from uphill areas behind the walls would be collected in concrete ditches behind the retaining walls and conveyed to existing outfalls via channels or storm sewers.

On the east side of the roadway along the banks of Broad Branch, 21 segments of retaining walls, totaling over 2,300 feet in length, would be required. Similar to Build Alternatives 2, 3, and 3 Modified, the walls would be designed to extend 3.5 feet above the top of the curb, as viewed from within the roadway, to meet DDOT safety standards. The total wall height would range from 3 to 17 feet. Much of this height would occur below ground surface so the portion of the wall visible from the stream side would be limited to 4.5 to 6.5 feet high (**Table 2-5**). The 16 retaining walls on the west side of the roadway range from 3 to 16 feet high and total nearly 4,700 feet in length. Soil stability analysis to be conducted during final design would confirm requirements for the walls; walls may be decreased in height or eliminated based on the results of studies. Although there is an increase in the number of retaining walls compared to Build Alternatives 2, 3, and 3 Modified, the average length of each retaining wall is shorter than either of the other alternatives.

Table 2-5. Retaining Walls – Build Alternative 4 (measurements in feet)

WEST SIDE						EAST SIDE					
SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH	SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH
R1W	26+14	27+69	6.25	6.25	153.69	R1E	18+50	19+57	2.50	2.50	104.82
R2W	28+17	28+73	8.00	8.00	55.95	R2E	29+55	30+05	13.00	6.50	100.65
	28+73	29+61	11.75	11.75	86.66	R3E	31+95	34+45	10.25	5.25	257.59
	29+61	30+40	6.25	6.25	78.34	R4E	38+00	38+35	10.00	4.00	35.34
R3W	33+08	36+06	8.00	8.00	273.49	R5E	39+56	40+35	14.75	4.00	79.77
	36+06	38+86	3.00	3.00	296.31	R6E	44+37	45+00	15.75	5.25	59.36
	38+86	39+12	5.50	5.5	25.86	R7E	45+59	46+09	16.50	4.75	47.18
R4W	39+25	39+96	8.25	8.25	72.27	R8E	46+45	49+65	16.25	5.00	316.62
R5W	42+21	42+42	8.00	8.00	14.97	R9E	53+24	55+05	13.25	4.50	182.01
R6W	43+95	44+82	10.00	10.00	99.16	R10E	57+52	57+93	12.00	4.50	34.91
R7W	46+26	47+56	8.25	8.25	134.63	R11E	65+38	65+69	13.25	4.50	31.34
	47+56	48+86	15.75	15.75	131.47	R12E	66+19	66+59	17.25	4.50	37.84

► *Continued.*

Table 2-5. Retaining Walls – Build Alternative 4 (measurements in feet)

WEST SIDE						EAST SIDE					
SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH	SEGMENT	START	END	HEIGHT	VISIBLE HEIGHT	LENGTH
R8W	51+02	51+30	6.50	6.50	28.70	R13E	68+80	71+10	14.25	5.00	226.08
	51+30	52+22	13.00	13.00	87.85	R14E	76+69	77+16	11.50	4.00	46.77
	52+22	52+43	7.75	7.75	19.24	R15E	77+39	78+90	12.75	5.25	152.35
R9W	52+63	53+85	7.50	7.50	119.27	R16E	80+55	80+70	10.00	4.50	14.90
	53+85	55+23	12.50	12.50	137.51	R17E	81+00	81+90	11.25	5.00	87.82
	55+23	56+47	6.00	6.00	116.36	R18E	82+55	83+50	8.75	4.50	92.60
R10W	60+02	65+63	6.50	6.50	519.02	R19E	83+90	84+39	7.50	4.25	48.69
R11W	67+61	68+55	7.25	7.25	95.73	R20E	85+15	88+24	9.50	5.75	307.67
R12W	68+95	69+69	3.00	3.00	74.26	R21E	90+61	91+40	13.75	6.25	79.20
	69+69	72+75	8.25	8.25	305.88						
R13W	73+28	77+44	2.50	2.5	403.37						
	77+44	78+40	6.25	6.25	92.20						
	78+40	79+26	11.00	11.00	86.64						
	79+26	81+81	6.50	6.50	258.95						
R14W	82+05	82+84	5.75	5.75	82.62						
	82+84	85+50	13.75	13.75	272.50						
	85+50	86+15	6.25	6.25	65.00						
R15W	86+57	87+20	5.00	5.00	62.67						
R16W	87+46	88+34	6.00	6.00	88.76						
	88+34	90+87	13.75	13.75	253.53						
	90+87	91+71	9.00	9.00	82.74						
Total Length					**4,675.59**						**2,343.52**

Note: the location and height of these walls are shown in detailed alignment maps contained in Appendix B of the October 2013 EA.

Similar to Build Alternatives 2, 3, and 3 Modified, the wall segments are required to meet current design criteria. The majority of walls proposed on the east side of the roadway would be located within several feet of or partially overlap the footprint of existing stone walls. Several of these walls are contributing resources to the Rock Creek Park Historic District and traverse both DDOT and NPS property. DDOT would conduct necessary engineering studies, including stability analysis and wall crash rating analysis, to assess the condition of existing walls. The information would be used to determine whether new walls would need to be constructed to replace existing walls or whether existing walls could be restored and stabilized in their existing location to meet design standards. Where replacement structures are required, DDOT would construct the new walls within the existing wall's footprint. DDOT would also examine feasible methods to tie new walls into existing walls while ensuring structural stability and safety. Where existing walls cannot be restored, stone from the walls would be retained for potential reuse in the construction of new walls.

Drainage and Stormwater Management. Stormwater management upgrades are similar to those identified in Build Alternatives 2, 3, and 3 Modified. The Soapstone Creek Culvert structure would be slightly wider over Soapstone Creek. The concrete strip footing foundations on which

the precast concrete arch rests would be approximately 45 feet long and the road deck over Soapstone Creek for Build Alternative 4 would be approximately 29 feet in width to accommodate the six-foot sidewalk on the west side of Broad Branch Road (the same roadway width as Build Alternatives 3 and 3 Modified).

Project Cost and Duration. The total estimated project cost for Alternative 4 is $57.5 million. The approximate construction duration is 36 months.

2.4 ALTERNATIVES ELIMINATED FROM CONSIDERATION

During the alternatives development process, several alternative strategies and concepts were considered but eliminated, as described further in the following section.

2.4.1 ROADWAY ALTERNATIVES

During the collaborative alternatives development process, the study team worked with stakeholders and the public to develop a range of alternatives that incorporate elements to address each of the project's needs. Alternative concepts that were considered but then dismissed from consideration included:

- potential widening to increase vehicular capacity,
- upgrading the roadway's classification and design standards,
- raising the roadway profile above the 10-year floodplain,
- changing the roadway from a two-way to a one-way roadway to allow space for cyclists, and
- the provision of a shared use path or bicycle lane on the west side of Broad Branch Road.

Improvements to **increase vehicular capacity** were dropped from consideration as current and future travel demands do not indicate a need for additional capacity. Traffic volumes are projected to remain below 5,000 vehicles per day (vpd). Similarly, travel demand management (TDM) strategies and transit alternatives for this low-capacity roadway were also eliminated from further consideration.

Upgrading Broad Branch Road's **classification** and **raising the roadway profile** were eliminated from consideration early in the study due to the potential impacts on Rock Creek Park and the adjacent diplomatic residences. Upgrading the roadway classification would include design standards for increased speeds. To achieve even a 35-mph design speed (minimum 30 mph) would require 12-foot travel lanes and grades less than 4%. Findings from alignment and profile studies suggest that major earthwork and extensive regrading with frequent use of retaining walls would be required to achieve these design standards and to raise the road above the 10-year floodplain. Such improvements would not be in keeping with the topography and character of the local setting and given the relatively low traffic volumes on the roadway (under 5,000 vpd), they were dismissed from further consideration. A 25-mph design can be achieved in the roadway corridor, and when combined with traffic calming measures, speeds can be controlled to address the project's safety concerns.

The proposal to alter the roadway from a two-way to a one-way roadway was first considered as part of a DDOT feasibility study conducted more than 10 years ago. One travel lane would be removed to allow for the incorporation of bicycle and pedestrian facilities. The concept received considerable support for its incorporation of the other modal elements; however, it resulted in potential lengthy, circuitous travel for autos. Entry to Broad Branch Road would be limited to the northern or southern terminus, and as such, would cause extended travel to reach the entry points. One-way travel also poses problems for travelers who miss turns to intersecting roadways or drives – resulting in a nearly two-mile trip to return to the turning point. After much consideration, the one-way concepts were dismissed again.

The provision of a **shared use path** on the west side of Broad Branch Road was eliminated because it was determined that separate bicycle and pedestrian facilities better met safety and connectivity objectives for these facilities. Provision of a **bicycle lane** in both travel directions was also eliminated because it would not allow sufficient space for a separation between the roadway and the sidewalk, which is consistent with pedestrian safety objectives and the context of the project setting.