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4 Affected Environment and Environmental Consequences

This chapter of the Draft Environmental Impact Statement (DEIS) discusses the existing conditions, potential consequences or impacts and mitigation of the proposed project as compared to the No Build Alternative. The analysis is organized by resource areas (i.e., elements of the built and natural environment) and includes both potential adverse and beneficial impacts or consequences. The analysis that follows is based on the National Environmental Policy Act (NEPA) and federal and state regulations and guidelines (appendix E). The United States Department of Transportation (USDOT), through the Federal Transit Administration (FTA), has adopted regulations to implement NEPA (23 C.F.R. 771). This DEIS identifies the NEPA Preferred Alternative, which is required in order to have the option to pursue a combined Final Environmental Impact Statement (FEIS)/Record of Decision (ROD) under MAP-21.

The proposed project alternatives are described in DEIS chapter 2 and potential impacts or consequences to environmental resources and mitigation measures are presented in chapter 4 in the following manner:

- No-Build Alternative

- NEPA Preferred Alternative (Common Segments + C2A + NHC2 + Duke/VA Medical Centers Trent/Flowers Drive Station + Farrington Road Rail Operations and Maintenance Facility [ROMF])
- Project Element Alternatives
  - Little Creek Alternatives (C1, C1A, C2)
  - New Hope Creek Alternatives (NHC LPA, NHC 1)
  - Duke/VA Medical Centers Station – Duke Eye Center Station Alternative
  - ROMF Alternatives (Leigh Village ROMF, Patterson Place ROMF, Cornwallis Road ROMF, Alston Ave ROMF)

The footer of the DEIS document is a representation of the NEPA Preferred and the Project Element Alternatives being considered in this DEIS. The color schema presented in the graphic is carried through the figures presented in this section of the DEIS. The blue line represents the NEPA Preferred Alternative. The Little Creek Alternatives (C1, C1A, and C2) are represented with a red dashed line. The New Hope Creek Alternatives (NHC LPA, NHC 1) are represented with a green dashed line. In the areas where the alignment alternatives are presented, station locations will differ from the NEPA Preferred Alternative.

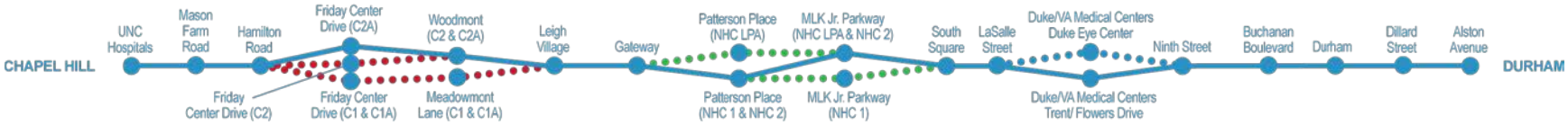
Chapter 2 describes each of the alternatives in detail.

The No Build Alternative is the future condition of planned transportation facilities and services in 2040 within the corridor if the D-O LRT Project is not implemented; it provides the basis against which the NEPA Preferred Alternative and Project Element Alternatives are compared.

The No-Build Alternative is the future condition of transportation facilities and services in 2040 within the corridor if the D-O LRT Project is not implemented; it provides the basis against which the NEPA Preferred and Project Element Alternatives are compared. While the NEPA Preferred Alternative assumes the implementation of the funded transportation improvement projects included in the Metropolitan Transportation Plan (MTP) for implementation by 2040 within the D-O Corridor, the No-Build Alternative assumes all the projects in the MTP except the D-O LRT Project. The list of No-Build Alternative projects is included in appendix M.

Chapter 4 includes a discussion of the affected environment, environmental consequences and mitigation of potential impacts of the D-O LRT Project for the natural and built environment. This chapter also includes avoidance and minimization of potential impacts to resources considered in the development of the NEPA Preferred Alternative. It also contains a discussion on potential construction impacts and staging. It is organized as follows:

- 4.1 Land Use and Zoning
- 4.2 Socioeconomic and Demographic Conditions (including economic impact for the project)
- 4.3 Neighborhoods and Community Resources
- 4.4 Visual and Aesthetic Conditions
- 4.5 Historic and Archaeological Resources
- 4.6 Parklands and Recreational Areas/Section 6(f)
- 4.7 Natural Resources
- 4.8 Water Resources
- 4.9 Air Quality
- 4.10 Noise and Vibration
- 4.11 Hazardous, Contaminated, and Regulated Materials
- 4.12 Safety and Security



- 4.13 Energy
- 4.14 Acquisitions, Relocations, and Displacements
- 4.15 Utility Impacts
- 4.16 Construction
- 4.17 Indirect and Cumulative Impacts

Each section in this chapter is organized as follows:

- **Methodology**: an overview of the methods used to evaluate each resource area, description of the regulatory considerations and study area, which vary by resource type
- **Affected Environment**: a summary of the existing conditions in the study area
- **Impact Evaluation** (Environmental Consequences): a summary of the potential direct impacts on the natural and built environment for each of the resource areas as a result of the implementation of the D-O LRT Project
- **Mitigation Measures**: the measures that will be implemented to avoid, minimize, or mitigate impacts as appropriate

The Council on Environmental Quality (CEQ) regulations (40 C.F.R. § 1508.7 and 1508.8) define the impacts and effects that must be addressed and considered by federal agencies in satisfying the requirements of the NEPA process, which includes the following direct, indirect, and cumulative impacts:

- Direct impacts or effects are caused by the action (D-O LRT Project) and occur at the same time and place. Direct impacts are discussed in each section of chapter 4.
- Indirect impacts or effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Indirect effects are discussed in section 4.17.
- Cumulative impacts are the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Cumulative impacts are discussed in section 4.17.

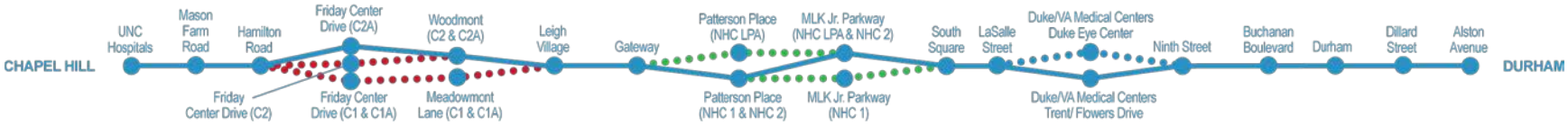
As required by the Code of Federal Regulations, Title 40 Part 1505.2(b), both No Build and Build Alternatives are considered to be environmentally preferable, depending on the factors considered. However, the No-Build Alternative does not meet the Purpose and Need for the Project. **Tables 4.0-1 and 4.0-2** include a summary of the impacts and mitigation by the environmental resource areas.

Several resource areas are expected to experience no impacts or limited impacts. These include the following:

- Land Use, Public Policy, and Zoning
- Socioeconomic Conditions
- Air Quality and Greenhouse Gases
- Energy Use
- Utility Impacts
- Safety and Security

Technical Documentation:

Individual environmental topics were evaluated for the proposed project alternatives in technical reports. The technical reports were used to document more detailed analyses and data for the individual environmental topics that were evaluated for the project. The following D-O LRT Project technical reports for the Affected Environment and Environmental



Consequences section are included in appendix K:

- Environmental Impact Statement Methodology Report (K.13)
- Neighborhoods and Community Resources Technical Report (K.14)
- Visual and Aesthetics Technical Report (K.15)
- Historic Resources - Area of Potential Effects (APE) (K.16)
- Archaeological Resources – Area of Potential Effects APE (K.17)
- Architectural History Survey for Durham-Orange Light Rail Project, Durham and Orange Counties, North Carolina (K.18)
- Archaeological Background Information (K.19)
- Natural Resources Technical Report (K.21)
- Water Resources Technical Report (K.22)
- Air Quality Technical Report (K.23)
- Noise and Vibration Technical Report (K.24)
- Limited Phase I Environmental Site Assessment (K.25)

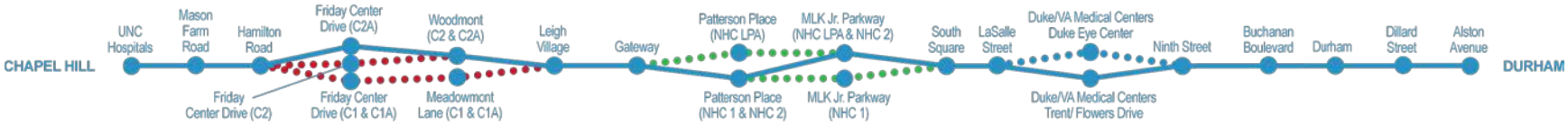


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Land Use and Zoning *Section 4.1*	• No impacts anticipated: consistent with Local Planning Efforts. The D-O LRT Project would result in a conversion of lower density land uses to higher density and mixed-use land uses.	• NHC LPA Alternative would be more consistent with transportation plans, but less consistent with plans to protect bottomlands in the area	*NEPA Preferred and Project Element Alternatives Mitigation* • Impacts are considered beneficial and as such, no mitigation would be required.
Socioeconomic and Demographic Conditions *Section 4.2*	• No adverse impacts anticipated: expected to concentrate population, households, and employment around LRT stations • The tax revenue losses due to property acquisitions because of the D-O LRT Project would be minimal in comparison to the overall tax base and anticipated longer-term development would help replenish the tax revenue. • Increased mobility, improved access and mobility for transit-dependent populations	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • These impacts are considered beneficial and as such, no mitigation would be required. • Mitigation efforts would include the identification and promotion of redevelopment, infill, and economic development opportunities by the affected areas.

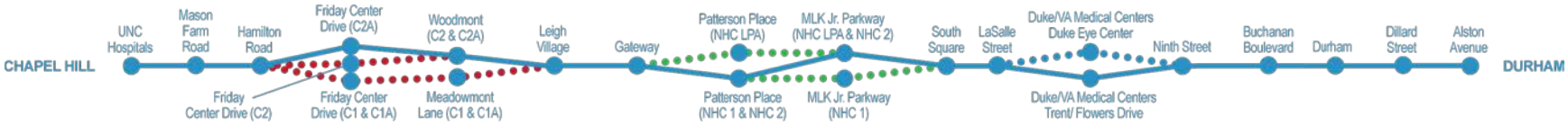


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Neighborhoods and Community Resources *Section 4.3*	• Impacts to access and mobility and community resources in some places • Improves mobility and access for communities and to community facilities	• C2 and New Hope Creek Alternatives would result in no impacts. • The Duke Eye Center Station Alternative would impact community resources • The use of the Levine Jewish Community Center campus facilities and community cohesion may be affected by the presence of the Cornwallis Road ROMF.	*NEPA Preferred Alternative Mitigation* • Protective fencing along the alignment to ensure safety at Glenwood Elementary School • Impacts to the Patterson's Mill Country Store and surrounding residential development by the Farrington Road ROMF will be mitigated through landscaping, vegetative screening, and modifying access to the store. • New roadway constructed between Larchmont Road and Snow Crest Trail to maintain connectivity • Due to the widening of Erwin Road proposed as part of the project, care will be taken to provide safe and convenient pedestrian access across the corridor. • Coordination with Duke University to ensure that services provided at the John Hope Franklin Center are relocated and maintained • At the John Avery Boys and Girls Club, maintain or replace existing fence along the field and playground and improve recreational facilities • Implement and enforce parking management policies at park and ride locations • *Temporary Mitigation*: Coordination with Chapel Hill-Carrboro City Schools and Durham Public Schools to identify detours for impacted school bus routes *Project Element Alternatives Mitigation* • C1 and C1A Alts – pedestrian connectivity to The Cedars maintained including a marked crosswalk, displaced residences relocated in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 • Duke Eye Center Station Alternative – same mitigation for the John Hope Franklin Center as the NEPA Preferred Alternative

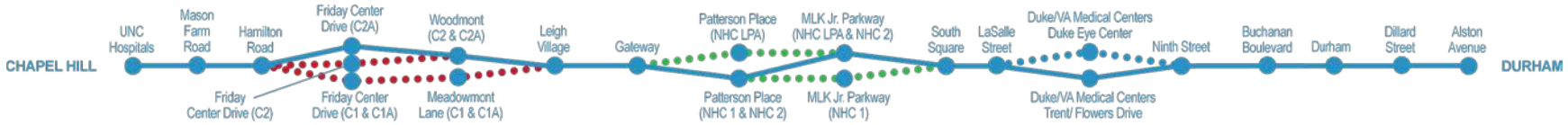


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Visual and Aesthetic Conditions *Section 4.4*	• Visual impacts range from Low to Moderate-High	• C1 and C1A Alternatives would have high visual impacts	*NEPA Preferred and Project Element Alternatives Mitigation* • Using interdisciplinary design teams to create aesthetic guidelines and standards in the design of project elements • Integrating facilities with area redevelopment plans • Planting appropriate vegetation in and adjoining the project right-of-way • Replanting remainder parcels • Using source shielding in exterior lighting at stations and auxiliary facilities • Art-in-Transit opportunities • Providing landscaping and aesthetic treatments when in close proximity to residences with aerial structures
Cultural, Historic, and Archaeological Resources *Section 4.5*	• Preliminary determination of no adverse effects • Indirect impacts to 13 of 25 architectural historic properties within APE	• Little Creek, New Hope Creek, and Duke Eye Center Alternatives would have no effect on architectural historic properties	*NEPA Preferred and Project Element Alternatives Mitigation* • Design commitments for visual screening for properties in rural and residential settings

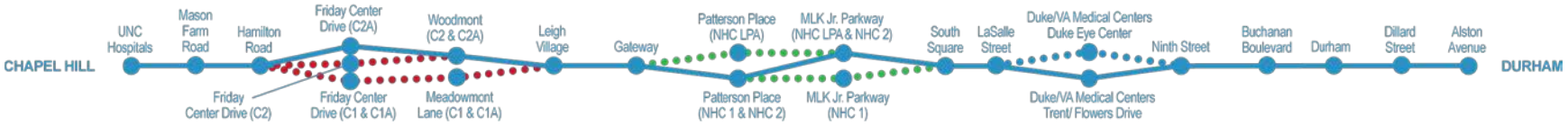


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Parklands and Recreational Areas *Section 4.6*	• Direct impacts to 5 parks (13.3 acres), elevated crossings of an open space resource and trails	• Little Creek Alternatives would result in additional acres of parkland impacts. • The Little Creek and NHC LPA Alternatives would result in additional elevated crossings of trails.	*NEPA Preferred Alternative Mitigation* • Triangle Transit will provide financial compensation for purchase and development of replacement park property of at least equivalent value with the property acquired, or, where appropriate, enhancement of the existing facility to compensate for impacts. • UNC Finley Golf Course: One golf hole will be redesigned • UNC Cross Country Trails: Pedestrian underpass would be installed and the trails realigned to maintain connectivity in a manner consistent with existing conditions • Jordan Game Lands (USACE Property): Replace reservoir water storage, compensate for the loss of marketable timber, relocate roads and signage, and construct a public access parking area *Project Element Alternatives Mitigation* • UNC Finley Golf Course: Two golf holes will be redesigned in the Little Creek Alternatives • New Hope Creek Trail and New Hope Preserve Trail: Elevated track barriers will be incorporated into the project in order to mitigate the moderate noise impacts predicted at these resources for the NHC LPA Project Element Alternative.

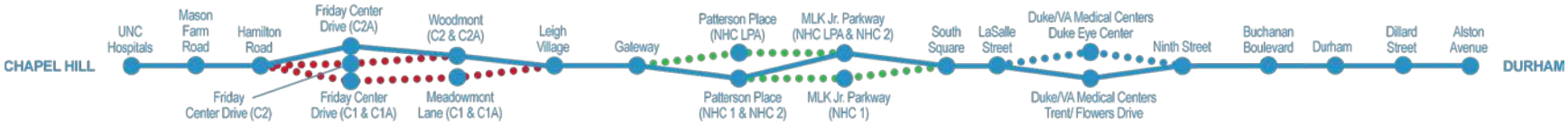


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Natural Resources *Section 4.7*	• Approximately 316 acres of habitat would be impacted • No significant adverse impacts to terrestrial or aquatic wildlife anticipated • No significant impacts to federal or state-listed threatened or endangered species anticipated • No impacts to farmland	• Little Creek and New Hope Creek Alternatives would impact more acres of habitat	*NEPA Preferred and Project Element Alternatives Mitigation* • Avoidance of bisecting floodplain and bottomland habitat degrading the quality and relatively intact character of the natural heritage corridor • Avoidance and minimization of impacts by consideration of alternative alignments, placement of piers outside of wetlands and streams to the greatest extent possible, use of bottomless culverts, and top-down construction techniques • Compensatory mitigation measures will be developed in consultation with the USACE and DWR during the Section 404/401 permitting process • If construction is to take place during nesting season for migratory birds, a nesting survey will be conducted prior to construction • Mitigation measures, if required, will be developed in consultation with the NCWRC and NCDA for wildlife, habitat, and threatened and endangered species pending review of the Natural Resources Technical Report. • Mitigation measures are not required by the USFWS based on a determination of no effect
Water Resources *Section 4.8*	• No groundwater impacts anticipated	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Avoidance and minimization of impacts by consideration of alternative alignments, placement of piers outside of wetlands and streams to the greatest extent possible, use of bottomless culverts, and top-down construction techniques • Compensatory mitigation measures will be developed in consultation with the USACE and DWR during the Section 404/401 permitting process • Each station location and park-and-ride facility would implement BMPs for the collection and treatment of
	• Impacts to 3,413 linear feet (0.438 acre) of streams	• No substantial variation	
	• Impacts to 0.558 acre of wetlands	• C1, C1A, C2, and NHC 1 Alternatives would impact fewer acres of wetlands	
	• Impacts to 216,455 square feet (4.97 acres) of Riparian Buffer Zone 1	• No substantial variation	

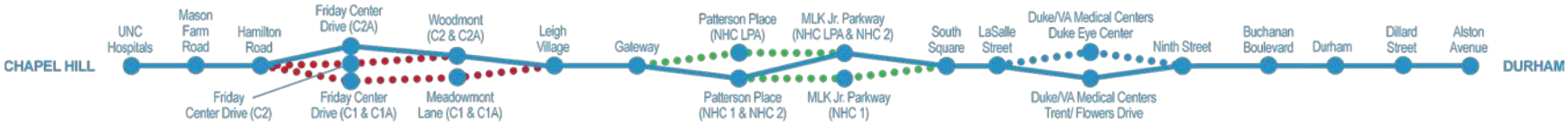


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
	• Impacts to 178,517 square feet (4.10 acres) of Riparian Buffer Zone 2	• C1, C2, and NHC 1 Alternatives would impact fewer acres of Riparian Buffer Zone 2 • C1A and NHC LPA Alternatives would impact more acres	stormwater runoff. Mitigation measures for increases in 100-year flood elevation greater than 0.1 feet would be implemented, pending hydraulic studies *Temporary Mitigation*: The North Carolina *Erosion and Sediment Control Planning and Design Manual* (1988 – updated June 2006) and the NCDOT design specifications will be used to minimize the impacts to land and water resources
	• Impacts to 0.005 acre of open water/ponds	• Little Creek Alternatives would impact more acres of open water/ponds	
	• Impacts to 6.420 acres of 100-Year Floodplain	• C1, NHC LPA, NHC 1 Alternatives would impact more acres of 100-Year Floodplain • C1A Alternative would impact fewer acres	
	• Impacts to 0.378 acre of 500-Year Floodplain	• New Hope Creek Alternatives would impact more acres of 500-Year Floodplain	
	• Impacts to 0.880 acre of Floodway	• NHC LPA Alternative would impact more acres of Floodway • the NHC 1 Alternative would impact fewer acres	
Air Quality *Section 4.9*	• No impacts anticipated: no violations of the 1-hour or 8-hour NAAQS for CO are expected	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Modeled concentrations for the worst intersections are well below the NAAQS requirements; therefore, mitigation measures are not warranted.

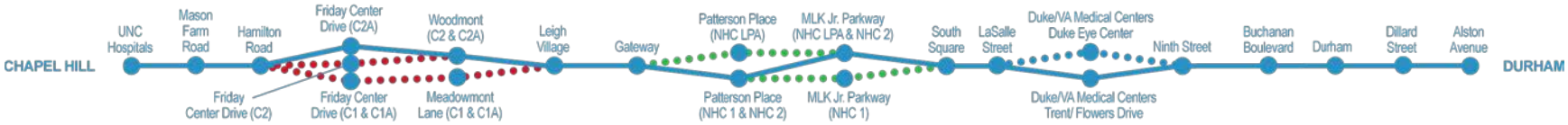


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Noise and Vibration *Section 4.10*	• One severe noise impact, 4 moderate noise impacts, 8 vibration impacts, and 13 ground-borne noise impacts	• Little Creek Alternatives would have more noise, vibration, and ground-borne noise impacts • NHC LPA Alternative would have more noise impacts, but the NHC LPA Alternative and NHC 1 Alternative would have fewer ground-borne noise impacts	*NEPA Preferred and Project Element Alternatives Mitigation* • In accordance with the FTA Guidance Manual, a detailed vibration analysis will be conducted during the Engineering phase to further evaluate geotechnical conditions and more precisely predict the vibration effects of the proposed light rail system on area receptors. • Noise mitigation measures include acquisition and elevated track barriers. Vibration mitigation measures consist of special track support systems, resilient fasteners, ballast mats, resiliently supported ties, and floating slabs.
Hazardous, Contaminated, and Regulated Materials *Section 4.11*	• 41 high risk sites, 83 medium risk sites within 500 feet of alternative	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Triangle Transit will perform a full Phase I or Phase II Environmental Site Assessment for high risk properties following ASTM standards prior to construction • Medium risk properties will have their closure status or current site status reviewed with NCDENR before starting construction *Temporary Mitigation*: • Preventive measures to minimize exposure of the public, community residents, and construction workers to hazardous materials • Construction waste will be disposed of at approved sites • Handling and storage of fuels and other materials will follow Occupational Safety and Health Administration, state, and local standards.

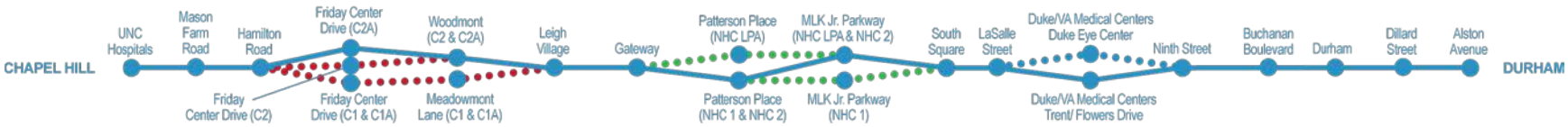


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Safety and Security *Section 4.12*	• Minimal impacts anticipated: potential safety hazards at stations, light rail vehicles, park-and-ride facilities, impacts to police, security, and emergency service operations	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Strategies such as CPTED and the use of police, private security patrols, proper lighting, and security cameras would be employed as appropriate to make the light rail facilities and operations as safe and secure as possible. • Design considerations such as platform location and length, pedestrian crossings, and alignment design would be used to facilitate the safe operation of the light rail system. • Pedestrian and bicyclist considerations such as building pedestrian bridges and underpasses to prevent the need to traverse the trackway at grade; segregating and delineating the track area using design elements such as fencing, pylons, road surface markings; and developing public education programs to explain how to use the system safely
Energy *Section 4.13*	• No impacts anticipated: annual energy savings of 83 billion BTUs compared to the No Build Alternative	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • The NEPA Preferred and Project Element Alternatives would result in an estimated annual energy savings compared to the No Build Alternative. Mitigation measures are not warranted.
Acquisitions, Relocations, and Displacements *Section 4.14*	• 92 potential full acquisitions, 145 potential partial acquisitions, 65 displacements	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Acquisition and relocation process would be conducted in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R 24), as amended.

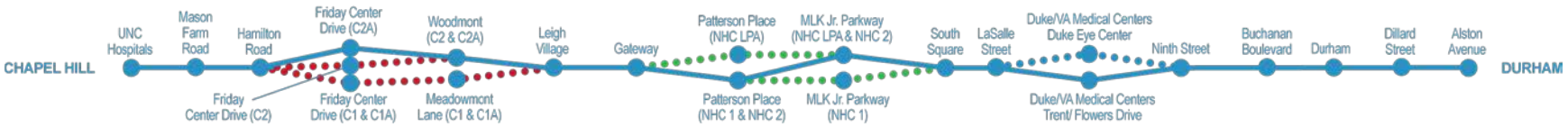


Table 4.0-1: Summary of Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Utility Impacts *Section 4.15*	• Minimal impacts anticipated: potential impacts to 85 miles of utility lines	• C1, C1A, and NHC 1 Alternatives would have 10 percent less utility impacts	*NEPA Preferred and Project Element Alternatives Mitigation* • Existing utilities will be surveyed during the Engineering phase and efforts will be made to avoid or limit impacts to existing utilities when practical. • Where relocation will be required, efforts will be made to consolidate existing utilities where practical. • Measures will be taken to minimize utility service outages and to schedule them with the utility owner and the customer such that they would present the least inconvenience. • Residences and businesses will be notified of utility work.
Construction *Section 4.16*	• Generally temporary impacts to the factors discussed in this table	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Project construction, education, and outreach plan would be developed during the Engineering phase • Construction impacts minimized through selection and implementation of BMPs • Pedestrian and vehicular access to businesses, universities, medical facilities, and residences will be maintained

[a] C2A, NHC 2, Trent/Flowers Drive Station

[b] Variation of Alignment and Station Alternatives from the NEPA Preferred Alternative

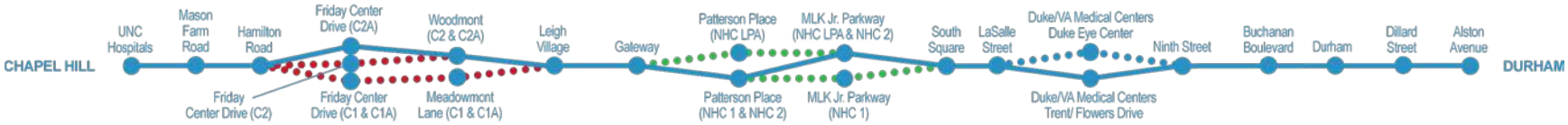


Table 4.0-2: Summary of ROMF Alternatives Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Land Use and Zoning *Section 4.1*	• Minimal impacts anticipated: not consistent with the future land use for this site identified in the Durham Comprehensive Plan	• Cornwallis Road and Alston Avenue ROMFs would be consistent with future land use designations	*NEPA Preferred Alternative (Farrington Road ROMF) Mitigation* • Comprehensive plan amendment and rezoning would be required of the Farrington Road ROMF. *Project Element Alternatives Mitigation* • Comprehensive plan amendment and rezoning would be required of the Leigh Village or Patterson Place ROMFs. Rezoning would be required for the Cornwallis Road ROMF, but a comprehensive plan amendment would not be required.
Socioeconomic and Demographic Conditions *Section 4.2*	• No impacts anticipated	• Alston Avenue ROMF: potential loss of employment due to displacement of existing businesses	*NEPA Preferred Alternative (Farrington Road ROMF) Mitigation* • No impacts are anticipated; as such no mitigation would be required. *Project Element Alternatives Mitigation* • Mitigation for the loss of employment at the Alston Avenue ROMF location may include helping existing businesses locate nearby. Any businesses that would be displaced by the project would be compensated in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R 24).

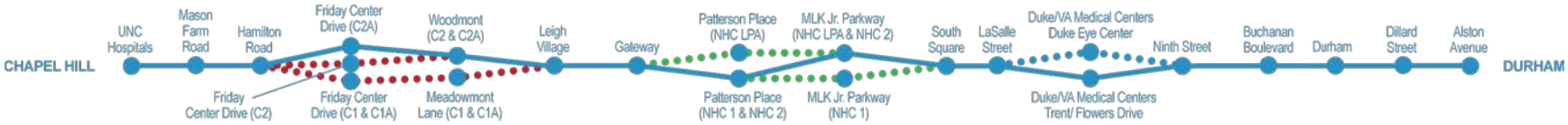


Table 4.0-2: Summary of ROMF Alternatives Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Neighborhoods and Community Resources *Section 4.3*	• Acquisition of a portion of the parcel that contains Patterson's Mill Country Store, but the store could remain with modifications to its access	• Leigh Village ROMF would remove several homes and require the acquisition of Patterson Mill's Country Store and Walter Curtis Farm • Patterson Place ROMF may impact community cohesion of surrounding neighborhood • Cornwallis Road ROMF may impact community cohesion and access and use of the Levin Jewish Community Center • Alston Avenue ROMF would impact community cohesion due to the relocation of existing businesses	*NEPA Preferred Alternative (Farrington Road ROMF) Mitigation* • Impacts to the Patterson's Mill Country Store and surrounding residential development will be mitigated through landscaping, vegetative screening, and modifying access to the store. *Project Element Alternatives Mitigation* • Displaced residents and businesses would be relocated in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R Part 24). • Impacts to Walter Curtis Hudson Farm would be mitigated in accordance with Section 106 and Section 4(f) requirements • Mitigation at the Patterson Place and Cornwallis Road ROMF locations would include landscaping and a visual barrier
Visual and Aesthetic Conditions *Section 4.4*	• Low visual impacts	• Visual impacts for other ROMF alternatives range from low to high	*NEPA Preferred and Project Element Alternatives Mitigation* • Impacts will be mitigated in accordance with Section 106 and Section 4(f) requirements, including landscaping. • Lighting would be aimed towards the ROMF to reduce spillage onto neighboring properties and adjacent roadways
Cultural, Historic, and Archaeological Resources *Section 4.5*	• Preliminary determination of no adverse effects, but effect upon the Walter Curtis Hudson Farm	• Patterson Place, Cornwallis Road, and Alston Avenue ROMFs would have no effects • Leigh Village ROMF would have an adverse effect upon the Walter Curtis Hudson Farm	*NEPA Preferred Alternative (Farrington Road ROMF) Mitigation* • Design commitments for visual screening for properties in rural and residential settings *Project Element Alternatives Mitigation* • If the Leigh Village ROMF is selected, the FTA and SHPO will develop methods for avoidance, minimization, or mitigation of impacts to the resource under the Section 106 consultation process, and may require a Memorandum of Agreement between FTA, Triangle Transit, and SHPO.

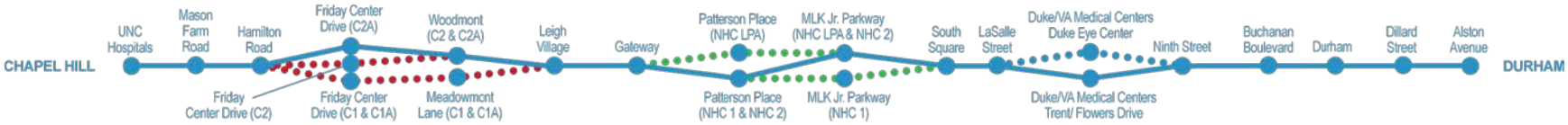


Table 4.0-2: Summary of ROMF Alternatives Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Parklands and Recreational Areas *Section 4.6*	• No impacts anticipated	• Patterson Place ROMF would impact 0.3 acres of open space and cross the New Hope Preserve Trail elevated	*NEPA Preferred Alternative (Farrington Road ROMF) Mitigation* • No impacts are anticipated; as such no mitigation would be required. *Project Element Alternatives Mitigation* • Triangle Transit will provide financial compensation for purchase and development of replacement park property of at least equivalent value with the property acquired, or, where appropriate, enhancement of the existing facility to compensate for direct and indirect impacts. • New Hope Preserve Trail: Elevated track barriers will be incorporated into the project in order to mitigate the predicted severe noise impacts
Natural Resources *Section 4.7*	• Approximately 25 acres of habitat would be impacted • No significant adverse impacts to terrestrial or aquatic wildlife anticipated • No significant impacts to federal or state-listed threatened or endangered species anticipated • No impacts to farmland	• Other ROMF alternatives would impact fewer acres of habitat	*NEPA Preferred and Project Element Alternatives Mitigation* • Avoidance and minimization of impacts by consideration of alternative alignments, placement of piers outside of wetlands and streams to the greatest extent possible, use of bottomless culverts, and top-down construction techniques • Compensatory mitigation measures will be developed in consultation with the USACE and DWR during the Section 404/401 permitting process • Mitigation measures, if required, will be developed in consultation with the USFWS, NCWRC, and NCDA for wildlife, habitat, and threatened and endangered species pending review of the *Natural Resources Technical Report*.
Water Resources *Section 4.8*	• No groundwater impacts anticipated		*NEPA Preferred and Project Element Alternatives Mitigation* • Avoidance and minimization of impacts by consideration of alternative alignments, placement of piers outside of wetlands and streams to the greatest extent possible, use of bottomless culverts, and top-down construction techniques • Compensatory mitigation measures will be developed in consultation with the USACE and DWR during the Section
	• Impacts to 683 linear feet (0.066 acre) of streams	• Other ROMF Alternatives would impact fewer streams	
	• Impacts to 0.325 acre of wetlands	• Other ROMF Alternatives would impact less acres of wetlands	

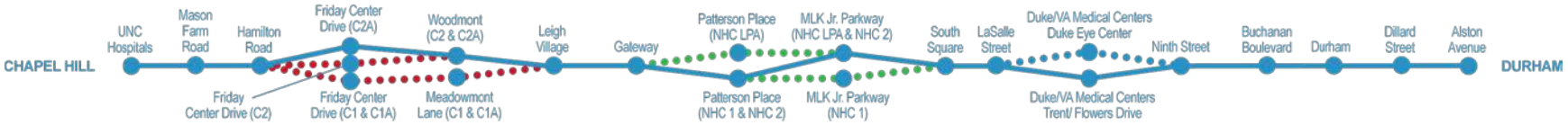


Table 4.0-2: Summary of ROMF Alternatives Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
	• Impacts to 45,713 square feet (1.05 acres) of Riparian Buffer Zone 1	• Other ROMF Alternatives would impact less acres of Riparian Buffer Zone 1	404/401 permitting process • BMPs would be implemented for the collection and treatment of stormwater runoff. • Mitigation measures for increases in 100-year flood elevation greater than 0.1 feet would be implemented, pending hydraulic studies *Temporary Mitigation*: The North Carolina *Erosion and Sediment Control Planning and Design Manual* (1988 – updated June 2006) and the NCDOT design specifications will be used to minimize the impacts to land and water resources
	• Impacts to 37,767 square feet (0.87 acre) of Riparian Buffer Zone 2	• Other ROMF Alternatives would impact less acres of Riparian Buffer Zone 2	
	• No impacts to open water/ponds	• Leigh Village ROMF would impact open water/ponds	
	• No impacts to the 100-Year Floodplain	• Cornwallis ROMF would impact the 100-Year Floodplain	
	• No impacts to the 500-Year Floodplain	• Cornwallis ROMF would impact the 500-Year Floodplain	
	• No impacts to the Floodway	• No substantial variation	
Air Quality *Section 4.9*	• No impacts anticipated: no violations of the 1-hour or 8-hour NAAQS for CO are expected	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Modeled concentrations for the worst intersections are well below the NAAQS requirements; therefore, mitigation measures are not warranted.
Noise and Vibration *Section 4.10*	• Severe noise impacts would occur at one location and moderate noise impacts would occur at four locations. • Vibration impacts would occur at 8 receptors and ground-borne noise impacts would occur at 13 receptors.	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Mitigation to noise impacts would be limited to noise barriers on the elevated track. • Vibration sensitive receptors impacted by project vibration would be mitigated through one or more special track support systems.

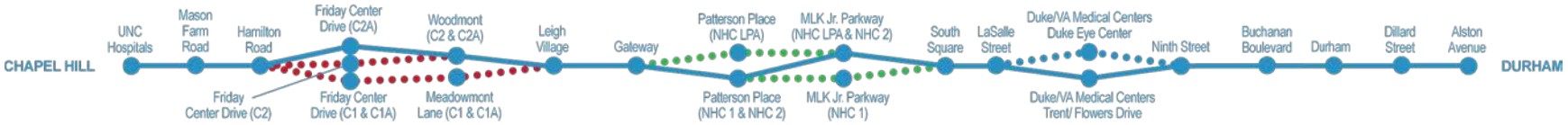


Table 4.0-2: Summary of ROMF Alternatives Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Hazardous, Contaminated, and Regulated Materials *Section 4.11*	• No impacts anticipated	• Cornwallis Road ROMF: 1 medium risk site, Alston Avenue ROMF: 2 high risk and 8 medium risk sites	*NEPA Preferred Alternative (Farrington Road ROMF) Mitigation* • No impacts are anticipated; as such, no mitigation would be required. • *Project Element Alternatives Mitigation* • Triangle Transit will perform a full Phase I or Phase II Environmental Site Assessment for high risk properties following ASTM standards prior to construction • Medium risk properties will have their closure status or current site status reviewed with NCDENR before starting construction *Temporary Mitigation*: • Preventive measures to minimize exposure of the public, community residents, and construction workers to hazardous materials • Construction waste will be disposed of at approved sites • Handling and storage of fuels and other materials will follow Occupational Safety and Health Administration, state, and local standards.
Safety and Security *Section 4.12*	• Minimal impacts anticipated	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Strategies such as CPTED and the use of police, private security patrols, proper lighting, and security cameras would be employed as appropriate to make the light rail facilities and operations as safe and secure as possible. •
Energy *Section 4.13*	• No impacts anticipated: the selection of the ROMF site does not result in a substantial difference in indirect energy use	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • The D-O LRT Project would result in an estimated annual energy savings compared to the No Build Alternative. Mitigation measures are not warranted.

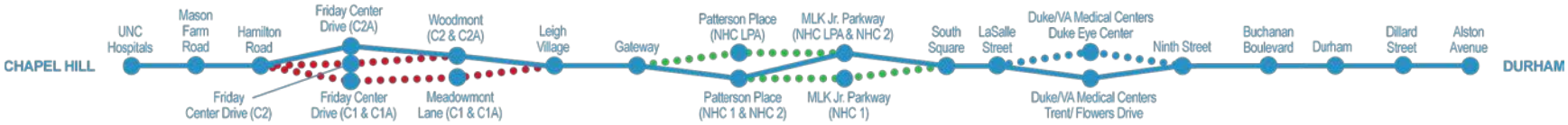
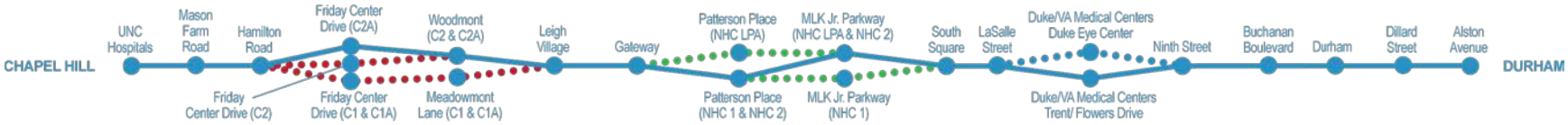


Table 4.0-2: Summary of ROMF Alternatives Impacts and Mitigation

Factor	Potential Impact and Benefit Summary		Potential Mitigation Measure Summary
	NEPA Preferred Alternative [a]	Project Element Alternatives [b]	
Acquisitions, Relocations, and Displacements *Section 4.14*	• 11 potential full acquisitions, 2 potential partial acquisitions	• The Patterson Place and Cornwallis Road ROMFs would result in fewer acquisitions while the Alston Road ROMF would result in more acquisitions	*NEPA Preferred and Project Element Alternatives Mitigation* • Acquisition and relocation process would be conducted in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R 24), as amended.
Utility Impacts *Section 4.15*	• Minimal impacts anticipated: potential impacts to the cell tower on site	• Minimal impact is anticipated; Leigh Village ROMF would also impact the cell tower	*NEPA Preferred Alternative (Farrington Road ROMF) Mitigation* • Cell tower may be accommodated into the design of the Farrington Road ROMF • For all the ROMF Alternatives, existing utilities running through or around the perimeter of the site may need to be modified as part of the ROMF construction. *Project Element Alternatives Mitigation* • Cell tower may be accommodated into the design of the Leigh Village ROMF • For all the ROMF Alternatives, existing utilities running through or around the perimeter of the site may need to be modified as part of the ROMF construction.
Construction *Section 4.16*	• Generally temporary impacts to the factors discussed in this table	• No substantial variation	*NEPA Preferred and Project Element Alternatives Mitigation* • Project construction, education, and outreach plan would be developed during the Engineering phase • Construction impacts minimized through selection and implementation of BMPs • Pedestrian and vehicular access to businesses, universities, medical facilities, and residences will be maintained

[a] Farrington Road ROMF

[b] Variation of ROMF Alternatives from the NEPA Preferred Alternative



4.1 Land Use and Zoning

Land use broadly refers to the different functions of human use of land (e.g., residential, commercial, industrial) and is influenced by development patterns and activity centers, population and employment levels, growth potential and trends, local and regional land use policies, and other factors that affect area growth. This section describes land use and land use policy in the D-O Corridor and the potential impacts of the alternatives under study in this DEIS. Population and employment data related to the land uses described in this section are presented in DEIS section 4.2. Effects to Neighborhoods and Community Resources are discussed in DEIS section 4.3.

4.1.1 Methodology

Data collection efforts focused on documenting the existing conditions in the D-O Corridor, including existing land use, land use development plans, and existing development and land use trends. Information relating to future land use plans and projections was obtained from the City of Durham, Town of Chapel Hill, and Durham and Orange counties. The study area for the land use impact assessment incorporated the eight evaluation areas described in DEIS section 4.1.2.1.

The following items were analyzed and are discussed in the following sections:

- Current land use and activity centers
- Local plans and regulatory environment, including zoning regulations
- Upcoming corridor development projects

The land use impact assessment focused largely on how the alternatives considered would affect land use and development patterns within the corridor as compared to the No Build Alternative. The assessment evaluated future conditions in the region as set forth in the local jurisdictions' land use plans and zoning ordinances and how consistent the alternatives under study in this DEIS are with those plans. Potential impacts to land use and development patterns within the corridor and mitigation measures are included in DEIS sections 4.1.3 and 4.1.4.

The impact of the ROMF alternatives is also analyzed.

4.1.2 Affected Environment

The D-O Corridor spans a diverse range of existing land uses, including major universities and medical facilities and commercial, residential, and mixed use areas. Opportunities also exist for new or intensified development in station areas throughout the corridor. Throughout this section, land use resources are described from west (Chapel Hill) to east (Durham), beginning with existing land uses and then transitioning to development trends.

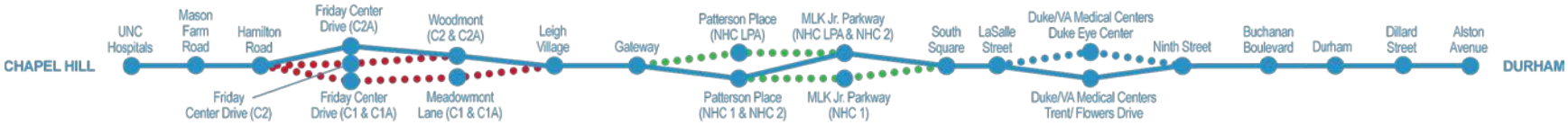
4.1.2.1 Existing Land Uses

To better classify the land uses within the corridor, the corridor was divided into eight evaluation areas that best reflect the general land use characteristics and major activity centers as described below. These eight evaluation areas are the University of North Carolina at Chapel Hill (UNC) Campus, east Chapel Hill, Leigh Village, US 15-501 Corridor, Duke West Campus and Medical Center, Old West Durham/Duke East Campus, downtown Durham, and east Durham and are shown on **Figure 4.1-1**. Projected future land use based on existing planning documents is illustrated on **Figure 4.1-2**.

UNC Campus

This evaluation area covers UNC's main campus, downtown Chapel Hill's business district on Franklin Street and Rosemary Street to the north, and residential neighborhoods to the east and south of the university. Land uses in this area are primarily institutional in nature.

UNC is a public research university made up of 14 schools and the College of Arts and Sciences. Student enrollment currently exceeds 29,000 with 18,350 undergraduates and 10,785 graduate and professional students, as of January 2015.



UNC Hospitals include several medical facilities in this area: North Carolina Memorial Hospital, North Carolina Children's Hospital, North Carolina Women's Hospital, North Carolina Cancer Hospital, and North Carolina Neurosciences Hospital. The UNC Medical School and the UNC Dental School, which also provide patient care services, are located here as well.

UNC Medical Facility

This area has the densest development along the proposed D-O LRT alignment. The core of the UNC Hospitals area is a dense campus environment with mid-rise buildings and structured and limited surface parking. Over 10,000 people are employed in this area, primarily in the UNC Hospitals and other UNC Medical, Dental, Public Health, Pharmacy, and Nursing buildings. The nearby Kenan Stadium can accommodate almost 60,000 spectators for football games and has limited parking. Many of the employees, students, and spectators arriving at UNC do so from neighboring Durham, Research Triangle Park, Raleigh, and beyond.

Mason Farm Road provides access to the southern part of the UNC campus. The University has been strategically acquiring land along Mason Farm Road for graduate student housing and other future purposes. The area also serves existing athletic buildings such as the Dean E. Smith Student Activities Center (Smith Center), a 24,000-seat special events center that is the home of the UNC men's basketball team. Automobile access for events at the Smith Center is limited and the majority of patrons must walk or utilize park-and-ride facilities from which Chapel Hill Transit (CHT) provides direct access.

Also in the vicinity are the Kenan-Flagler Business School and more than 2,000 beds of undergraduate and graduate student housing. Undergraduate and graduate student parking permits are limited and allocated on a lottery system, although freshmen are unable to apply for permits.

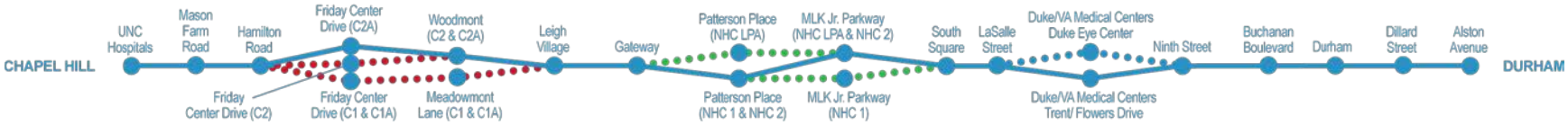
East Chapel Hill

This evaluation area consists of mixed-use and institutional uses as well as preserved natural areas.

Hamilton Road is located within the major east-west transportation corridor serving Chapel Hill, NC 54. A mixture of residential and commercial land uses, including older, small lot single-family and multi-family neighborhoods and new, higher density, mixed-use development characterizes the area.

Essential infrastructure and services for expanded mobility characterize the area, with sidewalks, multi-use paths, and frequent transit services, all contributing to the area's desirability.

Located on property owned by UNC, the William and Ida Friday Center for Continuing Education (Friday Center) provides conference and meeting facilities. The Friday Center includes surface parking for 500 vehicles as well as additional space for charter buses and a separate 860 space park-and-ride lot served by CHT. A 200-room hotel and a 380-unit multi-family townhouse project are also within this area.



East Chapel Hill

Meadowmont Village is located north of the Friday Center and is a planned, mixed-use, neo-traditional development with over 1,300 residential units, commercial, and retail space. It has a preserved transit corridor to support the fixed guideway system that was envisioned through the *US 15-501 Major Investment Study* (MIS) (1998 and 2001) for the D-O Corridor. An additional 60,000 square foot office building with 12 residential units and a new 10,000 square-foot day care center were recently completed.

East of the Friday Center, an area known as Woodmont is currently characterized by a mixture of semi-rural large-lot, single-family home sites and greenfield areas. Within the Woodmont area are newer multi-family apartments and townhouses.

Leigh Village

The Leigh Village area is under the jurisdiction of Durham County. Despite its central location between the Research Triangle Park, UNC, and rapidly growing populations in southern Durham and Orange counties, the area has been slow to develop and has remained largely low-density suburban development. This evaluation area covers a section of I-40, with Leigh Farm Park and the New Hope Creek Corridor to the east, an office park to the south, and suburbanizing residential neighborhoods to the west and north, including Durham's Five Oaks neighborhood.

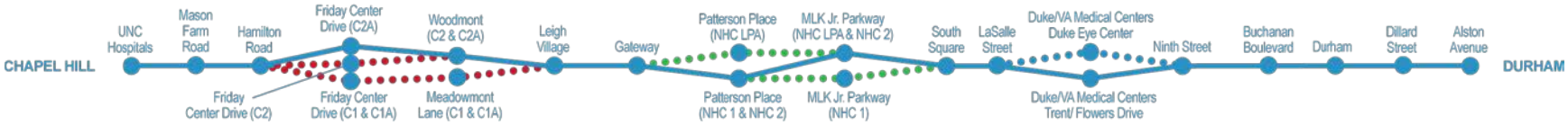
Friday Center

Currently, there are 600 acres of vacant land in the Leigh Village area. Several development plans are currently being discussed for these vacant acres. The North Carolina headquarters of Blue Cross Blue Shield, a major regional employer, is located adjacent to this area.

US 15-501 Corridor

This evaluation area includes the area east of I-40 along both sides of US 15-501. The US 15-501 corridor is suburban in character, with a mix of single-family and multi-family residential neighborhoods and suburban commercial development and shopping centers. This corridor serves as the primary thoroughfare for persons travelling between Durham and Chapel Hill.

Located near the county boundary, Patterson Place includes auto-oriented development (TOD) dominated by big-box national retailers. Within the past five years, a five-story hotel, an apartment complex, and a four-story Duke Medicine medical services center have been built in the Patterson Place area.



Patterson Place

The Martin Luther King Jr. Parkway area, located near the intersection of University Drive and Martin Luther King Jr. Parkway, is a busy commercial node. Immediately surrounding this area is a combination of retail and office uses that are predominantly auto-oriented.

Currently, the parcels surrounding the proposed South Square Station are predominantly commercial destinations, with a mixture of retail, restaurants, and other services. The western end of the limited-access portion of US 15-501 forms the western boundary of this area and Durham-Chapel Hill Boulevard, a multi-lane divided road, runs east-west less than ¼ mile to the north. Durham-Chapel Hill Boulevard is fronted on the north by the 17-story University Tower office building and a mixture of retailers, including restaurants and auto dealerships. There are plans to the south and east of the station for a large-scale, mixed-use development.

Residential communities with a combination of single-family homes, townhomes, and multi-family housing lie farther to the north of South Square. The South Square shopping node anchors the area south of Durham-Chapel Hill Boulevard with an assortment of national retailers and several out-parcels.

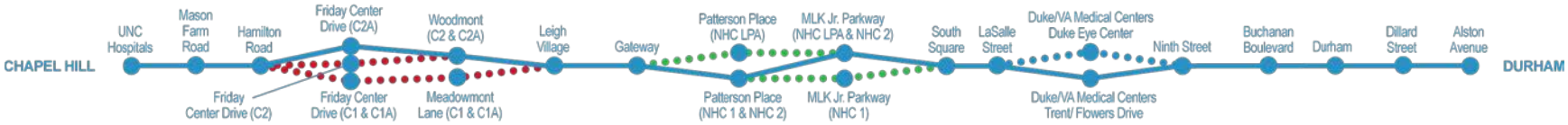
Duke West Campus and Medical Center

This evaluation area covers the Duke University Golf Club to the south, Duke University's West Campus at the evaluation area's center, and a mix of residential and commercial land uses west and north of West Campus. Durham neighborhoods in the evaluation area include Welcome Circle, Duke Forest, and Crest Street. Duke University is a private research university with more than 14,000 students enrolled in its undergraduate and graduate programs of study as of fall 2014.

The area near the intersection of LaSalle Street and Erwin Road serves many Duke students and employees. Duke University Medical Center, located to the south side of Erwin Road, is a large teaching hospital affiliated with the University. It is part of the larger Duke University Health System that provides a network of hospitals and medical services throughout the Triangle region.

This area is home to two of the largest employers in the region, Duke University and the Durham Veterans Affairs (VA) Medical Center. Most of the property in this area is owned by Duke University and is intensely developed along the south side of Erwin Road. In recent years, the north side of Erwin Road has experienced a boom in private redevelopment. Large mixed-use projects, with retail on the ground floor and residential units above, now line the north side of the street. Apartment complexes, many catering to Duke University graduate students, are located farther north of Erwin Road.

Another major activity generator is the Durham VA Medical Center. Founded in 1953, the medical center serves veterans in central and eastern North Carolina. The VA offers extended care and rehabilitation services, mental health services, social work, and specialty care related to the needs of veterans. The VA is located on the northwest quadrant of the intersection of Erwin Road and Fulton Street, east of which are additional Duke University and Medical Center facilities.



Durham VA Medical Center

Old West Durham/Duke East Campus

This evaluation area covers the Old West Durham neighborhood to the west, including the commercial district on Ninth Street; Duke University's East Campus and the Trinity Heights neighborhood at the evaluation area's center; Trinity Park neighborhood to the east; and portions of the Burch Avenue, West End, and Morehead Hill neighborhoods to the south.

Ninth Street is part of an existing mixed-use urban neighborhood between Duke University's Central and East Campuses, providing access to a large portion of the university. The cornerstone of the area is a three- to four-block long commercial corridor that features a mix of shops and restaurants and a rehabilitated historic textile warehouse converted to apartments and offices.

Traditional urban residential neighborhoods are within walking distances of the commercial district. Higher density office and residential development (five to six stories) has been recently completed.

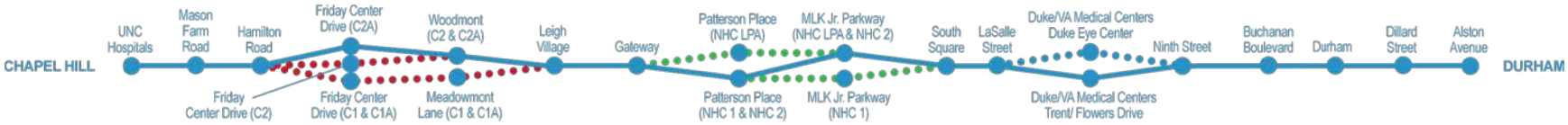
In the *Durham Comprehensive Plan*, the area around Ninth Street is identified as a Compact Neighborhood, Durham's equivalent of a TOD district. A TOD district is compact, densely developed, and typically includes a mix of land uses. In addition, to transit infrastructure, the districts are designed with robust pedestrian and bicycle infrastructure. A TOD typically includes less off-street parking than conventional suburban developments.

Duke University East Campus

Downtown Durham

This evaluation area includes the Warehouse District and Central Park neighborhoods to the north; the Cleveland-Holloway neighborhood to the east; downtown Durham at the evaluation area's center; portions of the Morehead Hill neighborhood to the west; and the Southside/St. Teresa neighborhood to the south. Centered to the north of NC 147 (Durham Freeway), downtown Durham is home to several key destinations. This includes the 10,000-seat Durham Bulls Athletic Park and the Durham Performing Arts Center (DPAC), which seats 2,800 and has over 150 shows scheduled per year. In 2013, DPAC was the fourth highest attended theater in the nation, attracting more than 350,000 guests (DPACNC 2014). Both of these destinations are on the American Tobacco Historic District campus, which also houses the Art Institute of Raleigh Durham, a YMCA, and residential units, offices, and restaurants. In addition, many public services, businesses, restaurants, and retail outlets are located in the downtown area.

In downtown Durham, the Durham Amtrak Station and Durham Transportation Center (served by Durham Area Transit Authority (DATA), Triangle Transit, Greyhound, and Megabus) provide transit connections within Durham and the southeastern United States (U.S.). The railroad tracks along the NCRR corridor bisect downtown. To the north is a



mixture of new and historic offices and commercial and residential buildings, some of which are mixed-use.

In the *Durham Comprehensive Plan*, portions of the evaluation area are contained within Design Districts, which "encourage intense development and transit and pedestrian oriented activity."

Downtown Durham

East Durham

The final evaluation area incorporates the Edgemont, Golden Belt, and Eastway Village neighborhoods to the north; the old east Durham neighborhood to the east; North Carolina Central University (NCCU) and Durham Technical Community College to the south; and the Southside/St. Teresa neighborhood to the west. The area is primarily comprised of the government services district of downtown to the north, rehabilitated historic mills (offices and residences) to the northeast (Golden Belt), and connections to NCCU's campus to the south.

Downtown Durham – East End

Immediately surrounding Dillard Street are several large-lot auto dealerships undergoing redevelopment. The existing railroad tracks constrain north-south access. While the location of NC 147 provides vehicular access, it also impairs pedestrian connections to the neighborhoods to the south.

The final area within the east Durham evaluation area is located near Alston Avenue. Here, land uses are primarily industrial, interspersed with commercial, single-family homes, and multi-family residences, many of which have been constructed within the past 15 years through the **Hope VI Program**. Existing railroad tracks and NC 147 are located closer together here, leaving a narrow strip of land that is largely former or active industrial land. Commercial businesses line Alston Avenue both to the north and to the south of NC 147. The R. Kelly Bryant pedestrian bridge, located east of the Alston Avenue interchange, provides a connection over NC 147 to the residential area south of the highway corridor. The bridge also functions as an attractive gateway into downtown and east Durham.

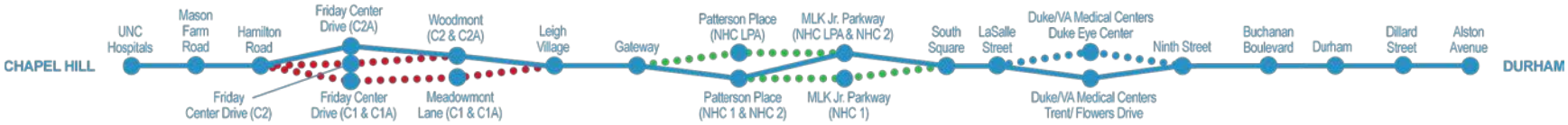
HOPE VI Program

Department of Housing and Urban Development effort to transform public housing and lessen poverty through incentives, partnerships, and grant assistance.

In the *Durham Comprehensive Plan*, the area around Alston Avenue is identified as a Compact Neighborhood, Durham's equivalent of a transit-oriented district.

4.1.2.2 Land Use Plans and Policies

Transit-supportive growth and development is expected to continue throughout the corridor due largely to positive market forces, supportive land use policies, and



capacity for growth and supportive public investments.

Market support for this type of development includes shifting lifestyle preferences toward more mixed-use, pedestrian-friendly, higher density projects, as well as strong population and economic growth in both Chapel Hill and Durham. Current growth, as well as predicted future growth in Durham and Orange counties is mostly due to the area's strong economic base driven by the two large research universities and affiliated medical centers, the private firms in Research Triangle Park, and proximity to Raleigh-Durham International Airport.

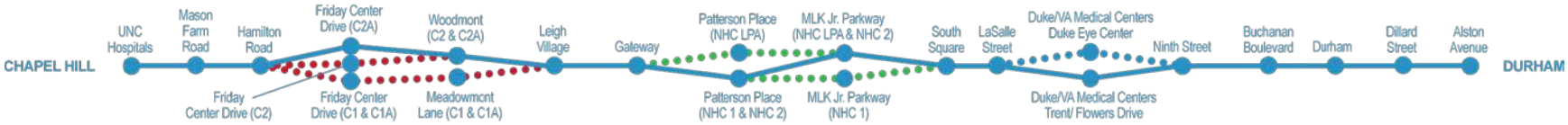
Over the past decade, Chapel Hill and Durham have either adopted, or are in the process of adopting, transit-supportive zoning districts that will be applied in station areas. Both Chapel Hill and Durham have zoning in place that is designed to support TOD in the corridor. This includes associated parking requirements for new development and re-development in and around station areas.

Orange County, Chapel Hill, and UNC

Chapel Hill is primarily located in Orange County, which has implemented urban growth boundaries to restrict urban sprawl. Specifically, the *Orange County, North Carolina 2030 Comprehensive Plan*, adopted in 2008, is intended to guide the county's future growth and land use patterns in a manner that enhances and protects the economic, environmental, and human resources that characterize Orange County. Specific objectives in the Comprehensive Plan include discouraging urban sprawl, coordinating land use patterns with municipalities and adjacent counties to facilitate the expanded use of non-auto modes of travel, and creating new zoning district(s) that allow for a mix of commercial and residential uses and a mix of housing types that create a more pedestrian-friendly development pattern. To preserve rural land uses and prevent sprawl, Orange County has a rural buffer around the towns of Chapel Hill and Carrboro. The rural buffer is a low-density residential area of 38,000 acres surrounding the towns and their respective Transition Areas that is projected to remain rural and not require urban services. Consistent with the County's plan, the NEPA Preferred and Project Element Alternatives would not provide service to either the rural buffer or transitional areas.

The *Chapel Hill 2020 Comprehensive Plan* was adopted in June 2012. The previous plan, adopted in 2000, had been supplemented by various small area plans and other documents that guide the vision for Chapel Hill. The plans include a focus on enhancing downtown as the center of the community, managing growth and change to protect the character of the Town's existing neighborhoods, and protecting the Town's rural areas and natural setting. This has been facilitated by implementation over the past two decades of the Urban Services Boundary and Rural Buffer agreements with Orange County, which have created a compact community surrounded on most sides by green rural areas that minimize sprawl. The *Chapel Hill 2020 Comprehensive Plan* includes references to the proposed light rail project station areas, TOD, and form-based code elements, which will be part of the short-term implementation strategy. Chapel Hill's first form-based code district was adopted in 2014 and it is adjacent to the half-mile radius around the proposed Gateway light rail station. Twenty potential TOD sites were identified, including one in the proposed Woodmont Station area, for which a conceptual plan was developed. Focus areas include the NC 54 and North US 15-501 areas that are near the NEPA Preferred and Project Element Alternatives and proposed station areas. The plan calls for focusing development of buildings up to six stories high around transit stations, with density decreasing further from the stations where existing residential areas are dominated by single-family homes.

The UNC *Campus Master Plan*, which was completed in 2001 and updated in 2006, established a blueprint for the University's future. The plan calls for identifying locations for a significant increase in on-campus student housing that would facilitate a



decrease in the number of students dependent on cars to get to campus. Its goal is a pedestrian-friendly campus where people find it easy to walk or bike. To accomplish this, the plan states, "transit service will be increased, parking will be put into a limited number of decks and the number of students living on campus will be increased."

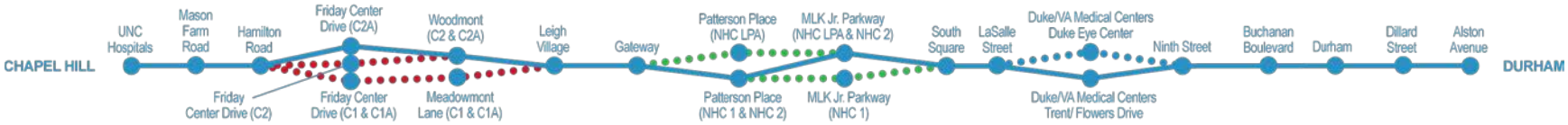
Durham City and County

The Durham City-County Planning Department is the planning agency for both the City and County of Durham. The *Durham Comprehensive Plan* organizes land use, transportation, urban design, and other characteristics around a framework of five development tiers: Downtown; Compact Neighborhood; Urban; Suburban, and Rural. Borrowing from the Urban-Rural Transect model, which defines a series of zones that transition from sparse rural-type development to a dense urban core, each of these tiers represents a unique character of development. An important element of the comprehensive plan is a conservation of the natural environment; the development tiers are designed to focus growth away from existing open space, streams, wetlands, and other natural resources to the extent possible. Updates to the plan (both the current update and future updates) could change some of the existing land use designations.

- The **Downtown Development** tier is, according to chapter 2 of the *Durham Comprehensive Plan*, "…where intense development and pedestrian activity is encouraged." The Buchanan Boulevard, Durham, and Dillard Street Stations are located within the downtown development tier.
- The **Compact Neighborhood** tier was designed to facilitate TOD and establishes the policy foundation for a compact district that includes a mix of uses and is pedestrian friendly. Currently, Compact Neighborhoods are designated around the Duke Medical Center, Ninth Street, and Alston Avenue Stations. In addition, the comprehensive plan directs the Durham City County Planning Department to convert the other light rail station areas (LaSalle, South Square/MLK, Patterson Place, and Leigh Village) into Compact Neighborhoods and apply Compact Design zoning through a Compact Neighborhood plan. Local area plans and updates to the Unified Development Ordinance, adopted in 2006, to support transit are in progress and are consistent with these objectives, as described in subsequent sections of this document.

With increased certainty of station locations, the Durham City-County Planning Department is proposing to re-evaluate the Compact Neighborhood Tier boundaries established in the 2005 *Durham Comprehensive Plan* to better reflect the current light rail proposal. Since 2005, the light rail alignment has shifted and stations have been relocated, added, and removed. This proposed re-evaluation will likely result in four-part changes to the Future Land Use Map, including (1) revising Compact Neighborhood tier boundaries; (2) converting suburban transit areas along the D-O LRT corridor to Compact Neighborhoods and revising their boundaries; (3) amending the underlying future land use designations in the Compact Neighborhoods to Design District; and (4) removing the suburban transit areas not along the D-O LRT corridor. The *Durham Comprehensive Plan* calls for focusing additional growth and employment into these compact neighborhoods to contain urban sprawl, create more walkable neighborhoods, and provide more affordable housing with high-quality access to transit.

To further support the development of transit-oriented communities, the City of Durham has charged an interdisciplinary group of City staff with identifying strategic infrastructure needs within light-rail station areas. The Station Area Strategic Infrastructure (SASI) team includes representatives from planning, transportation, sewers, water, and finance. The SASI team is examining each station area to identify necessary enhancements to basic infrastructure that would allow the City



to realize the full potential of the development around stations in the NEPA Preferred and Project Element Alternatives, and explore how these improvements could be funded in ways such as value capture. Specific improvement could include sidewalk upgrades, expanded sewer lines, establishment of street grid patterns, and zoning modifications.

The *Downtown Durham Master Plan* was first prepared in 2000, updated in 2008, and is being updated again in 2015 by Downtown Durham Inc., a nonprofit organization that promotes revitalization of downtown. This master plan outlines goals, objectives, and strategies that revolve around several themes, including (1) the City Center as a focal point; (2) connectivity; (3) residential infill development; (4) public sector investment; and (5) enhancing the capacity of downtown organizations. The plan includes strategies to establish downtown as the pivotal activity center in Durham and the region, and to promote a vibrant, compatible, well connected mix of uses to increase the density and activity of the area. The plan makes specific reference to the identification of future parking needs and strategies to best meet this need including the location of future public parking infrastructure, parking requirements for mixed-use development, and the identification of public-private partnerships.

The *Duke University Campus Master Plan* (2000) sets principles and goals for the Duke University and Medical Center Campus Plan. Duke University is planning a long-term large-scale redevelopment of its Central Campus, which will take place over the remainder of the 21st Century. Plans for Phase I construction were estimated at half a million square feet of new academic, residential, and social space totaling nearly $400 million. Redevelopment of Duke's Central Campus would have a significant impact on the Ninth Street Station area. One of the goals of this campus plan is to make Duke a walkable and bikeable campus "by integrating pedestrian, bicycle, and transit circulation into the overall movement system; separating such systems where appropriate; and by exercising caution in the location of parking areas and parking access to strengthen connections and minimize conflicts with pedestrians". The plan notes the importance of the north entrance to the campus along Trent/Flowers Drive, where buildings were originally built with entrances from the adjacent parking lots. To help create a more pedestrian friendly environment in this area, there is also a focus on reorienting the buildings to activate the street along both roads by adding building entrances on the street sides of these buildings.

The *North Carolina Central University 2007 Campus Master Plan*, originally adopted in 1995, was last updated in 2007. The Master Plan update anticipates significant construction projects on the existing campus footprint and expansion into adjoining neighborhoods. These expansion plans will result in increased development and a change in land use along the Alston Avenue corridor and station area, as well as on the Fayetteville Street corridor and in the Dillard Street station area.

4.1.2.3 Corridor Development Projects

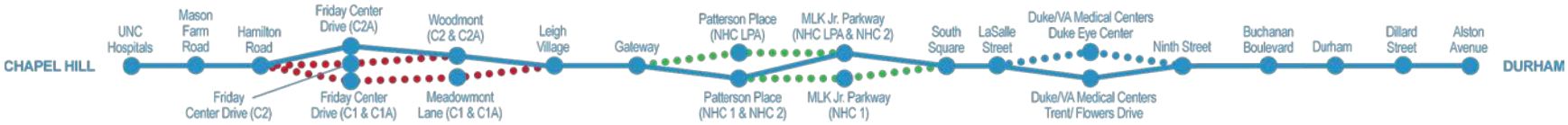
The proposed project corridor is experiencing significant redevelopment as a result of a growing local economy and supportive land use plans and policies. These projects are creating more density in the corridor and around station areas and will create new mobility needs. Key development projects and plans that will continue to shape land use in the corridor are discussed below.

UNC Campus Area Evaluation Area

UNC Hospitals Station: In the southern part of the UNC Campus Area, additional growth is planned near the UNC Hospitals Station, including several large health care and research buildings.

East Chapel Hill Evaluation Area

Hamilton Road Station: Near the Hamilton Road Station, Chapel Hill and a private developer/property owner have planned for



the redevelopment of the Glen Lennox area to increase the number of residential units and add office/commercial space. The results include an anticipated change from the current 440 units up to a maximum of 1,500 units. The Development Agreement was approved by the Town Council in June 2014 and will incorporate mixed-use office, retail, and restaurants into six new apartment buildings that will capitalize on higher density and vertical development.

Woodmont Station: A portion of the Woodmont Station area has been approved for a mixed-use project known as Woodmont (previously Hillmont) that includes 300,000 square feet of office, 70 multi-family apartments, and 60,000 square feet of retail. The approved project has not moved forward and may be revisited in the future to be more consistent with TOD standards and local plan expectations around station areas.

US 15-501 Corridor Evaluation Area

Patterson Place Station: The Patterson Place apartment complex project that is under development is designed as a $40.1 million upscale apartment community expected to include 322 units in three-story residential buildings.

Southwest Durham at 15-501: Developers have applied to rezone portions of three parcels along Southwest Durham Drive and US 15-501 from a suburban, residential development district (RS-20), to General Commercial, where businesses and other commercial activities would occur. Of the 27.24 acres, approximately 12.45 are anticipated to be rezoned with the application.

Duke West Campus and Medical Center

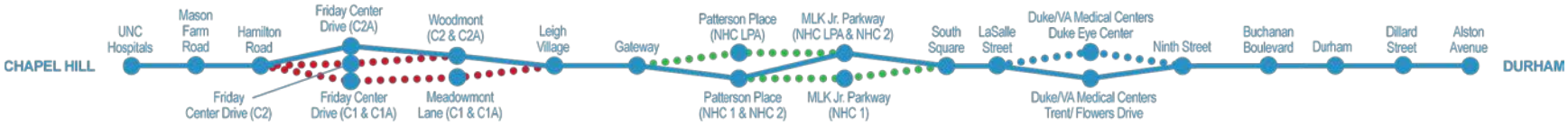
Duke/VA Medical Centers Station: Duke University is planning for additional growth in the Erwin Road corridor, including multiple new healthcare buildings. The university is also developing a pedestrian trail corridor along the east side of Emergency Drive.

Old West Durham/Duke East Campus Evaluation Area

Ninth Street Station: Several projects are planned or underway near the Ninth Street Station:

- Duke University is planning a long-term, large-scale redevelopment of its Central Campus. Initial plans for Phase I construction were estimated at half a million square feet of new academic, residential, and social space valued at nearly $400 million. It is anticipated that the redevelopment will include 500 bed spaces for students. Ultimately, redevelopment of Duke's Central Campus will have a significant impact on the Ninth Street Station area.
- Solis Ninth Street, an apartment building of up to six stories is currently being developed. It will provide 10,000 square feet of space for shops and restaurants and 222,046 square feet of apartments on about 2.7 acres on Ninth Street near the proposed station. It is anticipated to open in 2015.
- Crescent Ninth Street, a $47 million four-story apartment complex with 303 units, is partially open (as of January 2015) and partially under development and is being constructed in the architectural style of historic Erwin Mill.
- The developer of Crescent Ninth Street also developed Crescent Main, a $41 million apartment complex project that opened in the fall of 2014. The complex has a three-story building and a four-story building with a combined 208 apartment unit capacity. It is located on a 4-acre lot bound by West Main Street, 15th Street, and Rutherford Street, about two blocks from Duke University Central Campus and Duke University Medical Center.

Buchanan Boulevard Station: In August 2013, the City Council approved a $1.3 million incentive package for the redevelopment of the former McPherson Hospital complex into a 100-room boutique hotel, along with residential, restaurant/retail, and office space. This building is under construction as of January 2015.



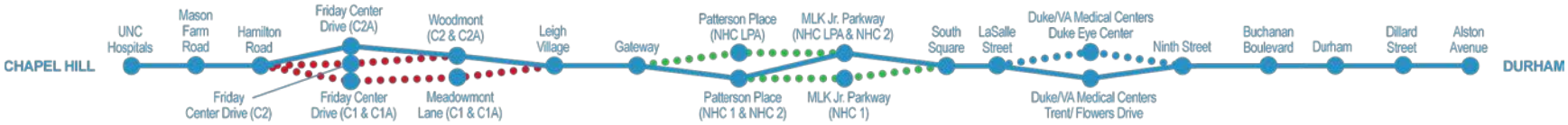
Downtown Durham Evaluation Area

Durham Station: Numerous projects are planned or underway near the Durham Station:

- At 605 West, a developer team constructed a $46.1 million, 338-unit apartment building on a 3.2-acre tract on West Chapel Hill Street.
- A mixed-income apartment complex, Southside East Phase I, is under construction on 6.2 acres along Lakewood Avenue between South Roxboro and Fayetteville Streets. The Southside project area encompasses approximately 125 acres located south of the Durham Freeway and just north of NCCU. The first apartments were opened in April 2014 and will continue to open as they are completed.
- The 17-story SunTrust Bank building was recently converted into a 125-room boutique Museum Hotel with a restaurant, bar, and a museum showing rotating exhibits of museum-quality, contemporary art that is open free to the public 24 hours a day. This project opened in early 2015.
- A $20 million, 183-unit apartment complex, Whetstone Apartments, opened at the corner of Jackson and Willard streets, near the North Carolina Mutual Life Insurance Company headquarters building.
- There is a proposal for Liberty Warehouse, the former tobacco auction warehouse on Rigsbee Avenue, to be redeveloped to include 246 apartments, a parking deck, and ground-floor retail shops. As proposed, the existing building will be demolished and replaced with a 320,000-square-foot mixed-use complex on the edge of Durham Central Park. The project will be open in spring of 2016.
- The Chesterfield cigarette manufacturing building was acquired at the end of 2013 by a real estate investment and development company specializing in facilities defined as for-profit and not-for-profit institutions, especially universities, university-related research parks, and healthcare systems. Demolition and construction has begun on the site, on which developers plan to convert the building into a research facility with a 600 to 800 space parking deck.

Dillard Street Station: Several projects are planned or underway near the Dillard Street Station:

- Between the proposed Dillard Street and Durham Stations, plans are underway to construct a $40 million 26-story, 424,000-square foot high-rise at the former Woolworth's site between Parrish and Main streets. A Certificate of Appropriateness approval was received from the Durham Historic Preservation Commission in April 2013. The project timeline calls for construction to begin in early 2015 and completion is anticipated in 2017. The project is planned to house about 21,000 square feet of street-level retail space; interior parking on floors two and three; 62,000 square feet of office space on floors three, four, and five; and a stepped-back tower accommodating 130 to 134 apartments, the top six floors of which are contemplated as for-sale units of 1,750 to 2,400 square feet.
- A residential apartment building is under development on Pettigrew Street just east of Dillard Street on the former Hendrick Chevrolet dealership site. The development will include 305 apartment units and a 444-space parking deck. The apartment building will cover approximately one-third of the former dealership site. Additional high density development is envisioned on the other portions of the site; however, at this time only the apartment building portion has been submitted to the City for development approval.



East Durham

Alston Avenue Station: NCCU enrollment has been continually increasing and currently is at more than 8,000 students (January 2015). In order to accommodate this increased enrollment, NCCU adopted a Campus Master Plan Update in 2007. The *North Carolina Central University 2007 Campus Master Plan* anticipates significant construction projects on the existing campus footprint.

4.1.3 Environmental Consequences

The No Build Alternative is not consistent with adopted land use controls, policies, and guidelines, which have light rail in the D-O Corridor identified in those plans, and therefore the resulting land uses would not be consistent with the compact development that is planned in these areas.

The following sections describe the environmental consequences of the NEPA Preferred and Project Element Alternatives in comparison to the No Build Alternative.

4.1.3.1 NEPA Preferred Alternative

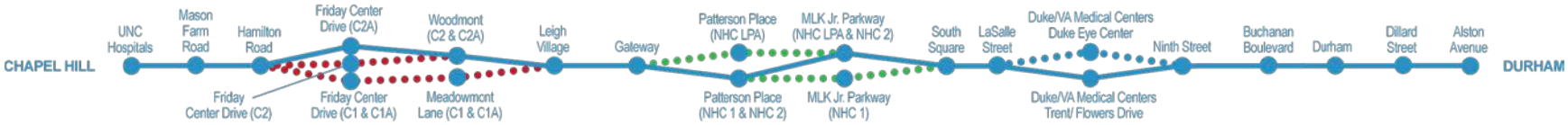
Existing infrastructure is already in place to support growth within the corridor, as it is fully located within the area that receives public services from the Town of Chapel Hill or the City of Durham. Both municipalities have capacity for growth in terms of planned infill and redevelopment in the corridor, and many residents support transit-oriented growth. In addition, extensive policies are in place to help guide that development, and market forces for future development are positive. The NEPA Preferred and each of the alignment alternatives are consistent with the municipalities' and counties' preference that development should be encouraged to occur in a compact, sustainable, and transit-oriented manner.

The comprehensive plans for both municipalities are designed around the NEPA Preferred and Project Element Alternatives. The *Chapel Hill 2020 Comprehensive Plan* and the *Durham Comprehensive Plan* have focused growth and development around stations. The comprehensive plans for both municipalities are designed around the NEPA Preferred and Project Element Alternatives. The Chapel Hill 2020 comprehensive plan and the Durham Comprehensive Plan have focused growth and development around stations.

Chapel Hill 2020 identifies the NC 54 corridor as a future focus area targeted for transit-oriented growth and transit-supportive infrastructure including bicycle and pedestrian improvements. Although the plan contemplates both the C1/C1A Alternatives light rail routing through Meadowmont and the C2/C2A Alternatives light rail routing south of NC 54, the NEPA Preferred (C2A) and C2 Alternatives would be more supportive of transit-oriented development in the areas identified by the Town of Chapel Hill for future growth in the plan. In addition, the Town of Chapel Hill has expressed a preference for the NEPA Preferred (C2A) or C2 Alternatives as documented in DEIS chapter 9.

The 2012 update of the *Durham Comprehensive Plan* includes a Regional Transit Plan that directs the City-County Planning Department, in conjunction with Triangle Transit, to develop or participate in the development of Compact Neighborhood Plans that are focused around TOD, and to implement new transit-oriented zoning districts. The corridor identified in the *US 15-501 Major Investment Study (MIS) Phase II Report* (2001) has been preserved as developers have requested rezoning. In April 2015, the City-County Planning Department initiated a public process to update the Compact Neighborhood Tier boundaries identified in the 2005 *Durham Comprehensive Plan*, in part so that the areas would be consistent with and centered on the NEPA Preferred and Project Element Alternatives under study in this DEIS.

Light rail transit in the corridor would provide identifiable, permanent infrastructure, faster travel times, and more reliable service than the No Build Alternative. These improvements would greatly enhance the convenience and attractiveness of transit services in the corridor, and provide greater



transit access within the corridor – enhancing market conditions in support of higher-density land use patterns.

The project's capital improvements, notably stations, would establish the permanence of the system to workers, residents, and visitors in the corridor; to businesses and property owners; and to developers and investors. These improvements, which would not occur in the No Build Alternative, signal a long-term commitment to provide transit services in support of further density and development.

The NEPA Preferred Alternative would result in a conversion of less dense land uses into higher density uses near stations. These impacts are considered beneficial and consistent with local planning. The NEPA Preferred Alternative is also consistent with the environmental conservation goals stated in the local plans. In addition to focusing growth in the station areas and away from existing open space, the C2A and NHC 2 Alternatives avoid dividing sensitive natural areas by utilizing existing transportation corridors as described in DEIS section 4.6, 4.7, and 4.8.

All station sites are either within the Downtown Tier or Urban Tier, or are expected to be within the Compact Neighborhood Tier at the conclusion of the *Durham Comprehensive Plan* update currently underway and would therefore be consistent with future land use plans once that process is complete. The ROMF site at the Farrington Road location is not consistent with the future land use for this site identified in the *Durham Comprehensive Plan*.

4.1.3.2 Project Element Alternatives

Little Creek Alternatives

The comprehensive plan for Chapel Hill focused growth and development around the stations of the NEPA Preferred and Project Element Alternatives. The 2012 update of the *Chapel Hill 2020 Comprehensive Plan* included an alignment alternative near C2/C2A Alternative, as well as C1/C1A Alternatives. The Town of Chapel Hill expressed its preference for an alignment running south of NC 54 (C2, C2A Alternatives) that would be more supportive of planned future growth than C1 and C1A Alternatives. These alternatives would result in a conversion of less dense land uses into higher density uses near stations. These impacts are considered beneficial and consistent with local planning.

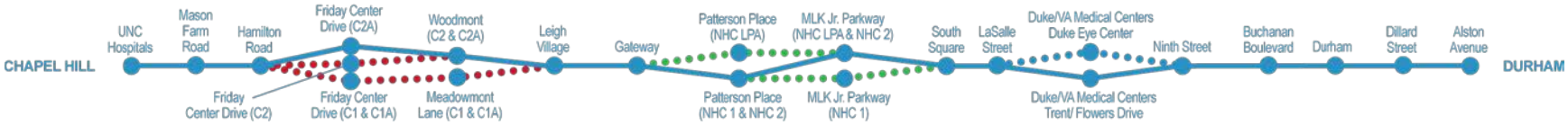
New Hope Creek Alternatives

While the NHC LPA Alternative was recommended in the *US 15-501 MIS Phase II Report*, as well as subsequent transportation and land use plans, it is only somewhat consistent with the local planning efforts. The areas around the stations associated with this alternative are planned for compact development but it would not protect the New Hope Creek Bottomlands from being divided. As such, the other NHC Alternatives are more consistent with the *Durham Comprehensive Plan*.

These alternatives would result in a conversion of less dense land uses into higher density uses near stations. These impacts are considered to be beneficial and consistent with local planning efforts.

Duke/VA Medical Centers Station: Duke Eye Center

Either station location would be consistent with the *Durham Comprehensive Plan*, which has focused growth and development around proposed light rail stations. No conversion of existing land use would be required for this alternative. However, one of the goals of the *Duke University Campus Master Plan* (2000) is to make Duke a walkable and bikeable campus. The plan also notes the importance of the north entrance to the campus along Trent/Flowers Drive, where buildings were originally built with entrances from the adjacent parking lots. To help create a more pedestrian friendly environment in this area, there is also a focus on reorienting the buildings to activate the street along both roads by adding building entrances on the street sides of these buildings, making the Trent/Flowers Drive Station more consistent with the vision



for the area as defined in the *Duke University Campus Master Plan* (2000).

ROMF Alternatives

The consistency of the five ROMF sites with regional and local plans is summarized in **Table 4.1-1**. Three of the ROMF alternatives (the Leigh Village, NEPA Preferred Alternative [Farrington Road], and Patterson Place) are inconsistent with the future land use designation in the comprehensive plan. Each of these three sites is currently zoned residential and the comprehensive plans identify commercial uses in the future. The remaining two ROMF alternatives (Cornwallis Road and Alston Avenue) would be consistent with future land use designations in the comprehensive plan.

4.1.4 Mitigation Measures

Under the No Build Alternative, the planned transportation improvements assumed in local plans would not occur. As such, municipalities and institutions may revise local land use plans; however, no mitigation would be needed for the D-O LRT Project.

The mitigation measures for the NEPA Preferred and Project Element Alternatives are described in the following sections.

4.1.4.1 NEPA Preferred and Project Element Alternatives

With the exception of direct impacts caused by displacements, which could result in a change in land use, no other adverse impacts to land use are anticipated with the construction of the D-O LRT Project. Regional and local planning activities encourage more intensified growth in the region, particularly in and around future transit stations. As compared to the No Build Alternative, the D-O LRT Project would result in a conversion of lower density land uses to higher density and mixed-use land uses, including retail, commercial, and residential development. However, this conversion is consistent with future land use plans

In addition, commercial space will be incorporated within the proposed parking deck at the Alston Avenue Station. These impacts are considered beneficial and as such, no mitigation would be required.

Construction of the ROMF at the Farrington Road site will require land use entitlements including a comprehensive plan amendment and rezoning. It is expected that the City and/or County of Durham will place conditions on the approvals that appropriate mitigation measures are included in the design, including strategies to complement the surrounding context such as use of architectural styles and/or landscape design.

During Engineering, Triangle Transit will continue to coordinate with property owners and residents near the site to develop and refine these strategies. The public will also have the opportunity to comment on the design through a public hearing as part of the City and/or County approval process.

4.1.4.2 ROMF Alternatives

Mitigation of the impacts of a change in land use for the Leigh Village and Patterson Place ROMF Alternatives would be the same as the NEPA Preferred Alternative (Farrington Road). Mitigation for the Cornwallis Road ROMF Alternative would be similar although a comprehensive plan amendment would not be required. The Alston Avenue ROMF Alternative would not require mitigation for land use impacts.

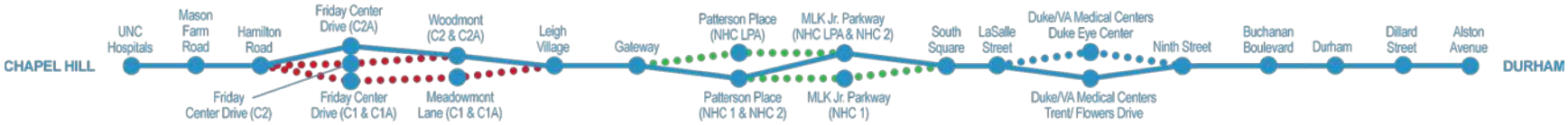


Table 4.1-1: Land Use/Zoning of ROMF Sites under Consideration

ROMF Site	Existing Use	Comprehensive Plan Designation	Comprehensive Plan Amendment Required?	Current Zoning	Rezoning Required?
Leigh Village	Residential- single-family homes, and retail	Commercial/office	Yes	Residential-Suburban-20 (RS-20)	Yes - zoning is not consistent with a ROMF.
Farrington Road (NEPA Preferred Alternative)	Residential- single-family homes	Commercial, office, very low-density residential	Yes	Residential-Suburban-20 (RS-20)	Yes - zoning is not consistent with a ROMF.
Patterson Place	Not developed	Commercial zoning in a suburban transit area node	Yes	Residential-Suburban-20 (RS-20)	Yes - zoning is not consistent with a ROMF.
Cornwallis Road	Former Pepsi distribution center, currently being redeveloped as a mini-storage facility	Industrial	No	Commercial General (CG)	Yes - zoning is not consistent with a ROMF.
Alston Avenue	Industrial/ Warehousing	Industrial	No	Industrial Light (IL) Compact Neighborhood Tiers	No - current industrial light zoning is consistent with a ROMF.

Source: AECOM 2015.

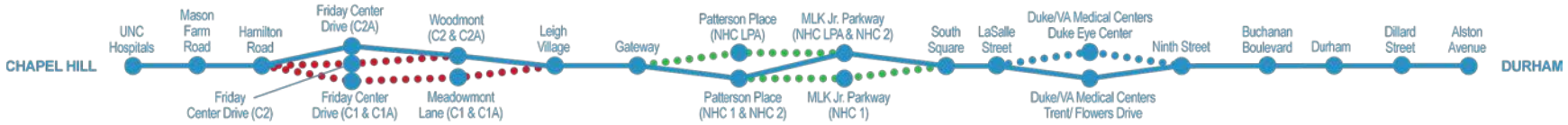


Figure 4.1-1: Existing Land Uses in the D-O Corridor

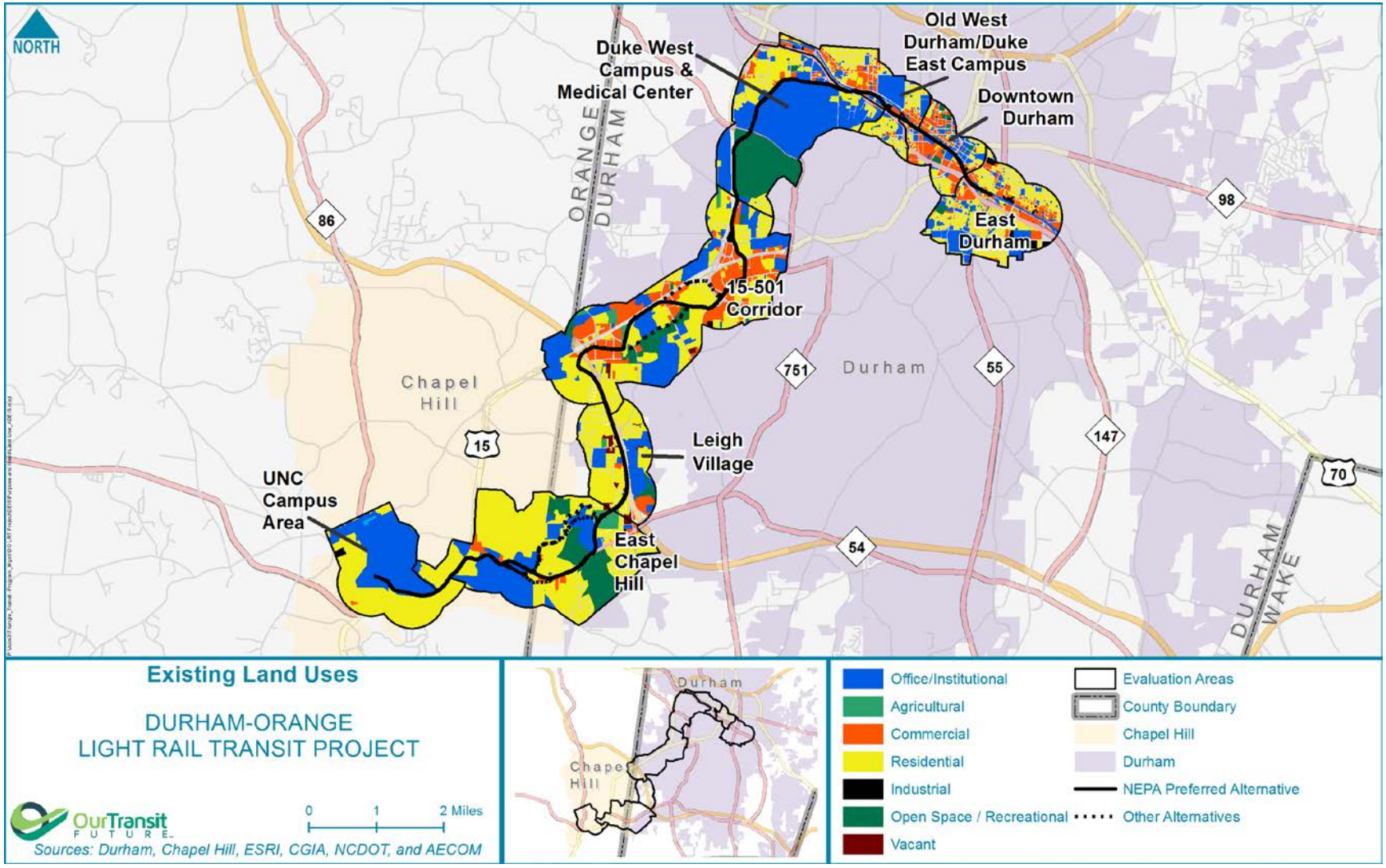
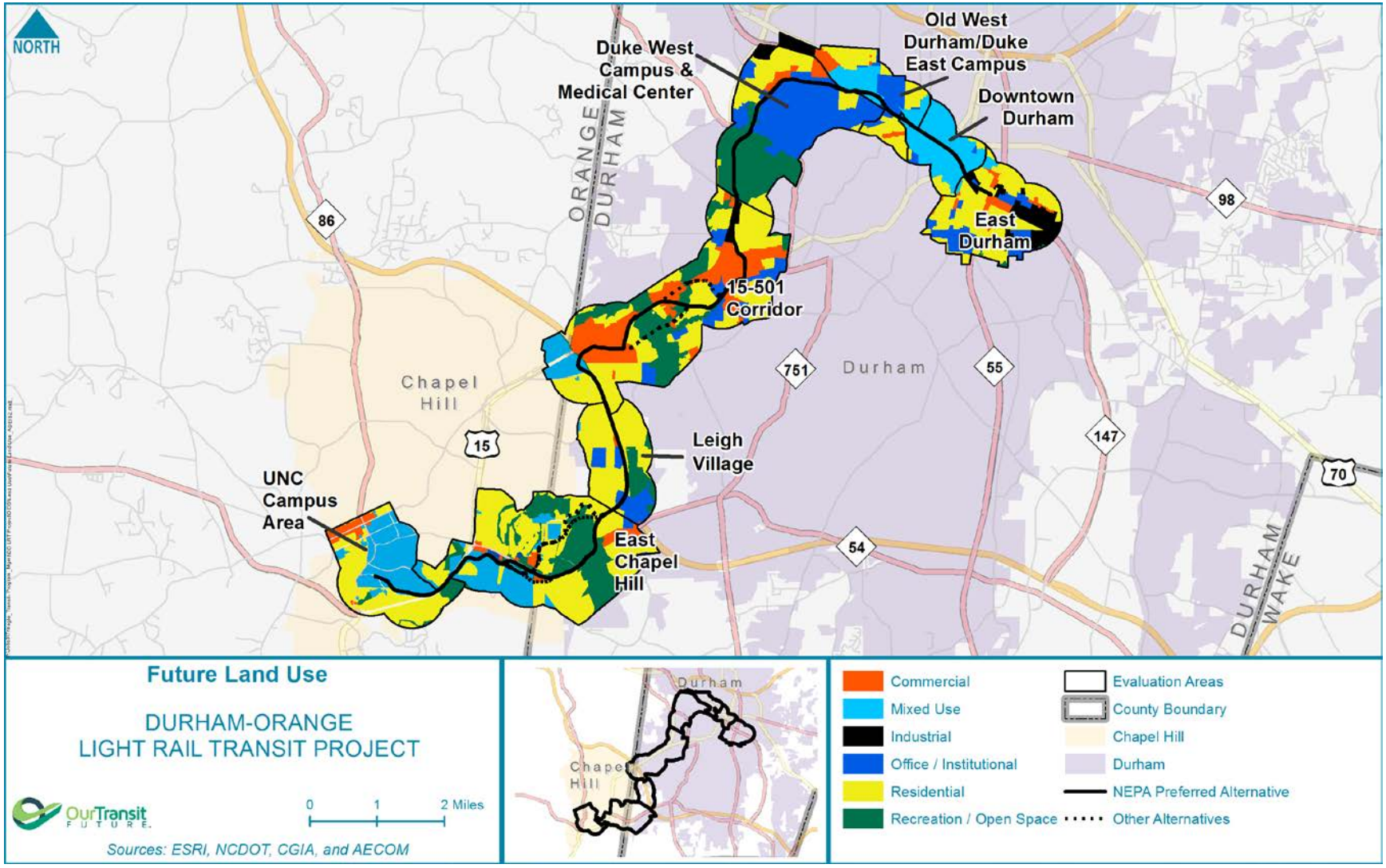


Figure 4.1-2: Future Land Uses in the D-O Corridor



4.2 Socioeconomic and Demographic Conditions

This section describes the existing socioeconomic characteristics (population, households, and employment) of the study area, and includes a discussion of the existing demographic profile for transit dependent and limited English proficient (LEP) populations. To ensure that potential effects to people and communities are integrated into the decision making process for transit investments, NEPA specifically requires the consideration of social and economic impacts of the proposed project. Note that minority and low-income populations are specifically discussed in DEIS chapter 5.

Existing and future population, households, and employment characteristics of the D-O Corridor are discussed in this section. Other economic factors that would be anticipated to result from the construction and operation of the alternatives under study in the DEIS, such as economic output, government finances, and the impacts on the local economy, are also discussed. Potential mitigation measures are also included, where appropriate.

4.2.1 Methodology

This section describes how the socioeconomic and demographic analyses for this DEIS were conducted.

Transit dependent populations are identified as follows:

In general, the following populations are considered to be reliant on transit and are included in the demographic analysis:

- Zero-car households
- Ages under 18 and over 65

4.2.1.1 Socioeconomic Analysis: Population, Households and Employment

The study area used to conduct the socioeconomic analysis included eight evaluation areas, which are more fully described in DEIS section 4.1. The evaluation areas include the following:

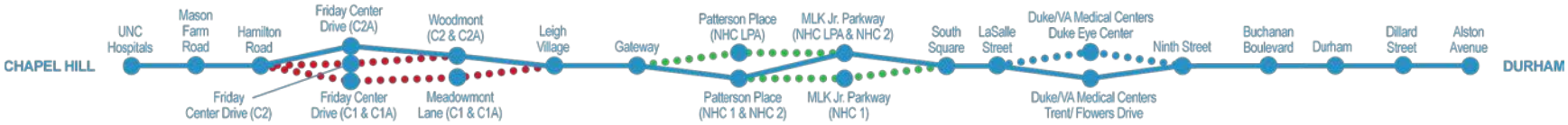
- UNC Campus Area
- East Chapel Hill
- Leigh Village
- US 15-501 Corridor
- Duke West Campus and Medical Center
- Old West Durham/Duke East Campus
- Downtown Durham
- East Durham

Base year (2010) data and horizon year (2040) estimates were obtained from the Triangle Regional Model (TRM) traffic analysis zones (TAZ) as used in the development of the Capital Area Metropolitan Planning Organization (CAMPO) and Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO) *2040 Metropolitan Transportation Plan* (MTP). The socioeconomic analysis also included a more detailed level of review and incorporated ½-mile distance around the proposed D-O LRT stations in accordance with FTA *Reporting Instruction for the Section 5309 New Starts Criteria* (FTA 2013).

Data sources for the socioeconomic analysis are as follows:

- Socioeconomic data prepared for the Triangle Regional Model used in the development of the 2040 Metropolitan Transportation Plan
- Traffice analysis zones (TAZ) are geographical units used for travel demand modeling.
- The 2010 county-level population data were obtained from the U.S. Census Bureau's 2010 Demographic Profile.

Base year (2010) data and horizon year (2040) estimates were obtained from the TAZs that fall entirely within or partially



within ½-mile of the proposed stations. Population, households, and employment were calculated using the ½-mile buffers for 2010 and 2040. In locations where multiple station alternatives, less than 500 feet apart, were evaluated, the ½-mile was calculated using a single point between the station alternatives. Since TAZs may be relatively large, this approximation would not be expected to change the results of analysis.

The Sample Methodology for Estimating Station Area Socio-Economic Statistics, contained in the *Reporting Instruction for the Section 5309 New Starts Criteria* served as a guide for calculating or splitting the number of people, households, dwelling units, and jobs in areas where the ½-mile buffers overlapped (FTA 2013). There were only minor differences in the overlapping areas of the Hamilton Road and Friday Center Stations; as a result, an average was used to represent the population, households, and jobs for these stations.

4.2.1.2 Demographic Analysis: Transit Dependent and Limited English Proficient Populations

The study area for the demographic analysis is the same as the socioeconomic study, described above. Existing demographic conditions for transit dependent and LEP populations were identified using U.S. Census Bureau American Community Survey (ACS) 5-year (2007-2011) data at the county level (Durham and Orange counties) and the block group level and analyzed within the study area. The source of the data used in the demographic analysis is North Carolina Department of Transportation's (NCDOT) Demographic Excel Tool, which contains data obtained from the U.S. Census Bureau's American FactFinder and the National Historic Geographic Information System (NHGIS) website.

The data used for categorizing and mapping LEP populations, zero-car households, and populations under 18 and over 65 years within the study area was derived from the CAMPO and DCHC MPO 2040 MTP.

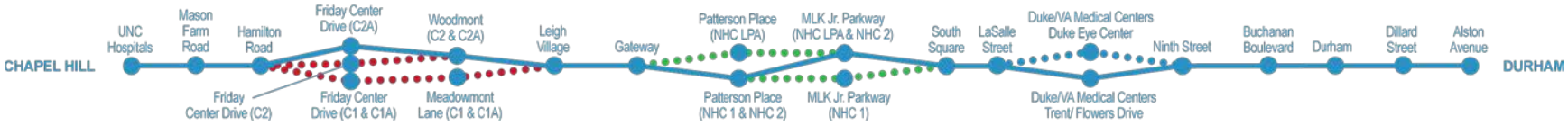
4.2.1.3 Government Finance and Tax Sources

To estimate the fiscal effects of the proposed D-O LRT Project, government finance and tax sources were reviewed, in particular property taxes, which are the largest source of revenue for the local municipalities and counties. Data on properties that would be acquired by the project were obtained from the Durham County and Orange County Property Assessors. For this analysis, the anticipated change in the tax base because of property acquisitions for the proposed D-O LRT Project was estimated.

Tax base - the total assessed value of real estate subject to property tax within a county

4.2.1.4 Economic Effects of Operation and Maintenance

The analysis follows standard FTA procedures concerning economic impacts. Available regional input-output modeling systems and economic multipliers utilized estimates of the incremental operating and maintenance costs (in constant 2015 dollars) of the No Build Alternative over existing public transit costs in Durham and Orange counties (inflated to 2015 costs). A comparison of the NEPA Preferred Alternative (Alternative C2A, NHC 2, Trent/Flowers Drive Station, and Farrington Road ROMF) with Project Element Alternatives was utilized to examine the direct effects of the operation and maintenance on the direct, indirect/induced, and total demand factors of the alternatives in terms of regional jobs and earnings. Economic impact multipliers are based upon the most recent available maintenance and operation multipliers as published in the 2014 American Public Transportation Association (APTA) update. The combined direct, indirect, and induced effects serve to quantify total/final demand effects of light rail operations and maintenance on regional jobs and earnings.



4.2.2 Affected Environment

The following discussions focus on the existing socioeconomic and demographic conditions within the defined study area. Information on current government and finance tax sources is also provided.

4.2.2.1 Socioeconomic Data: Population, Households, and Employment

Socioeconomic data were reviewed at the county, study area, and station area levels. **Table 4.2-1** summarizes population, households, and employment for 2010 and projected for 2040. Growth in all three categories is anticipated to occur in both Orange and Durham counties and within the study area. With a combined population over 400,000 for Orange and Durham counties, approximately 20 percent of the population lives in the study area. The East Chapel Hill evaluation area is projected to nearly triple in population by 2040, which coincides with the growth in number of households. Some evaluation areas are projected to experience decline in population and households (UNC Campus Area and Duke West Campus and Medical Center); nevertheless, these areas are expected to see substantial gains in employment by 2040. East Durham is the only evaluation area projected to experience a decline in employment by over 50 percent by 2040.

Demographic Data: Transit Dependent and Limited English Proficient Populations

Populations of interest also included transit dependent and LEP populations. **Table 4.2-2** lists the total population and percentages for LEP, zero-car households, and people under age 18 and over age 65 for Durham and Orange counties, in the study area and each evaluation area. **Figures 4.2-1** through **4.2-3** show the concentrations of these communities of concern using the mapping categories previously identified. DEIS chapter 9 can be referenced for more information related to LEP outreach.

Median Household Income

As listed in **Table 4.2-3**, the 2010 median household income for the study area was $51,287, which was slightly higher than the 2010 county estimates for Orange and Durham. Within the study area, the east Durham evaluation area had the lowest median household income at $24,019 and the US 15-501 Corridor had the highest at $87,902.

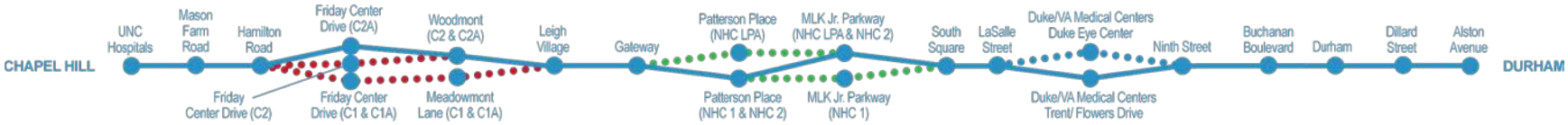
4.2.2.2 Government Finance and Tax Sources

City of Durham, Durham County, Orange County, and the Town of Chapel Hill rely primarily on property tax revenues, which constitute the funds for general government services. The second largest source of revenue is sales taxes at 9 to 22 percent. Other sources of general fund revenues (primarily of intergovernmental transfers and service charges) account for revenue other than sales tax. In addition, the jurisdictions have a number of special revenue and enterprise funds that allocate funds for a specific purpose.

The City of Durham adopted a downtown Durham Municipal Service District in 2011 (Durham City Council, Res. No. 9761). The district serves as a Business Improvement District providing specialized services within a defined 488-acre area of downtown Durham. The District currently charges a rate of seven cents per $100 of assessed valuation and generates approximately $375,000 per year in revenues (City of Durham 2011).

The three largest sources of funding for Triangle Transit are revenues from vehicle rental taxes, vehicle registration fees, and special sales tax revenue. The vehicle rental tax generated revenue of approximately $9 million in 2013. The vehicle registration tax generated revenue of approximately $5.6 million in 2013 (Research Triangle Regional Public Transportation Authority, *Fiscal Year 2015 Budget for the Durham-Orange Bus and Rail Investment Plan*, 2014).

In April of 2013, Durham and Orange counties began collecting an additional half-cent sales tax dedicated to paying for



expanding transit within the two jurisdictions. For the fiscal year (FY) ending June 30, 2014, the revenue generated from the additional half-cent sales tax was approximately $6.5 million in Orange County and $22.0 million in Durham County (*FY 2014 Durham County Bus and Rail Investment Progress Report,* 2014; *FY 2014 Orange County Bus & Rail Investment Progress Report*, 2014).

4.2.3 Environmental Consequences

The following sections describe the environmental consequences of the NEPA Preferred and Project Element Alternatives in comparison to the No Build Alternative. Growth in population, households, and employment is expected to occur whether the proposed D-O LRT Project is built; local plans and policies account for this growth. However, the location and character of the growth accounted for in those plans is predicated on the assumption that the D-O LRT Project would be constructed.

4.2.3.1 NEPA Preferred Alternative

Socioeconomic and Demographic Effects

The proposed D-O LRT Project is not expected to increase or decrease population, households, or employment from the regional perspective. However, it is anticipated to shift and focus where growth would occur. It is reasonable to expect that population, households, and employment growth would be more concentrated near the LRT stations if the proposed D-O LRT Project is constructed. The D-O LRT Project would benefit transit-dependent populations by providing increased mobility and improved access and connectivity. The Light Rail Alternative would serve as a spine to link the residential growth with new employment opportunities in the D-O Corridor. A discussion of potential impacts to minority and low-income populations is provided in detail in DEIS chapter 5.

As listed in **Table 4.2-4**, the proposed station areas of the NEPA Preferred Alternative would serve approximately 53,000 residents, 25,800 households, and employment of 119,100, in 2040. The NEPA Preferred Alternative would also serve over 13,000 transit dependent persons living within ½-mile of the stations, as well as a LEP population of over 2,600.

Government Finance and Tax Sources

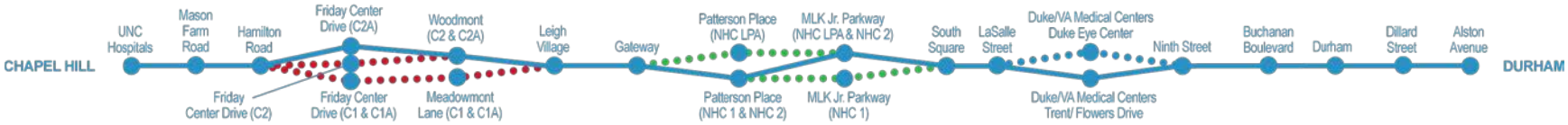
Since property taxes are the largest source of revenue for the City of Durham, Durham County, Orange County, and the Town of Chapel Hill, this section evaluates the potential direct effect of the NEPA Preferred and Project Element Alternatives on the tax base of both Durham and Orange counties. When private property is acquired by a public entity, the property is no longer subject to property taxes and is removed from the tax base. This analysis presents the total assessed value of the properties that would be acquired for the NEPA Preferred and Project Element Alternatives as documented in DEIS section 4.14.

The acquisition of private property, which would be necessary to build the NEPA Preferred Alternative, is anticipated to result in a decrease in the property tax base for both Durham and Orange counties. As listed in **Table 4.2-5**, based on current market values and tax rates, the potential reduction of the property tax base for the NEPA Preferred Alternative is $55.9 million. It is important to note that this figure is relatively low, given the large amount of public right-of –way and land to be acquired from public agencies and not-for-profit institutions.

This decrease in the property tax base represents a conservative (high) estimate because it does not account for any relocation or replacement of the value elsewhere within the counties. In addition, likely increases in the property tax base due to redevelopment in the transit station areas are not accounted for.

Operation and Maintenance Economic Impacts

The NEPA Preferred Alternative and Project Element Alternatives have relatively similar total, final incremental demand effects in terms of full-time equivalent (FTE) employment and labor costs and earnings



(2015 dollars). The NEPA Preferred and Project Element Alternatives would all introduce approximately 480 incremental full-time equivalent jobs above the No Build Alternative and $22.8 million to $23.0 million (2015 dollars) incremental labor cost/earnings above the No Build Alternative (**Table 4.2-7**). The NEPA Preferred Alternative has a total/final demand effect above the No Build Alternative of 480 jobs and $22.9 million (2015 dollars) in labor/costs/earnings. There is little difference among the Little Creek and New Hope Creek Alternatives in projected employment and annual earnings.

Employment Impacts

It is anticipated that the number of employees who would report to work at the ROMF would be between 110 and 175 based on peer transit systems with light rail (National Transit Database 2012) as listed in **Table 4.2-9.** In contrast, employment at the NEPA Preferred Alternative ROMF site (Farrington Road) is currently less than 25 employees (U.S. Census Center for Economic Studies, LEHD 2014). Therefore, the employment impact would range from a net gain of 85 jobs to a net gain of 175 jobs on that site. Construction jobs are discussed in DEIS section 4.16.

4.2.3.2 Project Element Alternatives

Little Creek Alternatives

Socioeconomic and Demographic Effects

The station area socioeconomics and demographic conditions are similar for the Little Creek Alternatives as compared to the NEPA Preferred Alternative (C2A) (**Table 4.2-4**).

Property Tax Base

As listed in **Table 4.2-5**, the C1A Alternative would result in a higher reduction in the property tax base at approximately $4.7 million annually (total for both counties), when compared to the NEPA Preferred Alternative (C2A). Similarly, the C1 and C2 Alternatives would also result in a higher reduction in the property tax base at $2.3 million and $1.1 million, respectively, when compared to the NEPA Preferred Alternative (C2A).

New Hope Creek Alternatives

Socioeconomic and Demographic

As listed in **Table 4.2-4**, the New Hope Creek Alternatives would serve the same number of population, households, and employment, as well as LEP and transit-dependent populations as the NEPA Preferred Alternative.

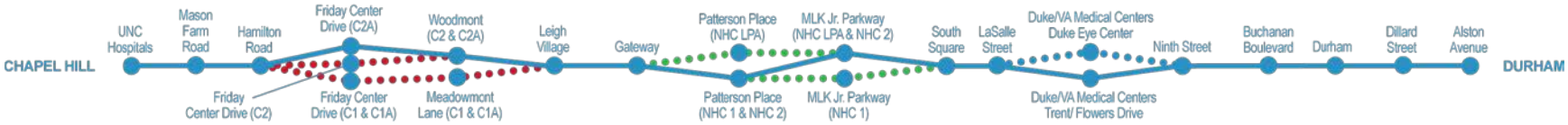
Property Tax Base

As listed in **Table 4.2-5**, the NHC 1 Alternative would result in a higher reduction in the property tax base at approximately $5.6 million annually (total for both counties) when compared to the NEPA Preferred Alternative (NHC 2). Similarly, the NHC LPA Alternative would also result in a higher reduction in the property tax base at $2.9 million when compared to the NEPA Preferred Alternative due to differences in value of the private property to be acquired.

Duke/VA Medical Centers Station: Duke Eye Center

Socioeconomic and Demographic

The Duke/VA Medical Station would serve the highest employment of all the proposed D-O LRT stations. The Trent/Flowers Drive Alternative totals are included in the NEPA Preferred Alternative. The Duke Eye Center Alternative would serve approximately 600 more people under the 2010 condition, as compared to the NEPA Preferred Alternative. However, by 2040, the Duke Eye Center Alternative would serve slightly fewer people (**Table 4.2-4**) than the NEPA Preferred Alternative station location. The difference in jobs between Duke Eye Center Alternative and the NEPA Preferred



Alternative station location is minor. The LEP population within the Duke Eye Center Alternative station area is slightly higher than the LEP population within the NEPA Preferred Alternative station location. Similarly, the number of transit dependent populations is slightly higher at Duke Eye Center Alternative. Comparatively, the difference between the Duke Eye Center Alternative and the NEPA Preferred Alternative station location is minor.

Property Tax Base

The Duke Eye Center Alternative would result in a similar change in the property tax base compared to the Trent/Flowers Drive Alternative as part of the NEPA Preferred Alternative (**Table 4.2-5**).

ROMF

Socioeconomic and Demographic

There would not be effects from the development of ROMFs related to transit service provided to populations, households, LEP, and transit-dependent populations.

Property Tax Base Effects

The Alston Avenue ROMF would cause the highest reduction in property tax base at $18 million while the Farrington Road ROMF, included in the NEPA Preferred Alternative, would have the lowest impact on the tax base at $1.6 million (**Table 4.2-8**). Also, see DEIS section 4.17 for a more detailed discussion of indirect and cumulative impacts

Employment Impacts

As noted previously, it is anticipated that between 110 and 175 employees would work at the ROMF. Current employment at the Leigh Village, Patterson Place, and Cornwallis Road ROMF Alternative sites is similar to the NEPA Preferred Alternative (Farrington Road) with 25 or fewer existing jobs, and would therefore result in a similar net gain employment as shown in **Table 4.2-9**. In contrast, at the Alston Avenue ROMF Alternative site, there are between 150 and 250 existing jobs. As such, selection of the Alston Avenue ROMF Alternative would result in an employment impact ranging from a net loss of 140 jobs to a net gain of 25 jobs.

4.2.4 Mitigation Measures

The mitigation measures for the NEPA Preferred and Project Element Alternatives are described in the following sections.

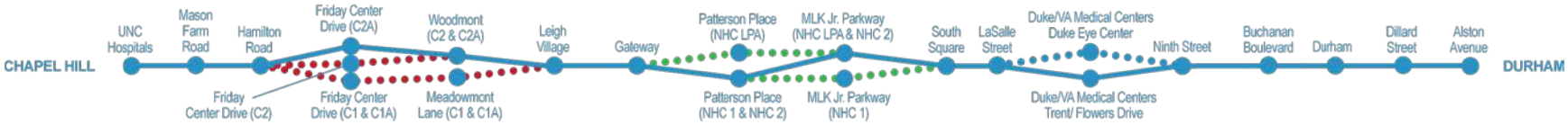
Under the No Build Alternative, there would be no project-related impacts to the socioeconomic or demographic conditions. However, the No Build Alternative may have a negative impact on the potential for redevelopment and future economic development, particularly within the proposed ½-mile station areas. No mitigation is required for the No Build Alternative.

The redistribution of growth in population, households, and employment that could be generated by the proposed D-O LRT Project is consistent with local plans and policies. The proposed D-O LRT Project is not expected to result in negative effects to economic output, job creation, or income. Therefore, mitigation measures would not be warranted.

In addition, commercial space will be incorporated within the proposed parking deck at the Alston Avenue Station, which may result in new jobs being added to the neighborhood.

If the Alston Avenue ROMF Alternative is selected, potential exists for loss of employment with the displacement of businesses that are currently located on the site. This could be mitigated by working to help the businesses to relocate nearby (DEIS section 4.14). Any businesses that would be displaced by the project would be compensated in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R. 24).

The tax revenue losses due to property acquisitions because of the NEPA Preferred and Project Element Alternatives would be minimal in comparison to the overall tax base and anticipated longer-term



development would help replenish the tax revenue. Mitigation efforts would include the identification and promotion of redevelopment, infill, and economic development opportunities by the affected areas. Mitigation efforts would also include proactive policies to relocate businesses near their existing location to offset any potential property tax revenue loss.

There are potential impacts related to the construction of the transit alternatives that may require mitigation measures. These are addressed in DEIS section 4.16.

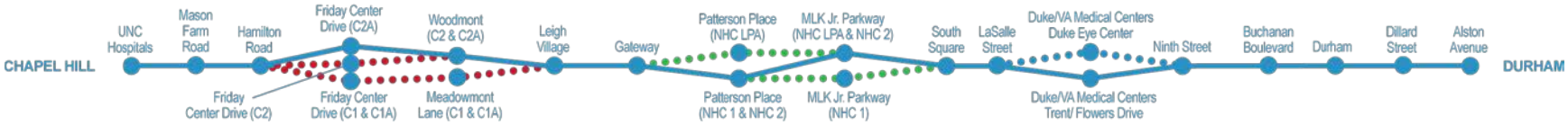


Table 4.2-1: Population, Households, and Employment, 2010 and 2040

Area	2010 Population	2040 Population	2010 Households	2040 Households	2010 Employment	2040 Employment
UNC Campus Area	14,000	7,300	6,100	3,300	8,100	37,300
East Chapel Hill	4,900	13,600	2,000	6,800	1,700	12,800
Leigh Village	1,300	5,600	500	2,600	400	3,900
US 15-501 Corridor	19,500	24,700	8,100	11,700	4,500	28,500
Duke West Campus & Medical Center	14,400	9,400	6,500	4,600	8,900	38,900
Old West Durham / Duke East Campus	8,600	6,300	4,000	3,200	8,300	10,900
Downtown Durham	4,400	6,700	2,000	3,400	17,700	21,700
East Durham	7,700	9,600	3,200	3,900	21,700	10,400
Study Area	74,900	83,200	32,400	39,400	71,200	164,400
Orange County	133,800	187,700	51,500	76,600	71,000	120,300
Durham County	267,600	421,700	109,300	178,100	190,100	306,500

Source: US Census Bureau, 2010 Demographic Profile and socioeconomic data prepared for the 2040 MTP. Numbers may not sum due to rounding.

Table 4.2-2: 2010 Demographic Conditions

Area	%LEP	% Zero-Car Households	% Under 18 & 65-and-Over
UNC Campus Area	2%	27%	5%
East Chapel Hill	2%	6%	35%
Leigh Village	5%	5%	28%
US 15-501 Corridor	16%	12%	27%
Duke West Campus & Medical Center	19%	23%	17%
Old West Durham / Duke East Campus	8%	21%	16%
Downtown Durham	8%	35%	28%
East Durham	5%	50%	34%
Study Area	18%	22%	21%
Orange County	3%	7%	30%
Durham County	4%	9%	32%

Source: American Community Survey 5-year Estimates (2007-2011) Block Group data. Population numbers have been rounded to the nearest hundred; percentages have been rounded to the nearest whole number.

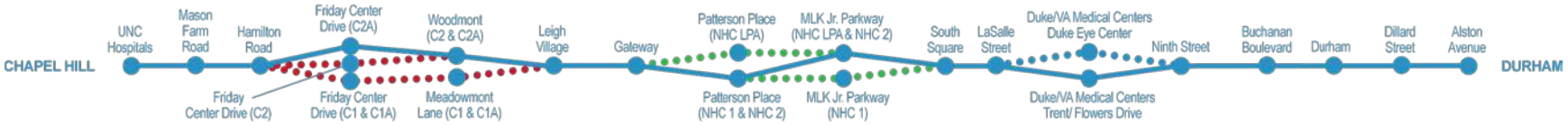


Table 4.2-3: Estimated Median Household Income by Evaluation Area, 2010

Area	2010
UNC Campus Area	$39,526
East Chapel Hill	$66,391
Leigh Village	$76,003
US 15-501 Corridor	$87,902
Duke West Campus & Medical Center	$47,533
Old West Durham / Duke East Campus	$43,236
Downtown Durham	$25,690
East Durham	$24,019
Total (Average) of Evaluation Areas	$51,287

Source: U.S. Census; 2010 ACS 1- year estimates.
Note: Numbers may not sum due to rounding.

Table 4.2-4: Station Area Socioeconomic and Demographic Conditions Compared to NEPA Preferred Alternative

	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives [b]			New Hope Creek Alternatives		Duke/VA Medical Centers
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center [c]
Population								
2010	-	25,500	-100	-100	0	0	0	600
2040	-	53,000	-1,000	-1,000	0	0	0	-200
Households								
2010	-	12,600	-100	-100	0	0	0	0
2040	-	25,800	-600	-600	0	0	0	100
Employment								
2010	-	75,000	500	500	0	0	0	200
2040	-	119,100	0	0	0	0	0	-100
Limited English Proficient Population								
2007-2011	-	2,700	0	0	0	0	0	100
Zero Car Households								
2007-2011	-	2,400	10	10	0	0	0	10

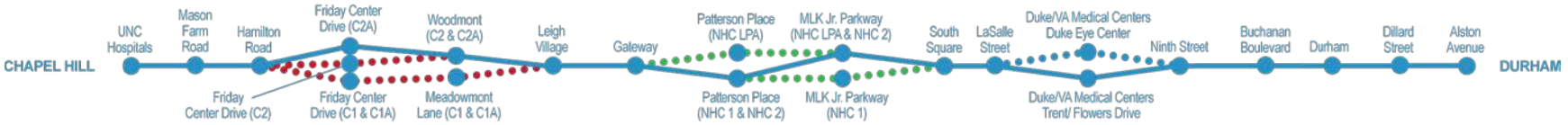


Table 4.2-4: Station Area Socioeconomic and Demographic Conditions Compared to NEPA Preferred Alternative

	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives [b]			New Hope Creek Alternatives		Duke/VA Medical Centers
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center [c]
Under 18/Over 65								
2007-2011	-	10,900	-60	-60	0	0	0	100

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] Variance from NEPA Preferred Alternative for cluster total that includes Hamilton Road Station, Friday Center Drive Station and either the Meadowmont Lane Station (C1/C1A) or Woodmont Station (C2/C2A).

[c] Variance from NEPA Preferred Alternative for cluster total that includes the LaSalle Street Station and Ninth Street Station because of overlapping in ½-mile buffers.

Table 4.2-5: Tax Base Effects of NEPA Preferred and Project Element Alternatives and Economic Impacts during Construction

County	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives			New Hope Creek Alternatives		Duke/VA Medical Centers [b]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Orange	$ -	$3,280,000	$160,000	$160,000	$40,000	$ -	$ -	$ -
Durham	$ -	$52,630,000	$2,130,000	$4,570,000	$1,010,000	$2,870,000	$5,640,000	$ -
Total	$ -	$55,910,000	$2,290,000	$4,730,000	$1,050,000	$2,870,000	$5,640,000	$ -

Source: Vantage Point, AECOM 2015.

Note: Totals in the tables are rounded to the nearest $1,000.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] Due to the fact that the Duke/VA Medical Centers Station Alternatives would be located on a common light rail alignment, it is not anticipated that the Duke Eye Center Station Alternative would result in a change in the property tax base.

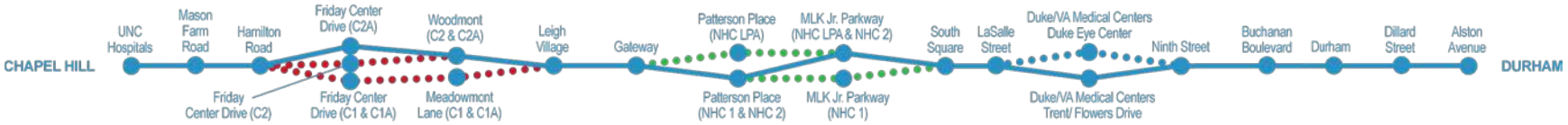


Table 4.2-6: Incremental Labor, Cost, and Earnings from Annual Operations and Maintenance

	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[c]			New Hope Creek Alternatives[c]		Duke/VA Medical Centers [b, c]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Labor/Costs/Earnings	$0	$22,940,000	-$40,000	+$30,000	+$10,000	-$70,000	+$25,000	+$0
Employment (FTE)	0	480	-1	+0	+0	-2	+0	+0

Source: Vantage Point, AECOM 2015.

Note: Constant 2015 Dollars.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] - Due to the fact that the Duke/VA Medical Centers Station Alternatives would be located on a common alignment, the Duke Eye Center Station Alternative would have the same ongoing labor, costs, and earnings from annual operations and maintenance.

[c] In comparison to the NEPA Preferred Alternative

Table 4.2-7: Estimated Change in Property Tax Base – ROMF Alternatives

	Leigh Village	Farrington Road [a]	Patterson Place	Cornwallis Road	Alston Avenue
Orange	$ -	$ -	$ -	$ -	$ -
Durham	$ 1,550,000	$ 1,320,000	$ 3,790,000	$ 3,140,000	$ 18,010,000
Total	$ 1,550,000	$ 1,320,000	$ 3,790,000	$ 3,140,000	$ 18,010,000

Source: Vantage Point, AECOM 2015.

Note: 2015 Dollars.

[a] NEPA Preferred Alternative ROMF.

Table 4.2-8: Estimated Change in On-Site Employment—ROMF Alternative

ROMF Alternatives	Employment		
	Existing	ROMF	Net Change
Leigh Village	< 25	110-175	+85 to +150
Farrington Road [a]	< 25	110-175	+85 to +150
Patterson Place	< 25	110-175	+85 to +150
Cornwallis Road	< 25	110-175	+85 to +150
Alston Avenue	150-250	110-175	-140 to +25

Source: Vantage Point, AECOM; National Transit Database 2012; U.S. Census Center for Economic Studies.

[a] NEPA Preferred Alternative ROMF.

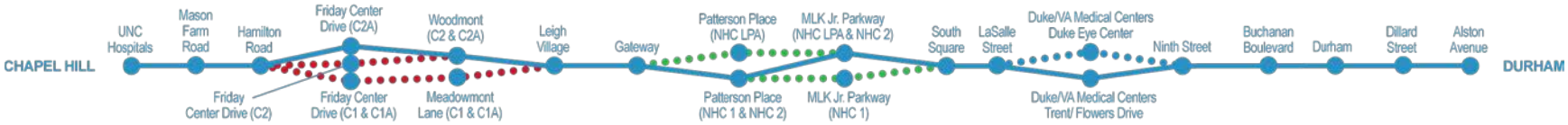


Figure 4.2-1: Limited English-Speaking Populations in Study Area

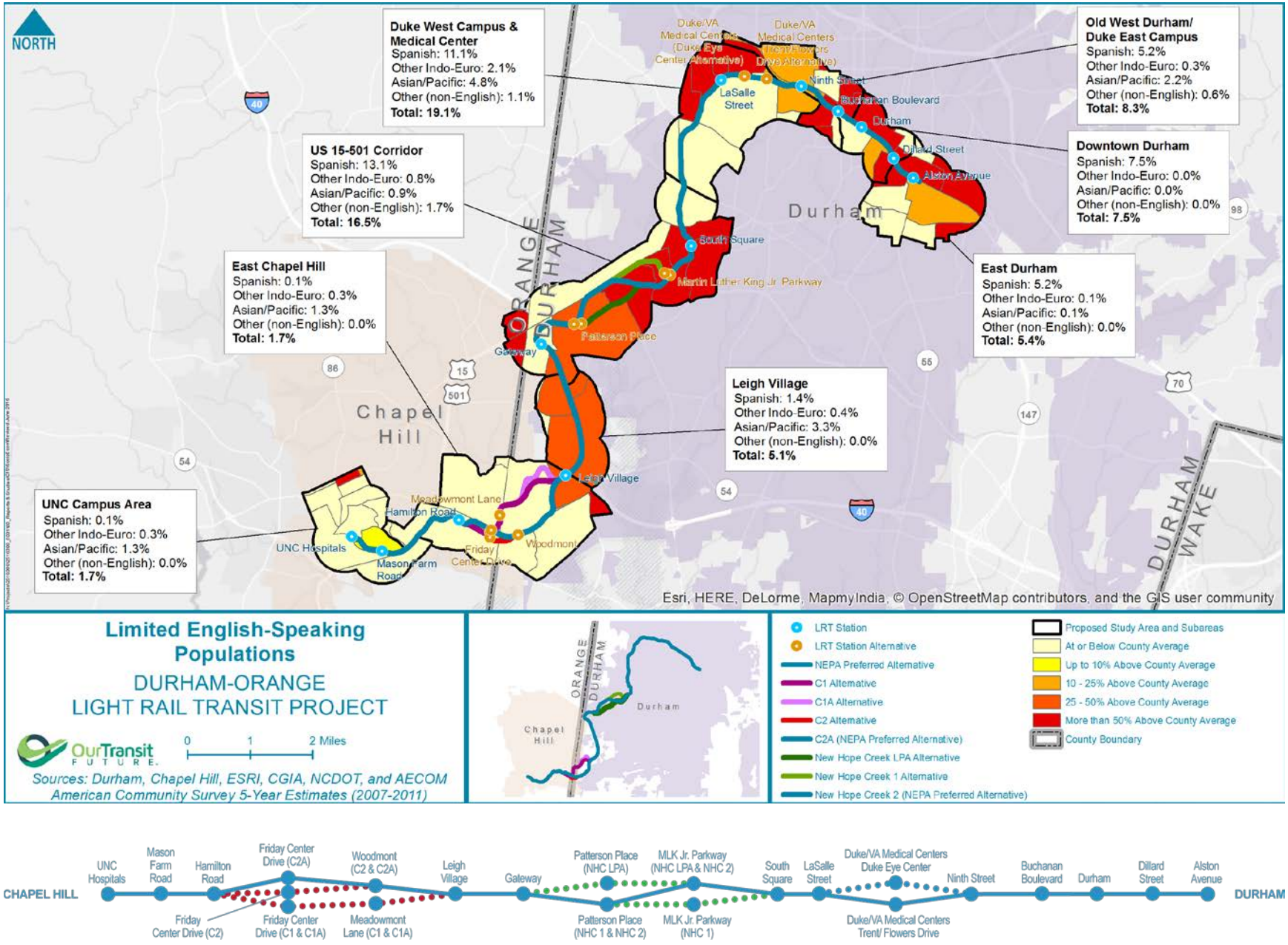
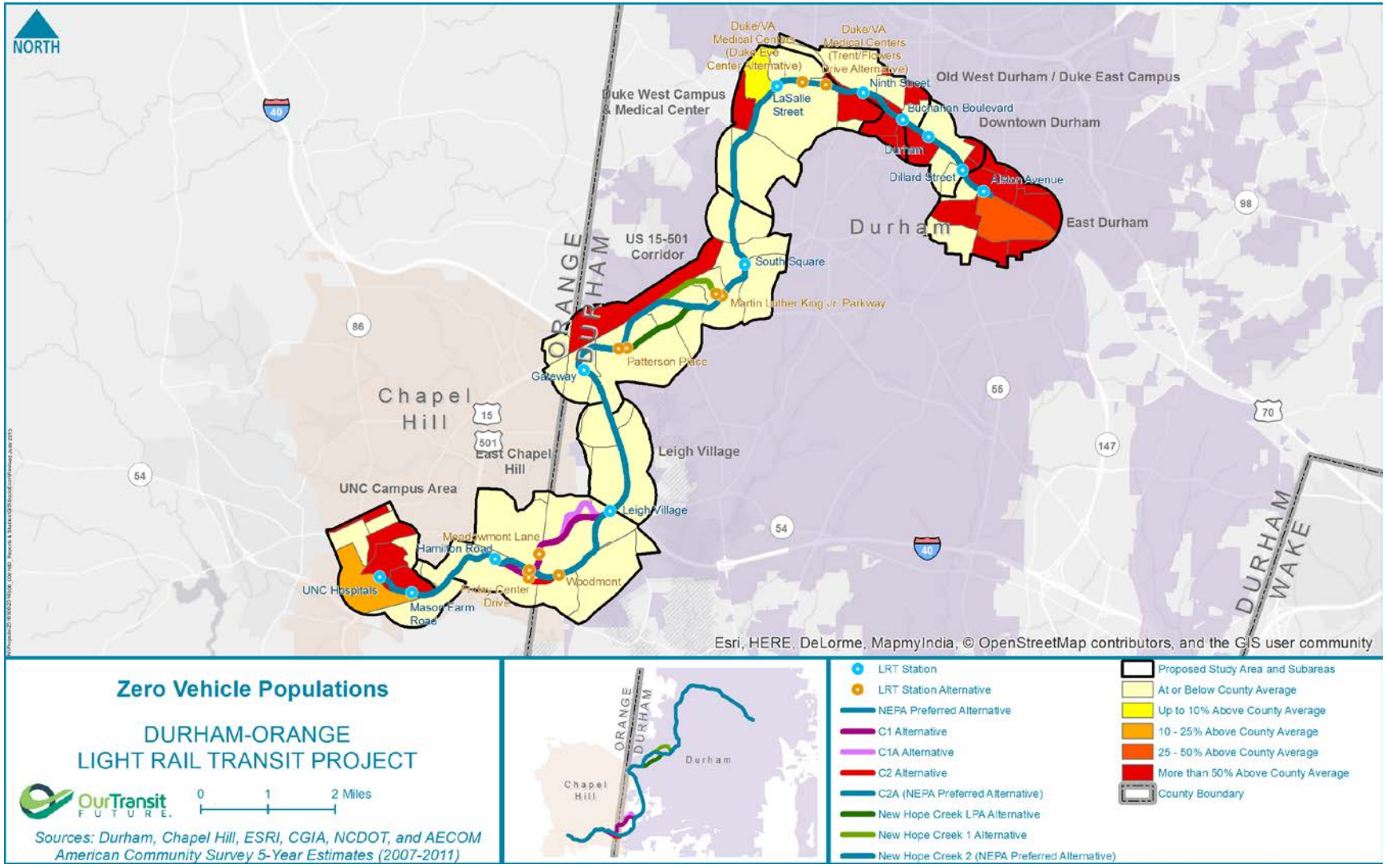


Figure 4.2-2: Zero Vehicle Populations in Study Area



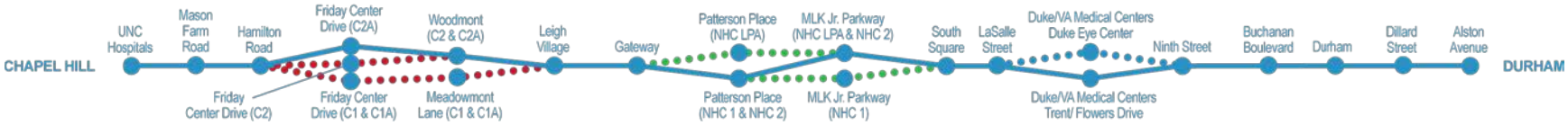
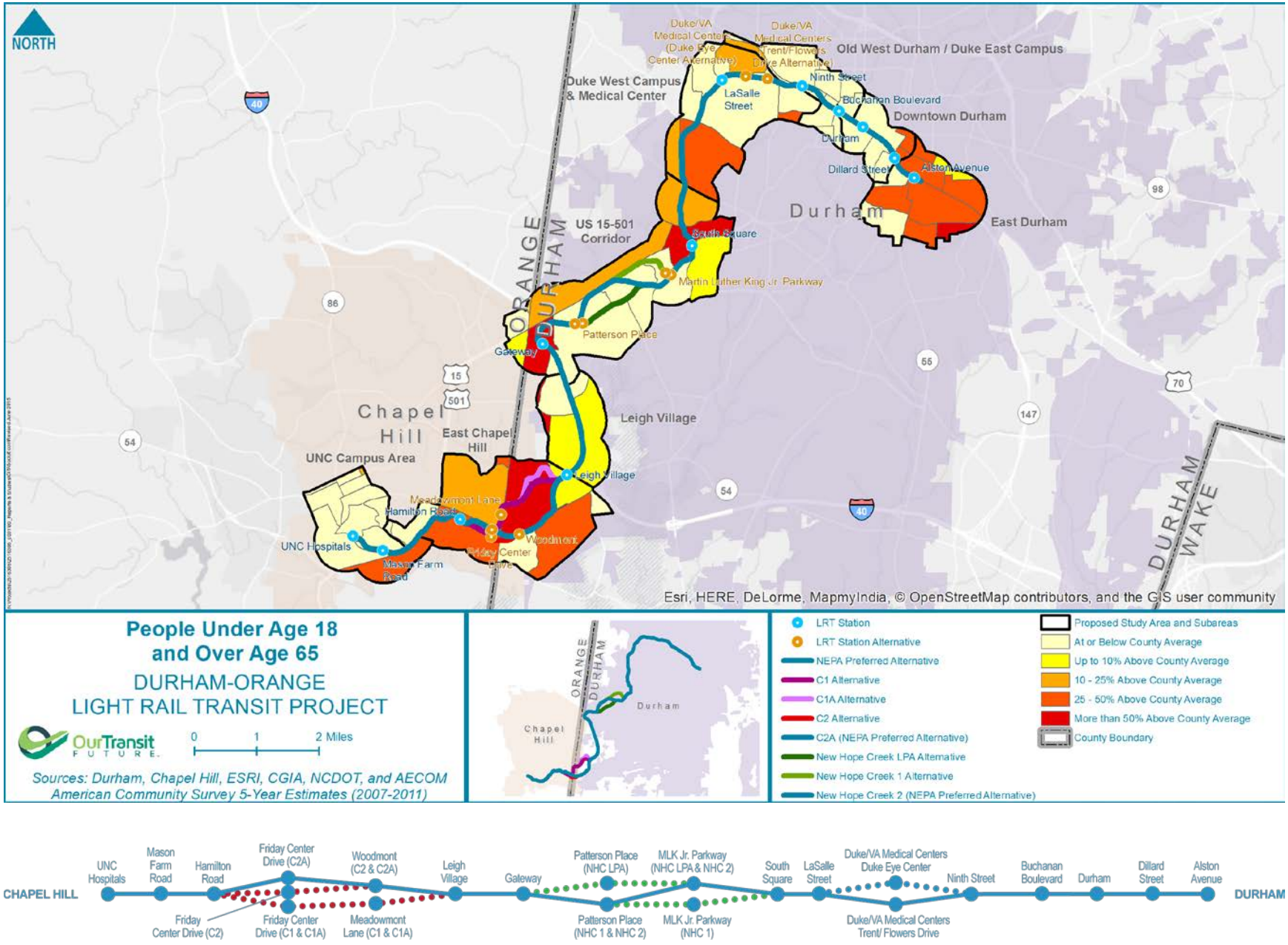


Figure 4.2-3: People Under Age 18 and Over Age 65 in Study Area



4.3 Neighborhoods and Community Resources

This section describes neighborhoods and community resources within the D-O Corridor and the potential direct effects that would be associated with the NEPA Preferred and Project Element Alternatives in comparison to the No Build Alternative. Detailed descriptions of neighborhoods and community resources in the study area are included in appendix K.14 and indirect effects are discussed in DEIS section 4.17. Effects to environmental justice communities are evaluated in DEIS chapter 5.

4.3.1 Methodology

The study area for evaluating neighborhoods and community resources includes the land area within ¼-mile on either side of the proposed alignment(s) and in a ½-mile radius from proposed stations. This represents the area where project benefits are likely to be greatest as well as the average distance that a person is willing to walk to access a station. It also includes university and neighborhood boundaries identified by local stakeholders.

Neighborhoods and potential impacts to neighborhoods are described using eight evaluation areas, developed by grouping the project corridor into areas using the following criteria (see **Figure 4.3-1**):

- Similarities in land use and context
- Proximity to and likeliness of using a particular proposed station, park-and-ride facility, or ROMF
- Transportation functionality/connectivity

Descriptions of study area neighborhoods are based on site visits, aerial photography, internet research, interviews with local planners, and local planning documents. Neighborhoods are described qualitatively in terms of their general land use and socioeconomic characteristics. Major community resources in each evaluation area are noted. Community resources provide basic needs and services to communities and neighborhoods and include the following:

- Educational facilities
- Places of worship
- Public safety services and facilities
- Medical and social service facilities
- Community centers and event resources
- Government offices
- Libraries
- Post offices

Data on community resources were obtained in part from the North Carolina Center for Geographic Information and Analysis, Orange and Durham counties' GIS departments, ADC Map books, and field reviews conducted in July and September 2013. In addition, information was confirmed during interviews with local municipal planners, who provided additional insights. Information on specific resources, including addresses and other descriptive data, was obtained from field visits and internet research. A detailed inventory of community resources in the study area is included in appendix K.14.

Due to the large number of places of worship (more than 80 in the study area), they are not discussed in this section unless they would be directly affected by the project. In addition, recreational resources, including parks, trails, and greenways, and bicycle and pedestrian facilities are not discussed in this section; refer to DEIS section 4.6 for information on these resources.

Potential effects are discussed qualitatively in terms of the following types of impacts. The magnitude of impact was generally determined based on review of the preliminary design plans, relative level of perceived impacts, public input, professional judgment, and knowledge of the study. How each criterion was assessed is described below:

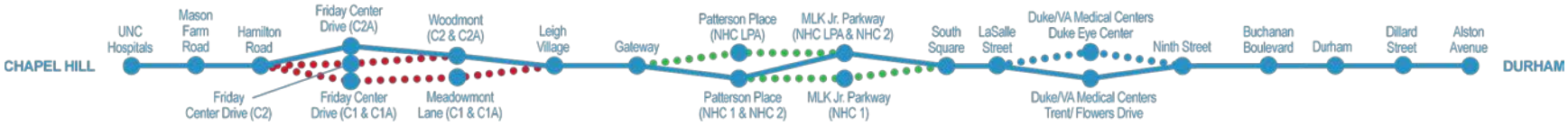
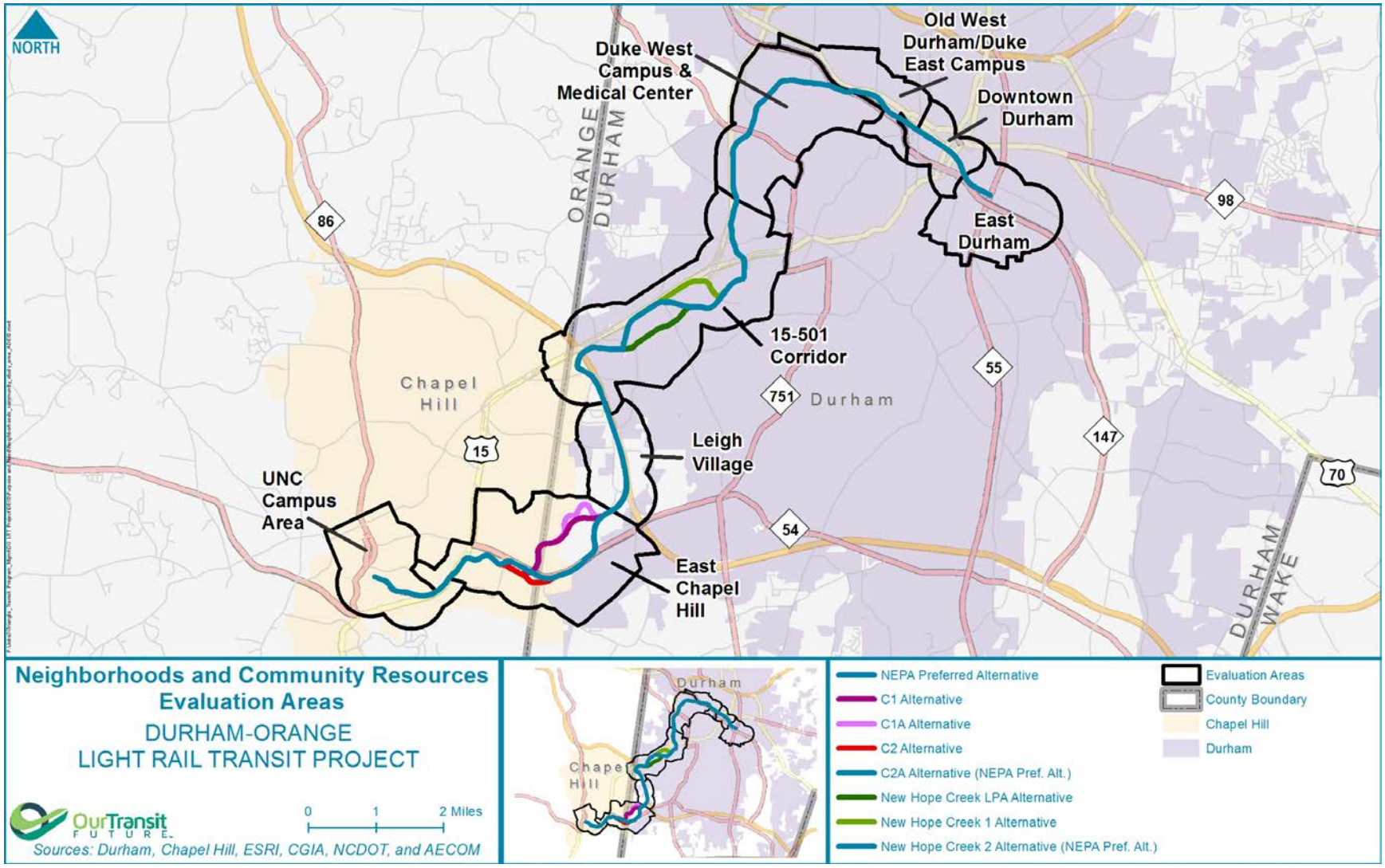


Figure 4.3-1: Neighborhoods and Community Resources Evaluation Areas



- **Access and Mobility** - Access and mobility may be affected when changes are made to the transportation network. Changes to the transportation network because of the proposed D-O LRT Project are described in chapter 3, Transportation. While the terms "access" and "mobility" are often used interchangeably when discussing a transportation project, they have distinct definitions and care should be taken to use the appropriate term for a given circumstance. These definitions apply to all modes of transportation, including non-vehicular transport.

  Access - the ability to reach private property from a transportation network.

  Mobility - the ability to move around a transportation network.

  – Access effects were assessed by determining where the alternatives would result in changes to the existing pattern of vehicular or pedestrian/bicycle traffic, how they would restrict access at locations where access currently exists, or where new or enhanced access would be provided.

  – Mobility effects were assessed through the change in transportation options, as well as changes in the efficiency of travel. These impacts are indicated by the expansion, addition, reduction, or removal of travel lanes, transit, or pedestrian facilities.

Introduction of an at-grade light rail crossing to a roadway is not considered an impact to neighborhood access or mobility since the potential for disruption caused by the gate operations is intermittent and very short. Impacts of at-grade crossings on overall traffic operations of the roadway network are discussed in DEIS section 3.2.

- **Community Cohesion** – Community cohesion reflects a variety of factors including the degree to which people have a sense of belonging to their neighborhood or community; are connected by social, work, or other relationships; share values or a common vision for their community; or share other bonds linking individuals to one another or to their community as a whole.

  Community cohesion effects are assessed by determining potential disruption in the interaction among people and groups within a community, the use of community resources, residential stability, and length of time residents have resided in the community. These impacts may occur because of a physical barrier, change in land use, or other effects of a project. Public input received on the proposed project was also considered.

- **Community Resources** - Community facility effects are assessed by determining whether there are property impacts or changes in access or parking that would affect community resources.

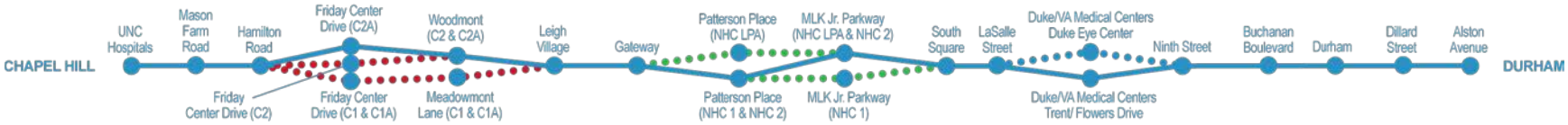
4.3.2 Affected Environment

The following sections describe the affected environment for the NEPA Preferred and Project Element Alternatives using eight evaluation areas described in DEIS section 4.1.

4.3.2.1 UNC Campus Area

This area includes the UNC main campus, UNC medical facilities, downtown Chapel Hill's business district on Franklin Street and Rosemary Street to the north, and residential neighborhoods, such as Forest Hills, Westwood, and Rocky Ridge Farm, to the east and south of the university. **Table 4.3-1** presents the community resources in this evaluation area.

This area also has high proportions of low-income (DEIS chapter 5) and transit dependent populations (DEIS section 4.2) due to the number of UNC students living in this area.



4.3.2.2 East Chapel Hill

The East Chapel Hill area includes the NC 54 corridor serving Chapel Hill and spans the Orange-Durham county border. This area is characterized by a mix of older, small lot, single-family and multi-family neighborhoods and newer, higher density, mixed-use development. Main residential areas include the Laurel Hill-Rocky Ridge area, Glen Lennox, the Oaks, and Meadowmont.

This area also includes Finley Golf Course and the NC Botanical Gardens. Neighborhoods surrounding the Botanical Gardens, such as Finley Forest and Downing Creek, generally have larger, wooded lots and winding streets. Other subdivisions in this area include The Highlands and Falconbridge. Major community resources in this area are listed in **Table 4.3-2**.

4.3.2.3 Leigh Village

The Leigh Village area includes the area between the I-40/NC 54 interchange and where Farrington Road crosses I-40. This area is rural-suburban with scattered single-family homes. There are also a few small suburban subdivisions in the area west of I-40 between George King Road and Farrington Road, including Marena Place, Weston Downs, Glenview Park, Prescott Place, Chicopee Hills, and Devonshire.

Table 4.3-3 identifies the community resources in this area.

4.3.2.4 US 15-501 Corridor

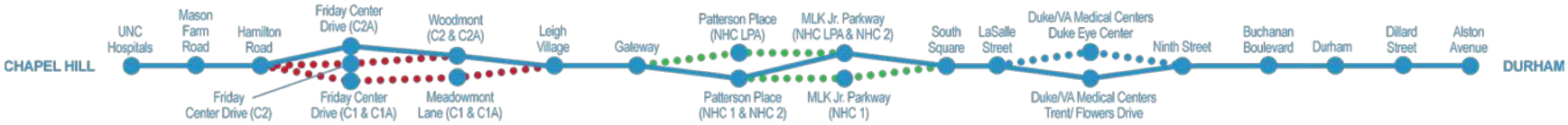
The US 15-501 Corridor area includes the US 15-501/I-40 interchange and the US 15-501 Corridor east to Cornwallis Road, including the New Hope Creek area and the South Square area. The corridor is characterized by commercial and retail development, including the New Hope Commons, Patterson Place, and South Square shopping centers. These shopping areas are surrounded by residential areas ranging from large lot single-family homes to large apartment complexes.

Durham neighborhoods in the area include Five Oaks, Westgate Townes, Valley Run, Parc at University Tower, Cameron Woods, Pickett Park, The Commons, Beech Hill, The Forest at Duke, Duke Forest, and Colony Park. Apartment complexes include Level 51 Ten Student Apartments, Lenox at Patterson Place Apartments, Colonial Grand Apartments, Oak Creek Village, Glenbrook, Beech Lake Apartments, Springfield Apartments, Laurel Trace Apartments, Alden Place, The Mews Townhomes, South Square Townhomes, South Point Apartments, Pinnacle Ridge Apartments, Royal Oaks Apartments, and Hawthorne at the View Apartments. The area's community resources are listed in **Table 4.3-4**.

4.3.2.5 Duke West Campus and Medical Center

The Duke West Campus and Medical Center area extends from Cornwallis Road to Campus Drive, including the Washington Duke Golf Course and Duke University's West and Central campuses and Medical Center complex. The area also includes residential and commercial areas bounded by Erwin Road to the south, US 15-501 to the west, and NC 147 to the north. Two of the region's largest employers are located in this area – Duke University Medical Center and the Durham VA Medical Center. Most of the property in this area south of Erwin Road is owned by Duke University and is intensely developed as part of the campus or the medical center. In the *Durham Comprehensive Plan*, the medical center area is identified as a Compact Neighborhood, Durham's equivalent of a transit-oriented district. Refer to DEIS section 4.1 for discussion on the comprehensive plan. Community resources in this area are identified in **Table 4.3-5**.

Durham neighborhoods in this area include Welcome Circle, Duke Forest, and Crest Street. Duke University West and Central campuses provide housing for undergraduate and graduate students. While there is some new mixed-use development along Erwin Road, particularly around the intersection with LaSalle Street, the area



remains predominantly a mix of older and newer multi-family residential neighborhoods. Apartment complexes, many catering to Duke University graduate students, are located farther north of Erwin Road along Morreene Road and LaSalle Street, including Belmont Apartments, Poplar West Apartments, Bradford Ridge Apartments, Lofts at Lakeview, Campus Walk, Heights at LaSalle, and Trinity Commons at Erwin.

This area has high proportions of low income (DEIS chapter 5) and transit dependent populations (DEIS section 4.2) due to the number of Duke University students living in this area. Proportions of minority and limited English proficiency (LEP) populations are also high; with the LEP concentration being the highest of all areas (DEIS section 4.2).

4.3.2.6 Old West Durham/Duke East Campus

The Old West Durham/Duke East Campus area includes Old West Durham, Duke East Campus and surrounding neighborhoods (Trinity Heights and Trinity Park), Ninth Street, and the Burch Avenue area. In Old West Durham, homes are single-family, detached residences that vary in style. Trinity Heights and Trinity Park are historic neighborhoods comprised of tree-lined streets and older homes in an urban setting. Some houses have been updated and many are listed on the National Register of Historic Places. Residents in this area are a diverse mix of owners and renters from a variety of ethnic backgrounds.

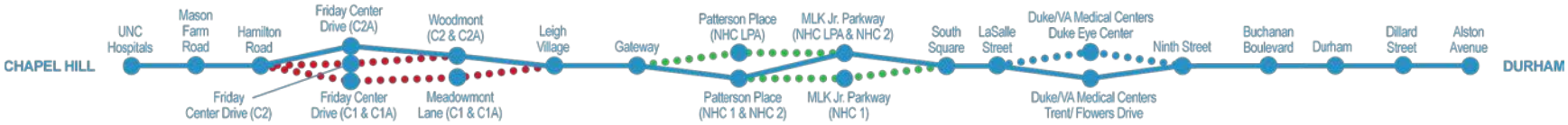
The Ninth Street area is a mixed-use urban neighborhood between Duke University's Central and East Campuses that includes a three- to four-block long commercial corridor with a mix of shops and restaurants, a rehabilitated historic textile warehouse converted to apartments and offices, and several new apartment complexes. In the *Durham Comprehensive Plan* and Unified Development Ordinance, the Ninth Street area is identified as a Compact Neighborhood. Refer to DEIS section 4.1 for more information on the comprehensive plan.

Burch Avenue, part of Durham's historic West End, features a wide range of historic house styles and sizes, including small- to mid-sized homes, historic duplexes, and rental properties. **Table 4.3-6** presents community resources in this area.

4.3.2.7 Downtown Durham

The downtown Durham area includes the Warehouse District, Central Park, Central Business District, Southside, Cleveland-Holloway, and Morehead Hill areas. The existing railroad corridor bisects the evaluation area. The Warehouse District, Central Park, Brightleaf Square retail area, and the Central Business District are located north of the rail corridor. Much of this area falls within the downtown Durham Historic District, which has specific zoning and design standards to preserve its historic integrity. These neighborhoods consist of a mixture of both new and historic office, commercial, and residential buildings, some of which are mixed use. Located to the south of the railroad tracks are more large-scale entertainment-focused venues, including the American Tobacco Campus, Durham Bulls Athletic Park, and the Durham Performing Arts Center (DPAC) as well as over 1 million square feet of office space and some apartments in and around the American Tobacco Campus. The Durham Amtrak Station and the Durham Intermodal Transportation Center (Durham Station) are located in this area. NC 147 also divides the area, separating the Southside and Morehead Hill neighborhoods from downtown Durham. These communities south of NC 147 are primarily single-family residential.

Table 4.3-7 identifies the community resources in this area, many of which are associated with the City of Durham or Durham County government or are cultural facilities commonly found in downtown settings, such as theaters, museums, the performing arts center, and convention facilities.



4.3.2.8 East Durham

The east Durham area includes the campuses of NCCU and Durham Technical Community College. The area also includes the Northeast Central Durham neighborhoods of Albright, Eastway Village, Golden Belt, Edgemont, old east Durham, and Hoover Road/Owen Street, as well as the Southeast Central Durham area. The area has long been divided by the railroad tracks, and more recently by the construction of NC 147 in the 1960s and 1970s. Many of these neighborhoods have experienced a lack of investment over the last several decades; however, some are now transitioning or are planned for redevelopment. There is a mix of single-family homes (some vacant) and apartments. Along the railroad tracks, there are some industrial uses. Community resources in this area are listed in **Table 4.3-8**.

4.3.3 Environmental Consequences

This section discusses the effects of the NEPA Preferred and Project Element Alternatives compared to the No Build Alternative on neighborhoods and community resources in the study area. The following sections describe potential effects of the project alternatives on these resources.

Under the No Build Alternative, neighborhoods and community resources in the study area would not benefit from enhanced access to transit and the resulting increased mobility associated with implementation of the NEPA Preferred and Project Element Alternatives.

The introduction of the physical elements of the NEPA Preferred and Project Element Alternatives, when in proximity to neighborhoods and community resources, would have potential to cause both positive and negative impacts. The NEPA Preferred and Project Element Alternatives would include new stations, park-and-ride facilities, substations, maintenance facility, trackwork, and an overhead catenary system located along neighborhoods within the corridor and would result in permanent physical changes in the light rail corridor, as well as changes to local traffic operations and street patterns. **Table 4.3-9** is a summary of effects that could be expected throughout the corridor from implementing the NEPA Preferred and Project Element Alternatives. Potential impacts are included in **Table 4.3-9** and discussed in the following sections. For a detailed discussion of the analysis in each evaluation area by alternative, see appendix K.14.

4.3.3.1 NEPA Preferred Alternative

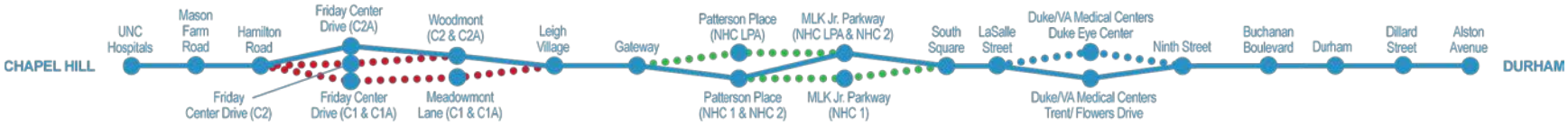
East Chapel Hill Area

Access and Mobility

The NEPA Preferred Alternative would be directly behind Glenwood Elementary School and would form a barrier between the school and neighborhoods to the south, including Highland Woods. The wooded area behind the school is used for educational purposes by several classes at the school. Protective fencing will be placed along the alignment to ensure the safety of the school children but will also eliminate access to the wooded area as an outdoor classroom.

Community Resources

UNC's Friday Center would benefit from improved access provided by the NEPA Preferred Alternative. Access to community resources in Meadowmont would be improved over the C2 Alternative but not as much as the C1 and C1A Alternatives due to the greater walking distance that would be required from the proposed station (see DEIS section 4.3.4.2).



US 15-501 Corridor

Access and Mobility

The NEPA Preferred Alternative would follow the property line between Springfield Apartments and Laurel Trace Apartments to University Drive. Travel patterns would be modified in and around these complexes as Larchmont Road (access to Alden Apartments and Westgate Condominiums) would be restricted to a right turn only at University Drive.

Duke West Campus and Medical Center

Community Resources

The NEPA Preferred Alternative would require the demolition of Duke's John Hope Franklin Center, and Triangle Transit will work with Duke University to ensure that the services provided at that facility are relocated and maintained. In addition, access and parking at Duke University Hospital and the Durham VA Medical Center would be affected. Right-of-way acquisition would be required from institutional uses along both sides of Erwin Road to accommodate Erwin Road travel lanes and the NEPA Preferred Alternative. This would require the reconfiguration of parking lots and access to some facilities along Erwin Road, such as the Durham VA Medical Center and Duke University. Access to these facilities would be maintained, though some would be restricted to right turns only. Based on coordination with Duke University Medical Center, full access would be maintained at Emergency Drive.

Old West Durham/Duke East Campus

Community Resources

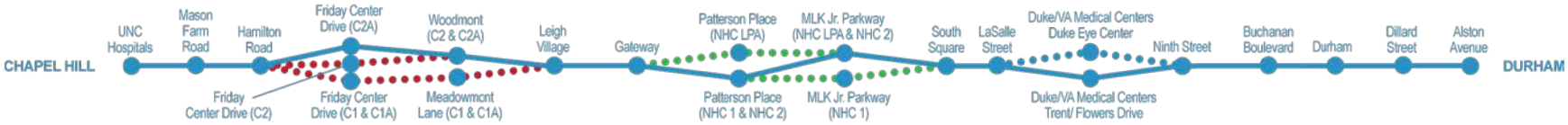
Several community resources are located in this area, including medical services and facilities associated with Duke University. Medical services include Pettigrew Rehabilitation Center, West Pettigrew Dialysis Center, medical offices in the E.K. Powe House, and Hillcrest Convalescent Center. As discussed below there could be changes in access and parking associated with individual properties.

The proposed Ninth Street Station would be on an elevated platform on retained fill, and the NEPA Preferred Alternative would continue on aerial structure across Erwin Road and follow the south side of West Pettigrew Street through parking areas associated with Pettigrew Rehabilitation Center, West Pettigrew Dialysis, and E.K. Powe House. The NEPA Preferred Alternative would be elevated over Swift Avenue before turning south away from Pettigrew Street on aerial structure on new transportation right-of-way across the entrance and parking for Hillcrest Convalescent Center.

Access to Pettigrew Rehabilitation Center, West Pettigrew Dialysis, and E.K. Powe House would remain from Pettigrew Street, though cars would pass under the proposed aerial structure, and parking areas for each would be reconfigured to accommodate structural supports.

Additionally, the NEPA Preferred Alternative would cross the existing entrance to Hillcrest Convalescent Center from West Pettigrew Street, as well as some parking areas associated with the facility. There would not be impacts to the facility's buildings. Other potential impacts, such as noise and vibration and visual impacts, are discussed in their respective sections of this DEIS.

Several Duke University facilities would be in close proximity to the alignment, including the Center for Documentary Studies, Smith Warehouse, and transportation services housed in a building on Buchanan Boulevard. The NEPA Preferred Alternative would impact parking associated with the Center for Documentary Studies. The NEPA Preferred Alternative would follow the property line between the Smith Warehouse parking lot and NC 147, and there would be no direct impacts to the Smith Warehouse. East of Buchanan Boulevard, warehouses used by Duke University transportation services would be demolished to make room for the NEPA Preferred Alternative and proposed Buchanan Boulevard Station.



East Durham

Community Resources

The property that includes the John Avery Boys and Girls Club, at the corner of Grant Street and Pettigrew Street, would be impacted when Pettigrew Street is shifted to accommodate the NEPA Preferred Alternative; however, there would be no impacts to buildings. A signal house would be included on the property in the vicinity of their recreational facilities. There would be enhanced access to the Boys and Girls Club due to proximity to the proposed Alston Avenue Station and from associated road and pedestrian improvements around the station, including improvements of Grant Street and Pettigrew Street, by introducing a marked crosswalk. The existing fence along the playground and field will either be maintained or replaced. Based on the fencing and improved sidewalk it is not anticipated that the NEPA Preferred Alternative would introduce a safety concern.

Farrington Road ROMF

Under the NEPA Preferred Alternative, the ROMF would be located west of I-40, just south of where Farrington Road crosses over I-40. The proposed site is located in a predominately large lot suburban/rural area. The introduction of a ROMF would remove six single-family homes and replace them with a ROMF. The Farrington Road ROMF would also require the acquisition of a portion of the parcel that contains Patterson's Mill Country Store. However, this is not the portion of the parcel where the store is located, but it would require modifying access to the store. In addition, the Farrington Road ROMF would avoid direct impacts to the Walter Curtis Hudson Farm, which is eligible for listing on the National Register of Historic Places. As a result, the store could remain with modifications to its access.

4.3.3.2 Project Element Alternatives

Little Creek Alternatives

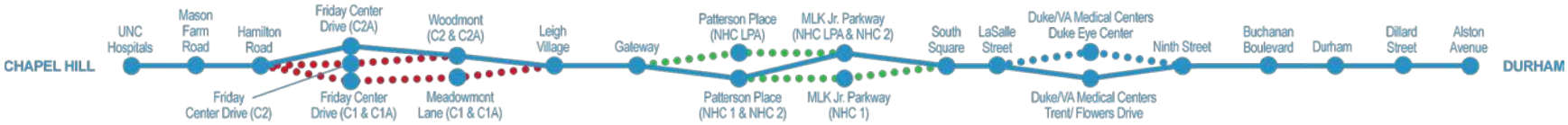
Community Cohesion

A future transit corridor was preserved through Meadowmont when the community was planned and constructed. However, some community residents have expressed opposition to the C1 and C1A Alternatives, stating that they believe the alignments would create a perceived barrier through the community, even though the location of the corridor had been well documented prior to development of the neighborhood, and the alignments would be primarily at grade. In particular, residents have expressed concerns about dividing The Cedars retirement facility from the rest of the Meadowmont community, although there would be at-grade crossings of the light rail tracks at Meadowmont Lane and Green Cedars Lane.

There would be no direct impacts to businesses in Meadowmont. The C1 Alternative would displace two single-family residences: one residence due to right of way needs, the second residence to mitigate for the predicted vibration/ground borne noise impacts and aesthetic impacts. The C1A Alternative would displace one single-family residence at Iron Mountain Road/Park Bluff Drive due to right of way needs for the alignment.

Through the more developed portions of the Meadowmont community, it is not anticipated that community cohesion would be affected. However, in the vicinity of Iron Mountain Road the loss of single-family homes would result in an effect on community cohesion. Iron Mountain Road is a small cul-de-sac in the northeastern portion of Meadowmont that is somewhat separated from the larger Meadowmont community. There are currently four single-family homes on Iron Mountain Road, and these residents consider themselves a community.

No impacts to neighborhoods or community resources are anticipated from the C2 Alternative.



New Hope Creek Alternatives

Effects to access and mobility enhancements and community cohesion would be the same as those described in the NEPA Preferred Alternative. No community resources would be directly impacted by the New Hope Creek Alternatives.

Duke/VA Medical Centers Station: Duke Eye Center

Impacts of the Duke Eye Center Station Alternative would be the same as those described for the NEPA Preferred Alternative.

ROMF Alternatives

The remaining ROMF alternatives are discussed in the following sections.

Leigh Village

The Leigh Village ROMF Alternative would be located between Farrington Road and I-40 near the intersection of Ephesus Church Road and Farrington Road. The proposed site is a large lot located in a predominately suburban/rural area. The introduction of a ROMF would remove a local landmark, Patterson's Mill Country Store, and several single-family homes, which would be uncharacteristic of current development in the area. The Leigh Village ROMF would require the acquisition of the Patterson's Mill Country Store property and Walter Curtis Hudson Farm, which is eligible for listing on the National Register of Historic Properties; refer to DEIS section 4.6 and DEIS chapter 6.

Patterson Place

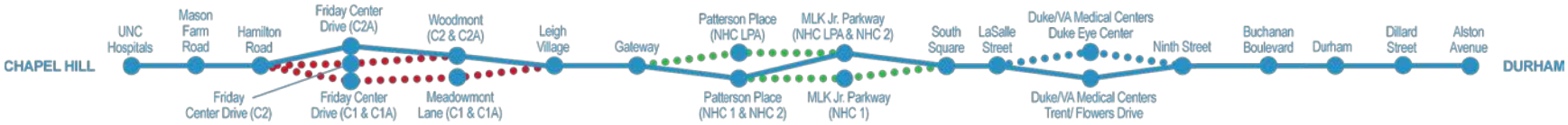
The Patterson Place ROMF Alternative would be located in an existing wooded area between US 15-501 and Colonial Grand Apartments east of Southwest Durham Drive. The NHC LPA Alternative would pass on the opposite side of the apartment complex, which means that the selection of this site would surround the complex with light rail infrastructure. Although the apartment complex is a cohesive community; it is isolated from the larger community by wooded area and its layout. The Patterson Place ROMF site is currently undeveloped; however, a development proposal was submitted to the City of Durham in October 2014 for this location. The Patterson Place ROMF Alternative may have an impact on the community cohesion of the apartment complex.

Cornwallis Road

The Cornwallis Road ROMF Alternative would be located east of US 15-501 and south of Cornwallis Road. The site is currently developed as an industrial site and the existing former Pepsi plant is being redeveloped into a self-storage facility. The proposed site is immediately adjacent to the existing Judea Reform Congregation, Levin Jewish Community Center (Levin JCC), and the Lerner Jewish Community Day School (Lerner School) campus (Campus). Western Bypass would be relocated to accommodate construction of the ROMF, as such, access to and use of the Campus may be affected. The Levin Jewish Community Center Campus is a cohesive community, with extensive outdoor facilities including a swimming pool, track, playgrounds, gardens, and reflection areas. The use of the facilities and community cohesion of the Campus may be affected by the presence of the Cornwallis Road ROMF. A portion of the Cornwallis Road ROMF site (2.5 to 3.5 acres) has been gifted to the Jewish Federation of Durham-Chapel Hill to expand the Campus. During public involvement, many who use the Campus's resources expressed concern that the ROMF may negatively affect community cohesion at the Campus (see also DEIS chapter 9).

Alston Avenue

The Alston Avenue ROMF Alternative would be located east of the proposed Alston Avenue Station near Briggs Avenue, between Pettigrew Street and NC 147. The site is currently an industrial area and includes buildings and paved parking areas. The site is regularly accessed by large trucks and has rail access. The ROMF would not require freight rail access, so the existing spur would be removed. The



relocation of several of the existing businesses including Brenntag and Eastern Carolina Organics and the resulting loss in employment (150 to 250 jobs) would have an impact on community cohesion in the area as those workers may frequent local businesses. In addition, residents voiced concern that if these businesses leave the area, it may be more difficult to attract new industrial businesses because there will be a smaller existing base.

4.3.4 Mitigation Measures

Under the No Build Alternative, there would be no impacts to neighborhoods or community cohesion due to the proposed D-O LRT Project. As such, project-related mitigation would not be warranted.

4.3.4.1 NEPA Preferred Alternative

A summary of mitigation measures is provided below for the impacts associated with the NEPA Preferred Alternative. For further information, refer to the technical reports provided for each resource. Triangle Transit will continue to coordinate with affected residents, businesses, and community facilities to identify strategies to minimize the effects of the NEPA Preferred Alternative.

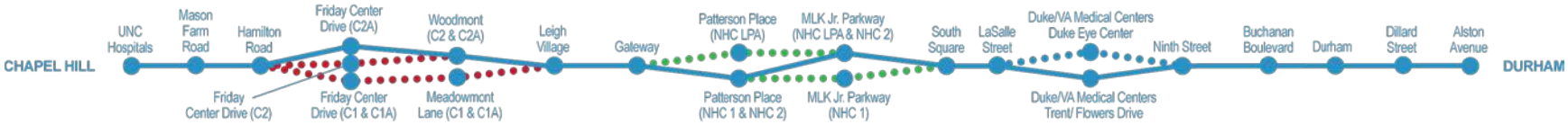
- For potential impacts to the Glenwood Elementary School, protective fencing will be placed along the proposed alignment and a pedestrian underpass will be designed to preserve access to the trails and enhance safety along the path. .
- Impacts to the Patterson's Mill Country Store and surrounding residential development from the NEPA Preferred Alternative and Farrington Road ROMF will be mitigated through landscaping, vegetative screening, and modified access to the store.
- To mitigate the impact of restricting Larchmont Road to a right turn only at University Drive, a new roadway connection will be constructed between Larchmont Road and Snow Crest Trail to provide access from Larchmont Road to the signalized intersection at Snow Crest Trail and University Drive.
- Due to the widening of Erwin Road proposed as part of the project, care will be taken to provide safe and convenient pedestrian access across the corridor.
- Mitigation for impacts to the John Hope Franklin Center will include working with Duke University to ensure that the services provided at that facility are relocated and maintained.
- Mitigation of the potential for spillover parking in station areas will include monitoring and coordination with local jurisdictions and institutional stakeholders to implement and enforce parking management policies.
- For potential impacts to the John Avery Boys and Girls Club, the existing fence will either be maintained or replaced along the field and playground, and improvements to the recreational facilities will be made. Also, road and pedestrian improvements along Grant Street and Pettigrew Street will be implemented including a marked crosswalk.
- The displaced residences would be relocated in accordance with Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R. Part 24). Triangle Transit will continue to coordinate with affected residents, businesses, and community facilities to identify strategies to minimize the effects.

4.3.4.2 Project Element Alternatives

Little Creek Alternatives

None of the mitigation measures described in section 4.3.4.1, NEPA Preferred Alternative, are associated with the portion of the alignment in the vicinity of Little Creek (C2A). Additional mitigation will be required if the C1 or C1A Alternatives are selected.

In the Meadowmont community, improvements will be implemented to



maintain pedestrian connectivity to The Cedars, including a marked crosswalk. .

New Hope Creek Alternatives

No additional mitigation will be required for the implementation of the NHC LPA or NHC 1 Alternative.

Duke/VA Medical Centers Station: Duke Eye Center

The Duke Eye Center Station Alternative will have similar impacts as the NEPA Preferred Alternative's Trent/ Flowers Drive Station Alternative. Mitigation for impacts to the John Hope Franklin Center will include working with Duke University to ensure that the services provided at that facility are relocated and maintained. Triangle Transit will continue to coordinate with Duke University to identify strategies to minimize the effects of the impacts associated with the Duke Eye Center Station Alternative.

ROMF Alternatives

Mitigation strategies for the impacts of the ROMF Alternatives will be site-specific. Triangle Transit will continue to coordinate with affected residents, businesses, and community facilities to identify strategies to minimize the effects of the selected ROMF Alternative. Mitigation associated with the each of the ROMF Alternatives is discussed below, with the exception of the Farrington Road ROMF included in the NEPA Preferred Alternative which is discussed in DEIS section 4.3.4.1.

- **Leigh Village**: Impacts to the Walter Curtis Hudson Farm will be mitigated in accordance with Section 106 and Section 4(f) requirements, refer to DEIS section 4.5 and DEIS chapter 6. The displaced residents of the single-family homes will be relocated in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R. Part 24).
- **Patterson Place**: To mitigate impacts to community cohesion for the Colonial Grand Apartments, enhanced pedestrian access, landscaping, and a visual barrier will be implemented.
- **Cornwallis Road**: Impacts to the Levin Jewish Community Center campus will be mitigated through fencing, landscaping and a visual barrier. Acquisition of the Jewish Federation of Durham-Chapel Hill property would be mitigated consistent with other property acquisition, as discussed in section 4.14.4.
- **Alston Avenue**: The relocation of several of the existing businesses including Brenntag and Eastern Carolina Organics will be performed in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R. Part 24).

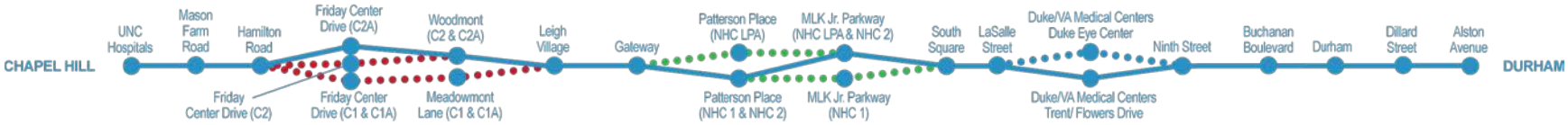


Table 4.3-1: UNC Campus Area Community Resources

Type of Resource	Name	Location
Schools	UNC	Chapel Hill
	Montessori Academy of Chapel Hill and daycare	1200 Mason Farm Road, Chapel Hill
Public Safety and Services	UNC Public Safety Department	285 Manning Drive, Chapel Hill
	South Orange Rescue Squad	202 Roberson Street, Carrboro
	Chapel Hill Fire Station #1	403 Martin Luther King, Jr. Boulevard, Chapel Hill
Medical Facilities	Ambulatory Care Center	102 Mason Farm Road, Chapel Hill
	NC Memorial Hospital	101 Manning Drive, Chapel Hill
	NC Clinical Cancer Center	101 Manning Drive, Chapel Hill
	NC Women's and Children's Hospitals	101 Manning Drive, Chapel Hill
	NC Neurosciences Hospital	101 Manning Drive, Chapel Hill
	UNC Family Medicine Center	590 Manning Drive, Chapel Hill
Social Services	Community House	100 West Rosemary Street, Chapel Hill
Special Event Facilities	Ackland Art Museum	101 South Columbia Street, Chapel Hill
	Coker Arboretum	100 Old Mason Farm Road, Chapel Hill
	Morehead Planetarium	250 East Franklin Street, Chapel Hill
	Wallace Plaza	150 East Rosemary Street, Chapel Hill
	Kenan Memorial Stadium	104 Stadium Drive, Chapel Hill
	Dean Smith Center	300 Skipper Bowles Drive, Chapel Hill
	Memorial Hall	141 East Cameron Avenue, Chapel Hill
	Forest Theatre	23 South Boundary Street, Chapel Hill
	NC Botanical Gardens – Reeves Auditorium	100 Old Mason Farm Road, Chapel Hill
Post Offices	Downtown Chapel Hill	179 East Franklin Street, Chapel Hill
	UNC Student Stores	207 South Road, Chapel Hill
Libraries	Davis Library & UNC University Libraries	208 Raleigh Street and various locations on UNC campus
County and Municipal Offices	Town of Chapel Hill	405 Martin Luther King, Jr. Boulevard, Chapel Hill

Source: Planning Communities 2015.

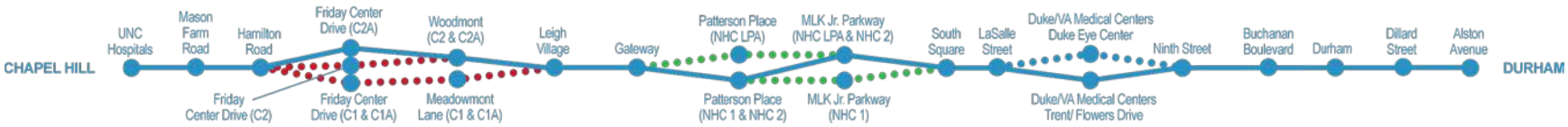


Table 4.3-2: East Chapel Hill Community Resources

Type of Resource	Name	Location
Schools	Glenwood Elementary School	2 Prestwick Road, Chapel Hill
	Rashkis Elementary School	601 Meadowmont Lane, Chapel Hill
	St. Thomas More School	920 Carmichael Street, Chapel Hill
Public Safety and Services	Chapel Hill Fire Station #2	1003 South Hamilton Road, Chapel Hill
	Durham Fire Station #16	6303 Farrington Road, Durham
Medical Facilities	UNC Imaging and Outpatient Center	1350 Raleigh Road, Chapel Hill
	UNC Health Care Heart Center	300 Meadowmont Village Circle, Chapel Hill
	Carolina Clinic at UNC	315 Meadowmont Village Circle, Chapel Hill
	UNC Hospital Wellness Center	100 Sprunt Street, Chapel Hill
	UNC Urgent Care	6013 Farrington Road, Chapel Hill
	Duke Medicine Primary Care	801 West Barbee Chapel Road, Chapel Hill
Social Services	Ronald McDonald House	101 Old Mason Farm Road, Chapel Hill
	SECU Family House at UNC Hospital	123 Old Mason Farm Road, Chapel Hill
	YMCA – Meadowmont	301 Old Barn Lane, Chapel Hill
Senior Services and Facilities	Carolina House of Chapel Hill	100 Lanark Road, Chapel Hill
	The Cedars of Chapel Hill Retirement Community	100 Cedar Club Circle, Chapel Hill
	Chapelwood	205 Hales Wood Road, Chapel Hill
	Clare Bridge of Chapel Hill	2230 Farmington Drive, Chapel Hill
	Wynwood of Chapel Hill	2220 Farmington Drive, Chapel Hill
Special Event Facilities	Paul J. Rizzo Conference Center	150 DuBose House Lane, Chapel Hill
	William and Ida Friday Center for Continuing Education	100 Friday Center Drive, Chapel Hill

Source: Planning Communities 2015.

Table 4.3-3: Leigh Village Community Resources

Type of Resource	Name	Location
Schools	Creekside Elementary School	5321 Ephesus Church Road, Durham
	Montessori Community School	4512 Pope Road, Durham
Special Event Facilities	Patterson's Mill Country Store	5109 Farrington Road, Chapel Hill

Source: Planning Communities 2015.

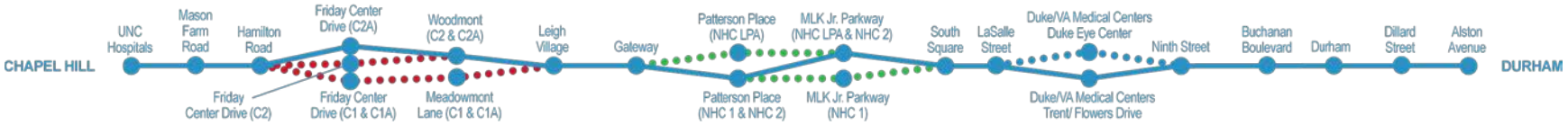


Table 4.3-4: US 15-501 Corridor Community Resources

Type of Resource	Name	Location
Schools	Sherwood Githens Middle School	4800 Old Chapel Hill Road, Durham
	Durham Academy (Middle School)	3116 Academy Road, Durham
	Montessori Children's House of Durham	2800 Pickett Road, Durham
	Sandra E. Lerner Jewish Community School	1935 Cornwallis Road, Durham
Public Safety and Services	Durham Police Department – District 3	8 Consultant Place, Durham
	Durham County Fire Station (Parkwood)	4200 Farrington Road, Durham
	Parkwood EMS Station 2	4200 Farrington Road, Durham
Medical Facilities	Duke Medical Plaza Patterson Place	5324 McFarland Drive, Durham
	North Carolina Orthopedic Clinic	3609 SW Durham Drive, Durham
	Southwest Durham Family Medicine	3612 Shannon Road, Durham
	Structure House	3017 Pickett Road, Durham
Social Services	Goodwill Community Foundation	4318 Garret Road, Durham
	Social Security Administration Building	3004 Tower Boulevard, Durham
	Caring House	2625 Pickett Road, Durham
Senior Services and Facilities	Carillon Assisted Living of Durham	4713 Garrett Road, Durham
	Durham Regent Retirement Community	3007 Pickett Road, Durham
	Forest at Duke Assisted Living	2701 Pickett Road, Durham
Community Centers	Levin Jewish Community Center	1937 West Cornwallis Road, Durham
Post Offices	Shannon Road Post Office	3710 Shannon Road, Durham
Libraries	Southwest Regional Library	3605 Shannon Road, Durham

Source: Planning Communities 2015.

Table 4.3-5: Duke West Campus and Medical Center Community Resources

Type of Resource	Name	Location
School	Duke University	Durham
Public Safety and Services	Durham County EMS Station 3	2400 Pratt Street, Durham
	Duke University EMS	301 Swift Avenue, Townhouse #3, Durham
	Duke University Police Department	502 Oregon Street, Durham
Medical Facilities	Duke Center for Living	3475 Erwin Road, Durham
	Lenox Baker Children's Hospital	3000 Erwin Road, Durham
	Duke MRI	3000 Erwin Road, Durham

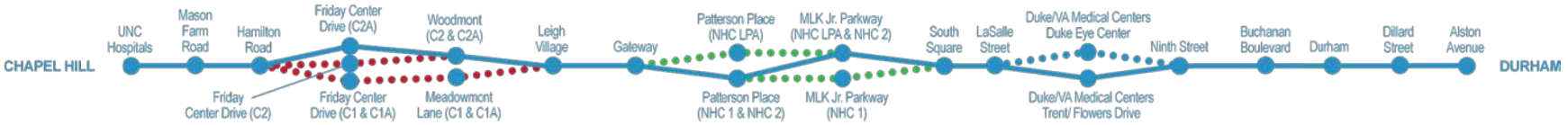


Table 4.3-5: Duke West Campus and Medical Center Community Resources

Type of Resource	Name	Location
	Duke Health Center	932 Morreene Road, Durham
	Duke Sleep Disorders Center	2800 Campus Walk Avenue, Durham
	Pavilion East at Lakeview	2608 Erwin Road, Durham
	Duke Diet and Fitness Center	501 Douglas Street, Durham
	Duke Eye Center	2351 Erwin Road, Durham
	Duke Ambulatory Surgical Center	120 East Carver Street, Durham
	Duke University Hospital	2301 Erwin Road, Durham
	Duke Clinics	40 Duke Medicine Circle, Durham
	Duke Adult Psychiatry Clinic	2213 Elba Street, Durham
	Duke Fetal Diagnosis Center	200 Trent Drive, Durham
	Durham Child Development and Behavioral Health Clinic	402 Trent Drive, Durham
	Duke Family Medical Center	2100 Erwin Road, Durham
	Duke Family Care Program	2100 Erwin Road, Durham
	UniHealth Post-Acute Care of Durham	3100 Erwin Road, Durham
	Grace Healthcare of Durham	411 South LaSalle Street, Durham
	Durham VA Medical Center	508 Fulton Street, Durham
Senior Services and Facilities	UniHealth Post-Acute Care (Erwin Gardens)	3100 Erwin Road, Durham
	Durham Nursing & Rehab Center (Grace Healthcare Center)	411 South LaSalle Street, Durham
Community Centers	Morreene Road Neighborhood Center	1102 Morreene Road, Durham
	W.I. Patterson Neighborhood Center	2614 Crest Street, Durham
Special Event Facilities	Page Auditorium	402 Chapel Drive, Durham
	Cameron Indoor Stadium	301 Whitford Drive, Durham
	Duke Chapel	401 Chapel Drive, Durham
	Sarah B. Duke Gardens	420 Anderson Street, Durham
	Nasher Museum of Art	2001 Campus Drive, Durham
	John Hope Franklin Center	2204 Erwin Road, Durham
Post Offices	Kangaroo Drive (West Durham) Post Office	3520 Kangaroo Drive, Durham
Libraries	Perkins Library System	411 Chapel Drive, Durham and various locations on Duke University campus

Source: Planning Communities 2015.

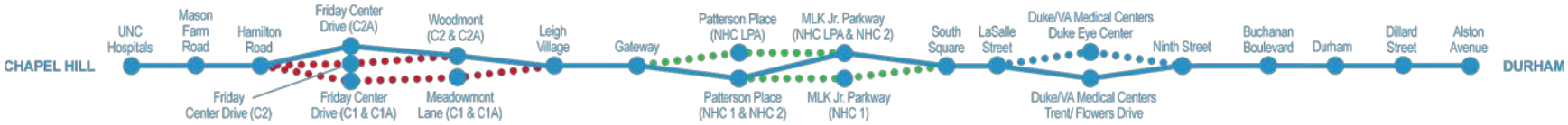


Table 4.3-6: Old West Durham/Duke East Campus Community Resources

Type of Resource	Name	Location
School	Duke University	Durham
	EK Powe Elementary School	913 Ninth Street, Durham
	George Watts Elementary School	700 Watts Street, Durham
	Durham School of the Arts Magnet Middle & High School	401 N. Duke Street, Durham
	Healthy Start Academy (Charter School)	807 West Chapel Hill Street, Durham
	Indigo Montessori School	1101 West Main Street, Durham
	Immaculata Catholic School	721 Burch Avenue, Durham
Public Safety and Services	Durham Fire Station #2	1001 Ninth Street, Durham
Medical Facilities	West Pettigrew Dialysis Center	1515 West Pettigrew Street, Durham
	EK Powe Elementary Wellness Center	913 Ninth Street, Durham
Social Services	Emily Krzyzewski Family Life Center	904 West Chapel Hill Street, Durham
Senior Services and Facilities	Pettigrew Rehabilitation and Healthcare Center	1515 West Pettigrew Street, Durham
	Hillcrest Convalescent Center	1417 West Pettigrew Street, Durham
Community Centers	West End Community Center	705 Kent Street, Durham
Special Event Facilities	Baldwin Auditorium	1336 Campus Drive, Durham

Source: Planning Communities 2015.

Table 4.3-7: Downtown Durham Community Resources

Type of Resource	Name	Location
Public Safety and Services	Durham Emergency Communications Center	505 West Chapel Hill Street, Durham
	Durham Fire Station #1	139 East Morgan Street, Durham
	Durham Police Headquarters	505 West Chapel Hill Street
	Durham Police Department – District 5	516 Rigsbee Avenue, Durham
	Durham County Sheriff	510 South Dillard Street, Durham
Social Services	Self Help	301 West Main Street, Durham
	YMCA - Downtown Durham	218 West Morgan Street, Durham
	Durham Center for Senior Life	406 Rigsbee Avenue, Durham
	Durham County Criminal Justice Resource Center	326 East Main Street, Durham
	Durham Housing Authority	330 East Main Street, Durham
	Center for Community Self-Help	301 West Main Street, Durham
	YMCA – American Tobacco Campus	410 Blackwell Street, Durham

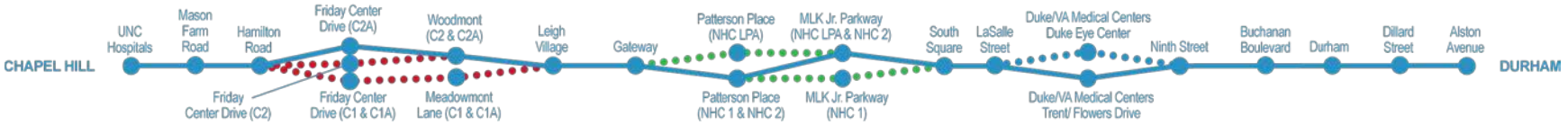


Table 4.3-7: Downtown Durham Community Resources

Type of Resource	Name	Location
	Genesis Home	300 North Queen Street, Durham
	Urban Ministries of Durham	410 Liberty Street, Durham
	Durham County Public Health Department	414 East Main Street, Durham
	Durham County Veterans Services	414 East Main Street, Durham
	El Centro Hispano	600 East Main Street, Durham
Senior Services and Facilities	Durham Center for Senior Life	406 Rigsbee Avenue, Durham
Special Event Facilities	Durham Central Park/Farmers Market	501 Foster Street, Durham
	Museum of Durham History	500 West Main Street, Durham
	Carolina Theatre	319 N. Chestnut Street, Durham
	Durham Centre Plaza	300 West Morgan Street, Durham
	Durham Armory	212 Foster Street, Durham
	Durham Convention Center	301 West Morgan Street, Durham
	CCB Plaza	201 North Corcoran Street, Durham
	American Tobacco Campus	318 Blackwell Street, Durham
	Durham Bulls Athletic Complex	409 Blackwell Street, Durham
	Durham Performing Arts Center	123 Vivian Street, Durham
Federal Government Office	US District Court	323 East Chapel Hill Street, Durham
Post Offices	Downtown Durham	323 East Chapel Hill Street, Durham
County and Municipal Offices	Durham County Social Services Department	300 North Duke Street, Durham
	Durham County Board of Elections	706 West Corporation Street, Durham
	Durham Transit Center	515 West Pettigrew Street, Durham
	Durham Civic Center Complex	301 West Morgan Street, Durham
	Durham City Hall	101 City Hall Plaza, Durham
	Durham Convention & Visitor's Bureau	101 East Morgan Street, Durham
	Durham County Courthouse	200 E Main Street, Durham
	Durham County Correctional Institution	219 South Mangum Street, Durham
	Durham County Government	501 South Dillard Street, Durham
Libraries	Durham County Library - Main Branch	300 North Roxboro Street, Durham

Source: Planning Communities 2015.

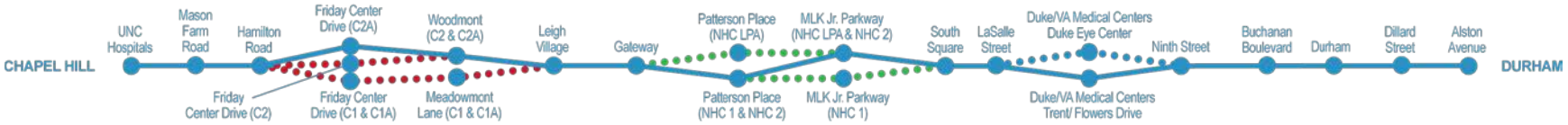


Table 4.3-8: East Durham Community Resources

Type of Resource	Name	Location
Schools	NCCU	1801 Fayetteville Road, Durham
	Eastway Elementary School	610 Alston Avenue, Durham
	CC Spaulding Elementary School	1531 S Roxboro Street, Durham
	W.G. Pearson Elementary School	3501 Fayetteville Road, Durham
	W.G. Pearson Magnet Middle School	600 East Umstead Street, Durham
	Burton Elementary School	1500 Mathison Street, Durham
	RN Harris Magnet School	1520 Cooper Street, Durham
	DTCC	1637 Lawson Street, Durham
	Maureen Joy Charter School	107 South Driver Street, Durham
Public Safety and Services	Durham County EMS Station 2	615 Old Fayetteville Street, Durham
	NCCU Police Department	2010 Fayetteville Road, Durham
Medical Facilities	DaVita Dialysis Center	601 Fayetteville Road, Durham
	Lincoln Community Health Center	1301 Fayetteville Road, Durham
Social Services	John Avery Boys & Girls Club (United Way Boys and Girls Clubs of America)	808 East Pettigrew Street, Durham
	Durham Rescue Mission	1201 East Main Street, Durham
	It Takes A Village Workforce	2207 Ashe Street, Durham
	Lincoln Community Health Center	1301 Fayetteville Road, Durham
Senior Services and Facilities	Durham Hosiery Mill Apartments	804 Angier Avenue, Durham
	W.D. Hill Senior Center	1308 Fayetteville Road, Durham
Community Center	W.D. Hill Recreation Center	1308 Fayetteville Road, Durham
	T.A. Grady Neighborhood Center	531 Lakeland Street, Durham
	Hayti Heritage Center	804 Old Fayetteville Street, Durham
	Tahti's Place Community Center	1607 Angier Avenue, Durham
Special Event Facilities	NCCU Museum of Art	NCCU Campus
	O'Kelly Riddick Stadium	NCCU Campus
County and Municipal Offices	Durham Neighborhood Improvement Services Impact Team	Driver Street, Durham
	Durham County Library - S.L. Warren Branch	1201 Fayetteville Road, Durham
Libraries	James E. Shepherd Memorial Library	NCCU Campus
	Durham Tech Main Campus Library	1637 Lawson Street, Durham

Source: Planning Communities 2015.

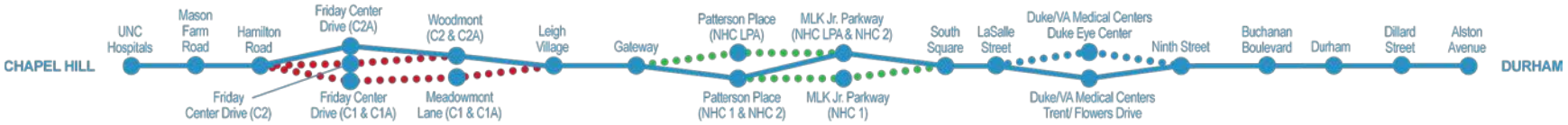


Table 4.3-9: Summary of Potential Impacts on Neighborhoods

Evaluation Area	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives			New Hope Creek Alternatives			Duke/VA Medical Centers
			C1	C1A	C2	NHC LPA	NHC 1	NHC 2	Duke Eye Center
UNC Campus Area	No impact	No Impact							
East Chapel Hill	No impact	AM, CR	CC	CC	No impact				
Leigh Village	No impact	No Impact							
US 15-501 Corridor	No impact	AM				No impact	No impact	No impact	
Duke West Campus	No impact	CR							CR
Old West Durham/Duke East Campus	No impact	CR							
Downtown Durham	No impact	No Impact							
East Durham	No impact	CR							

Source: Planning Communities 2015.

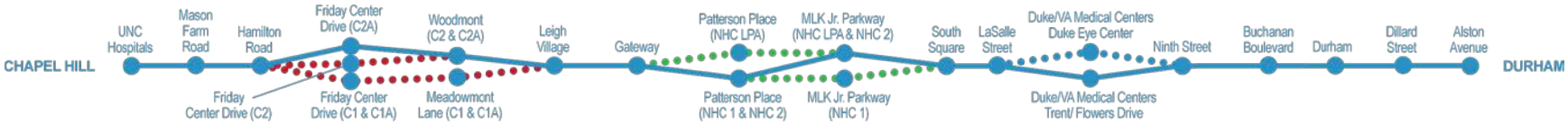
Key:

AM Impacts to access and mobility

CC Impacts to community cohesion

CR Impacts to community resources

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.



4.4 Visual and Aesthetic Conditions

This section provides an overview of visual conditions along the D-O LRT Corridor and identifies potential effects related to the proposed D-O LRT Project on the visual environment. Appendix K.15 contains the detailed analysis of the visual and aesthetic considerations. This section also discusses potential mitigation measures related to visual quality. The aesthetic quality of a community is comprised of visual resources, or the physical features that make up its visible landscape.

Visual resources: Features that make up the visible landscape such as buildings and natural areas.

Visual character: A description, such as natural, urban, or rural, of what a landscape unit looks like based on the order of the patterns composing the landscape. The elements of these patterns are the form, line, color, and texture of the visual resources. Their relationships can be described in terms of dominance, diversity, and continuity.

Visual quality: Describes the rating of the visual character and the viewer's experience.

NEPA identifies aesthetics as one of the factors in the human environment that must be considered in determining the effects of a project. Federal regulations require that visual impacts be addressed for Section 106 and Section 4(f) resource properties. (Refer to DEIS section 4.5 and DEIS chapter 6 for further discussion on visual effects on historic properties and Section 4(f) properties, respectively). A table summarizing all applicable federal, state, and local plans and policies with provisions for protecting, enhancing, and developing resources related to visual integrity and quality of communities and areas is contained in appendix K.15.

4.4.1 Methodology

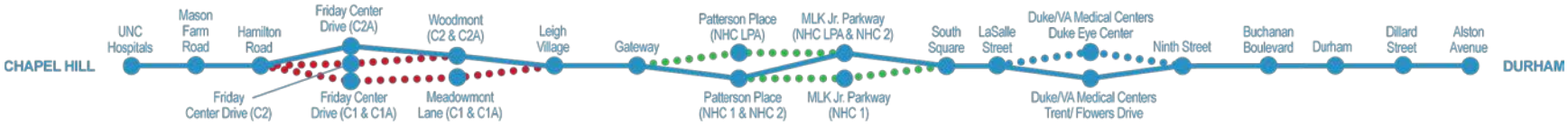
As FTA does not have visual assessment guidelines, Triangle Transit used publications from the Federal Highway Administration (FHWA) for guidance in conducting analyses related to visual and aesthetic conditions and impacts of the proposed D-O LRT Project. The publications consulted for this analysis include FHWA's *Visual Impact Assessment for Highway Projects* (FHWA 1981); *Guidance for Preparing and Processing Environmental and Section 4(f) Documents* (FHWA 1987); and "Esthetics and Visual Quality Guidance Information" (FHWA 1986). The methodology for identifying visual and aesthetic effects generally follows this guidance and includes the following steps:

- Establish the viewshed and landscape units
- Identify existing visual environment, character, and quality
- Identify viewers, viewer preferences, and viewer exposure to areas where the project would be visible
- Describe the likely visual changes and visual impacts of the project
- Summarize significant changes in visual quality that would occur
- Develop potential mitigation measures for significant changes in visual quality

Field visits, photographs, elevation data, and adopted local plans were used to document visual and aesthetic resources within the visual assessment study area. The following subsections describe the methods used for each of these steps.

4.4.1.1 Viewshed and Landscape Units

The visual assessment study area for the viewshed generally includes the land within 200 feet on either side of the proposed D-O LRT alignment due to tree cover and the built nature of the corridor. In areas where the proposed D-O LRT alignment would be elevated, the viewshed is expanded to 1,000 feet.



Viewshed: the area that can be seen from the proposed D-O LRT alignment and the areas from which the proposed D-O LRT can be seen.

The proposed D-O LRT Project's viewshed was divided into 10 landscape units for the purposes of segmenting the viewshed into areas with similar land uses and visual characteristics (**Figure 4.4-1**). Important visual features used to determine these landscape units include land use, architectural characteristics of development, highways, recreational facilities, and natural features. These elements are fully described in appendix K.15, Table 4.

Landscape units: geographic areas within the viewshed where views would have a similar context or character.

4.4.1.2 Visual Character and Visual Quality

After identifying the viewshed and landscape units, a description of existing conditions in each landscape unit was prepared to identify three key concepts: visual resources, visual character, and visual quality.

Where there is high existing visual quality, it is important to evaluate and understand potential effects that would result from the introduction of new visual elements. Visual quality is subjective, but is generally described in terms of vividness, intactness, and unity. These terms, and a qualitative scale for rating high, moderate, and low visual quality, are explained in **Table 4.4-2**.

4.4.1.3 Viewers, Exposure, and Sensitivity

Viewers are the people who look upon the current viewshed, and their exposure and sensitivity to change need to be identified and understood prior to assessing visual impacts of the project. Viewers were identified during field visits, based on the land uses within each landscape unit. Viewer exposure and sensitivity related to views were identified through the review of the plans listed in appendix K.15 and validated based on public comments received during public meetings related to concerns about project visual elements. The meetings were held during D-O LRT Project Scoping under NEPA (for more information see also DEIS chapter 9).

The scale used to characterize the exposure and sensitivity of viewers is provided in **Table 4.4-3**. As projects have a wide-range of visual resources and project elements, a contextual, project-based typical rating is developed. The typical rating of exposure and sensitivity by viewer-type for the proposed D-O LRT Project is provided in **Table 4.4-4**. Careful consideration of any changes to the view is important where there are viewers with high exposure and high sensitivity.

4.4.1.4 Visual Changes and Visual Impacts

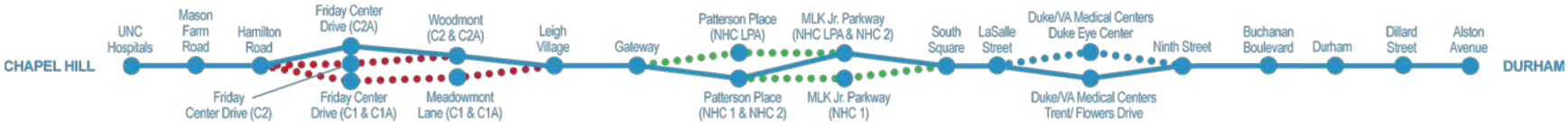
Visual impacts are the combination of (1) changes to visual resources and (2) viewers' responses to those changes. Changes may be perceived as detracting from or enhancing visual resources.

Visual Impact is the combination of Visual Resource Change and Viewer Response. A large visual change does not necessary result in a visual impact if there are no sensitive viewers.

There are two ways the NEPA Preferred and Project Element Alternatives can change visual resources in each landscape unit: (1) by removing or altering existing visual resources, or (2) by introducing new elements that alter the visual character.

4.4.2 Affected Environment

The existing condition of the visual environment including the visual character and visual resources are summarized by landscape unit in **Table 4.4-5**. Each landscape unit and its associated visual resources are depicted in appendix K.15.



4.4.2.1 Summary of Viewers, Viewer Preferences, and Exposure by Landscape Unit

Landscape Unit #1: University (UNC)

Viewers in this area include students, faculty, staff, and university visitors coming onto UNC's campus; patients and staff of UNC Hospitals; residents living in Odum Village, Mason Farm, and Baity Hill campus housing or single-family homes in the area; those attending events at the Dean E. Smith Student Activities Center or other facilities on campus; motorists; and transit riders.

This area is part of UNC's south campus area and, according to the UNC *Campus Master Plan*, will undergo numerous changes in the future. This includes demolition of some existing structures (Odum Village residences), addition of new structures or redevelopment of existing structures, and changes in road patterns, landscaping, and streetscaping. Viewers in this area anticipate changes to the evolving campus environment. **Figure 4.4-2** provides the location and representative visual features of Landscape Unit #1.

Landscape Unit #2: Mixed Use/Institutional

Viewers in this area include motorists, Botanical Garden visitors and nature enthusiasts, pedestrians, area residents and church members, shoppers, office workers, golfers, conference attendees, and transit riders. **Figure 4.4-3** provides the location and representative visual features of Landscape Unit #2.

Landscape Unit #3: Natural

Motorists and transit riders would have low sensitivity; however, residents of George King Road and those using the wooded area (nature enthusiasts, hikers, and hunters) would be highly sensitive to changes in the visual environment. **Figure 4.4-4** provides the location and representative visual features of Landscape Unit #3.

Landscape Unit #4: Interstate

Viewers in this area include motorists, residents, and transit riders. The majority of viewers in this unit would be motorists traveling on I-40. **Figure 4.4-5** provides the location and representative visual features of Landscape Unit #4.

Landscape Unit #5: Suburban Commercial

Viewers in this area include motorists and transit riders, shoppers, office workers, residents, business owners, and those using the New Hope Creek wooded area (pedestrians, nature enthusiasts, and hikers). **Figure 4.4-6** provides the location and representative visual features of Landscape Unit #5.

Landscape Unit #6: Recreational

Viewers in this area include motorists and transit riders, golfers, and users of Al Buehler Trail and Duke Forest (pedestrians, nature enthusiasts, runners, and hikers). **Figure 4.4-7** provides the location and representative visual features of Landscape Unit #6.

Landscape Unit #7: University (Duke)

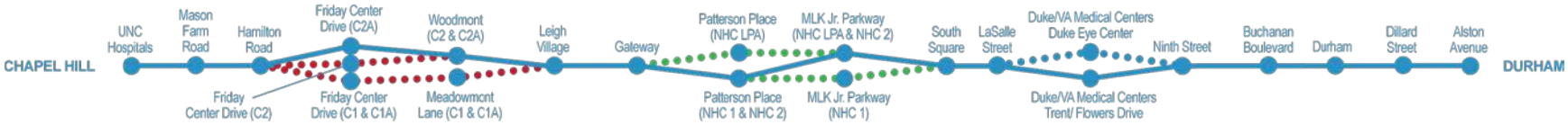
Viewers in this area include motorists and transit riders, pedestrians, shoppers, office workers, apartment residents; Duke University students, staff, and faculty; and medical center staff and patients. **Figure 4.4-8** provides the location and representative visual features of Landscape Unit #7.

Landscape Unit #8: Historic / Emerging Urban

Viewers in this area include motorists and transit riders, residents of neighboring mixed-use developments and historic districts, Duke East Campus students and staff, shoppers, patients at medical facilities, church members, and pedestrians. **Figure 4.4-9** provides the location and representative visual features of Landscape Unit #8.

Landscape Unit #9: Downtown Urban

Viewers in this area include motorists and transit riders, pedestrians, office workers,



church members, residents of converted warehouses and historic districts, sporting event attendees, performing arts patrons, and shoppers enjoying dining, nightlife, and other entertainment alternatives. **Figure 4.4-10** provides the location and representative visual features of Landscape Unit #9.

Landscape Unit #10: Urban Industrial

Viewers in this area include motorists and transit riders, children at the Boys and Girls Club, church members, and residents. **Figure 4.4-11** provides the location and representative visual features of Landscape Unit #10.

4.4.3 Environmental Consequences

The proposed D-O LRT Project would introduce new visual elements to the viewshed. These new elements could negatively affect visually sensitive resources by altering the view to and/or from the resource, or by adding an element that would be out of scale or character of the existing visual context. These new visual elements would include: the light rail vehicles and trackway; station platforms; sidewalks, ramps or pedestrian bridges; the overhead catenary system that powers the electric light rail vehicles; Traction Power Substations (TPSS), communications cabinets, signal houses, and crossing cases; existing right-of-way modifications; bridges and retaining walls; park-and-ride lots; parking deck; and the ROMF. Examples of these elements are shown in **Table 4.4-1.**

Areas with significant visual impacts resulting from the NEPA Preferred and Project Element Alternatives are summarized in **Table 4.4-6**, while ROMF visual impacts are summarized in **Table 4.4-7**. The NEPA Preferred Alternative does not differ substantially from the other alternatives; however, the alternative alignments C2 and C2A are rated Moderate in Landscape Unit #3 relative to alternative alignments C1 and C1A, which are significant visual impacts, primarily due to the visual change that would occur in the natural areas. Under the No Build Alternative, there would be no visual or aesthetic impacts to visual resources. A full discussion of the

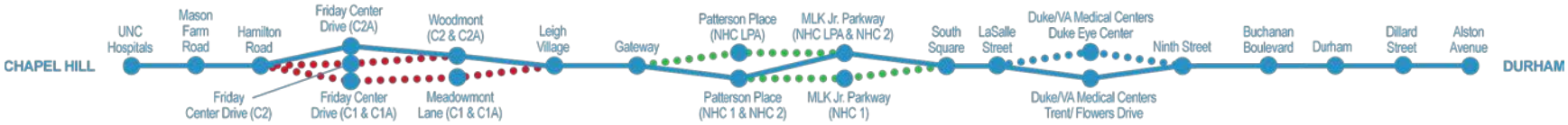


Table 4.4-1: Potential New Visual Elements

Typical Visual Element	Description	Examples
Light rail vehicles and trackway	Light rail vehicles and the trackway on which the vehicles would operate.	 Minneapolis, MN  Norfolk, VA
Station platforms	To accommodate passenger boarding and deboarding, typical station platforms would be 270 feet long with canopies that would be approximately 12 feet high; stations could have landscaping and design elements to enhance visual compatibility with the surrounding area.	 Portland
Sidewalk, ramps and pedestrian bridges	To accommodate access to the station platforms, sidewalk, ramps, and pedestrian bridges may be necessary. These accommodations may require modifications to the existing right-of-way.	

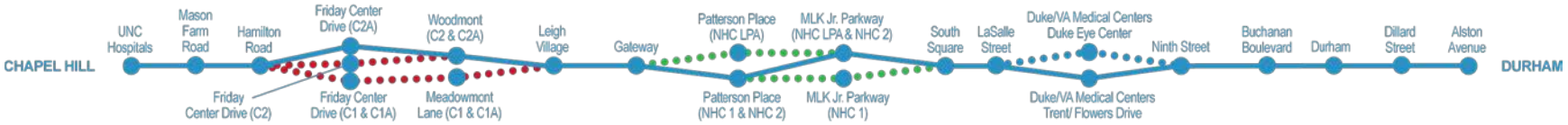
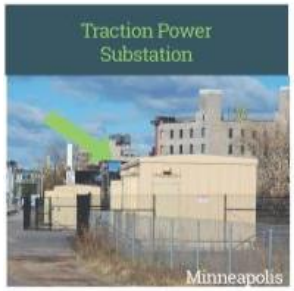


Table 4.4-1: Potential New Visual Elements

Typical Visual Element	Description	Examples
Overhead catenary system (OCS)	Light rail vehicles would be electrically powered by an overhead catenary system that would require construction of poles to support overhead wires.	 Overhead catenary – Poles  Overhead catenary – Wires
Traction power substations, communications cabinets, signal houses, and crossing cases	To provide electricity throughout the proposed D-O Corridor, electric substations would need to be located within the rail right-of-way or at station locations; substations would be one-story, corrugated metal, approximately 40 feet wide by 60 feet long. Signal houses would be approximately 10 feet wide by 30 feet long by 10 feet high and located close to tracks. Crossing cases would be at each at-grade crossing to operate lights and switches.	  

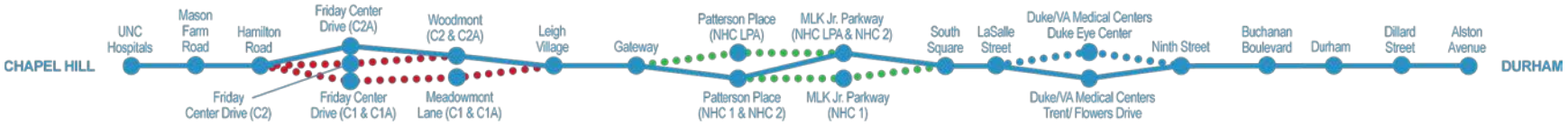
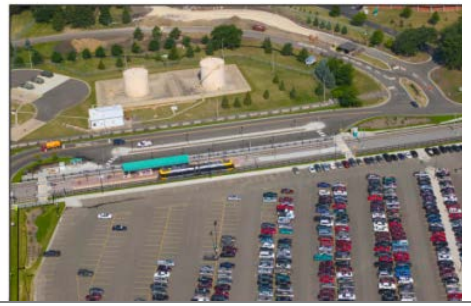


Table 4.4-1: Potential New Visual Elements

Typical Visual Element	Description	Examples
Existing right-of-way modifications	Street widening and modifications to existing right-of-way, including removal of vegetation or business signage or other physical alterations to private property.	
Bridges and retaining walls	Bridges to cross over existing roads or water features and retaining walls that are either approaches to these bridges or needed to hold back an existing slope to minimize property impacts.	
Park-and-ride lots	The number of parking spaces at each proposed park-and-ride lot would vary depending on the forecasted ridership and land availability. Parking could be provided as either surface lots or structured parking in a parking garage.	 

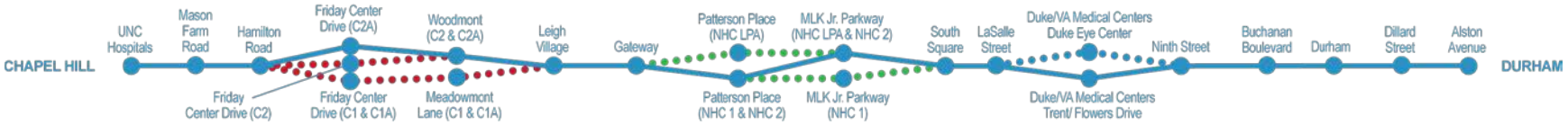
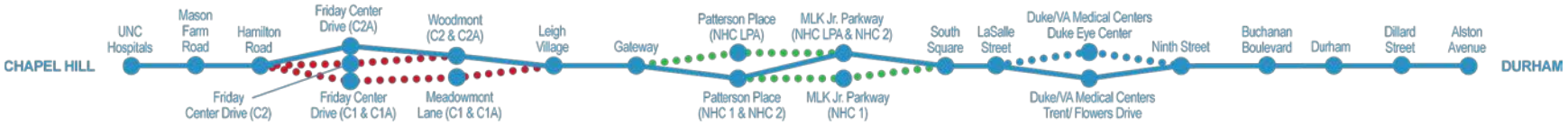


Table 4.4-1: Potential New Visual Elements

Typical Visual Element	Description	Examples
ROMF	The ROMF would provide maintenance, repair, cleaning, inspection, and storage of light rail vehicles. Five ROMF alternative sites are being considered (Leigh Village, Farrington Road, Cornwallis Road, Patterson Place, and Alston Avenue).	 



visual and aesthetic impacts is included in appendix K.15.

4.4.3.1 Project Element Alternatives

Rail Operations and Maintenance Facility (ROMF)

Some impacts would result regardless of which site is selected. Visual changes would include built facilities (maintenance buildings, office spaces, and shops) and infrastructure (parking and paved areas, tracks, switches, overhead contact lines, a traction power substation, and signals). All sites would have changes in topography due to grading; changes in structural features, such as removal of existing structures and construction of new buildings; changes to vegetation, such as removal of existing vegetation and planting of new vegetation; and addition of lighting. Lighting would be aimed towards the ROMF to reduce spillage onto neighboring properties and adjacent roadways.

Each site's context with the surrounding landscape and viewers would vary. Potential impacts associated with each site are described in **Table 4.4-7** and appendix K.15.

4.4.4 Mitigation Measures

This section describes potential mitigation measures for adverse visual and aesthetic impacts identified during the evaluation process and in coordination with other disciplines, including natural and built environment.

Under the No Build Alternative, there would be no visual or aesthetic impacts due to the proposed D-O LRT Project. As such, project-related mitigation would not be warranted.

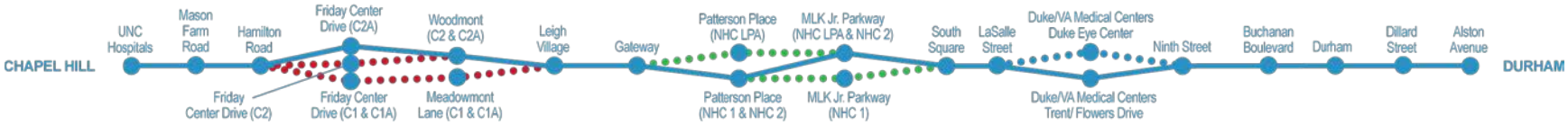
4.4.4.1 NEPA Preferred Alternative

Locations where impacts occur (identified in **Table 4.4-6** and **Table 4.4-7**) and the degree and nature of the impacts are noted in the previous sections. In addition to coordination with the Town of Chapel Hill and the City of Durham, the following potential mitigation options are proposed for the affected areas:

- Using interdisciplinary design teams to create aesthetic guidelines and standards in the design of project elements
- Integrating facilities with area redevelopment plans
- Planting appropriate vegetation in and adjoining the project right-of-way
- Replanting remainder parcels
- Using source-shielding in exterior lighting at ROMFs, stations, and auxiliary facilities
- Art-in-Transit opportunities
- Provide landscaping and aesthetic treatments when in close proximity to residences with aerial structures

The following mitigation measures were developed through public engagement and are recommended for site-specific potential visual impacts. Triangle Transit will continue to coordinate with affected residents, businesses, and community facilities to identify strategies to minimize the effects of the project.

- **Finley Golf Course (Landscape Unit #2)**: reconstructing affected holes and providing landscaping and protective wall based on a plan developed by the golf course designer, as described in chapter 6, Draft Section 4(f) Evaluation.
- **East 54/Hamilton Road Station (Landscape Unit #2)**: where feasible, additional landscaping along Prestwick Road will be incorporated during the Engineering phase. This additional landscaping along the golf course side, along with the continued growth and maturity of the existing street trees along Prestwick Road on the development side, will help obscure views of the protective netting adjacent to the station, OCS poles and wires, and station canopies. To the extent practicable, the station canopy lighting will be shielded by the canopies themselves or tilted away from adjacent buildings.



- **Patterson's Mill Country Store and Walter Curtis Hudson Farm (Landscape Unit #4)**: Addressed mitigation based on their special designation as a community resource on historic property and Section 4(f) property, respectively. Impacts will be mitigated in accordance with Section 106 and Section 4(f) requirements, including landscaping (section 4.5 and chapter 6).
- **Duke University Golf Course (Landscape Units #7 and #8)**: Triangle Transit will coordinate with Duke University to provide landscaping and vegetative screening for the golf course.

4.4.4.2 Project Element Alternatives

The Project Element Alternatives will require similar mitigation as the NEPA Preferred Alternative. Additional mitigation would include the following:

- **Little Creek Trail – Project Element Alternative C1A (Landscape Unit #3)**: Triangle Transit will coordinate with Durham County to ensure that the proposed trail extensions in this area would be located in a place that would not be visually affected by the LRT.
- **Levin Jewish Community Center – Project Element Alternative Cornwallis ROMF (Landscape Unit #5)**: Impacts to the Judea Reform Congregation and Lerner Jewish Community Day School Campus will be mitigated through fencing, landscaping, visual treatments, and a visual barrier.

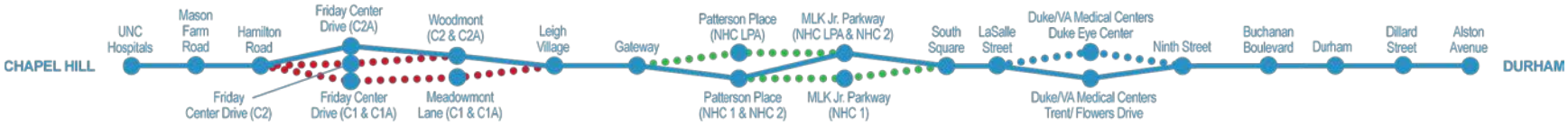


Table 4.4-2: Criteria and Scale for Rating Visual Quality

Criteria	Scale		
	High	Moderate	Low
Vividness The visual power or memorability of landscape components as they combine in striking and distinctive visual patterns	Highly memorable Elements combine in striking visual patterns Presence of distinct focal points	Somewhat memorable Elements form perceivable patterns	Not vivid Elements appear random with no perceivable pattern
Intactness The visual integrity of the natural and built landscape and its freedom from encroaching elements	Lack of man-made development Minimal to no encroachment to the landscape are visible	Man-made development disturbs the natural landscape and encroaches on the visual setting	The landscape has encroaching elements that create an eyesore to viewers
Unity The visual coherence and compositional harmony of the landscape considered as a whole	Man-made development blends with the natural landscape providing an integrated design with its setting	Some visual relation between man-made and natural setting	Man-made and natural patterns do not reinforce each other and visually look chaotic and jumbled

Source: *Visual Impact Assessment for Highway Projects* (FHWA 1981).

Table 4.4-3: Scale for Viewer Exposure and Sensitivity

Exposure	Sensitivity
High: Many viewers, consistent exposure for long periods of time, close proximity, unobstructed line of sight	High: Viewers' activity draws them to the view. View is important to the values and goals of the viewers or has cultural significance
Moderate: Some viewers, regular exposure for a short period of time, moderate proximity to the view, some obstructions to the view	Moderate: Viewers' activity may cause some distraction from the view. View is of some importance but is not culturally significant
Low: Few viewers, short duration, far from the view, obstructed view	Low: Viewers' activity distracts them from the view. Views are not supported by the values and goals of the viewers and do not have cultural significance

Source: *Visual Impact Assessment for Highway Projects* (FHWA 1981).

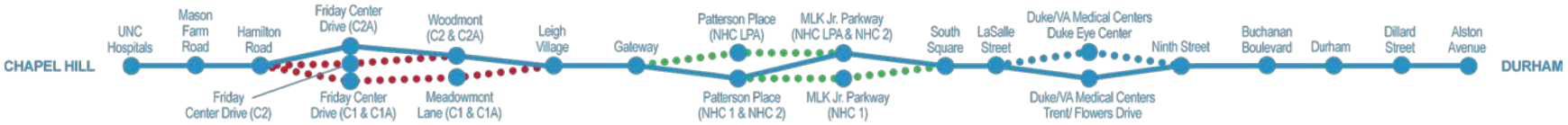


Table 4.4-4: Typical Exposure and Sensitivity by Viewer Type

Viewer Type	Exposure	Sensitivity
Residents – single- and multi-family housing	High	High
Residents and visitors in historic districts	High	High
Business owners	High	High
Golf course players	High	High
Bike and pedestrian trail users	Moderate	High
Nature enthusiasts, hikers, and hunters	Moderate	High
Children and teachers – school	Moderate	Moderate
University visitors, students, professors, staff	Moderate	Moderate
Church members	Moderate	Moderate
Hospital visitors, patients and staff	Moderate	Moderate
Shoppers	Moderate	Moderate
Office workers	Moderate	Low
Motorists	Moderate	Low
Transit riders	Moderate	Low
Performing arts patrons, conference attendees, and attendees at sporting events	Low	Moderate
Attendees at festivals	Low	Moderate

Source: Planning Communities 2014.

Table 4.4-5: Existing Conditions Summary by Landscape Unit

Landscape Unit	Figure	Visual Character	Representative Visual Resources
Landscape Unit #1 – University (UNC)	4.4-2	University campus with academic, research, and residential buildings, and open space *Vividness:* Moderate *Intactness:* Moderate *Unity:* Moderate Visual quality: Moderate	UNC Hospitals and research buildings (1) UNC student housing Odum Village (3), Single-family homes (4) Dr. Robert Zack Shankle House (5) Mason Farm Campus Housing(6) Kenan-Flagler Business School (7) Dean Smith Center (8) Baity House (10) UNC Medical Center (11)

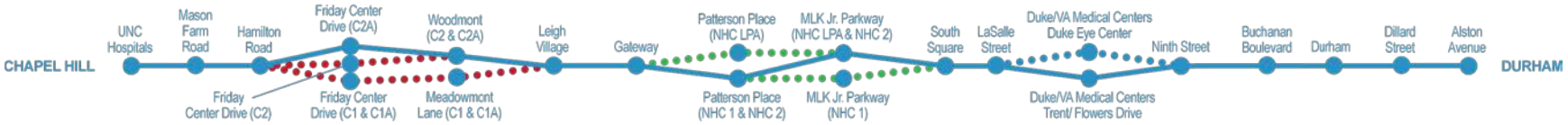


Table 4.4-5: Existing Conditions Summary by Landscape Unit

Landscape Unit	Figure	Visual Character	Representative Visual Resources
Landscape Unit #2 – Mixed use/ Institutional	4.4-3	C1 and C1A: Mix of commercial and institutional development along roadways with some newer mixed-use development; Meadowmont Village mixed use community *Vividness:* Moderate *Intactness:* Moderate *Unity:* Moderate Visual quality: Moderate	Morghan Creek Neighborhood (1) Bivens-Nelson House 2) NC Botanical Gardens (3) Churches [Aldersgate, St. Thomas More (6, 23)] The Highlands Woods neighborhood / historic district (6) Glenwood Elementary School (8) Finley Golf Course (11) Mixed use at East 54 (10) Meadowmont Village (16) The Cedars of Chapel Hill (17) Rizzo Conference Center (20)
		C2 and C2A: Mix of commercial or institutional development along roadways with some newer mixed-use development; residential subdivisions with single-family homes on wooded lots that are not visible from existing major roadways *Vividness:* Moderate *Intactness:* Moderate *Unity:* Moderate Visual quality: Moderate	Morghan Creek Neighborhood (1) Bivens-Nelson House 2) NC Botanical Gardens (3) Churches [Aldersgate, St. Thomas More (6, 23)] The Highlands Woods neighborhood / historic district (6) Glenwood Elementary School (8) Finley Golf Course (11) East 54 Urban Village (10) Exchange at Meadowmont (12) Friday Center for Continuing Education (14) Woodmont Station Residential (18)
Landscape Unit #3 – Natural	4.4-4	C1 and C1A: Wooded area owned and regulated by US Army Corps of Engineers comprised of wetlands, trees, and water resources *Vividness* - Moderate *Intactness* - High *Unity* – High Visual quality: High	Little Creek Trail (1)

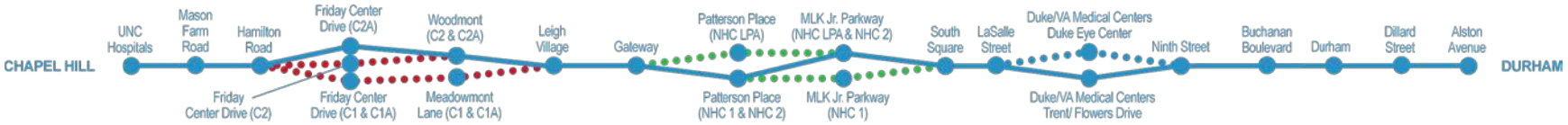


Table 4.4-5: Existing Conditions Summary by Landscape Unit

Landscape Unit	Figure	Visual Character	Representative Visual Resources
		C2 and C2A: Wooded area bordering NC 54; unpaved, gravel road with adjacent horse pastures and scattered single-family homes *Vividness* - Moderate *Intactness* - High *Unity* – High Visual quality: High	Single-Family Home (2) George King Road (3) Celeste Circle Neighborhood (4)
Landscape Unit #4 – Interstate	4.4-5	Interstate highway and interstate right-of-way lined by a wooded buffer, undeveloped parcels or single-family residential adjacent to the I-40 corridor Low density residential west of the I-40/US 15-501 interchange *Vividness* - Low *Intactness* - Moderate *Unity* - Moderate Visual quality: Moderate	Crescent Drive single-family homes (1) Farrington Road Area Single-Family Homes (2) Patterson's Mill Country Store (3) Walter Curtis Home (4)
Landscape Unit #5 – Suburban Commercial	4.4-6	NHC LPA: New development at Patterson Place; natural area surrounding New Hope Creek; undeveloped land along Garrett Road *Vividness* - Moderate *Intactness* - Moderate *Unity* – Low Visual quality: Moderate	US 15-501 / Mt. Moriah Road Commercial area (1) Patterson Place Shopping Center (2) Sayward Drive residences (4) Apartment complexes (6, 8, 10, 11, 12) New Hope Creek natural area (7)

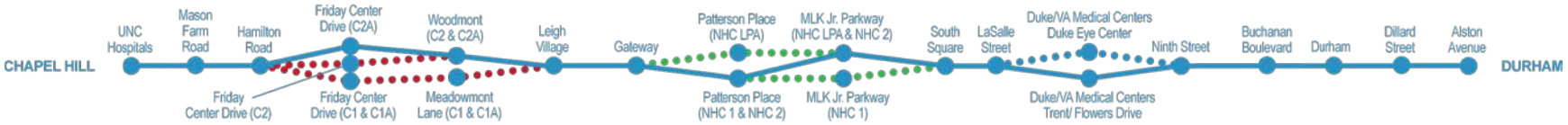


Table 4.4-5: Existing Conditions Summary by Landscape Unit

Landscape Unit	Figure	Visual Character	Representative Visual Resources
		NHC 1 and NHC 2: Typical suburban development with a mix of new and aging commercial shopping centers, apartment complexes, and office/institutional uses made up of many different architectural styles, developed and built over time *Vividness* - Moderate *Intactness* - Low *Unity* - Low Visual quality: Low	ITT Technical Institute (13) University Drive/Shannon Road commercial areas (17) University Tower (18) Durham Herald (22) Former Pepsi plant (24)
Landscape Unit #6 – Recreational	4.4-7	Highway right-of-way with wooded buffer and adjacent recreational areas (golf course, cross country trails, and forest) *Vividness* - Moderate *Intactness* - Moderate *Unity* – High Visual quality: Moderate	Duke Lemur Center (1) Al Buehler Cross Country Trail (2) Washington Duke Golf Course (3)
Landscape Unit #7 – University (Duke)	4.4-8	Blend of mixed-use development, older medical support buildings, parking decks and surface lots, dominated by large hospital complexes *Vividness* - Moderate *Intactness* - Low *Unity* – Moderate Visual quality: Moderate	Lenox Baker Children's Hospital (3) Trinity Commons (7) Durham VA Medical Center (11) Duke University Medical Center (12) John Hope Franklin Center (16) Duke University Central Campus Housing (18)

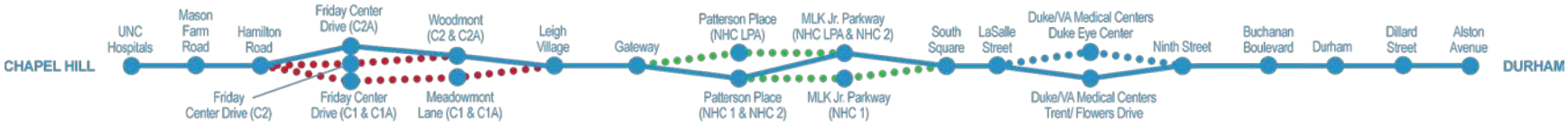


Table 4.4-5: Existing Conditions Summary by Landscape Unit

Landscape Unit	Figure	Visual Character	Representative Visual Resources
Landscape Unit #8 – Historic/ Emerging Urban	4.4-9	Architecturally cohesive historic buildings and redevelopment within the Ninth Street, East Campus and Trinity Park neighborhood areas *Vividness* - Moderate *Intactness* - Moderate *Unity* – High Visual quality: Moderate	Erwin Square (1) Erwin Mill Building (3) Sam's Quik Shop (5) Churches [Blacknall Memorial Presbyterian (6), St. Joseph's Episcopal Church (7)] Bull City Market (9) Medical facilities (Pettigrew Rehabilitation and Healthcare Center, Hillcrest Convalescent Center) Duke University East Campus (11) Duke Center for Documentary Studies (6) Smith Warehouse (14)
Landscape Unit #9 – Downtown Urban	4.4-10	Mixture of historic commercial buildings, renovated tobacco warehouses, government buildings, cultural and entertainment facilities dense development, gridded streets, and large-scale complexes for government, sports, and entertainment *Vividness* - High *Intactness* - Moderate *Unity* – Moderate Visual quality: Moderate	Duke Memorial United Methodist Church (2) Brightleaf Square (4) NC Mutual Life Building (5) West Village (6) Durham Transit Center (8) and Amtrak station (9) Downtown Durham Historic District (not numbered) American Tobacco Campus (10) Durham Performing Arts Center (12) Durham Bulls Athletic Park (13)
Landscape Unit #10 – Urban Industrial	4.4-11	Existing railroad tracks with adjacent industrial uses and scattered residential areas *Vividness* - Moderate *Intactness* - Low *Unity* - Low Visual quality: Moderate	Venable Tobacco Warehouse (1) Large churches [First Presbyterian (2), St. Phillips Episcopal (4), New Creation United Methodist (11)] John Avery Boys and Girls Club (7) Lovett Square Apartments (9) Durham Water Tower (17)

Source: *Visual and Aesthetics* (appendix K.15).

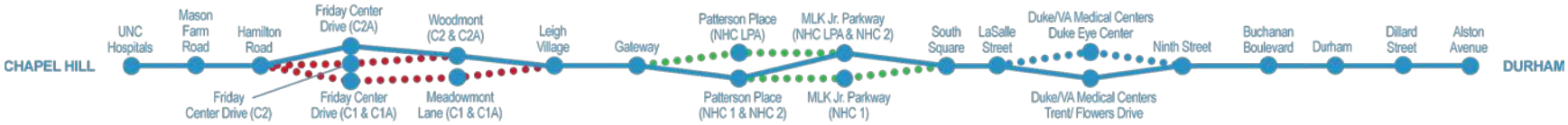
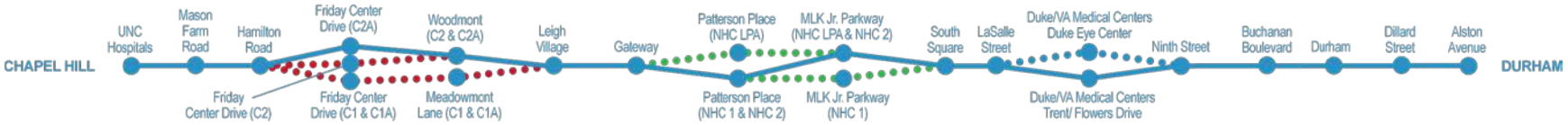
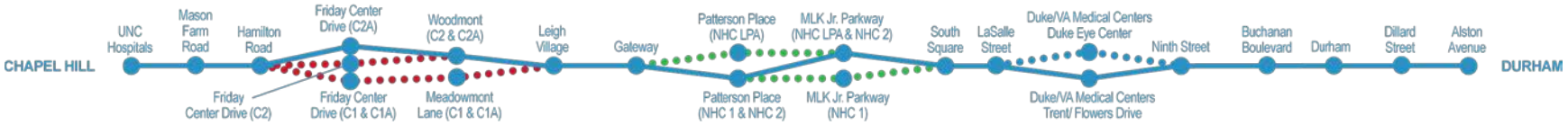


Table 4.4-6: Summary of Visual Impacts

Landscape Unit	Existing Visual Quality	Viewer Response	Visual Change	Overall Visual Impact	Impact Summary
#1 University (UNC Campus Area) [a]	Moderate	Moderate	Moderate	Moderate	Viewer exposure and sensitivity for these viewer groups is consistent with the scale described in Table 4.4-3 and Table 4.4-4 and would generally be low to moderate; residents are the only viewers in this area anticipated to have high exposure and high sensitivity.
#2 Mixed use/ Institutional (East Chapel Hill)	Moderate	--	--	--	Area church members, shoppers, and office workers would have moderate sensitivity to visual changes depending on their proximity to the project. Residents, golfers, Botanical Garden visitors, and pedestrians would be highly sensitive to visual changes. Motorists would have low to moderate sensitivity to the visual changes due to the speed at which they would be traveling and the short duration they would be exposed to them.
C1, C1A, C2	Moderate	Moderate	Minor – Substantial	Moderate	
C2A [a]	Moderate	Moderate	Minor – Substantial	Low – Moderate	
#3 Natural (East Chapel Hill)	High	--	--	--	The project's aerial structure crossing NC 54 would have an impact on the surrounding residents.
C1	High	Moderate	Substantial	Significant	
C1A	High	Moderate	Substantial	Significant	
C2 /C2A [a]	High	Moderate	Moderate	Moderate	



Landscape Unit	Existing Visual Quality	Viewer Response	Visual Change	Overall Visual Impact	Impact Summary
#4 Interstate (Leigh Village) [a]	Moderate	Moderate	Moderate	Moderate	Motorists would have short duration views of the NEPA Preferred and Project Element Alternatives where it parallels the interstate, and they would have low sensitivity to visual changes. The NEPA Preferred and Project Element Alternatives would pass several residences near Crescent Drive, Pope Road, and White Oak Drive, and these residents would have high sensitivity due to the proximity and duration of visual changes.
#5 Suburban Commercial (US 15-501 Corridor)	Low – Moderate	--	--	--	Motorists, transit riders, and office workers would have low sensitivity to visual changes; shoppers would be moderately sensitive to the visual changes, while residents, business owners, pedestrians, nature enthusiasts, and hikers would be highly sensitive to changes that affect the visual environment.
NHC LPA	Low – Moderate	Moderate	Moderate – Substantial	Moderate – Significant	
NHC 1	Low – Moderate	Low - High	Moderate – Substantial	Moderate – Significant	
NHC 2 [a]	Low – Moderate	Low - High	Minor - Substantial	Moderate - Significant	
#6 Recreational (Duke West Campus) [a]	Moderate	Moderate	Moderate	Moderate	Viewers would range from low to high sensitivity.
#7 University (Duke West Campus) [a]	Moderate	Moderate	Minor	Low – Moderate	The NEPA Preferred and Project Element Alternatives would be located primarily at grade and within existing transportation corridors through this unit. These viewers would have low to high sensitivity to changes in visual character, as defined in Table 4.4-4.
#8 Historic/Emerging Urban (Old West Durham/Duke East Campus) [a]	Moderate	Moderate	Moderate	Moderate	Viewer sensitivity would range from low to high depending on proximity and duration of exposure to visual changes.



Landscape Unit	Existing Visual Quality	Viewer Response	Visual Change	Overall Visual Impact	Impact Summary
#9 Downtown Urban (Downtown Durham) [a]	Moderate	Moderate	Minor	Low	Viewers would range from low to high sensitivity.
#10 Urban Industrial (east Durham) [a]	Low	Moderate	Minor - Substantial	Low – Moderate	The NEPA Preferred and Project Element Alternatives would be located along the existing transportation corridor that includes Pettigrew Street and the railroad. These viewers would have low to high sensitivity, consistent with descriptions in Table 4.4-4.

Source: *Visual and Aesthetics* (appendix K.15).

[a] NEPA Preferred Alternative.

Table 4.4-7: Summary of ROMF Visual Impacts

ROMF	Existing Visual Quality	Viewer Response	Visual Change	Overall Visual Impact
Leigh Village (Landscape Unit #4: Interstate)	Moderate	Low - High	Substantial	Significant
Farrington Road (Landscape Unit #4: Interstate) [a]	Moderate	Low - High	Substantial	Moderate
Patterson Place (Landscape Unit #5: Suburban/Commercial)	Moderate	High	Substantial	Significant
Cornwallis Road (Landscape Unit #5: Suburban/Commercial)	Moderate	Low – High	Minor – Substantial	Moderate – Significant
Alston Avenue (Landscape Unit #10: Urban Industrial)	Low	Low - Moderate	Minor	Low

Source: *Visual and Aesthetics* (appendix K.15).

[a] NEPA Preferred Alternative.

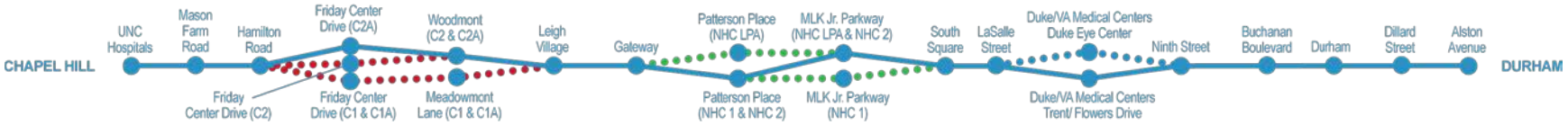
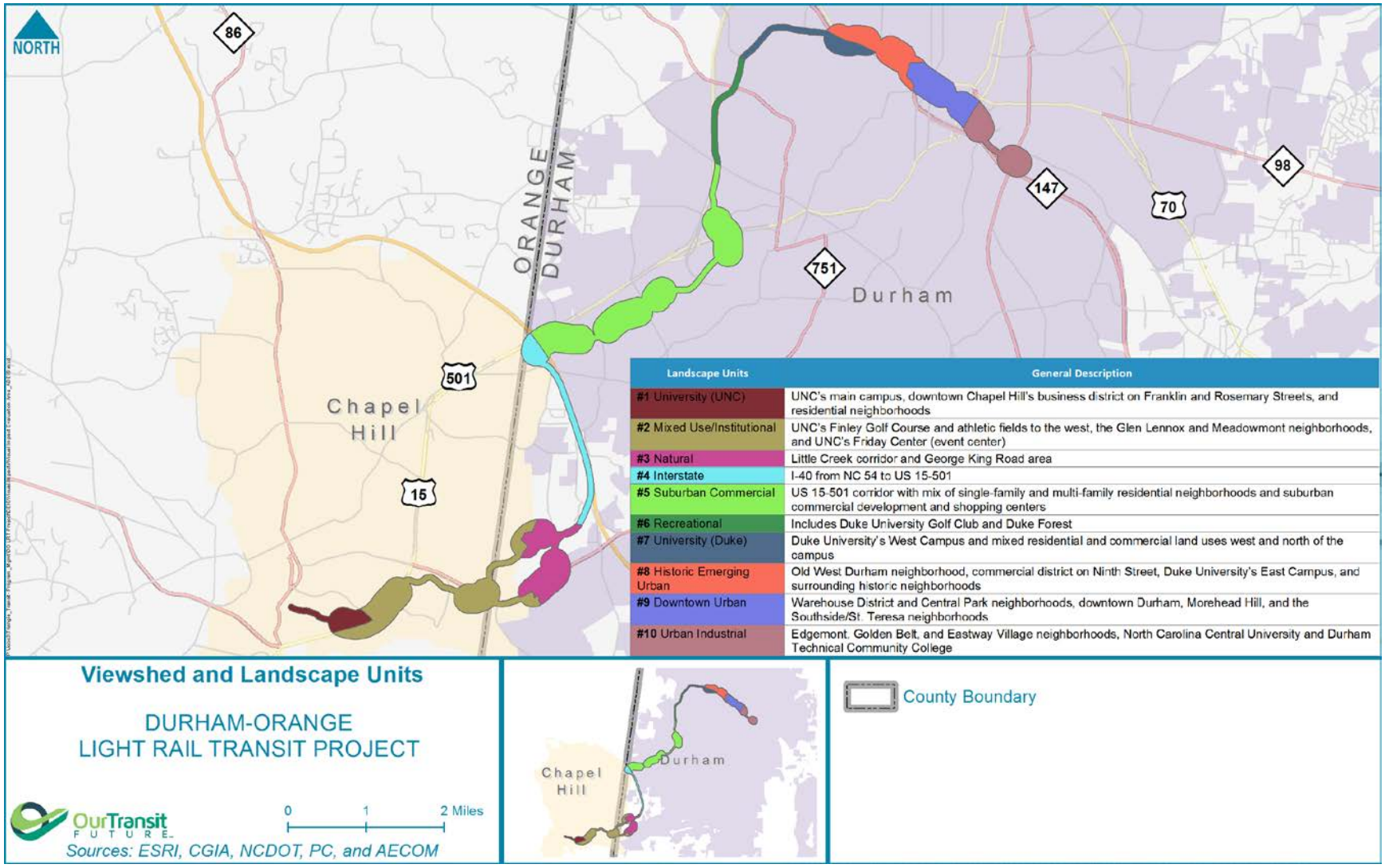


Figure 4.4-1: Viewshed and Landscape Units



Landscape Units	General Description
#1 University (UNC)	UNC's main campus, downtown Chapel Hill's business district on Franklin and Rosemary Streets, and residential neighborhoods
#2 Mixed Use/Institutional	UNC's Finley Golf Course and athletic fields to the west, the Glen Lennox and Meadowmont neighborhoods, and UNC's Friday Center (event center)
#3 Natural	Little Creek corridor and George King Road area
#4 Interstate	I-40 from NC 54 to US 15-501
#5 Suburban Commercial	US 15-501 corridor with mix of single-family and multi-family residential neighborhoods and suburban commercial development and shopping centers
#6 Recreational	Includes Duke University Golf Club and Duke Forest
#7 University (Duke)	Duke University's West Campus and mixed residential and commercial land uses west and north of the campus
#8 Historic Emerging Urban	Old West Durham neighborhood, commercial district on Ninth Street, Duke University's East Campus, and surrounding historic neighborhoods
#9 Downtown Urban	Warehouse District and Central Park neighborhoods, downtown Durham, Morehead Hill, and the Southside/St. Teresa neighborhoods
#10 Urban Industrial	Edgemont, Golden Belt, and Eastway Village neighborhoods, North Carolina Central University and Durham Technical Community College

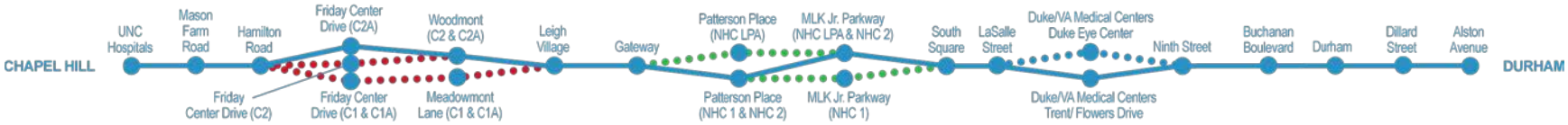


Figure 4.4-2: Landscape Unit #1 – University (UNC)

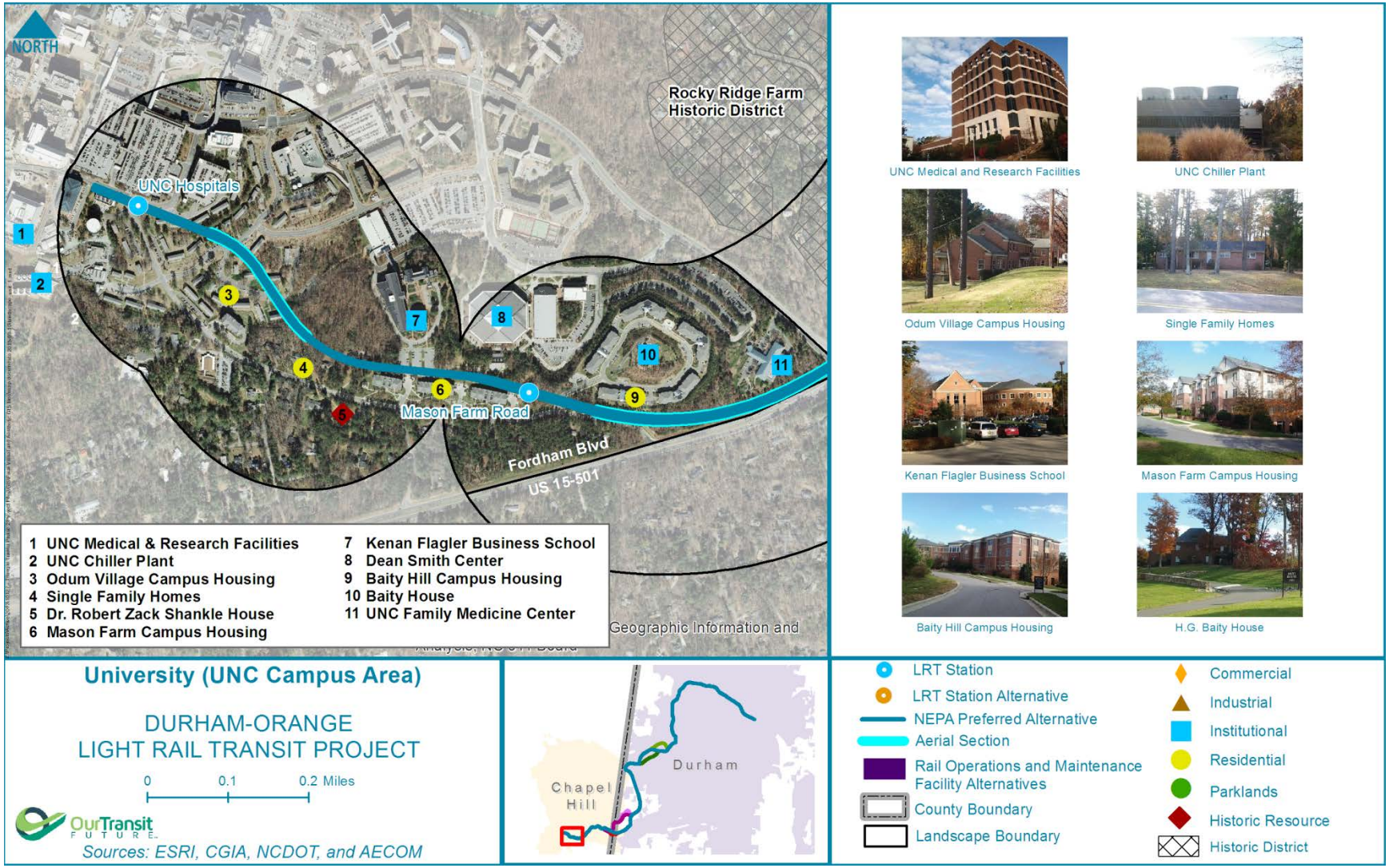


Figure 4.4-3: Landscape Unit #2 – Mixed Use/Institutional

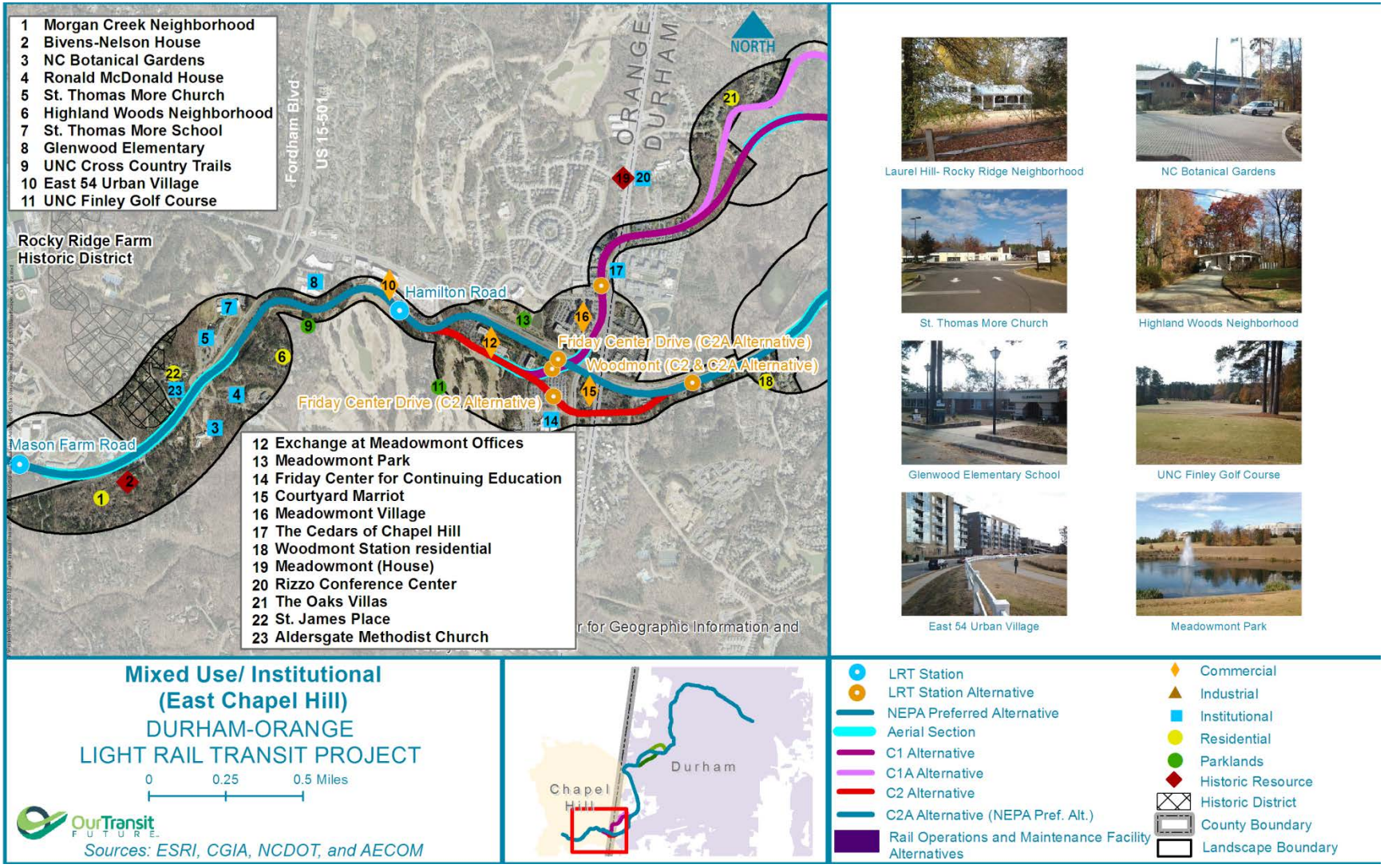


Figure 4.4-4: Landscape Unit #3 – Natural

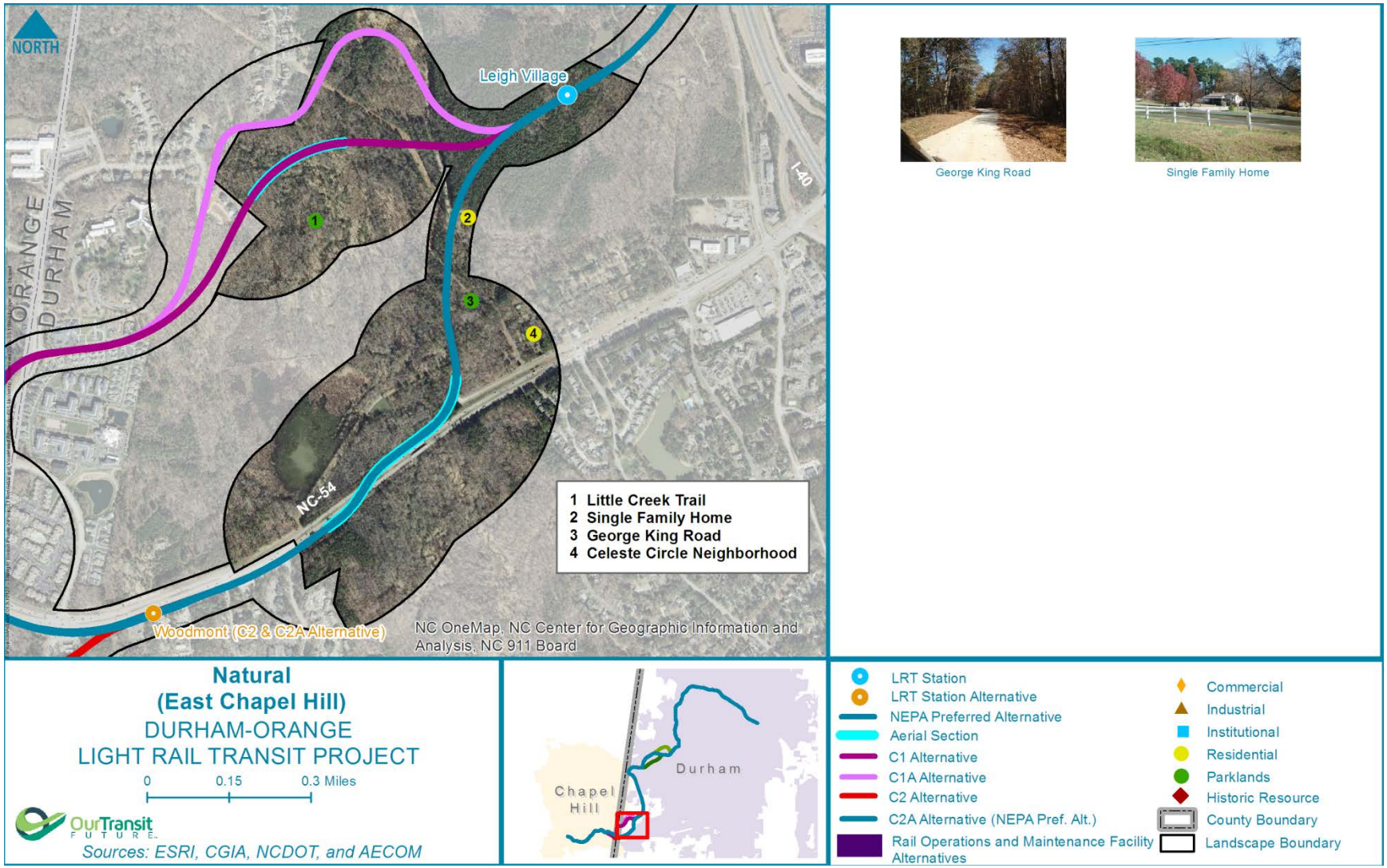


Figure 4.4-5: Landscape Unit #4 – Interstate

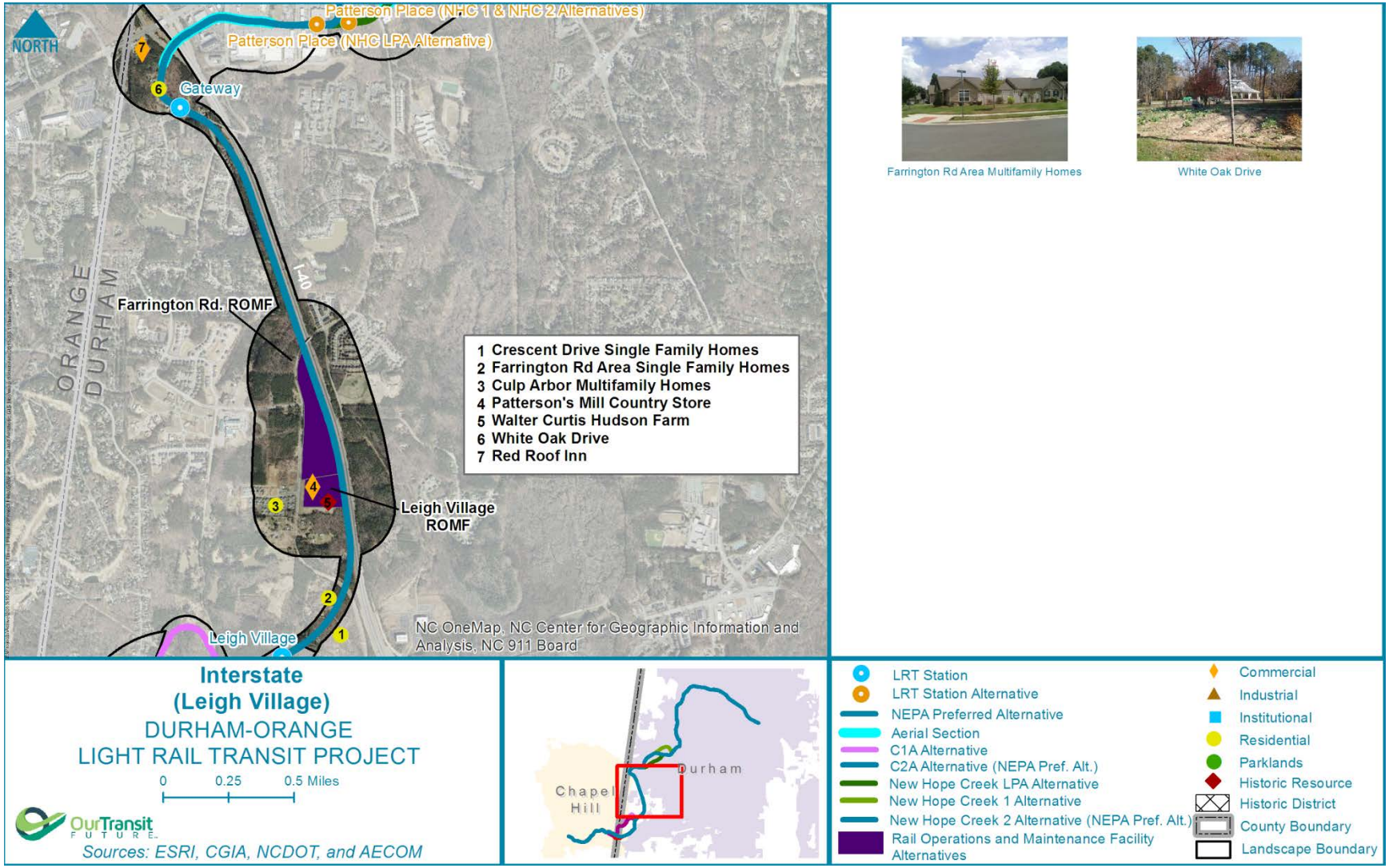
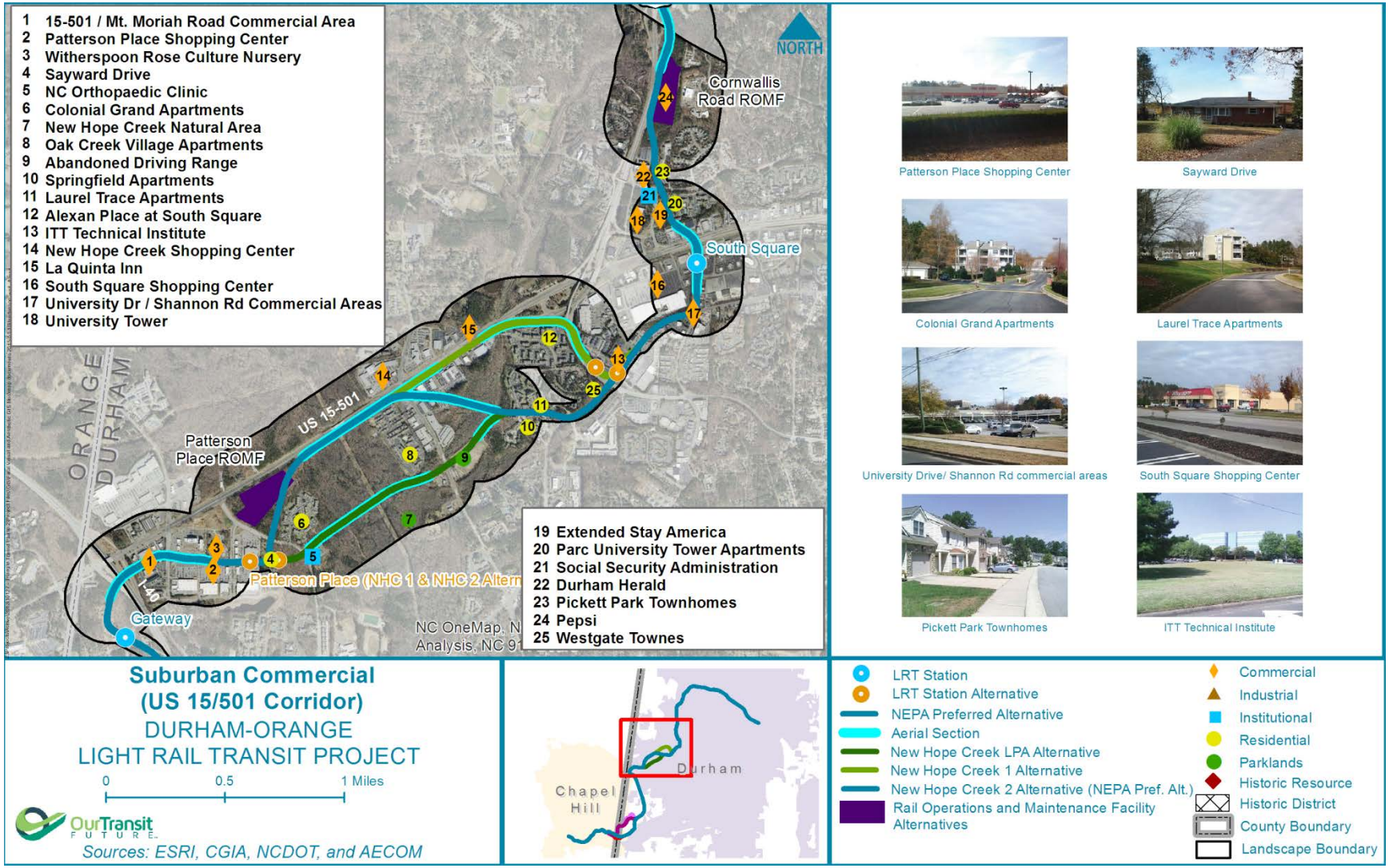


Figure 4.4-6: Landscape Unit #5 – Suburban Commercial



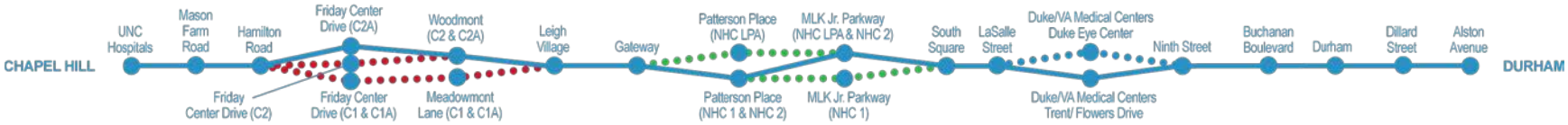
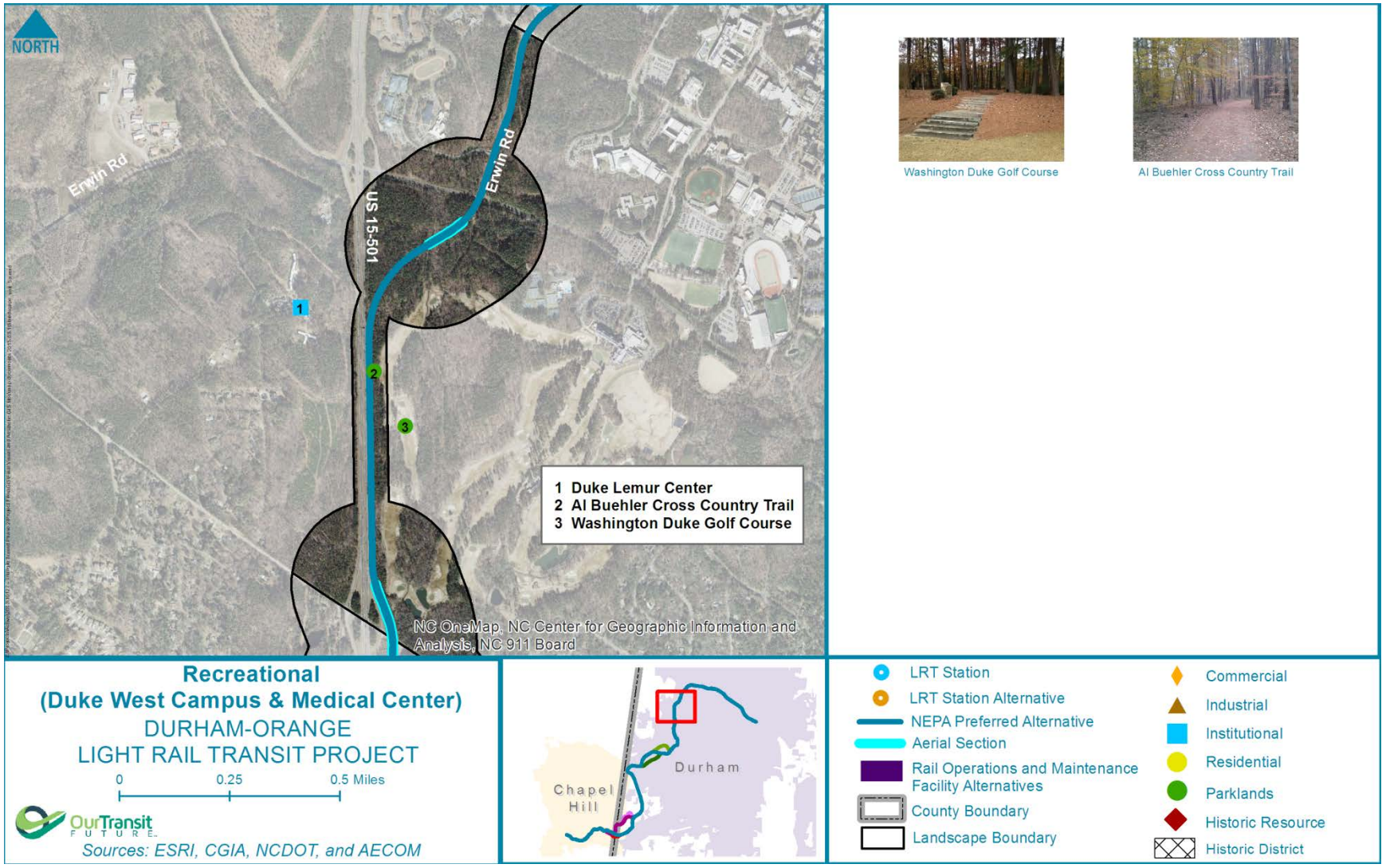


Figure 4.4-7: Landscape Unit #6 – Recreational



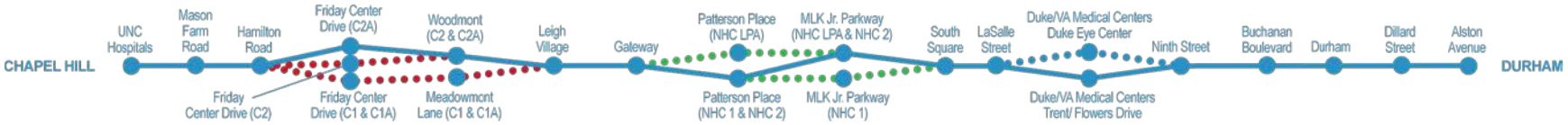


Figure 4.4-8: Landscape Unit #7 – University (Duke)

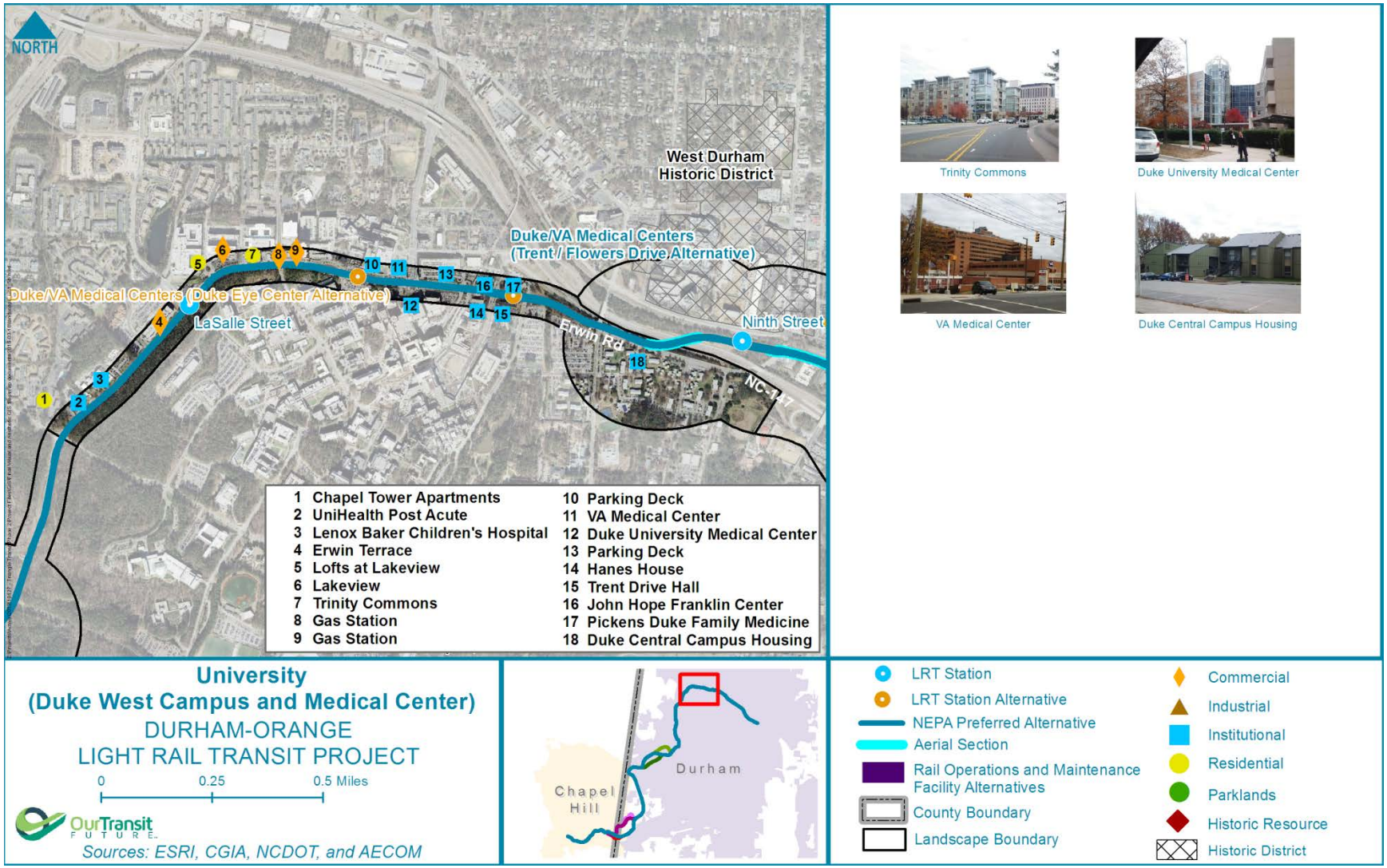


Figure 4.4-9: Landscape Unit #8 – Historic/Emerging Urban

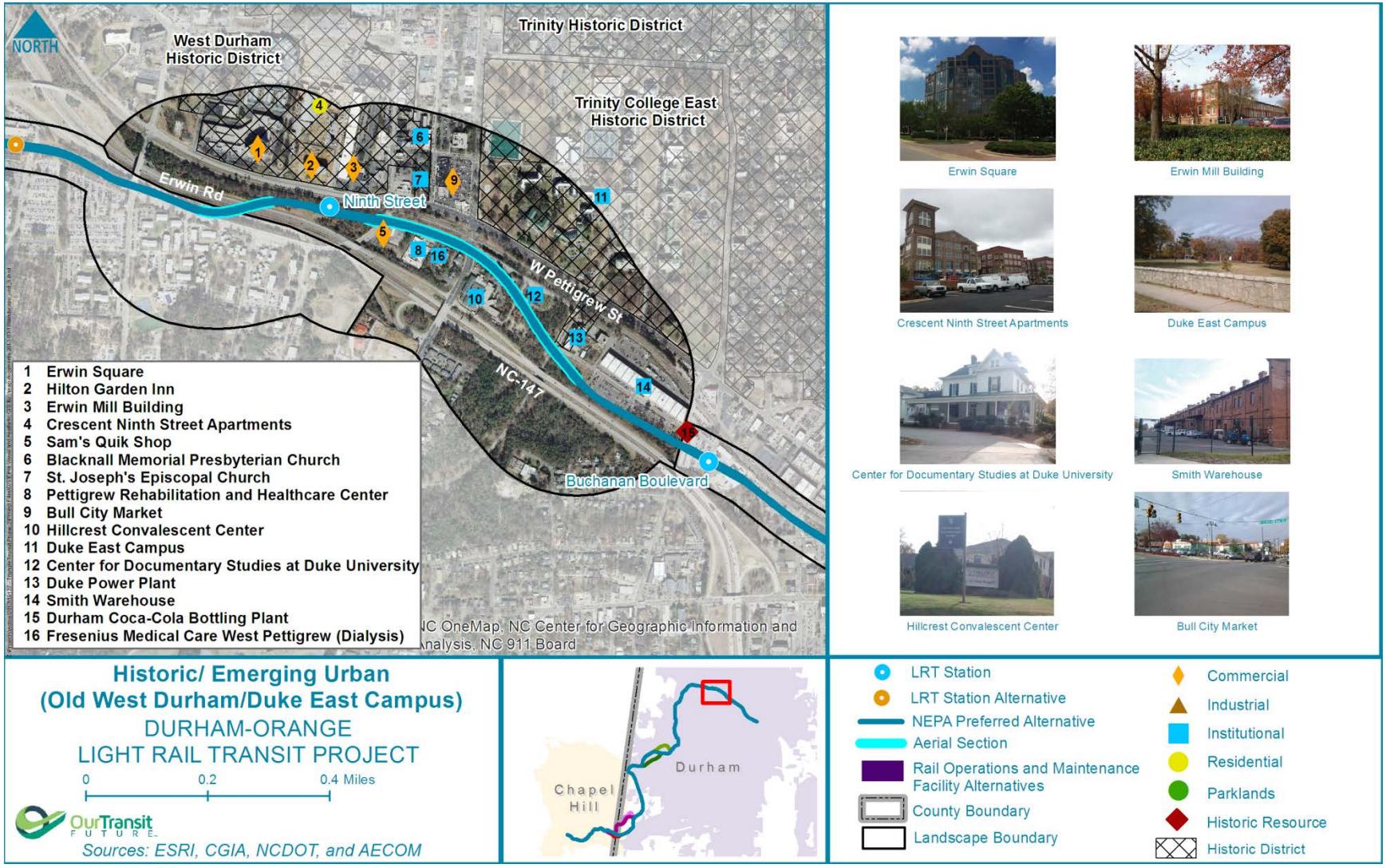


Figure 4.4-10: Landscape Unit #9 – Downtown Urban

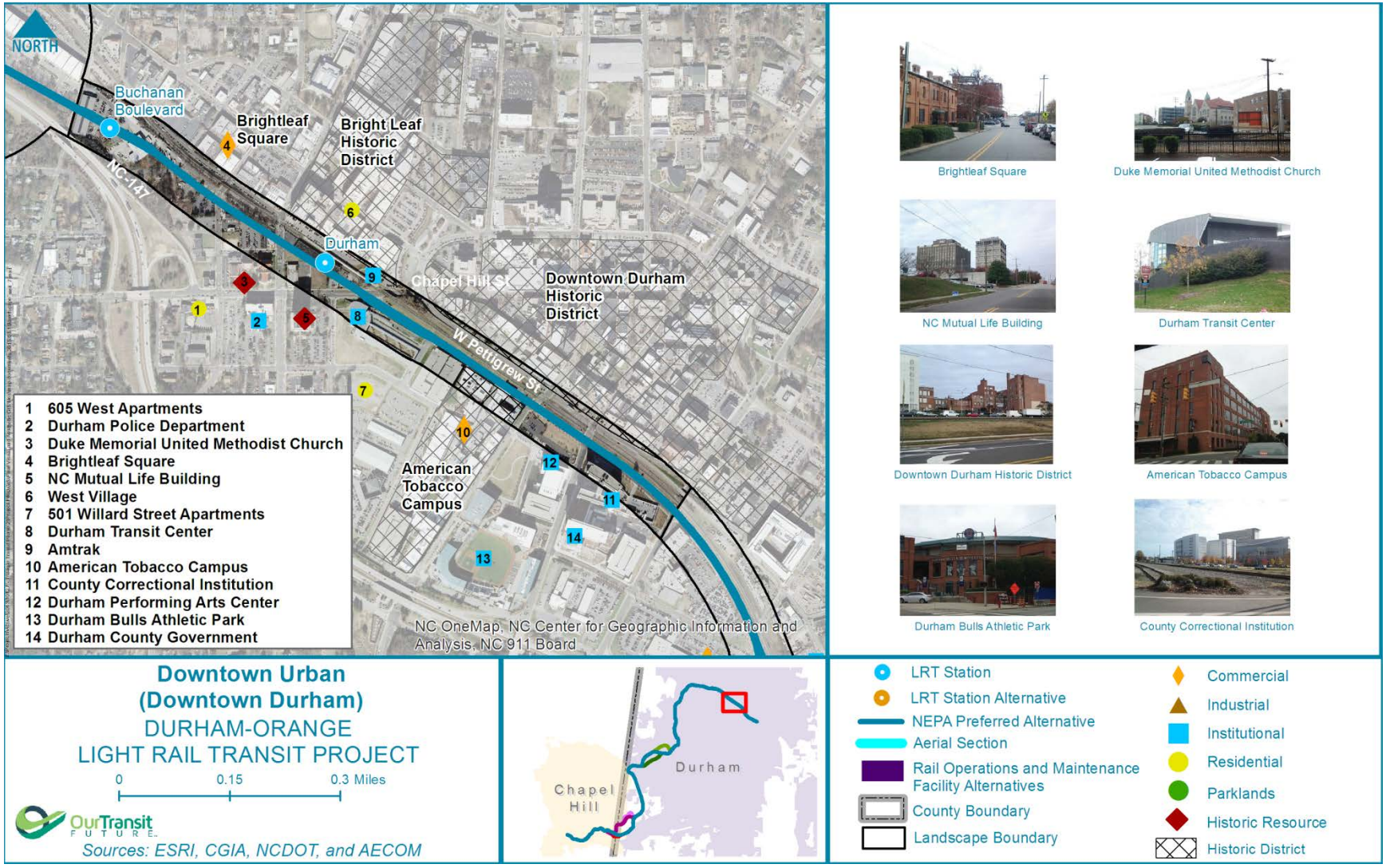
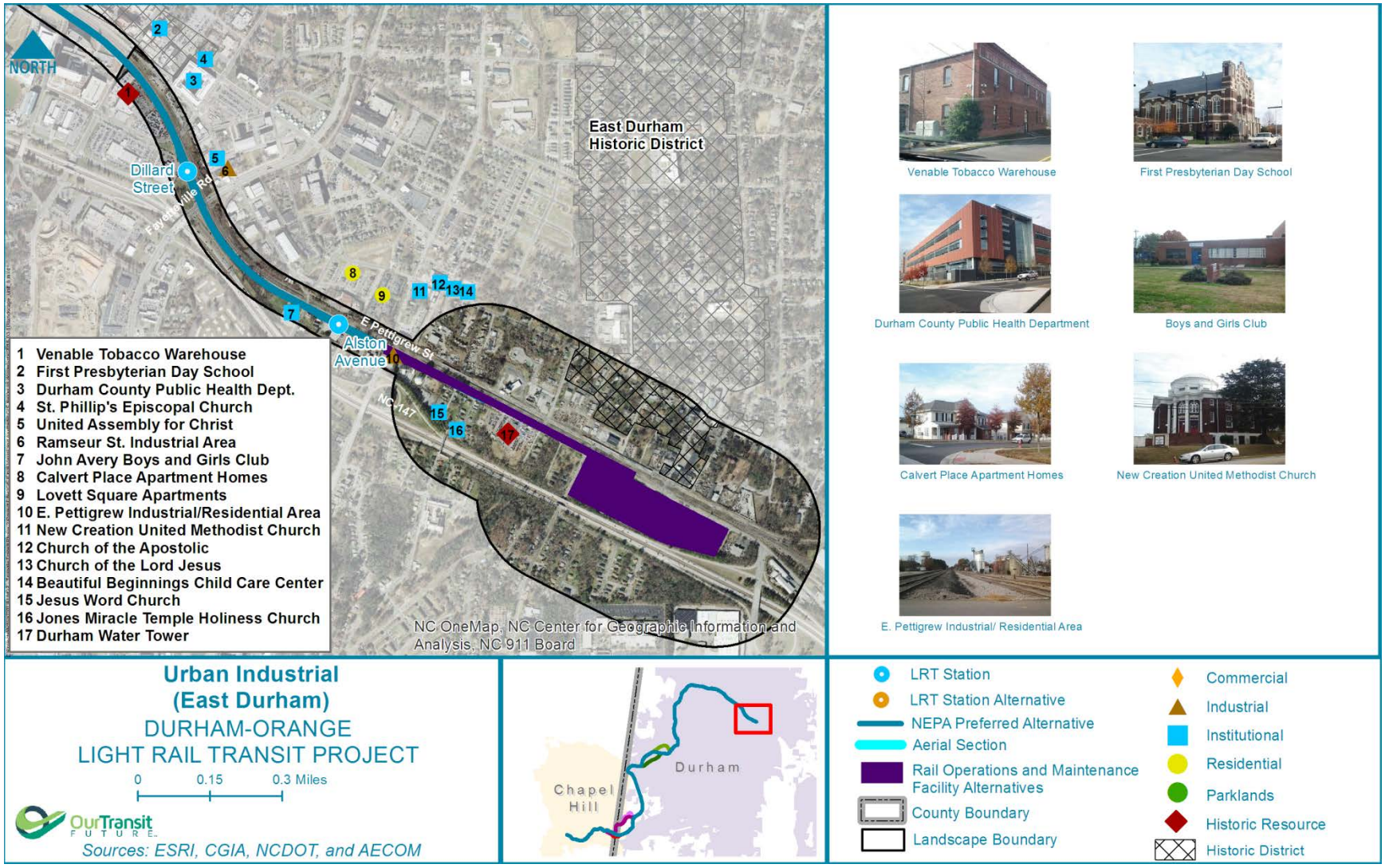


Figure 4.4-11: Landscape Unit #10 – Urban Industrial



4.5 Historic and Archaeological Resources

This section describes the potential direct effects of the proposed D-O LRT Project on archaeological resources and historic resources listed or eligible for listing on the National Register of Historic Places (NRHP). The current design avoids potential effects to these resources.

DEIS section 4.17 analyzes potential indirect effects to historic and archaeological resources which could occur as a result of the proposed D-O LRT Project but would be further removed in time or space. An example of a potential indirect effect would be the possibility for future private redevelopment of land within station areas that could affect historic or archaeological resources.

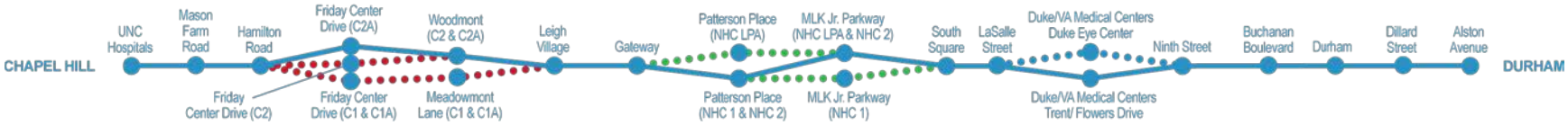
Applicable laws addressing historic properties include Section 106 of the National Historic Preservation Act (36 C.F.R. 800) and Section 110 of the NHPA (54 U.S.C. 306101-306114).

Information included within this section is based on the information provided in appendices K.16 through K.20.

Section 106 of the National Historic Preservation Act (NHPA): Requires federal agencies to consider the potential effects of a proposed federally funded project, also referred to as an undertaking, on historic properties.

Undertaking: In this section, the D-O LRT is generally referred to as an "undertaking," which is the term used in Section 106 to define a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a federal agency; those carried out with federal financial assistance; and those requiring a federal permit, license, or approval.

Historic Property: Prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places



4.5.1 Methodology

Section 106 requires consultation with the North Carolina State Historic Preservation Officer (SHPO), federally recognized Native American tribes with an interest in the area, local governments, and other consulting and interested parties. In accordance with the Section 106 process, the responsible federal agency (FTA is the lead federal agency for this undertaking) shall do the following:

- Identify the project's APE and any historic properties within the APE
- Assess the effects of the project on those historic properties
- Resolve adverse effects by exploring alternatives that avoid, minimize, or mitigate the adverse effects through project design, consultation with Section 106 consulting parties, and development of a Section 106 agreement document for mitigation of adverse effects to historic properties

While locally designated historic properties (properties designated or eligible for local designation as a historic resource by the Town of Chapel Hill, the City of Durham, and Orange and Durham counties) are not a part of the Section 106 process, consultation with locally important historic properties are subject to Section 4(f). Section 4(f) is covered in chapter 6 of this DEIS.

The Preliminary Determination of Effects was conducted for the NEPA Preferred Alternative. The *Section 106 Assessment of Effects for Historic Properties for Durham-Orange Light Rail Project* will be posted separately for public comment. Triangle Transit will provide notification of the availability of this report for review via the project website, local newspapers, and through the project's email contact list.

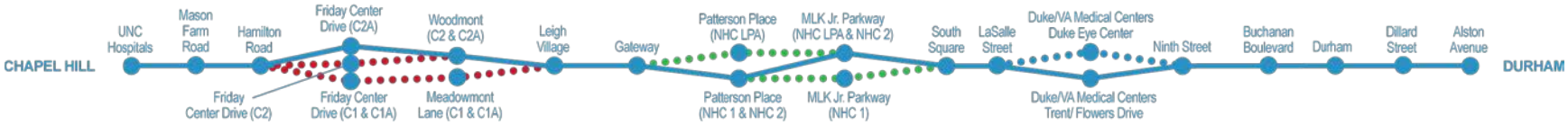
4.5.1.1 Consultation

Early Coordination with FTA, SHPO, Preservation Chapel Hill, Preservation Durham, and Orange County Department of Environment, Agriculture, Parks and Recreation was completed to inform the APE and identify potential eligible resources in April 2014. This early coordination also included the identification of locally designated historic properties for the purpose of Section 4(f).

Official invitations to consult in the Section 106 process under the provisions of 36 C.F.R. § 800.2 were sent in April and July of 2015. The following parties were invited to consult:

- Tribal Historic Preservation Officers of the Eastern Band of the Cherokee Indians and the Catawba Indian Nation
- The North Carolina SHPO
- State Archaeologists for the North Carolina Office of State Archaeology (OSA)
- Staff from
  - Preservation Chapel Hill
  - Preservation Durham
  - Preservation North Carolina
  - Durham City/County Planning
  - Orange County Department of Environment, Agriculture, Parks, and Recreation
  - Town of Chapel Hill
  - UNC
  - Duke University
  - Duke Medical Center
  - North Carolina Railroad Company

Undertaking: In this section, the D-O LRT is generally referred to as an "undertaking," which is the term used in Section 106 to define a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a federal agency; those carried out with federal financial assistance; and those requiring a federal permit, license, or approval.



A consultation meeting was held August 14, 2015 to review FTA's Preliminary Determination of Effects on the undertaking (NEPA Preferred Alternative). Consultation will continue with the consulting parties per Section 106 consultation requirements. Correspondence between these parties, Triangle Transit, and the FTA can be found in appendix N.

Area of Potential Effects (APE): The geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking

A separate APE has been defined for the following:

- Architectural historic properties
- Archaeological historic properties

4.5.1.2 APE Identification

An APE has been defined for this project for architectural historic properties. It is referred to as the "Architectural APE." A second APE, referred to as the "Archaeological APE," has been defined for archaeological historic properties.

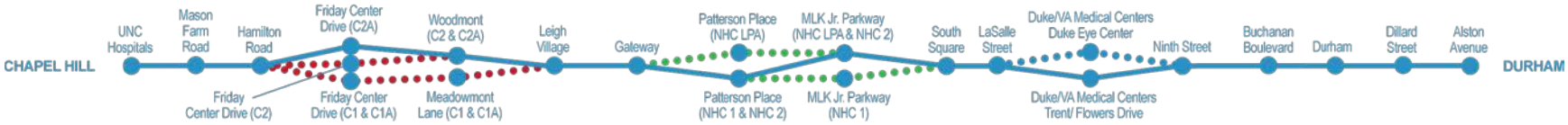
Architectural APE

An appropriate APE for architectural historic properties must account for any physical, auditory, atmospheric, visual, or change-in-use impacts to such properties. Area of potential effects means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.

The APE can be found in appendices K.16 and K.17.

The following architectural APE was delineated in the *Architectural Resources APE Report*:

- From its terminus in Chapel Hill until it reaches dense urban development in downtown Durham at South Gregson Street, the APE generally follows property boundaries extending 500 feet to either side of the centerline of the undertaking's alignment and alternative alignments, so is generally 1,000 feet wide (500 feet either side of centerline). However, due to the presence of several large parcels the APE was not expanded to include the full parcel if the parcel size was 10 acres or larger. Instead, the APE generally follows the 500-foot measure taking into account buildings and other barriers. The APE does, however, expand and contract outside of downtown Durham depending on the presence of I-40, proposed ROMFs, park-and-ride facilities, and the elevation of sections of track for the undertaking. In addition, the APE was expanded to include the entire boundary of any NRHP-listed or eligible properties/districts that are partially located within the area identified as the APE.
- The APE is less than 500 feet on either side of the centerline of the proposed project where it encounters I-40 in Durham County. From just north of I-40's interchange with NC 54 to just south of its interchange with Durham-Chapel Hill Boulevard (US 15 - 501), the APE terminates at the right-of-way on the east side of the interstate, short of 500 feet from the centerline of the undertaking.
- Within the urban core of the City of Durham, the APE is less than 500 feet from the centerline of the NEPA Preferred Alternative and the proposed Alston Avenue ROMF. From Buchanan Boulevard east to Briggs Avenue, it



includes the resources that directly overlook the corridor and the ROMF.

- At the eastern terminus of the undertaking at the Alston Avenue ROMF, the APE terminates at the right-of-way on the south side of the Durham Freeway (NC 147), short of 500 feet from the centerline of the undertaking and the southern edge of the ROMF.
- The APE extends farther than 500 feet from the centerline of the various corridors in the vicinity of the sites of four potential ROMFs in Durham County and at some sections where the track for the undertaking is elevated. At the Leigh Village and Farrington Road ROMF sites, the APE extends 500 feet west of the site. At the Patterson Place ROMF, the APE extends out 500 feet from the edges of the ROMF at all sides. It also extends 500 feet to the east of the Cornwallis Road ROMF.
- Where sections of the track for the undertaking are elevated, the APE may have been widened beyond a general 1000-foot width, depending on the nature of the elevation and the terrain.

Detailed analyses for these distances can be found in appendix K.16, which includes maps of the APE in Figures 1 through 21. The architectural APE was determined by the FTA in consultation with the SHPO (see SHPO letter of January 6, 2015 included in appendix G).

Identification of Historic Properties in Architectural APE

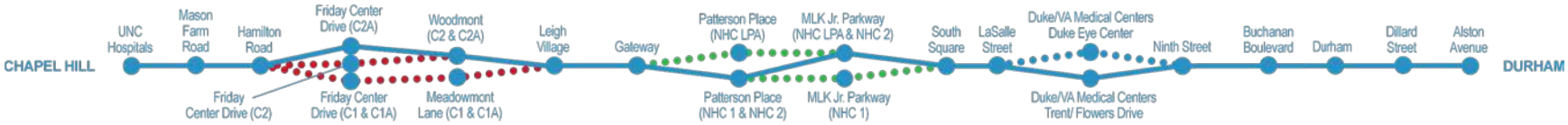
To identify historic properties in the Architectural APE, an architectural historic survey was conducted within the APE by an architectural historian. This survey focused on aboveground historic properties. Information was compiled on properties already listed in the NRHP or previously evaluated for eligibility via research at the SHPO. Field investigations were conducted to identify previously unevaluated aboveground resources that may merit listing on the NRHP and to reassess the continued eligibility of already identified architectural historic resources and historic properties.

In accordance with the Section 106 process per 36 C.F.R. Part 800, the findings of the architectural historical survey, along with FTA's eligibility determinations, were submitted to the SHPO. The SHPO reviewed and commented on the eligibility determinations (SHPO letter of April 16, 2015, included in appendix G). The FTA incorporated the SHPO's comments in the final *Architectural History Survey* report (May 2015 report included in appendix G). DEIS section 4.5.2.1 identifies the architectural historic properties located in the project's Architectural APE.

Archaeological APE

The APE for archaeology includes all areas of proposed construction activities or other potential ground-disturbing activities associated with construction. The following Archaeological APE was delineated in the *Archaeological Resources APE Report*:

- From its terminus in Chapel Hill until it reaches east Durham at Alston Avenue, the APE generally extends 100 feet to either side of the centerline of the undertaking's various corridors, so is generally 200 feet wide. The APE extends farther than 100 feet from the centerline of the various corridors in the vicinity of the sites of five potential ROMFs in Durham County and at some sections where there are proposed park-and-ride sites associated with several stations.
- At the Leigh Village and Farrington Road ROMF sites, the APE extends 100 feet west of the site. At the Patterson Place ROMF site, the APE extends out 100 feet from the edges of the ROMF at all sides. It also extends 100 feet to the east of the Cornwallis Road ROMF site. At the eastern terminus of the undertaking at the Alston Avenue ROMF site, the APE terminates at the right-of-way on the south side of the Durham Freeway (NC 147), short of 500 feet from the centerline of the undertaking



and 100 feet from the southern edge of the ROMF.

- The APE extends an additional 100 feet outside of the footprints of proposed park-and-ride locations. These facilities are located at the Friday Center, Leigh Village, Gateway, South Square, Dillard Street, and Alston Avenue stations.

Detailed analysis for these distances can be found in appendix K.17, which includes maps of the APE in Figures 1 through 21. The archaeological APE was determined by the FTA in consultation with the SHPO (see SHPO letter of January 6, 2015 included in appendix G).

4.5.1.3 Assessment of Effects

The APE was defined for the NEPA Preferred and Project Element Alternatives. However, for the purposes of assessing effects of the proposed D-O LRT project for this DEIS, FTA made its preliminary finding on the NEPA Preferred Alternative. As part of this DEIS FTA made a Preliminary No Adverse Effects finding for the historic properties in, or eligible for, the NRHP within the APE for the NEPA Preferred Alternative.

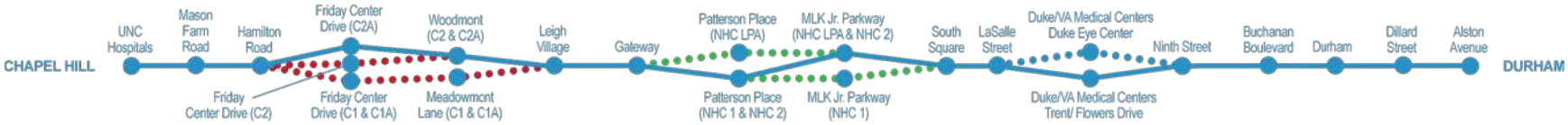
FTA intends to make a final determination of effects finding before the Final EIS/ROD at the conclusion of consultation with the SHPO, the consulting parties, and any public comments received on this DEIS and the Preliminary Determination of Effects Report. FTA will make a final determination of effects finding regarding archaeological resources once the alignment has been further defined. These determinations will be included with the combined FEIS/ROD if possible but will be addressed in either the FEIS/ROD or Section 106 agreement document between the NC State Archaeological Office, Triangle Tranist, and the FTA that will contain termis that will be executed prior to ground disturbing activities.

4.5.2 Affected Environment

Architectural historic properties within the Architectural APE are described, assessed, and depicted in appendix K.20 and described below. Appendix K.19 compiles information collected on previously recorded archaeological sites and during previous cultural resources management studies performed along/near the D-O LRT Project. The NRHP-eligibility of resources is based upon their significance, integrity, and ability to meet the requirements of NRHP Criteria A, B, C, and/or D.

4.5.2.1 Architectural Historic Properties

FTA has preliminarily determined that the project would have no adverse effect on the following historic properties:



[Dr. Robert Jack Shankle House (OR-2771), 1306 Mason Farm Road, Chapel Hill, Orange County]

The Dr. Robert Jack Shankle House was determined eligible for NRHP listing in 2015 under Criterion C for its architecture. Built for Dr. Shankle in 1957, it is a significant example of Mid-Century Modernist architecture in the Chapel Hill/Raleigh/Durham area.

NRHP Criteria for Evaluation

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in resources that possess integrity, and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of significant persons in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded or may be likely to yield, information important in history or prehistory.

H.G. Baity House (OR-2772), 1503 Baity Hill Drive, Chapel Hill, Orange County

The H.G. Baity House was determined eligible for NRHP listing in 2015 by the FTA under Criterion B, for its association with Dr. Herman Glenn "H.G." Baity, and under Criterion C for its architecture. Baity was the most important figure in the early/mid-twentieth-century history of sanitary engineering in North Carolina and was internationally recognized for his work. He built the Chateauesque-style brick house with the assistance of workmen in 1940 and lived in it, when he was not working abroad, until his death in 1975.

Bowers-Nelson House (OR-1465), 903 Coker Drive, Chapel Hill, Orange County

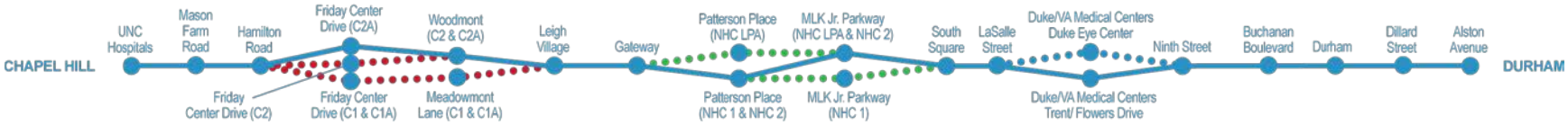
The Bowers-Nelson House was determined eligible for NRHP listing in 2015 by the FTA under Criterion C for its architecture. Built in 1960, it is a significant example of Japanese-influenced Mid-Century Modernist architecture in the Chapel Hill/Raleigh/Durham area.

Rocky Ridge Farm Historic District (OR-303 and OR-1748), Chapel Hill, Orange County

The Rocky Ridge Farm Historic District is a large twentieth-century residential neighborhood roughly bounded by Raleigh Road and Country Club Road on the north, Laurel Hill Road and Laurel Hill Circle on the east, Fern Lane on the south, and Ridge Road and the Coker Pinetum on the west. It was listed in the NRHP in 1989 and its boundaries were expanded in 2008. It is a notable example of planned suburbanization in Chapel Hill from the 1920s into the 1960s, with houses built in a range of popular styles. It was listed in the NRHP under Criteria A and C in the areas of community planning/development, landscape architecture, and architecture.

Highland Woods Historic District (OR-1460), Highland Woods Road, Chapel Hill, Orange County

The Highland Woods neighborhood was developed in eastern Chapel Hill in the mid-1950s. It was determined eligible for listing in the NRHP as a historic district in 2015 by the FTA under Criterion A within the area of community planning and development. Its combination of cooperative housing, intended to create reasonably priced homeownership and a close sense of community, with modernist architecture, which was intended to project the progressive ideals of the cooperative members who chose to be neighbors and friends, is an excellent representative of this area of significance. The historic district was also determined to be NRHP-eligible under Criterion C for its intact and often architect-designed Mid-Century Modernist architecture.



Rocky Ridge Farm Historic District

Dubose Tenant Farm Complex (OR-335 to OR-339), Chapel Hill, Orange County

The DuBose Tenant Farm Complex once included scores of acres of fields and woodlands dotted by tenant houses and outbuildings, which were roughly bounded by the modern Sprunt Street on the north, the modern Old Barn Lane on the east, NC 54 on the south, and the modern West Barbee Chapel Road and Old Barn Lane on the west. The complex was determined eligible for NRHP listing in 1994, but shortly thereafter, it was demolished for development of the Meadowmont subdivision, which was built on top of it. Due to this demolition and construction, the complex has lost its integrity and is no longer NRHP-eligible.

Highland Woods Historic District

Meadowmont (DH-1708), 150 DuBose Home Lane, Durham County

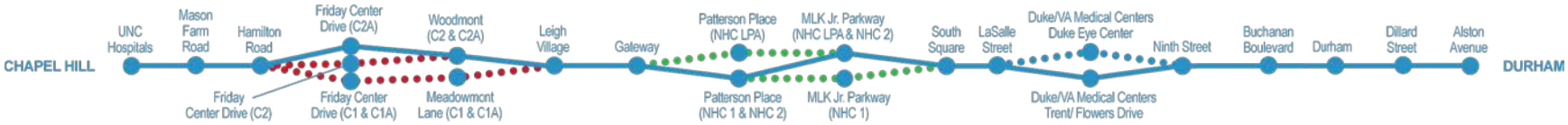
Meadowmont is anchored by its 1933 Georgian Revival-style estate house of the same name. It was listed in the NRHP in 1985 under Criteria A, B, and C for its association with the philanthropy of the John Sprunt Hill family; association with owners D. St. Pierre and Valinda (Hill) DuBose and architects Herbert G. Crisp and James R. Edmunds, Jr.; and for its architecture and landscape architecture. Following its listing almost all contributing resources within the approximately 28-acre property other than the house were supplanted by the Rizzo Conference Center development. Were Meadowmont's boundaries redrawn to reflect current conditions, they would contract to a much smaller area confined to the house and its immediate grounds.

Walter Curtis Hudson Farm (DH-2373), 5117 Farrington Road, Durham County

Walter Curtis Hudson physically built the house and outbuildings on his farm from 1918 through 1960. The outbuildings include a milkhouse/washhouse and a garage connected by a water filtration system and underground cistern, a woodshed, a brooder house, a log playhouse, a shop, and a barn. The farm was determined to be eligible for NRHP listing in 2015 by the FTA under Criterion C as a representative of a small Durham County farmstead of the early twentieth century. A store erected in 1972-1973 to the north, along with a few outbuildings, was found in 2015 not to be NRHP-eligible either individually or in association with the farm.

Ruth-Sizemore Store (DH-2561), 5520 Old Chapel Hill Road, Durham County

The small frame Ruth-Sizemore store was built in the mid-1920s as a rural crossroads store. It was determined to be eligible for NRHP listing in 2015 by the FTA under Criterion A in the area of significance of commerce as representative of a rural Durham County store. A much-altered house and pool hall adjacent to the store were found in 2015 not to be NRHP-eligible either individually or in association with the store.



Walter Curtis Hudson Farm

West Durham Historic District (DH-1134 and DH-1178), Durham, Durham County

The West Durham Historic District (DH-1134) consists of approximately 90 acres of late nineteenth/early twentieth-century industrial buildings and company-built housing, and an early twentieth century commercial district. It is roughly bounded by West Knox Street on the north, Ninth and Iredell streets on the east, West Main Street on the south, and Rutherford Street and Carolina Avenue on the west. It was listed in the NRHP in 1986 under Criterion C as an intact representative of late nineteenth and early twentieth-century industrial and residential architecture. The Erwin Cotton Mills Co. Mill No. 1 and Headquarters Building (DH-1178) within the district was built in the 1890s. It was individually listed in the NRHP in 1984 under Criteria A, B, and C for its economic role in Durham; association with Benjamin N. Duke, George W. Watts, and William A. Erwin; and for its architecture. Since the historic district was listed, much of its southern portion has been altered by modern development. Were its boundaries redrawn to reflect current conditions, they would contract at the south.

Ruth-Sizemore Store

Powe House (DH-1224 and DH-1225), 1503 West Pettigrew Street, Durham, Durham County

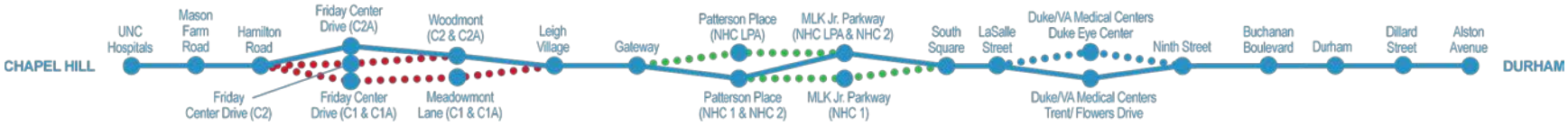
The frame Neoclassical Revival-style Powe House (DH-1224), erected in 1900, was listed in the NRHP in 1985 under Criteria A, B, and C for its symbolic status as the home of a textile industry executive; its association with Edward Knox Powe; and its architecture. In 1986 Sunnyside house (DH-1225) and Erwin Cottage were moved within the Powe House's NRHP boundaries and the SHPO recommended delisting the entire property. The FTA concurred in 2015 that the Powe House is no longer eligible for NRHP listing.

Trinity College East Campus Historic District (DH-1821), Durham, Durham County

The former campus of Trinity College, now the East Campus of Duke University, holds an impressive collection of early twentieth-century educational buildings built in the late nineteenth and early twentieth centuries and rebuilt in the 1920s and 1930s with money provided by the Duke Family. It is roughly bounded on the north by West Markham Avenue, on the east by North Buchanan Boulevard, on the south by West Main Street and Maxwell Avenue, and on the west by Campus Drive and Broad Street. In 2000 and 2009, the historic district was determined eligible for NRHP listing. The Campus Drive Underpass and Grade Separation within the district were determined individually eligible for NRHP listing under Criteria A and C for its history and architecture in 2005.

Smith Warehouse (DH-89), 114 South Buchanan Boulevard, Durham, Durham County

The exuberant design of the massive, brick, 1906 Smith Warehouse recalls medieval architecture and the Romanesque and Norman Revival styles. It was listed in the NRHP under Criteria A, B, and C for its



connection with the American Tobacco Company trust and the trust's economic role in Durham; its association with James B. Duke and other American Tobacco Company executives; and its architecture.

Smith Warehouse

Trinity Historic District (DH-927), Durham, Durham County

The Trinity Historic District is roughly bounded by West Club Boulevard and Green Street on the north, North Duke Street on the east, West Main Street on the south, and North Buchanan Boulevard and Broad Street on the west. It contains more than 930 resources, the large majority of which are single-family dwellings, on approximately 281 acres. The district was listed in the NRHP in 1986, and expanded in 2004 and 2008, under Criterion A for representing the efforts of the leaders who had created Durham's prospering economy to provide the public services and cultural amenities necessary for the community's continued development as a progressive city; under Criterion B for reflecting the business acumen of Julian S. Carr, Richard H. Wright, Brodie L. Duke, and many other smaller investors; and under Criterion C for its concentration of popular residential design from the 1890s into the 1950s.

Trinity College East Campus Historic District

Watts and Yuille Tobacco Warehouses (DH-87), 114 South Buchanan Boulevard, Durham, Durham County

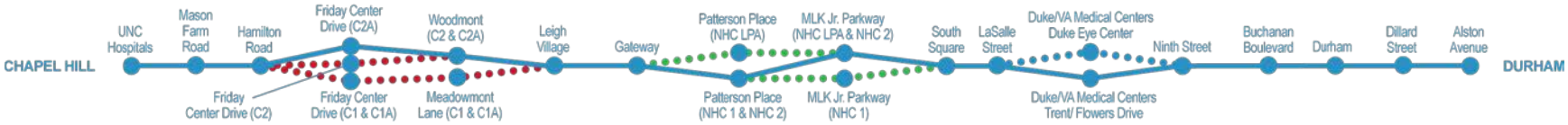
The pair of exuberantly designed warehouses that comprise the Watts and Yuille Tobacco Warehouses, built of brick in 1904, recall medieval architecture and the Romanesque and Norman Revival styles. The building was listed in the NRHP in 1984 under Criteria A, B, and C as a notable symbol of the American Tobacco Company trust; for its association with James B. Duke and his family, George W. Watts, and Thomas B. Yuille; and for its architecture.

Duke Memorial United Methodist Church (DH-1253), 504 West Chapel Hill Street, Durham, Durham County

The Duke Memorial United Methodist Church is a monumental brick building erected between 1907 and 1912 in the Gothic and Romanesque Revival styles. It was listed in the NRHP in 1985 under Criterion A for its association with the rapid growth of western Durham and the many tobacco workers in its congregation; under Criterion B for its association with Washington Duke and his sons; and under Criterion C for its architecture.

Bright Leaf Historic District (DH-71), Durham, Durham County

The Bright Leaf Historic District is roughly bounded by Minerva Avenue on the north, railroad tracks and Liggett and Morris streets on the east, railroad tracks and West Main Street on the south, and North Duke Street on the west, in the early industrial heart of Durham. It was listed in the NRHP in 1999 under Criterion A in the area of industry for its association with the history of tobacco manufacturing in Durham and under Criterion C in the area of architecture for its notable industrial design.



Duke Memorial United Methodist Church

North Carolina Mutual Building (DH-2477), 411 West Chapel Hill Street, Durham, Durham County

The Mid-Century Modernist North Carolina Mutual Building was designed, constructed, and opened between 1964 and 1966. It was designed by Los Angeles architect Welton Becket for the North Carolina Mutual Insurance Company. The skyscraper was determined to be eligible for listing in the NRHP, with national significance, under Criterion A in the area of African-American ethnic history as a landmark of African-American enterprise in the late twentieth century.

North Carolina Mutual Building

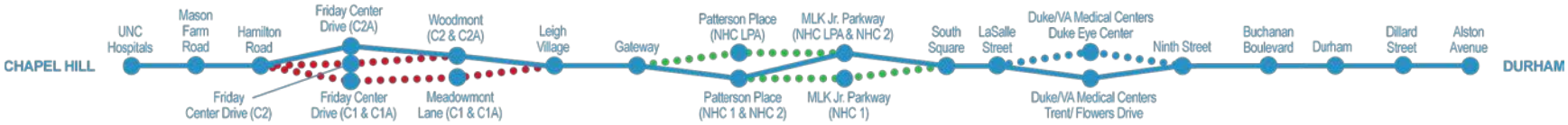
Downtown Durham Historic District (DH-1692), Durham, Durham County

The Downtown Durham Historic District was listed in the NRHP in 1977 within the areas of significance of architecture, commerce, politics/government, religion, and theater. It was additionally documented for the NRHP in 2012 and specified to be NRHP-eligible under Criteria A and C. The district is the core of historic downtown Durham and is largely contained by the loop that rings that core. It is roughly bounded by West Morgan, East Seminary, and East Parrish streets on the north, North Roxboro and North Queen streets on the east, Ramseur Street on the south, and Great Jones and West Morris streets on the west. Contained within its approximately 65 acres are more than 175 resources, almost all of which are commercial, governmental, religious, and other nonresidential multi-story buildings.

American Tobacco Company Manufacturing Plant (DH-1872 and DH-10), Durham, Durham County

The late nineteenth and early/mid-twentieth-century American Tobacco Company Manufacturing Plant (DH-1872) was listed in the NRHP in 2000 under Criterion A in the area of industry as symbolizing the history of the tobacco industry in Durham and under Criterion C in the area of architecture for its notable industrial design. Included within the NRHP boundaries of American Tobacco is the 1875-1903 W.T. Blackwell and Co. (Bull Durham) Tobacco Factory (DH-10), which was identified as a National Historic Landmark in 1974 for its significance as the first successful tobacco manufacturing company in North Carolina.

American Tobacco Company Manufacturing Plant



The approximately 17-acre factory complex occupies the Durham block bounded by West Pettigrew Street on the north, Blackwell Street on the east, Willard Street on the south, and Julian Carr Street on the west.

Southern Railway Bridge (Seaboard Coastline Railroad Overpass) (DH-2504 and DH-1867), Durham, Durham County

The early twentieth-century Southern Railway Bridge (Seaboard Coastline Railroad Overpass) was determined eligible for NRHP listing in 1999 under Criterion A in the area of transportation and under Criterion C for its design. The structure carries railroad tracks over South Roxboro Street at East Pettigrew Street in Durham. It does not have any precisely delineated boundaries. The property it stands on has no parcel number and is flanked to the east and west by, but separate from, a parcel owned by the North Carolina Railroad Company. Its boundaries likely encompass its footprint, including its wingwalls.

Southern Railway Bridge

Venable Tobacco Company Warehouse (DH-97), 302-304 East Pettigrew Street, Durham, Durham County

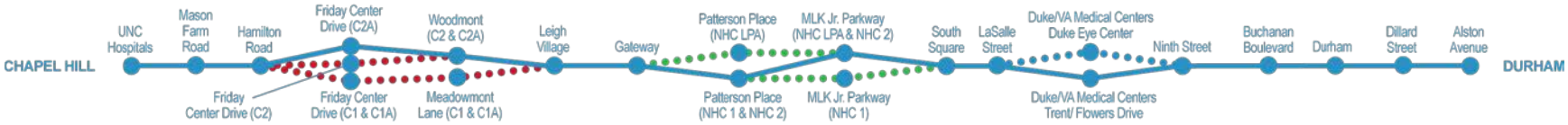
The Venable Tobacco Company Warehouse was listed in the NRHP in 1985 under Criterion A in the area of industry for its association with Durham's tobacco industry and Criterion C in the area of architecture for its handsome slow-burn design. The brick building was erected in 1905 and expanded in the 1910s.

Venable Tobacco Company Prizery and Receiving Room (DH-2560), 302-304 East Pettigrew Street, Durham, Durham County

The Venable Tobacco Company Prizery and Receiving Room was included in the NRHP in 2003 under Criterion A in the area of industry for its association with Durham's tobacco industry. The prizery was erected of brick about 1930 and its concrete-block receiving room about 1952.

Venable Tobacco Company Warehouse

Venable Tobacco Company Prizery and Receiving Room



Durham Water Tower and Valve House (DH-3508), 1318 East Pettigrew Street, Durham, Durham County

The Durham Water Tower and Valve House were erected in 1939. It was determined eligible for NRHP listing in 2015 by the FTA under Criterion A for its association with the local activities of the Federal Emergency Administration of Public Works, which funded it, and Criterion C as an excellent and unusually large example of a 1930s-era water tower.

East Durham Historic District (DH-2184), Durham, Durham County

The east Durham Historic District contains 965 resources, most of which are single-family residences, within its approximately 226 acres. It is roughly bounded by the Southern Railway right-of-way on the south, North Guthrie Avenue on the east, Holloway Street on the north, and Hyde Park Avenue, South Plum Street, and Vale Street on the west. The largest and most densely populated historic neighborhood in Durham, it was listed in the NRHP in 2004 under Criterion A in the area of community development and planning and under Criterion C in the area of architecture for its extensive collection of representative, early twentieth-century housing.

4.5.2.2 Archaeological Historic Properties

Appendix K.19 compiles information collected on previously recorded archaeological sites and during previous cultural resources management studies performed along/near the D-O LRT project. An assessment of areas along the proposed D-O LRT alignment that may require additional archaeological field studies in order to identify any archaeological historic properties is also provided in that report. At a meeting on September 14, 2014, the OSA reviewed the approach and report. In a letter dated January 6, 2015, the OSA concurred with the recommendations contained in that report (appendix K.19). Further archaeological efforts, including fieldwork, will be conducted as necessary to identify archaeological historic properties near the end of the Engineering phase and prior to Construction.

4.5.3 Environmental Consequences

This section discusses the effects the NEPA Preferred Alternative would have on historic properties in the study area as compared to the other Project Element Alternatives and the No Build Alternative.

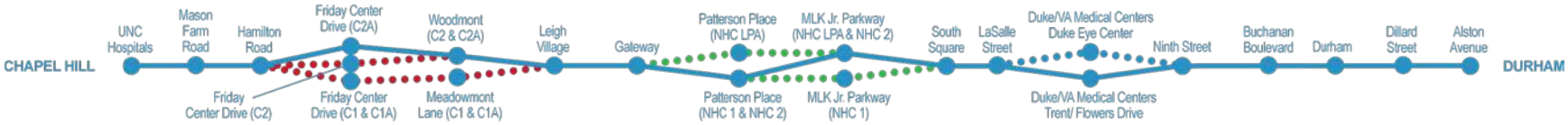
The FTA Preliminary Determination of Effect resulted in N Potential to Cause Effects for the No Build Alternative and No Adverse Effects for the NEPA Preferred Alternative.

4.5.3.1 NEPA Preferred Alternative

FTA has made a preliminary determination that the NEPA Preferred Alternative would have No Effect on 13 of the 25 architectural historic properties located within the Architectural APE as compared to the No Build. It would have No Adverse Effect upon the other 12 properties. However, Triangle Transit is committed to provide a landscape visual buffer for the following historic resources due to their non-urban settings: the Rocky Ridge Farm Historic District (HD), the Highland Woods HD, the Walter Curtis Hudson Farm, and the Ruth-Sizemore Store (**Table 4.5-1**). This visual buffer would provide a blooming of at least two seasons of each year. Triangle Transit will consult with property owners, historic district representatives, and the SHPO on the appearance of this buffer.

4.5.3.2 Project Element Alternatives

In areas where there are Project Element Alternatives, the Little Creek Alternatives, New Hope Creek Alternatives, and Duke Medical Centers/Duke Eye Center Alternative the effect on the 25 NRHP listed and/or eligible architectural historic properties located within the architectural APE would be the same as the NEPA Preferred Alternative. (**Table 4.5-1**).



ROMF Alternatives

The Leigh Village ROMF would take much of the property and many of the resources that comprise the NRHP-eligible Walter Curtis Hudson Farm (**Table 4.5-1**).

4.5.3.3 Archaeological Resources

NEPA Preferred Alternative

Archaeological site location information is confidential information under North Carolina General Statute 70-18 and not intended for public display or public viewing.

Based on Archaeological Background Information, appendix K19, impacts to archaeological resources will be minimal due to the previously disturbed nature and development within the APE. The Archaeological Background Information identified areas where further archeological surveys (Phase 1 and II) will be conducted during future engineering and prior to construction. The goal of a Phase I archaeological investigation is to locate and define the boundaries of archaeological site within a project area. The goal of Phase II archaeological investigation is to determine if a site is eligible for nomination to the NRHP under Criteria A, B, C, or D.

Phase I archaeological surveys are recommended for the following locations of the proposed D-O LRT Project (**Table 4.5-2**):

- North of Mason Farm Road between UNC and Fordham Boulevard
- Between George King Road and Interstate-40 (I-40)
- Farrington Road ROMF Site
- West of I-40 at the US 15/501 Interchange (Exit 270) (Gateway Station)
- Between US 15/501 and the NC 751-Erwin Road intersection

Additional Phase II archaeological testing projects may be required at the following locations dependent on nature and extent of potential ground disturbing activities.

- Archaeological site 31DH655
- PS-1
- PS-3

Project Element Alternatives

The Project Element Alternatives for crossing Little Creek and New Hope Creek as well as the Duke/VA Medical Centers Station Duke Eye Center would likely not increase the project's impact on archaeological resources. Phase I archaeological surveys would likely occur if the Leigh Village or Patterson Place ROMF were selected. Due to the disturbed nature of the Cornwallis Road and Alston Avenue ROMF sites Phase I archaeological surveys would not likely be required.

4.5.4 Mitigation Measures

The Preliminary Determination of Effects resulted in No Potential to Cause Effects for the No Build Alternative and No Adverse Effects for the NEPA Preferred Alternative. For this reason, no mitigation measures are recommended. If ordered to mitigate any indirect impacts on historic properties, the FTA will consult with the SHPO and other consulting parties about the design, landscaping, and other features of the NEPA Preferred Alternative at these historic properties. These efforts, as determined, will be included in the Final EIS/ROD.

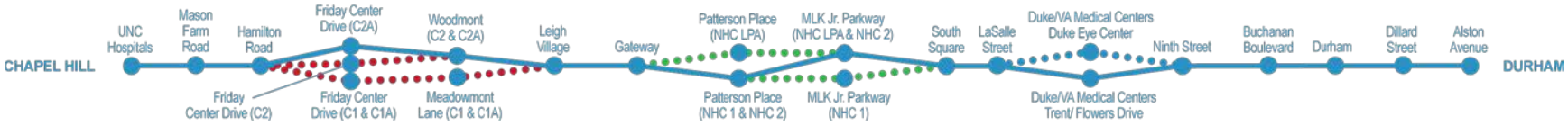
4.5.4.1 Historic Resources

NEPA Preferred Alternative

Because of the avoidance measures taken in the design of the NEPA Preferred Alternative and the measures included in the Final EIS/ROD, the NEPA Preferred Alternative would have no adverse effect on any of the architectural historic properties located within the Architectural APE. For this reason, no mitigation measures are recommended.

Project Element Alternatives

The Little Creek Alternatives, New Hope Creek Alternatives, and Duke Medical Centers/Duke Eye Center Alternative will have no adverse effect upon any historic resources. Therefore, mitigation measures



will not have to be developed for any of these alternatives.

ROMF Alternatives

The Patterson Place, Cornwallis Road, and Alston Avenue ROMFs will have no adverse effect upon any historic properties. Therefore, mitigation measures will not have to be developed for any of these ROMFs.

The Leigh Village ROMF will have an adverse effect upon the NRHP-eligible Walter Curtis Hudson Farm. If this ROMF is selected, the FTA and SHPO will develop methods for avoidance, minimization, or mitigation of impacts to the historic property under the Section 106 consultation process. These methods will be stipulated in the Final EIS/ROD and may require a Memorandum of Agreement between FTA, Triangle Transit, and SHPO.

4.5.4.2 Archaeological Historic Properties

The Memorandum of Agreement and Final EIS/ROD identifies measures required to mitigate impacts to archaeological historic properties if any are identified during archaeological Phase I or Phase II studies. The Final EIS/ROD will also detail the actions to be taken if an unanticipated discovery of archaeological resources is made during construction.

In the event of an inadvertent discovery of archaeological materials, construction within a 50 foot buffer around the material will cease. The construction manager will immediately contact the, SHPO, FTA and Triangle Transit. The SHPO and FTA will consult to determine appropriate actions to identify archaeological materials and mitigate adverse effects.

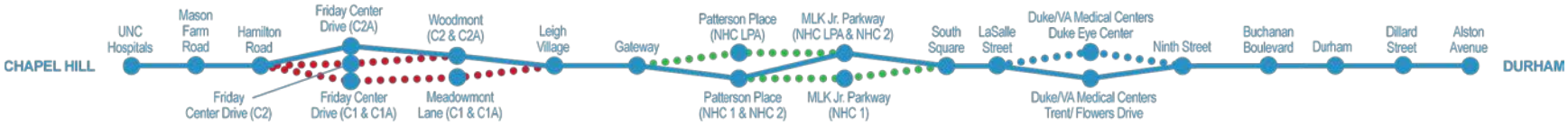


Table 4.5-1: Preliminary Effect Determination of the proposed D-O LRT Project Alternatives on Architectural Historic Properties

Historic Property	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives			New Hope Creek Alternatives		Duke/VA Medical Centers	ROMFs				
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center	Leigh Village	Farrington Road [b]	Patterson Place	Cornwallis Road	Alston Avenue
Dr. Robert Jack Shankle House	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
H.G. Baity House	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Bowers-Nelson House	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Rocky Ridge Farm Historic District	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Highland Woods Historic District	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Dubose Tenant Farm Complex	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Meadowmont	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Walter Curtis Hudson Farm	NE	NAE	NE	NE	NE	NE	NE	NE	AE	NAE	NE	NE	NE
Ruth-Sizemore Store	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
West Durham Historic District	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Powe House	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Trinity College East Campus Historic District	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Smith Warehouse	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Trinity Historic District	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Watts and Yuille Tobacco Warehouses	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Duke Memorial United Methodist Church	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

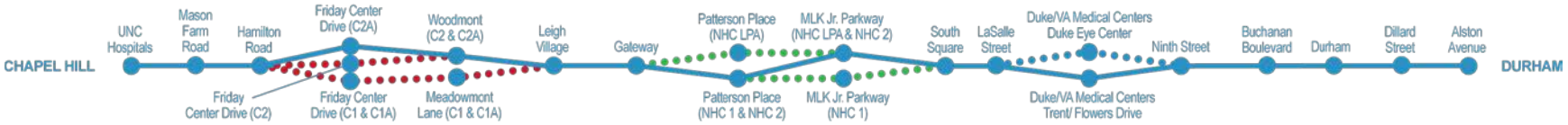


Table 4.5-1: Preliminary Effect Determination of the proposed D-O LRT Project Alternatives on Architectural Historic Properties

Historic Property	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives			New Hope Creek Alternatives		Duke/VA Medical Centers	ROMFs				
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center	Leigh Village	Farrington Road [b]	Patterson Place	Cornwallis Road	Alston Avenue
Bright Leaf Historic District	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
North Carolina Mutual Building	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Downtown Durham Historic District	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
American Tobacco Company Manufacturing Plant	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Southern Railway Bridge	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Venable Tobacco Company Warehouse	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Venable Tobacco Company Prizery	NE	NAE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Durham Water Tower	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
East Durham Historic District	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Source: AECOM 2015.

Note: NE = No Effect, NAE = No Adverse Effect, AE = Adverse Effect.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] Farrington Road ROMF is included in the NEPA Preferred Alternative.

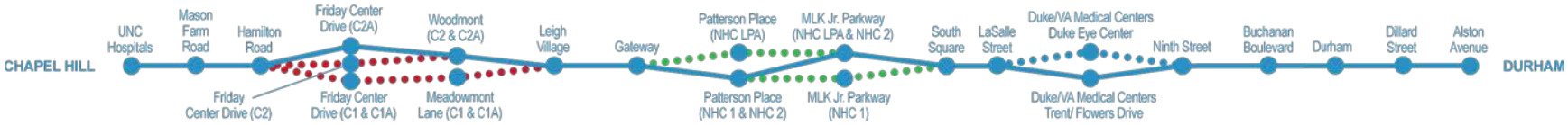
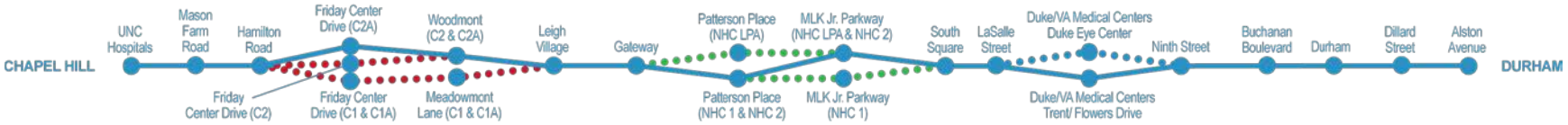


Table 4.5-2: Location of Recommended Phase I or II Archaeological Surveys

Historic Property	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives			New Hope Creek Alternatives		Duke/VA Medical Centers	ROMFs				
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center	Leigh Village	Farrington Road [b]	Patterson Place	Cornwallis Road	Alston Avenue
North of Mason Farm Road between UNC and Fordham Boulevard		X											
Between George King Road and Interstate 40 (I-40)		X	X	X	X								
Farrington Road ROMF Site		X								X			
West of I-40 at the US 15/501 Interchange (Exit 270) (Gateway Station)		X											
Between US 15/501 and the NC 751-Erwin Road intersection		X											
Archaeological site 31DH655		X											
PS-1		X											
PS-3		X											
Leigh Village ROMF									X				
Patterson Place ROMF											X		



4.6 Parklands and Recreational Areas/Section 6(f)

This section describes publicly and privately owned parks, recreational facilities, greenways/trails, and natural areas (including wildlife and waterfowl refuges) used for recreational purpose within the D-O Corridor. This section also includes identification of Section 6(f) Land and Water Conservation Fund Properties. Potential direct effects to parklands and recreational areas of the NEPA Preferred Alternative (common segments, C2A, NHC2, Trent/Flowers Station, and Farrington Road ROMF) and Project Element Alternatives (alignment alternatives at the Little Creek and New Hope Creek Crossings, a station alternative at the Duke/VA Medical Center, and four ROMF alternatives) are disclosed, as well as proposed mitigation measures.

Greenways and/or trails for which the primary purpose is transportation are addressed in DEIS section 3.7. Use of public park and recreation areas is considered in the Draft Section 4(f) Evaluation in chapter 6 of this DEIS as required by 23 C.F.R 774.

4.6.1 Methodology

Information on parklands and recreational facilities (including Section 6(f) Land and Water Conservation Fund [LWCF] properties, greenways, and trails) was obtained through review of the following:

- National Park Service (NPS) LWCF Project List by County and Summary Reports (NPS 2015)
- The Town of Chapel Hill Parks and Recreation website
- Durham City-County geographic information systems (GIS) data
- The Durham Parks and Recreation website
- Local planning documents
- Windshield survey of the study area Consultation with local planning departments and the North Carolina Division of Parks and Recreation (NCDPR).

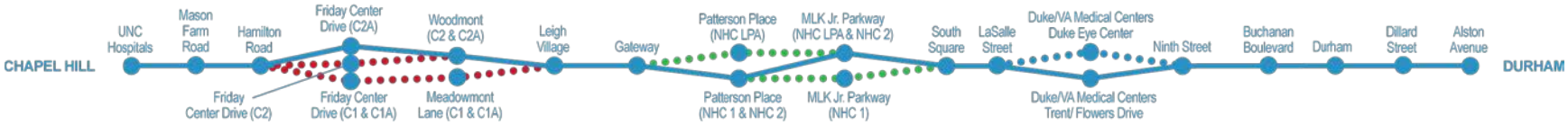
Natural areas (including federal wildlife and waterfowl refuges) were identified using GIS data from the North Carolina Wildlife Resources Commission (NCWRC), the USFWS National Wildlife Refuge System website (USFWS, 2015), and local parcel information.

The following local planning documents were used to identify parklands and recreational areas:

- Town of Chapel Hill Comprehensive Parks Plan, 2013-2022 (2013)
- Town of Chapel Hill Greenways Master Plan (2013)
- UNC *Campus Master Plan Update* (2006)
- Durham Parks and Recreation Master Plan (2013)
- Duke University Illustrative Master Plan Update, The 2024 Plan (2013)
- Durham Trails and Greenways Master Plan (2011)
- New Hope Corridor Open Space Master Plan (1991)
- Durham Chapel Hill Carrboro Metropolitan Planning Organization Joint *2040 Metropolitan Transportation Plan* (2013)

Future planned park and recreational resources were identified from the planning documents cited above and through

The **study area** includes the project footprint and is generally defined as areas within ¼ mile (1,320 feet) on either side of the NEPA Preferred and Project Element Alternatives and within ½ mile (2,640 feet) of proposed stations and ROMF alternatives. The study area also includes expanded areas for certain university and neighborhood boundaries (**Figure 4.6-1** through **Figure 4.6-4**).



coordination with park and recreational resource owners.

Parkland and recreational resources were then assessed for potential direct impacts that could result from the NEPA Preferred and Project Element Alternatives.

Impacts would occur when a resource is located within the footprint of an alternative. A substantial impact to a park or recreational resource would occur when the resource is altered to a degree that it would no longer serve its planned purpose. Estimates of land area impacts to parklands are based on the footprint of the proposed project, as shown in the *Basis for Engineering Design* (appendix L). The footprint is the anticipated limits of construction for the NEPA Preferred and Project Element Alternatives, meaning the area anticipated to be disturbed by construction activities.

In addition, potential impacts and recreational resources were evaluated to consider features of the park that may be impacted by the project. These contextual/character impacts refer to park and recreation facilities that are within the greater study area, but outside of the footprint.

Mitigation measures are recommended where substantial impacts would occur to the existing character of a park or recreation facility. Impacts to parklands and recreational resources related to changes to aesthetics, visual quality, noise and vibration are discussed in more detail in DEIS sections 4.4 and 4.10, as well as in the technical reports that support those sections, which are included in appendices K.15 and K.24, respectively.

4.6.2 Affected Environment

This section provides an inventory of existing and planned parkland and recreational facilities within the defined study area of the alternatives as described above.

4.6.2.1 Existing Parks, Recreational Facilities, and Section 6(f) Properties

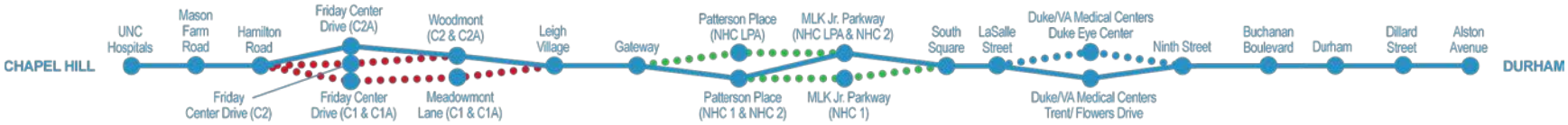
Public, university, and privately held park and recreation resources are present in the study area. Public parks and recreational resources are defined as facilities that are government owned. University resources include those parks or recreational facilities that are owned by either public or private universities.

Private parks and recreational resources include facilities that are not owned by a government agency and are not necessarily open for public use. Parks and recreational facilities within the study area are shown on **Figure 4.6-1** through **Figure 4.6-4**. Table 4.6-1 summarizes the location, ownership, and recreational opportunities within each facility/resource identified. For purposes of this analysis, the terms “greenway” and “trail” are used interchangeably and are used to describe linear natural and/or recreational use areas open to bike and pedestrian access that are not used for the primary purpose of transportation.

The NPS administers the LWCF and its oversight pertains to projects that would cause impact on the permanent conversion of recreational property acquired with the LWCF monies.

No parks funded by the LWCF were identified within the Orange County portion of the study area. However, there are 10 parks within the Durham City-County portion of the study area that were developed with grants from the LWCF. These 10 parks are noted in **Table 4.6-1**.

Under Section 6(f), any land or facility planned, developed, or improved with LWCF funds cannot be converted to uses other than parks, recreation, or open space unless land of at least equal fair market value and reasonably equivalent usefulness is provided. If a transportation project would cause such a conversion, regardless of funding sources, such replacement land must be provided.



4.6.2.2 Planned Greenways/Trails within the Study Area

Table 4.6-2 describes parklands and recreational facilities proposed in the study area. These planned greenway/trail facilities are also shown on **Figure 4.6-1** through **Figure 4.6-4**. Planned facilities are defined as those included in adopted plans for government and institutional entities.

4.6.3 Environmental Consequences

This section describes the potential impacts of the alternatives to parklands and recreational facilities.

Under the No Build Alternative, parklands and recreational facilities currently in the planning stages of development may be present within the study area. Existing parklands and recreation areas described in section 4.6.2 are anticipated to remain under the No Build Alternative. None of the parks listed in **Table 4.6-1** that were developed with grants from the LWCF are within the footprints of the NEPA Preferred Alternative or the Project Element Alternatives.

Section 6(f): The NEPA Preferred and Project Element Alternatives would not have an effect on Section 6(f) resources

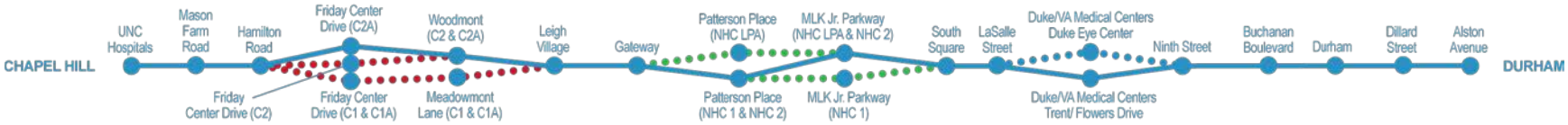
4.6.3.1 NEPA Preferred Alternative

This subsection presents an analysis of potential environmental consequences associated with the NEPA Preferred Alternative (i.e., segments common to all alternatives, C2A, NHC 2, Trent/Flowers Drive Station, and Farrington Road ROMF). The NEPA Preferred Alternative would impact three public existing parks (UNC Open Space, UNC Finley Golf Course, and USACE Lands), one private park (Duke University), and one planned public park (UNC Central Park South), with a total impact to 13.3 acres of parklands (**Table 4.6-3** and **Table 4.6-4**). It would also cross three proposed trails (East 54/Botanical Gardens, Little Creek Connector Trail, and the New Hope Creek Trail) (**Figure 4.6-5** and **Figure 4.6-6**). The NEPA Preferred Alternative would require a permanent easement from UNC within the planned area for the Central Park South open space. At this time, the parcels on which the park would be constructed are undeveloped and a construction timeline is not yet planned. UNC does not anticipate that the NEPA Preferred Alternative "would adversely affect the use, activities, features, or attributes of," the planned park. Therefore, potential impacts of the NEPA Preferred Alternative would retain the utility and functionally of the park.

In the vicinity of the NC Botanical Gardens (located on the south side of the NC 54 highway); the NEPA Preferred Alternative would be located on the north side of the NC 54 highway. On the north side of NC 54, 0.1 acre of permanent easement would be required from the Coker Pinetum. Due to the proximity of both the NC Botanical Gardens and associated trails to existing transportation infrastructure (NC 54) potential impacts to the character and context of the gardens and trails would be negligible in this location.

Two trails including the Coker Pinetum Trail and an extension of the East 54 Trail/NC Botanical Gardens access trail are planned on the north side of NC 54. Both would be in the vicinity and the footprint of the NEPA Preferred Alternative. The proposed Coker Pinetum Trail would terminate prior to intersecting with the proposed NEPA Preferred Alternative so no land acquisition would occur. Additionally, the termination point of this trail would be in an area that is already developed, and in close proximity to NC 54. Based on the above, potential impacts to the character and utility of this proposed trail are negligible.

The proposed East 54 Trail/NC Botanical Gardens Trail would begin near the termination point of the Coker Pinetum Trail and then head northwest adjacent to NC 54 before crossing to the south side of the highway and continuing east to the UNC Finely Golf Course. The NEPA Preferred Alternative would intermittently intersect



portions of the planned trail in this area. In sum, approximately 2,335 linear feet of the planned connector to the East 54 Trail/NC Botanical Gardens Trail would be located within the footprint of the proposed NEPA Preferred Alternative. The proposed East 54 Trail/NC Botanical Gardens Trail would maintain its functional utility where intersecting with the proposed NEPA Preferred Alternative because the light rail alignment would be elevated in these locations. As such, direct impacts to the proposed East 54 Trail/NC Botanical Gardens Trail would be negligible.

Approximately 7.1 acres of UNC-owned parklands lie within the footprint of the NEPA Preferred Alternative. UNC Central Park South constitutes 1.4 acres of the 7.1 acres. UNC Open Space (undeveloped/wooded land) makes up about 2.9 of the 7.1 acres, while a portion of the UNC Finley Golf Course property (also owned by UNC) makes up the remaining 3.2 acres.

The UNC Open Space undeveloped / wooded land measures roughly 120 acres in total and the NEPA Preferred Alternative would impact 2.9 acres of this overall total. This impact area represents a small fraction (2.4 percent) of the overall UNC Open Space area. Furthermore, no existing access ways to the UNC Open Space would be removed because of the NEPA Preferred Alternative. Based on the above, the degree of extent of impact to the UNC Open Space would be negligible overall, and because the NEPA Preferred Alternative is situated at the outward boundary of the UNC Open Space Area, no unique areas would be impacted and the degree of impact to the overall extent and character would be negligible.

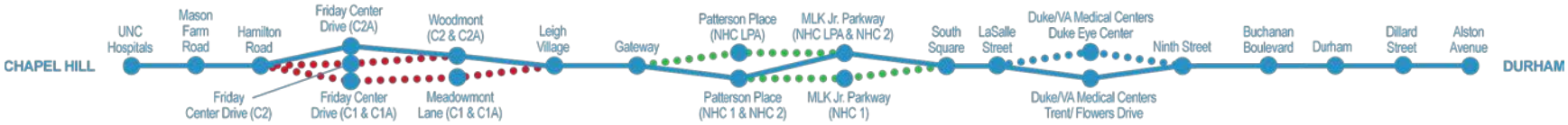
The NEPA Preferred Alternative would cross the edge of the UNC Finely Golf Course and nearby paths that are used for recreational purposes (running and walking, including use by the UNC cross country team). While existing access to the golf course would be preserved, the construction and operation of the NEPA Preferred Alternative would result in changes to the golf course and trails, as well as require the acquisition of a portion of the golf course.

The NEPA Preferred Alternative would require redesign of the course in the vicinity of the 17th hole and Hamilton Road Station. The redesign would be a moderate impact that would not change the utility of the golf course. The NEPA Preferred Alternative would also require realignment of the paths used for walking and by the UNC cross country team. The realignment would include construction of a pedestrian underpass and would maintain connectivity through the area for the paths.

The NEPA Preferred Alternative would have impacts to 0.2 acre of the US Army Corps of Engineers (USACE) property, not including the USACE property within existing NCDOT rights-of-way. The total acreage in the NCWRC Jordan Game Lands is 40,618 acres, so the proportion of direct impact the NEPA Preferred Alternative would have on these lands is negligible. Furthermore, construction and operation of this alternative would not impact unique portions of the USACE property or preclude the primary purpose and functionality of the property.

The addition of the alignment would also result in indirect impacts to users of the USACE property such as hikers and hunters. Light rail related infrastructure would alter the existing visual character of views toward the proposed light rail alignment from viewers within the USACE property. But within the greater context of these lands, the overall indirect impact to them because of the NEPA Preferred Alternative would also be negligible because the NEPA Preferred Alternative would travel through the USACE property adjacent to NC 54. As such, the existing character of the proposed alignment is dominated by a four lane highway.

The NEPA Preferred Alternative would cross approximately 310 linear feet of the planned Little Creek Connector Trail, which would be located on the Farrington Road bridge across I-40. The alignment would pass underneath this bridge. Proximity effects associated with the crossing of the alignment would be negligible since the trail is also crossing the interstate highway.



The NEPA Preferred Alternative would result in acquisition of approximately 5.6 acres of the Duke University property, and would include a bridge over the Al Buehler Cross Country Trail. The alignment may also be visible from the Washington Duke Golf Club. Much of the area crossed by the alignment is currently undeveloped/wooded land and is part of the larger Duke Forest. The property acquisition would not result in the conversion of any portion of the Duke University property currently in active recreation use to transit use. As such, the degree of potential impact to this resource is minimal. Since the alignment would cross over the Al Buehler Cross Country Trail on a bridge, the need to realign the trail would be avoided and the alignment would result in only negligible effects related to visual and noise conditions.

4.6.3.2 Project Element Alternatives

The following sections describe parkland and recreational property impacts for the Project Element Alternatives as compared to the NEPA Preferred Alternative.

Little Creek Alternatives

The Little Creek Alternatives include the C1, C1A, and C2 Alternatives. The following analysis individually compares each of the Little Creek Alternatives to the NEPA Preferred Alternative (C2A) (**Figure 4.6-5**).

C1 Alternative

The C1 Alternative would affect two parks (UNC Finley Golf Course [1.0 acre] and USACE property [2.6 acres]), with a total combined impact of 3.6 acres, or 3.3 acres more than the NEPA Preferred Alternative (**Table 4.6-3** and **Table 4.6-4**). The C1 Alternative would require reorganization and realignment of two holes on the UNC Finley Golf Course and would impact the paths utilized for running and walking and by the UNC cross country team. The C1 Alternative would introduce a new crossing of the USACE property.

The C1 Alternative would impact approximately 100 linear feet of the planned Little Creek Trail Extension; however, the light rail alignment would be elevated in this location and would not preclude the future construction or use of the planned trail. There may be temporary interruptions to trail access during construction depending which is constructed first.

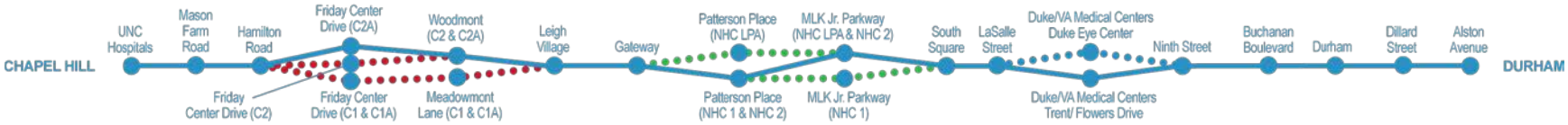
C1A Alternative

The C1A Alternative would affect two parks (UNC Finely Golf Course [1.0 acre] and Meadowmont Park [0.6 acre]). UNC Finley Golf Course and the UNC cross country trails would be affected as identified for Alternative C1 with an additional acre of land required and a combined 4.1 acres, or 3 acres more than the NEPA Preferred Alternative. Meadowmont Park would be affected through the acquisition of land for the alignment and minor proximity impacts (such as visual and noise) associated with light rail operating adjacent to the remainder of the park property. The C1A alignment alternative would have no impacts to the USACE property. Instead, the C1A Alternative would continue north around the USACE property bisecting the area between the Jordan Game Lands and Meadowmont Park.

The C1A Alternative would impact three trails, one existing (Little Creek Trail) and two planned (Little Creek Connector Trail and Little Creek Trail Extension). The existing Little Creek Trail is located in Meadowmont Park; the C1A Alternative would cross approximately 80 linear feet of this trail on an elevated structure. Therefore, the functionality and utility of the trail would remain intact. In addition, the C1A Alternative would cross approximately 760 linear feet of the planned Little Creek Connector Trail, and 85 linear feet of the planned Little Creek Trail Extension. All trails would be crossed on an elevated structure, so the C1A Alternative would not permanently affect their utility or functionality.

C2 Alternative

The C2 Alternative would impact approximately 1.2 acres of the UNC Finley



Golf Course and would impact the paths utilized for running and walking and by the UNC cross country team. Approximately 0.2 acre of the USACE property, not including NCDOT rights-of-way, would be impacted, for a combined total of 1.4 acres of parkland impacts. The C2 Alternative would not impact trails or greenways.

New Hope Creek (NHC) Alternatives

All of the New Hope Creek Alternatives would have proximity impacts to parklands and trails (**Figure 4.6-6**). These impacts are described in the sections that follow.

NHC LPA Alternative

The NHC LPA Alternative would impact approximately 235 linear feet of trails (135 linear feet of the existing New Hope Preserve Trail and 100 linear feet of the planned New Hope Creek Trail). The proposed alignment would cross over these trails, allowing trail users to pass under the alignment. The New Hope Preserve Trail crosses an existing utility corridor with trees cleared, electrical transmission towers, and overhead wires; the overall change in the visual character would be less substantial than if there were not already manmade features present in this corridor.

As discussed in DEIS section 4.10, projected noise levels at the New Hope Preserve Trail and New Hope Creek Trail (Site 66A) would result in a severe noise impact. These trails would pass below the elevated section of the NHC LPA alignment, approximately 20 feet below the tracks. The planned New Hope Creek Trail crosses US 15-501 to the north and the NHC LPA Alternative to the south. While the elevated guideway would visually impact the trail, the overall change to the trail would be minimal given that the existing highway structure and the utility corridor would also be visible from the trail. There may be temporary interruptions to New Hope Preserve Trail access during construction or to the New Hope Creek Trail if it is constructed before the proposed D-O LRT Project. The operation of the alternative would not preclude the future construction of the proposed New Hope Creek Trail.

NHC 1 Alternative

The NHC 1 Alternative would cross over approximately 50 linear feet of the planned New Hope Creek Trail, just south of where the trail would be crossed US 15-501, within the highway right-of-way. Given the existing highway, the overall visual impacts would be minimal. The proposed light rail alignment would be elevated; it would not preclude future construction of the trail.

Duke/VA Medical Centers Station: Duke Eye Center

The Duke/VA Medical Centers Station: Duke Eye Center Alternative would not impact parklands or trails.

4.6.3.3 ROMF

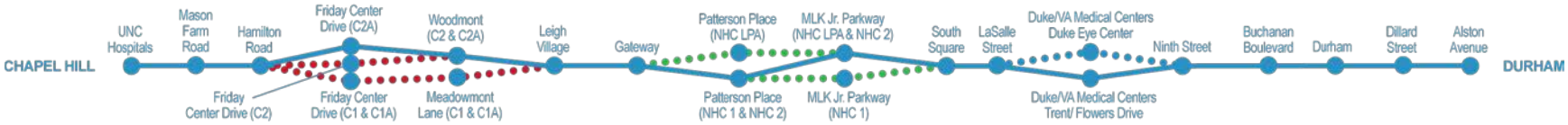
As part of the DEIS, four site alternatives for the ROMF are being evaluated: Leigh Village, Patterson Place, Cornwallis Road, and Alston Avenue.

The Patterson Place ROMF would require approximately 0.3 acre of Durham Open Space for non-revenue tracks, at grade and elevated, leading to the ROMF.

Approximately 30 feet of non-revenue tracks would also cross at the New Hope Preserve Trail, however the tracks would be elevated in this location so would not substantially affect the functionally or utility of the trail. Noise and visual impacts would be negligible and would not affect the use of the trail. The Patterson Place ROMF would only be viable if the NHC LPA is selected. No other ROMF Alternative would have direct impacts to parklands or trails.

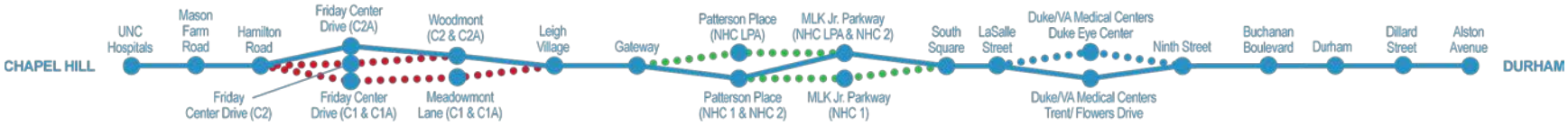
4.6.4 Mitigation Measures

Triangle Transit will coordinate with agencies with jurisdiction (i.e., UNC, Town of Chapel Hill, USACE, NCWRC, and City-County of Durham) to minimize potential



impacts to parklands and recreational resources. The following potential mitigation measures may be used to reduce substantial impacts to park and recreation resources impacted by the proposed alternatives.

- Acquisition of park property: Triangle Transit will provide financial compensation for purchase and development of replacement park property of at least equivalent value with the property acquired, or, where appropriate, enhancement of the existing facility to compensate for impacts in coordination with the respective agencies with jurisdiction. This mitigation will be provided for UNC Open Space, the planned UNC Central Park South, Coker Pinetum, Meadowmont Park, and Duke University properties impacted by the NEPA Preferred Alternative as identified in section 4.6.3. This mitigation would also be provided for park property acquisitions associated with Project Element Alternatives C1, C1A, C2, and the Patterson Place ROMF.
- UNC Finley Golf Course – the acquisition of property from the golf course would result in potential impacts as identified in section 4.6.3 under the NEPA Preferred Alternative and the Project Element Alternatives C1, C1A, and C2.
  - A plan to redesign the potentially affected golf course holes is complete and will be implemented as mitigation. For the NEPA Preferred Alternative, one golf hole (hole #17) will be redesigned. For Little Creek Alternatives C1, C1A, and C2 two golf holes (holes # 3 and #17) will be redesigned.
  - For all the alternatives, the project's design incorporates the realignment of the golf course cart paths
- UNC Cross Country Trails – The project's design incorporates the installation of a pedestrian underpass and the realignment of the UNC cross country trails to mitigate access constraints that would be introduced with the NEPA Preferred Alternative (and Project Element Alternatives C1, C1A and C2), and the use of the cart paths to maintain connectivity in a manner consistent with existing conditions.
- USACE property: Implementation of the following mitigation measures will reduce impacts within the USACE property associated with the NEPA Preferred Alternative or Project Element Alternative C2.
  - Replace reservoir water-storage volume lost due to fill below elevation 245 feet msl by excavation of an equal amount of new storage volume at the same elevation as the lost storage volume.
  - Compensate the NCWRC for loss of marketable timber. Timber value will be determined by a registered government forester and payment for timber will be collected at the time the easement is issued.
  - Complete the following mitigation measures, to the satisfaction of the NCWRC (This would require approximately 1.4 acres of temporary construction easement):
    - Relocate the access road to the existing impoundment parking area, place gravel on the parking lot, provide and install a new gate and informational signs.
    - Construct a gravel access road (16 feet wide) from the existing parking area to a second parking area along the D-O LRT alignment for the impoundment, and provide and install a new gate and informational signs.
    - Construct a public access parking area on the south side of NC 54, and provide and install a double gate and informational signs.



- Replace the existing Waterfowl Impoundment sign and install a new Game Lands access directional sign for new area along NC 54.
- Coordinate with USACE to locate fencing as appropriate.

- New Hope Creek Trail and New Hope Preserve Trail: Elevated track barriers will be incorporated into the project in order to mitigate the noise impacts predicted at these resources for the NHC LPA Project Element Alternative.

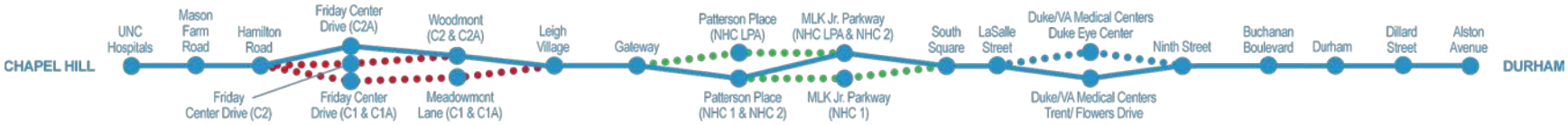


Table 4.6-1: Existing Parks, Trails/ Greenways

Map ID	Owner	Facility	Location	Description
1	Town of Chapel Hill	Hargraves Park	216 N. Roberson Street, Chapel Hill	Baseball fields, basketball courts, picnic shelters, playground, swimming pool, tennis courts
2	Town of Chapel Hill	Westwood Park	530 Dogwood Drive, Chapel Hill	Playground
3	Town of Chapel Hill	Jones Park	330 Purefoy Road, Chapel Hill	Natural area
5	Town of Chapel Hill	Merritt's Pasture Trail	Merritt's Pasture, Chapel Hill	Off-road pedestrian/bike trail
6	Town of Chapel Hill	Merritt's Pasture	Southern intersection of US 15-501 and NC 54, near Mt. Carmel Road, Chapel Hill	Natural area
7	Town of Chapel Hill	Wallace Plaza	150 E. Rosemary Street, Chapel Hill	Plaza
8	University (Public - UNC)	Coker Arboretum	399 E. Cameron Avenue, Chapel Hill	Arboretum
9	University (Public - UNC)	Battle Park Trails	Battle Park, Chapel Hill	Off-road pedestrian trail
10	University (Public - UNC)	Coker Pinetum	240 Manning Drive, Chapel Hill	Natural area
11	University (Public - UNC)	Mason Farm Biological Reserve/ UNC Open Space	100 Old Mason Farm Road, Chapel Hill	Arboretum
12	University (Public - UNC)	Battle Park	517 Park Place, Chapel Hill	Picnic tables, trails
13	University (Public - UNC)	UNC Disc Golf Course / Athletic Fields	414 Country Club Road, Chapel Hill	Tennis courts, disc golf course, outdoor recreation, softball fields
15	University (Public - UNC)	North Carolina Botanical Garden	100 Old Mason Farm Road, Chapel Hill	Botanical garden
16	University (Public -UNC)	UNC Finley Golf Course / Athletic Fields	Finley Golf Course Road, Chapel Hill	Golf course, athletic fields and trails
17	Town of Chapel Hill	Oakwood Park	20 Oakwood Drive, Chapel Hill	Picnic shelters, playground, tennis courts
18	Private Open Space	Chapel Hill-Carrboro YMCA	301 Old Barn Lane, Chapel Hill	Swimming pool
20	Private Open Space	Chapel Hill Country Club	103 Lancaster Drive, Chapel Hill	Country club and golf course
21	Town of Chapel Hill	Little Creek Trail	Meadowmont Park, Chapel Hill	Unpaved trails within park
22	Town of Chapel Hill	Meadowmont Park	621 Meadowmont Lane, Chapel Hill	Athletic fields, basketball courts
25/26	USACE Jordan Game Lands	USACE Jordan Game Lands & Waterfowl Impoundment	East of Meadowmont neighborhood, Durham County	Natural area
27	City-County of Durham	Leigh Farm Park	370 Leigh Farm Road, Durham	Disc golf course, greenway, picnic tables, Piedmont Wildlife Center, the Leigh Home (circa 1837, on National Register of Historic Places)
26	USACE Jordan Game Lands	USACE Jordan Game Lands	Immediately east of Leigh Farm Park, Durham County	Natural area

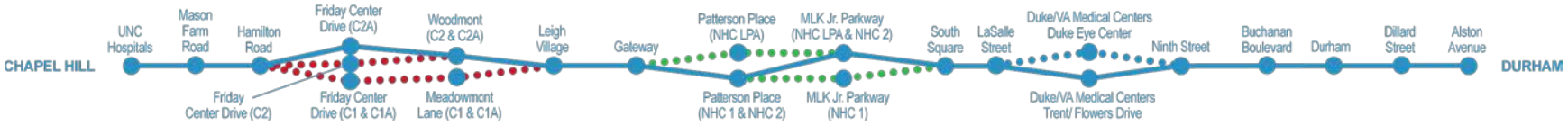


Table 4.6-1: Existing Parks, Trails/ Greenways

Map ID	Owner	Facility	Location	Description
29	City-County of Durham	Old Chapel Hill Road Park	3751 Southwest Durham Drive, Durham	Soccer field, playground, greenway, basketball courts, youth baseball fields, tennis courts
30a	City-County of Durham	New Hope Preserve Trail	North of Old Chapel Hill Road Park, Durham	Off-road pedestrian trail
30b	City-County of Durham	Durham Open Space	New Hope Creek Corridor	Open space with trail
36	City-County of Durham	Sandy Creek Park	3510 Sandy Creek Drive, Durham	Picnic shelters
37	City-County of Durham	Sandy Creek Trail	Sandy Creek Park, Durham	Off-road pedestrian/bike trail
39	City-County of Durham	Cornwallis Road Park	2830 Wade Road, Durham	Basketball courts, disc golf course, playground
40a	Duke University (Private)	Duke University Golf Club	2402 Academy Road, Durham	Golf course (includes Washington Duke Inn)
40b	Duke University (Private)	Al Buehler Cross Country Trail	2402 Academy Road, Durham	Trail on Duke University Golf Club
41	Duke University (Private)	Duke Forest	3900 Kerley Road (forest), Durham County	Natural area
42	City-County of Durham	Morreene Road Park	1102 Morreene Road, Durham	Basketball courts, youth baseball fields, picnic shelters, playground, tennis courts
43	City-County of Durham	W.I. Patterson Recreation Center	2614 Crest Street, Durham	Multi-purpose room, kitchen, computer lab, summer camp
44	City-County of Durham	Crest Street Park	2503 Crest Street, Durham	Basketball courts, adult baseball fields, picnic shelters, playground
45	Duke University (Private)	Sarah P. Duke Gardens	420 Anderson Street, Durham	Botanical garden
46	Duke University (Private)	Erwin Field	250 Oregon Street, Durham	Athletic fields
47	City-County of Durham	Burch Avenue Park	816 Burch Avenue, Durham	Picnic shelters, playground
48	Duke University (Private)	Duke East Campus Wall Loop	Duke East Campus, Durham	Off-road pedestrian trail
49	City-County of Durham	Trinity Park	410 Watts Street, Durham	Picnic shelters, playground, tennis courts
50	City-County of Durham	Durham Athletic Park	500 W. Corporation Street, Durham	Baseball park
51	City-County of Durham	Durham Central Park	502 Foster Street, Durham	Trails, picnic shelters, skateboard park, farmers market
52	City-County of Durham	Downtown Durham Armory	212 Foster Street, Durham	Multi-purpose room, kitchen, performance space, ballroom
53	City-County of Durham	Durham Centre Plaza	300 W. Morgan Street, Durham	Outdoor plaza/performance space

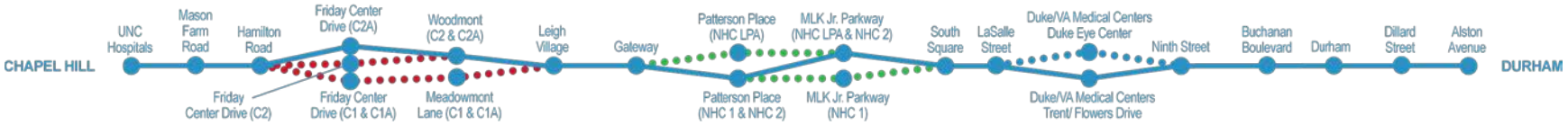


Table 4.6-1: Existing Parks, Trails/ Greenways

Map ID	Owner	Facility	Location	Description
54	City-County of Durham	CCB Plaza	201 N. Corcoran Street, Durham	Outdoor plaza/performance space
55	City-County of Durham	Oakwood Park	411 Holloway Street, Durham	Picnic shelters, playground
56	City-County of Durham	American Tobacco Trail	Downtown Durham to Chatham/Wake counties	Off-road pedestrian/bike trail
57	City-County of Durham	Hillside Park	1301 S. Roxboro Street, Durham	Basketball courts, youth baseball fields, greenway, picnic shelters, playground
58	City-County of Durham	W.D. Hill Recreation Center	1308 Fayetteville Street, Durham	Gym, multi-purpose room, computer lab, kitchen, dance room, arts & crafts room, mature adult space
60	City-County of Durham	Edgemont Park	205 S. Elm Street, Durham	Picnic shelters, playground
61	City-County of Durham	Bryant Bridge Trail	417 Lakeland Street, Durham	Off-road pedestrian/bike trail
62	City-County of Durham	Grant Street Park	918/1200 Grant Street, Durham	Playground
64	City-County of Durham	Burton Park	1100 Sima Avenue, Durham	Picnic shelters, basketball courts, playground
65	City-County of Durham	T.A. Grady Recreation Center	531 Lakeland Street, Durham	Multi-purpose room, kitchen, computer lab

Source: Town of Chapel Hill, Durham City-County, NCDPR and NCWRC.

Table 4.6-2: Planned Greenways/Trails in the Study Area

Map ID	Owner	Facility	Location	Description
4	Town of Chapel Hill	Morgan Trail Access	Near US 15-501/NC 54, Chapel Hill	This proposed pedestrian and bicycle path would connect sections of the Morgan Creek Trail with southern portions of Chapel Hill and Carrboro. The path would be surrounded by mixed-use land uses
14a	University (Public – UNC)	East 54 Trail/Botanical Gardens Access	Coker Pinetum, Chapel Hill	A pedestrian and bicycle path would connect UNC's central campus to US 15-501, NC 54 and the North Carolina Botanical Garden
14b	University (Public – UNC)	UNC Central Park South	UNC campus south of William Blythe Drive and north of Mason Farm Road	Central Park South is planned to be park for passive recreation

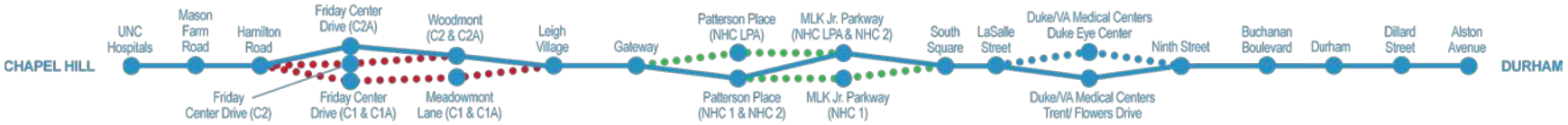


Table 4.6-2: Planned Greenways/Trails in the Study Area

Map ID	Owner	Facility	Location	Description
23	City-County of Durham	Little Creek Connector Trail	Meadowmont Lane to Old Chapel Hill Road, Chapel Hill/Durham	Off-road path along north side of NC 54
24	City-County of Durham	Little Creek Trail Extension	Meadowmont Park to NC 54, Chapel Hill	Off-road pedestrian trail
28	USACE and City-County of Durham	New Hope Creek Trail	Old Chapel Hill Road to NC 54, Durham	Off-road pedestrian trail through USACE property
31	USACE and City-County of Durham	New Hope Creek Trail	Link between US 15-501 and Orange County, Durham	Off-road pedestrian trail through natural area
32	City-County of Durham	Dry Creek Trail	Rear side of New Hope Commons Shopping Center, Durham	Off-road pedestrian trail
33	City-County of Durham	Long Branch Creek Trail	Trail spur east of New Hope Creek Corridor, Durham	Off-road pedestrian trail through natural area
34	City-County of Durham	Sandy Creek-Mud Creek Connector Trail	Link between Sandy Creek Trail and Mud Creek Trail, Durham	Off-road pedestrian trail connection
35	City-County of Durham	Mud Creek Trail	US 15-501 to main New Hope Creek Greenway, Durham	Off-road pedestrian/bike trail linking larger greenways
38	City-County of Durham	Sandy Creek Trail	Sandy Creek Park, Durham	Off-road pedestrian/bike trail within park and to Cornwallis Road
59	City-County of Durham	Pearsontown Trail	Grant Park, between E. Umstead Street and Lane Street (NCCU), Durham	Off-road pedestrian/bike trail in Grant Park
63	City-County of Durham	Rocky Creek Trail	Burton Park Trail to S. Briggs Avenue, Durham	Off-road pedestrian/bike trail
66	City-County of Durham	Burton Park Trail	Burton Park, 531 Lakeland Street, Durham	Off-road pedestrian/bike trail in Burton Park, along Third Fork Creek

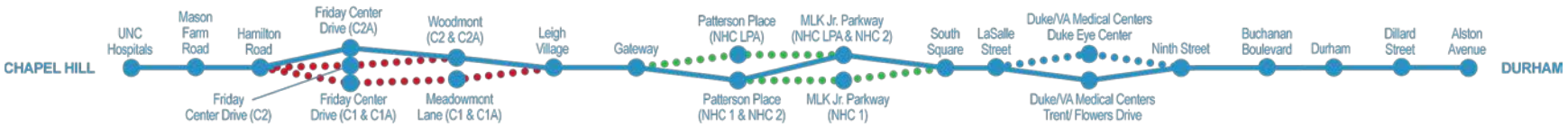


Table 4.6-3: Summary of Impacts to Parklands by Alternative

	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives			New Hope Creek Alternatives		Duke/VA Medical Centers
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Parklands(acres)	0	13.3	+3.3	+1.3	+1.1	+0	+0	+0
Trails/greenways crossed on elevated structure	0	0	+0	+1	+0	+1	+0	+0
Planned trails/ greenways	0	4	+1	+2	+0	+1	+0	+0

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

Table 4.6-4: Anticipated Direct Impacts to Parklands by Alternative

Alternatives	Parklands within Footprint	Impact (acres)	Trails within Footprint	Crossed at grade (feet)
NEPA Preferred Alternative	UNC Open Space	2.9	N/A	N/A
	UNC Central Park South	1.4	East 54/Gardens (proposed)	N/A
	Finley Golf Course	3.2	Little Creek Connector Trail (proposed)	0
	Coker Pinetum	0.1	N/A	N/A
	USACE Lands [a]	0.2 [b. c.]	Al Buehler Cross Country Trail	0
	Duke University (PRIVATE)	5.6	NHC Trail (proposed)	0
	TOTAL	13.4	TOTAL	0
C1	Finley Golf Course	1.0	N/A	N/A
	USACE Lands [a]	2.6 [d]	Little Creek Trail Extension (proposed)	0
	TOTAL	3.6	TOTAL	0
C1A	N/A	N/A	Little Creek Trail	0
	Finley Golf Course	1.0	Little Creek Connector Trail (proposed)	
	Meadowmont Park	0.6	Little Creek Trail Extension (proposed)	0
	TOTAL	1.6	TOTAL	0
C2	Finley Golf Course	1.2	N/A	N/A
	USACE Lands [a]	0.2 [b.c.]	N/A	N/A
	TOTAL	1.4	N/A	N/A
NHC LPA	N/A	N/A	New Hope Preserve Trail	0
	N/A	N/A	NHC Trail (proposed)	0
	N/A	N/A	TOTAL	0

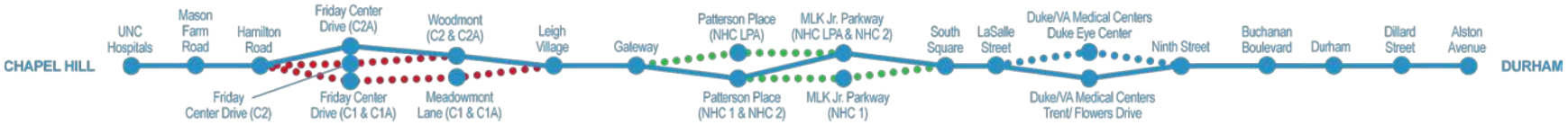


Table 4.6-4: Anticipated Direct Impacts to Parklands by Alternative

Alternatives	Parklands within Footprint	Impact (acres)	Trails within Footprint	Crossed at grade (feet)
NHC 1	N/A	N/A	NHC Trail (proposed)	0
	N/A	N/A	TOTAL	0
Leigh Village ROMF	N/A	N/A	N/A	N/A
Patterson Place ROMF	Durham Open Space	0.3	New Hope Preserve Trail	0
	TOTAL	0.3	TOTAL	0
Cornwallis Road ROMF	N/A	N/A	N/A	N/A
Alston Avenue ROMF	N/A	N/A	N/A	N/A

Note: N/A = not applicable; no parklands are located within the footprint of the alternative; no parklands are located in the vicinity of the Duke/VA Medical Centers station(s).

[a] USACE Lands (includes Jordan Dam and Lake, Gamelands, and Waterfowl Impoundment; all of which are owned by USACE).

[b] Additional 1.4 acres of impacts associated with the temporary easement and mitigation.

[c] Additional 1.7 acres of USACE property is within existing NCDOT right-of-way.

[d] Additional 0.7 acre of impacts associated with the temporary easement.

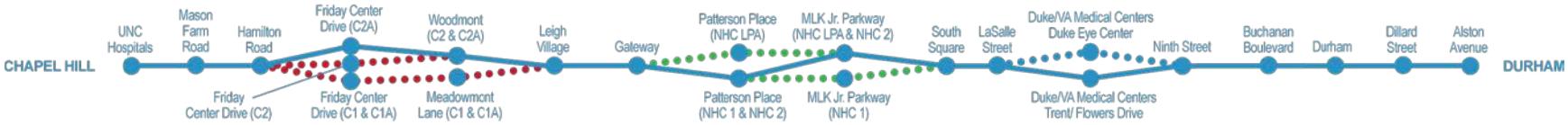
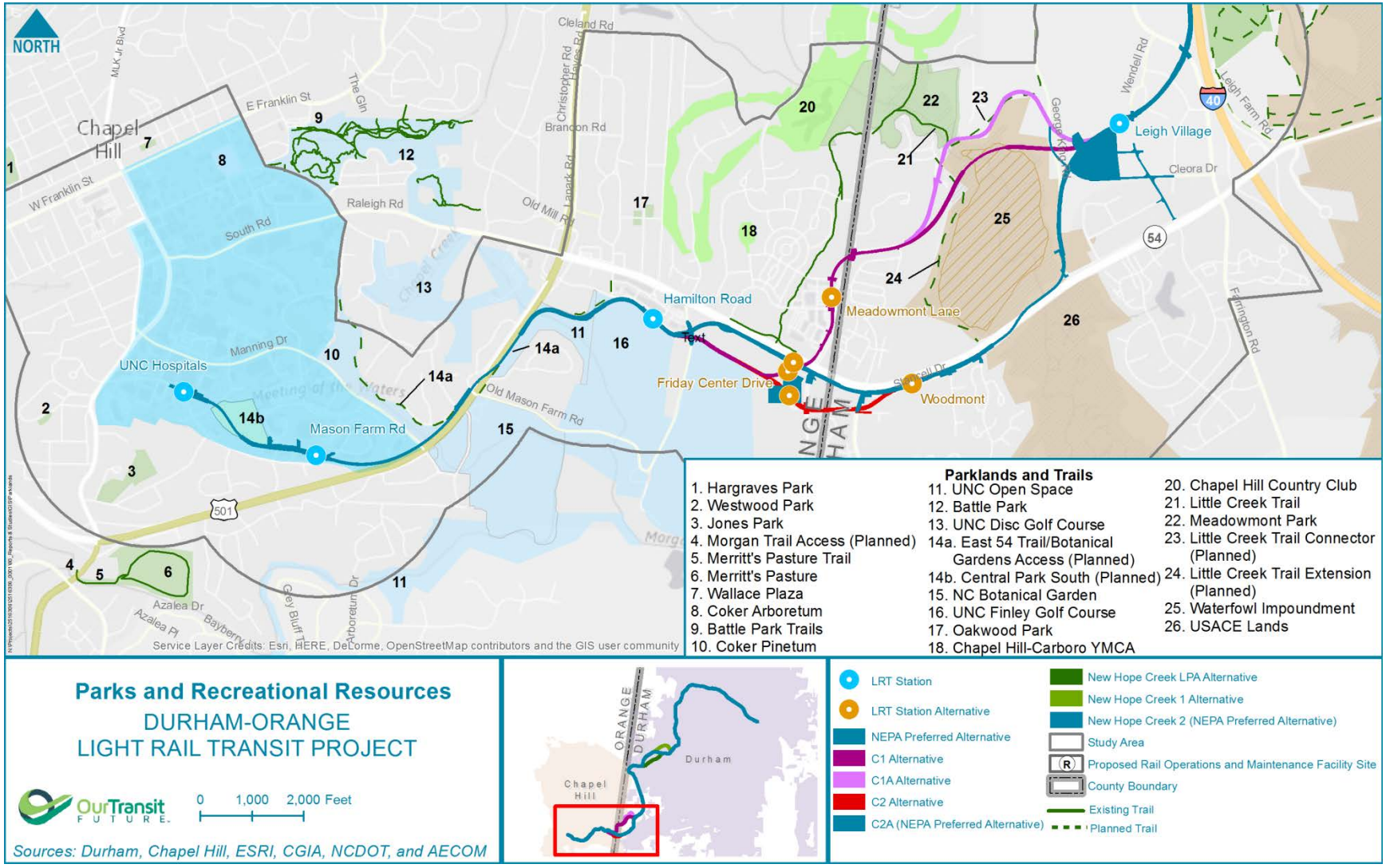


Figure 4.6-1: Parks and Recreational Resources within the Study Area (1)



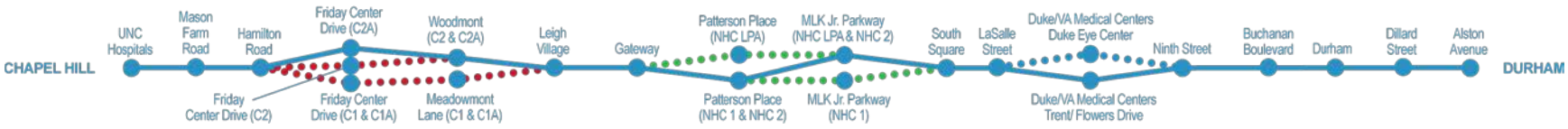


Figure 4.6-2: Parks and Recreational Resources within the Study Area (2)

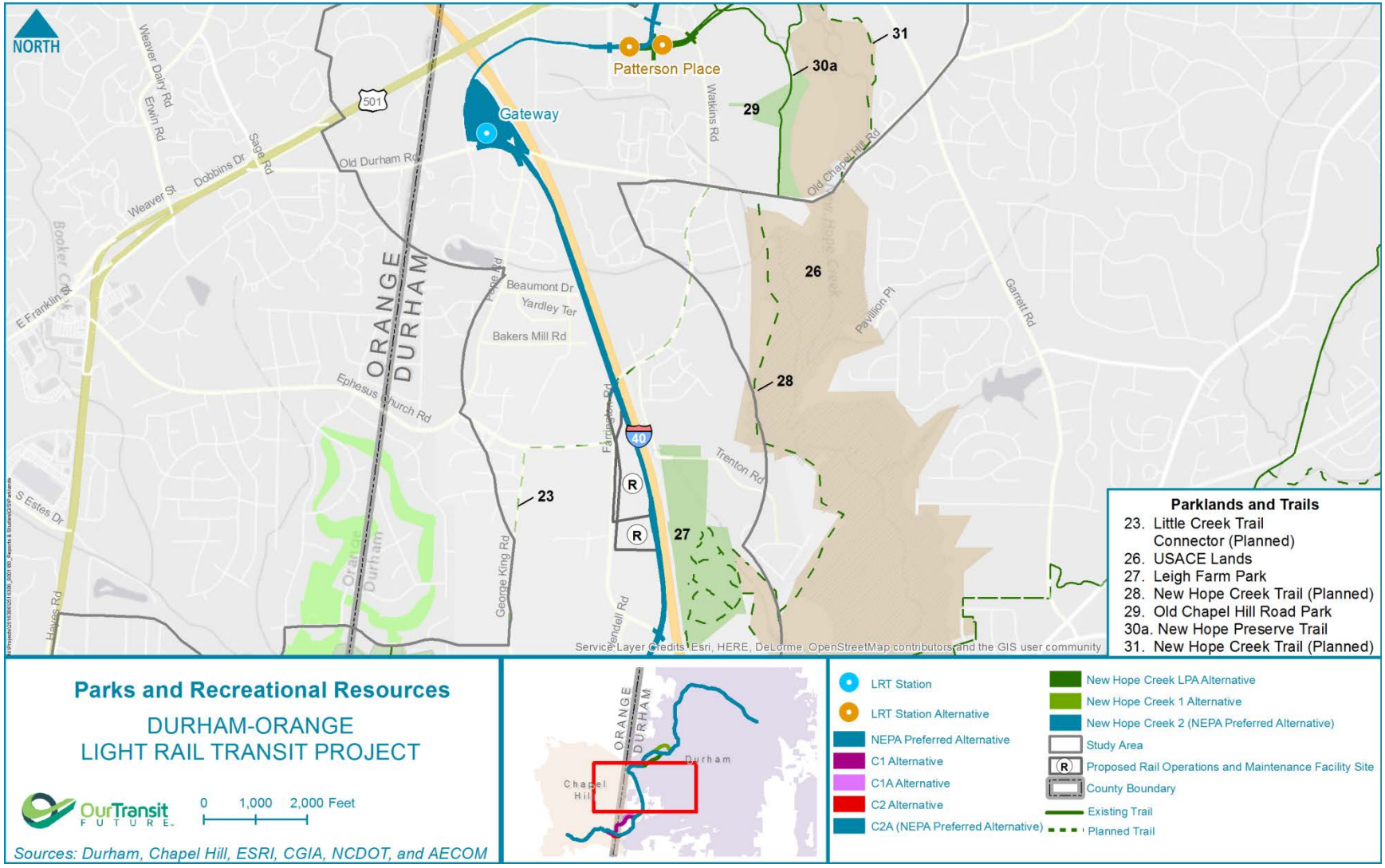


Figure 4.6-3: Parks and Recreational Resources within the Study Area (3)

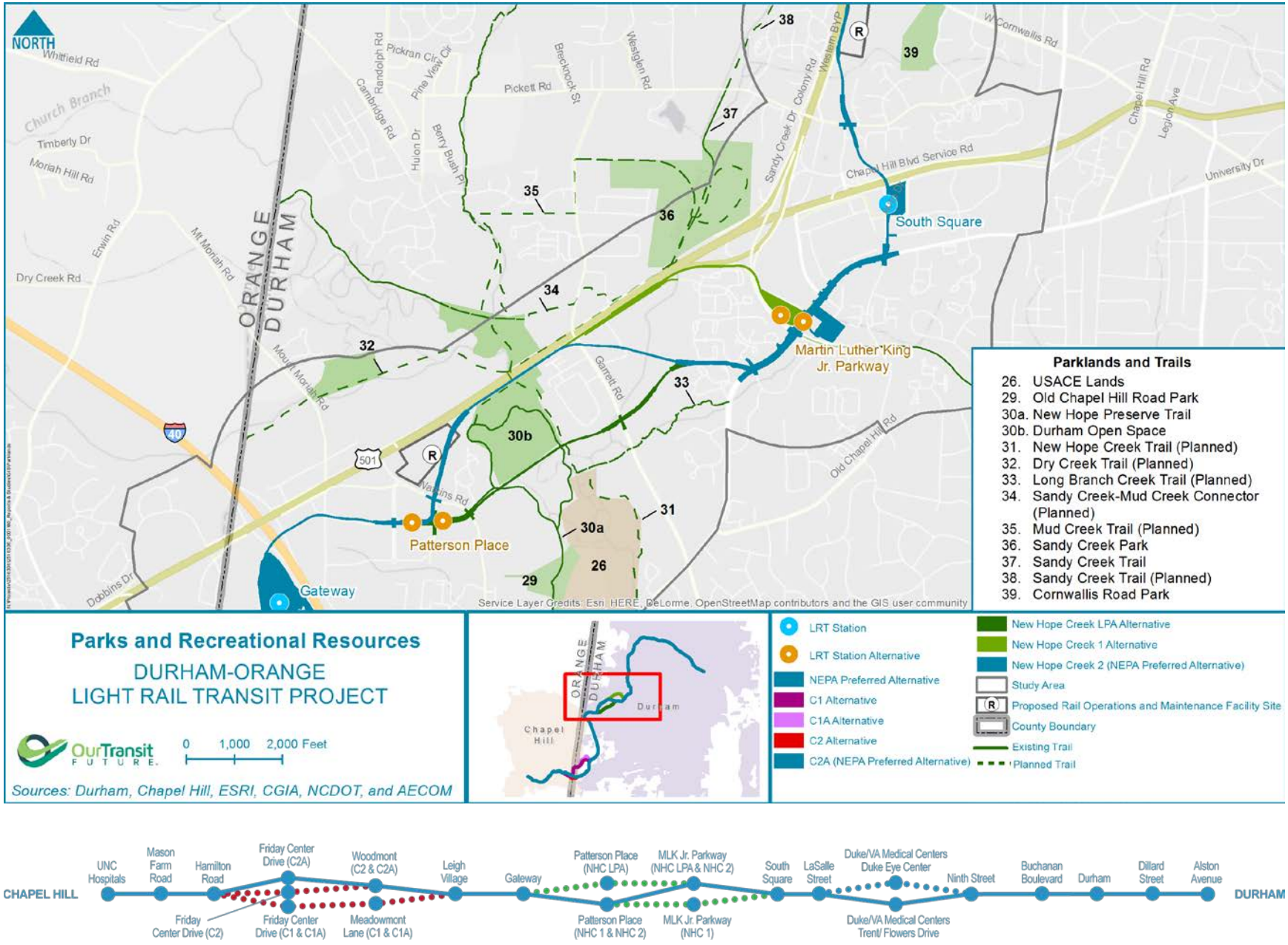


Figure 4.6-4: Parks and Recreational Resources within the Study Area (4)

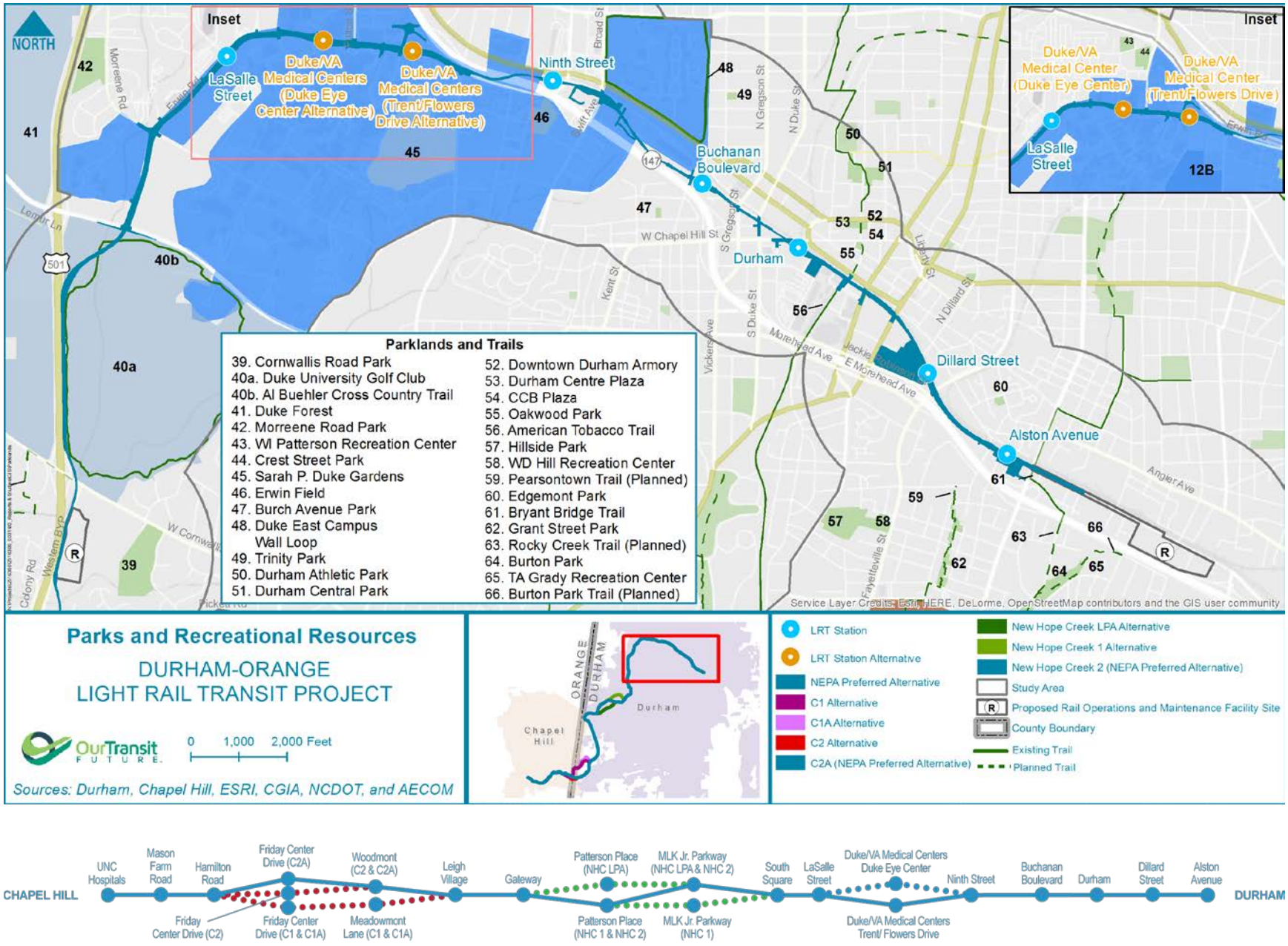


Figure 4.6-5: Little Creek Alternatives

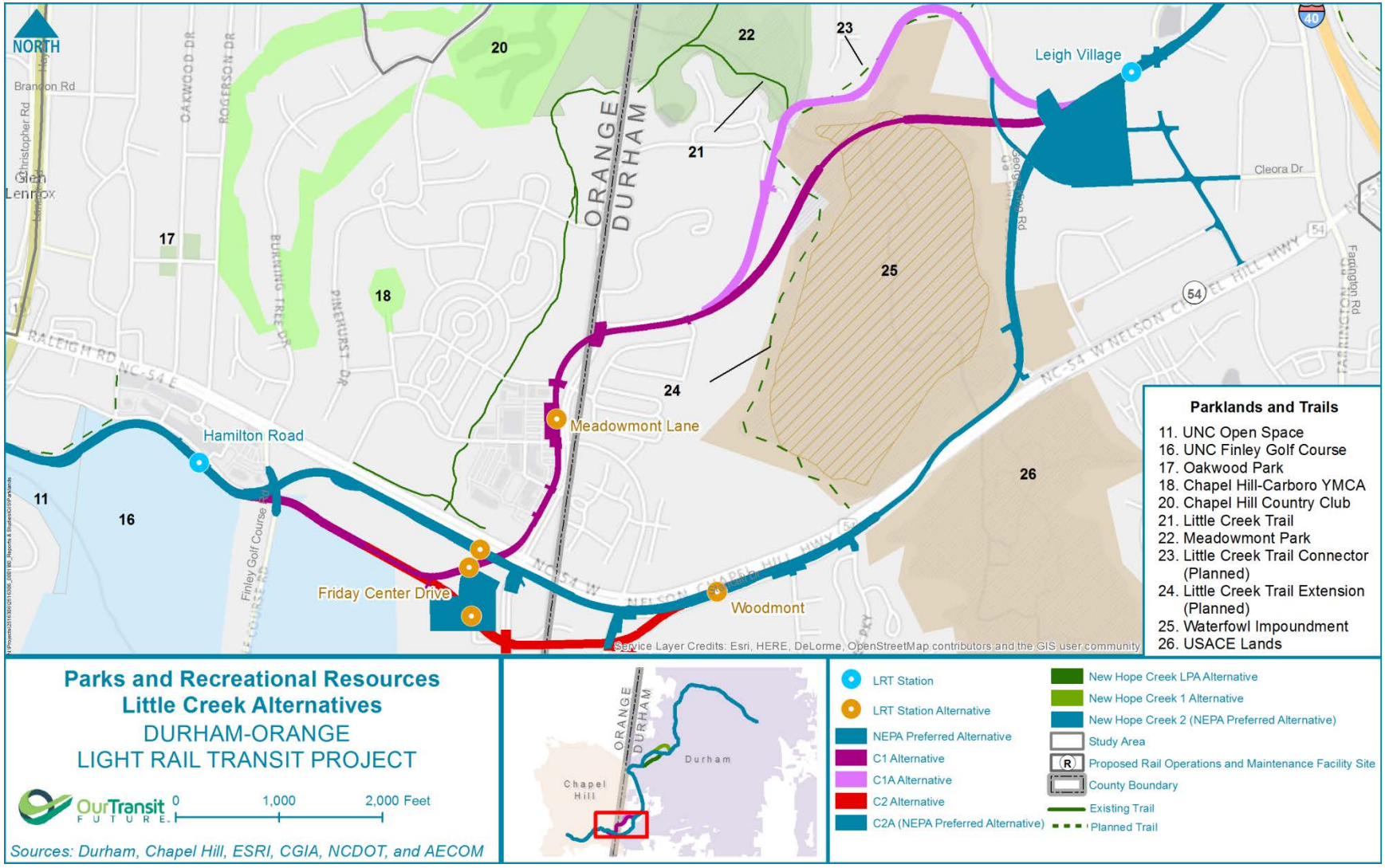
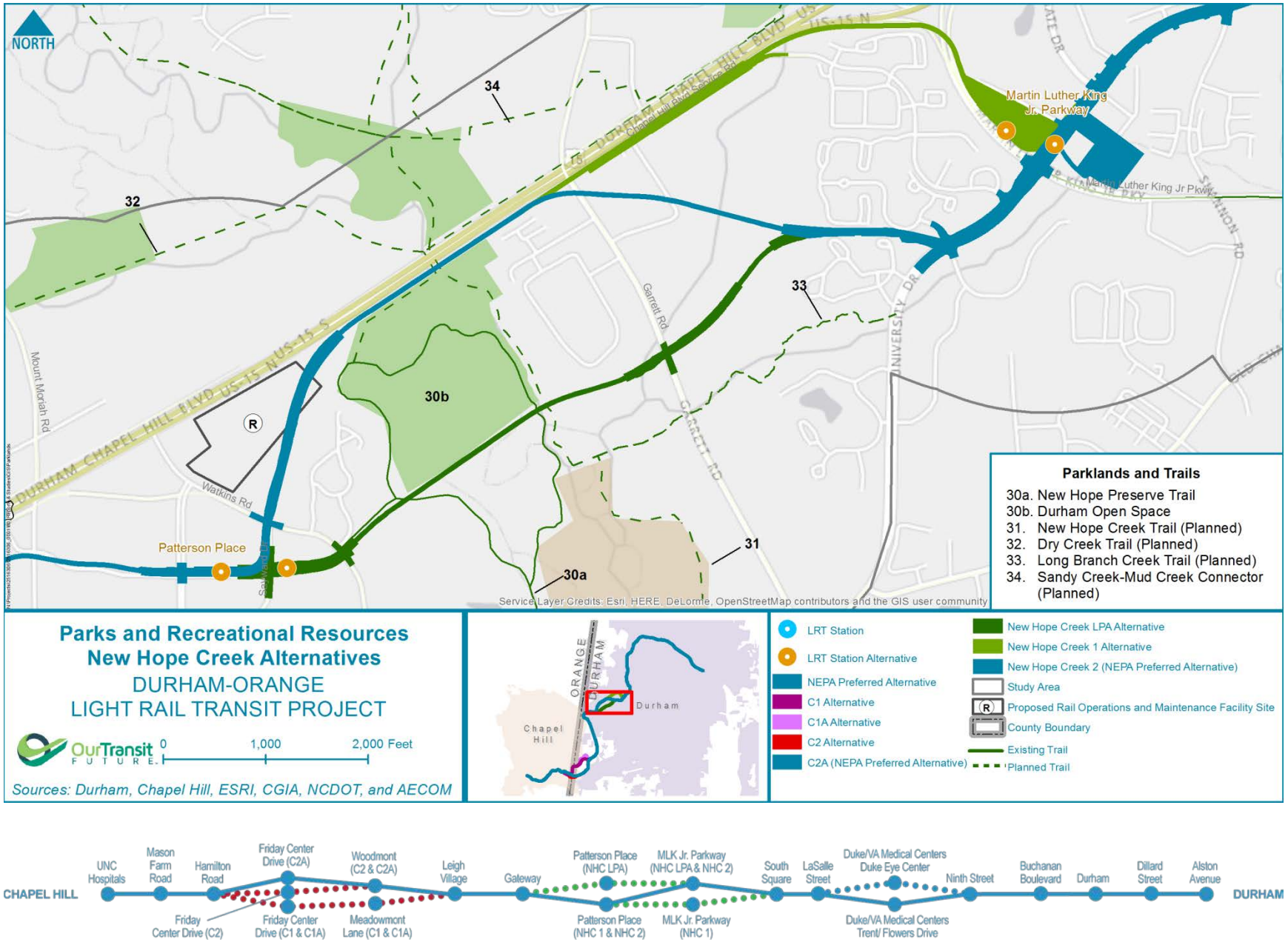


Figure 4.6-6: New Hope Creek Alternatives



4.7 Natural Resources

This section discusses the natural resources located within the D-O Corridor, including wildlife and habitats, with a focus on ecologically-sensitive areas and contiguous expanses of undisturbed lands. It documents federal and state-listed threatened and endangered species (fauna, flora, aquatic, and terrestrial).

This section also identifies the potential effects to natural resources that would result from implementation of the alternatives under study in this DEIS. Where potential adverse effects are identified, efforts to avoid, minimize, or mitigate these effects through design modifications are also discussed. Additional detail regarding the natural resources located within the D-O Corridor is contained in appendix K.21.

Types of Species

Flora: Relating to plant life and vegetation

Fauna: Relating to animal life

Aquatic: Relating to plants and animals living in water

Terrestrial: Relating to the land or earth

4.7.1 Methodology

Data were collected throughout the D-O Corridor, within an approximately 150-foot wide study area centered on the corridor. However, the assessment of effects was limited to a study area defined as the limits of construction for the NEPA Preferred and Project Element Alternatives, meaning the area anticipated to be disturbed by construction activities as shown in appendix K.21. This includes the NEPA Preferred and Project Element Alternatives alignments, stations, park-and-rides, and ROMF alternatives.

Information regarding the relevant resource areas was collected from a review of United States Fish and Wildlife Service (USFWS) Threatened and Endangered Species databases, the North Carolina Natural Heritage Program's (NCNHP) databases, Durham and Orange counties' soil surveys, aerial photography, topographic maps, and technical staff field investigations. The most current available data from local sources and recent aerial photography, supplemented by field work, were used in the analysis.

The environmental evaluation for this study began with a broad review of environmental factors to identify notable issues and constraints. Some of these factors and considerations were documented during project Scoping. Where relevant, this information provided the starting point for the environmental analysis.

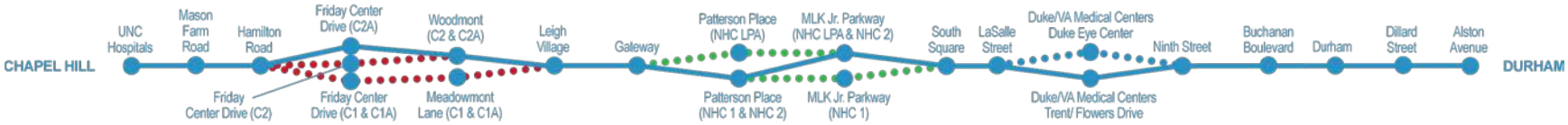
The natural resources evaluation primarily assessed site-specific effects, the significance of these effects, and what potential mitigation measures may be required because of these effects. Habitat connections were also addressed, including the New Hope Creek and Sandy Creek corridors and the Piedmont swamp forest ecological corridor connecting Duke Forest and Jordan Game Lands.

Wildlife expected within the study area was determined through review of supporting literature (Burt 1976; Martof et al. 1980; Sather et al. 2004; Sibley 2003; Duke University 2015). In addition, field investigations of the study area for habitat, wildlife, and threatened and endangered species were conducted between August 2013 and February 2015. The results of the field work were included in the GIS database for the project. The avoidance and minimization of impacts will be made to the extent possible. Where impacts to the environment are unavoidable, mitigation plans will be developed and incorporated.

4.7.2 Affected Environment

4.7.2.1 Soils

Natural Resources Conservation Service (NRCS) data for Orange and Durham counties identifies 41 soil types within the study area. Soils were determined based on a one-quarter mile search range from the



NEPA Preferred and Project Element Alternatives. A table identifying the 41 soil types identified and a corresponding map are presented in appendix K.21, Figures 17 through 31.

4.7.2.2 Habitat

Terrestrial Communities

Terrestrial communities are defined as a distinct association of species that reoccur throughout the landscape. Four terrestrial communities were identified in the study area: maintained/disturbed, mesic mixed forest, alluvial hardwood forest, and bottomland hardwood forest. A brief description of each community type follows. Figures depicting the areas of each terrestrial community within the project study area can be found in appendix K.21.

Maintained/Disturbed

This community incorporates several land cover types, including residential, commercial, industrial, recreational, and cleared/maintained transportation corridors. The majority of the study corridor is designated maintained/disturbed land. Plant communities in residential areas often contain a limited number of species, usually canopy trees that reflect larger populations that preceded development. Usually, introduced species predominate in maintained areas, and weedy species are opportunistic in recently disturbed areas.

Maintained/Disturbed Community at University Drive in Durham

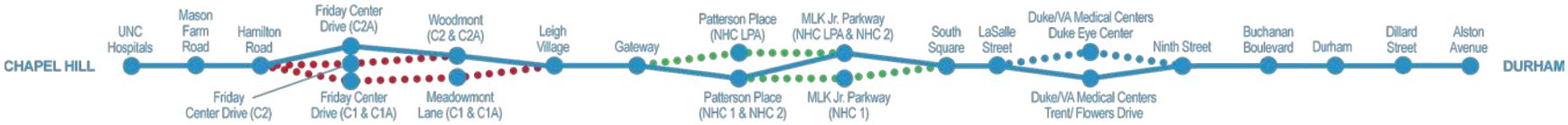
Mesic Mixed Forest

This community, if undisturbed, would most resemble mature, stable forests in this region that are usually characterized by a hardwood canopy. However, within the study area, this community is characterized by a mixture of pine and hardwood species, with pines occasionally comprising greater than 30 percent of the canopy. The community in the study area occurs primarily as a buffer around roads, residential, and other developed areas, and as secondary growth forest on previously-timbered or otherwise disturbed land.

Mesic Mixed Forest near Little Creek

Alluvial Hardwood Forest

Alluvial hardwood forest occurs throughout the study area along small streams. This community has a significant component of wetland species, particularly in the herb layer. These areas are intermittently flooded, and may contain standing water for extended periods in the winter and spring.



Alluvial Hardwood Forest Near University Drive in Durham

Bottomland Hardwood Forest

Bottomland hardwood forests are distinguished from the alluvial hardwood forests by the presence of larger streams and the landforms created from sediment deposits that occur within the larger floodplain areas.

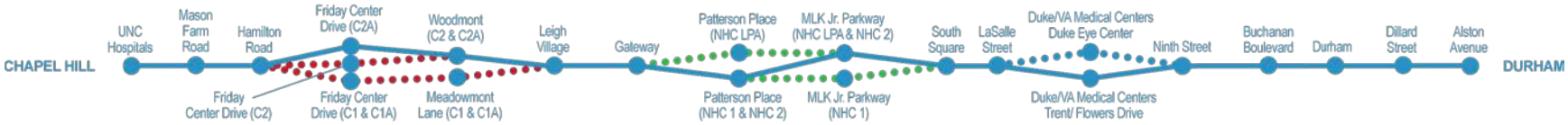
New Hope Creek Corridor Bottomland Hardwood Forest

New Hope Creek Corridor Bottomland Hardwood Forest

The broad bottomlands along New Hope Creek and its tributaries support some of the largest and oldest stands of hardwoods remaining in this part of the Piedmont, more than 4,480 acres (New Durham Conservation Commission 2011). These bottomland areas are of ecological significance as identified by NCWRC, NCDENR, and USFWS. The study area bisects the New Hope Creek Corridor bottomland hardwood forest in two locations: the US 15-501 Bottomlands (Wetlands labeled E, G, H, I, J, K, N, O, OOO, P, Q, U, UUU, V, VV, VVV, W, WWW, X, XX, XXX, YYY, ZZZ in DEIS section 4.8) and the Little Creek bottomlands (wetlands labeled Y, Z, AA, BB, CC, CCC, BBB, DD, DDD, EE, HHH, III, and FF in DEIS section 4.8). The *New Hope Corridor Open Space Master Plan* (Coulter Associates 1991) was developed and the New Hope Creek Corridor Advisory Committee was established to advise the local governments on implementing the plan. The following descriptions of bottomlands in the study area are extracted from the *Durham County Inventory of Important Natural Areas, Plants and Wildlife* (Hall and Sutter 1999); a copy of the selected portions of this report can be found in appendix K.21.

US 15-501 Bottomlands

The US 15-501 bottomlands are located between US 15-501 downstream to Old Chapel Hill Road. This part of the New Hope floodplain covers approximately 250 acres, most of which supports a fairly mature stand of bottomland hardwoods. Most trees range between 10 inches and 15 inches in diameter, but occasional specimens are over 3 feet in diameter. Canopy species observed include box elder, red maple, sugar maple, river birch, shagbark hickory, big shellbark hickory, mockernut hickory, southern hackberry, sweetgum, tulip poplar, loblolly pine, swamp chestnut oak, willow oak, and American elm. The plant list includes the large-flowered trout lily, yellow lady's slipper, and southern rein orchids found in some of the low areas. The rarest plant is big shellbark hickory, a species listed by



NCNHP as a candidate for the endangered and threatened list due to the small numbers found in North Carolina. There is a thriving population of small trees and one “patriarch” tree present within the D-O Corridor, but these trees are not located near any of the NEPA Preferred Alternative and Project Element Alternatives.

Little Creek Bottomlands

Little Creek is one of the larger tributaries of New Hope Creek. The portion of Little Creek within the study area is within the 100-year floodplain of Jordan Lake, and is part of the Jordan Lake Watershed Management Area. Little Creek Bottomlands are under water when Jordan Lake is at flood level. This area contains a large tract of bottomland hardwood forest that provides habitat for many species of forest-interior and other disturbance-sensitive animals. Canopy species observed include shagbark hickory, American beech, swamp white oak, red oak, hop hornbeam, and elm. Little Creek Bottomlands and Slopes is a NCNHP designated Significant Natural Heritage Area.

4.7.2.3 Wildlife

Wildlife, including terrestrial species, aquatic communities, and federal and state threatened and endangered species known to occur, or anticipated to occur within the study area are discussed in the following sections.

Terrestrial Wildlife

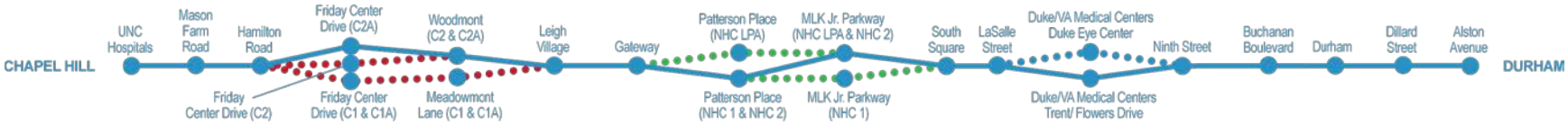
Due to the disturbed nature of the study area, all of the animal species observed are opportunistic species, meaning that they will inhabit any and all of the terrestrial communities discussed above. Animal species observed within the study area are discussed following the community descriptions. Wildlife directly observed or determined to be present through evidence (tracks, scat) during field investigations are indicated with an asterisk (*).

Bird species that utilize this community are those typical of developed areas in the Piedmont region of North Carolina. These species are tolerant of habitat fragmentation and regular disturbance. Typical birds of this community include the following: turkey vulture*, red-shouldered hawk, red-tailed hawk*, American robin*, northern cardinal*, eastern towhee, American crow*, eastern bluebird, northern mockingbird*, Carolina wren, song sparrow, white-throated sparrow, rock dove, red-bellied woodpecker*, mourning dove*, common grackle*, blue jay*, American goldfinch, northern flicker, European starling, and tufted titmouse*.

Mammals expected to be in the forested areas within the study area include both species acclimated to human disturbance and species typical of relatively undisturbed forests of limited size. Expected mammals are the eastern grey squirrel*, eastern red bat, white-tailed deer*, raccoon, eastern cottontail, opossum, eastern mole, gray fox, shorttail shrew, striped skunk, and white-footed mouse.

Primarily terrestrial reptiles and amphibians that utilize open and disturbed areas typical of this community include the following: rat snake, eastern fence lizard, corn snake, and slimy salamander. Primarily terrestrial reptiles and amphibians who would typically favor forested habitats in the region include the following: eastern box turtle*, American toad, five-lined skink, copperhead, gray treefrog, upland chorus frog*, wood frog, and slimy salamander.

Upland Chorus Frog found near Little Creek



Aquatic Communities

Aquatic communities within the study area consist of many small intermittent and perennial streams, as well as a few larger perennial streams (also see DEIS section 4.8) and their associated wetlands (e.g., New Hope Creek, Little Creek). Aquatic invertebrates and fish would be expected to be a major component of stream ecosystems, as primary and secondary consumers, and as prey items for organisms higher in the food chain. Typical aquatic organisms would include caddisflies*, mayflies*, craneflies, crayfish*, stoneflies*, dobson flies, dragonflies*, mosquitoes*, and black flies, bloodworm midge*, whirligig beetles, water boatman*, water striders*, crayfish*, snails*, Asiatic clam*, mosquito fish*, shiners*, and sunfish*.

New Hope Creek Corridor Bottomland Hardwood Forest

A species survey was conducted as part of the *Durham County Inventory of Important Natural Areas, Plants and Wildlife*, the New Hope Creek Corridor Bottomland Hardwood Forest (Hall and Sutter 1999). Selected portions of this report can be found in appendix K.21, which contains a more complete list of species identified within the US 15-501 and Little Creek Bottomlands located in the vicinity of the study area.

Significant species recorded within the US 15-501 Hardwood Bottomland included four-toed salamanders, dwarf waterdogs, and river otters. Residence of otters in this area is an indication of both the undisturbed qualities of this bottomland, as well as a substantial supply of fish and other aquatic species upon which they prey. The Little Creek Bottomland in the study area contains a waterfowl impoundment located north of NC 54.

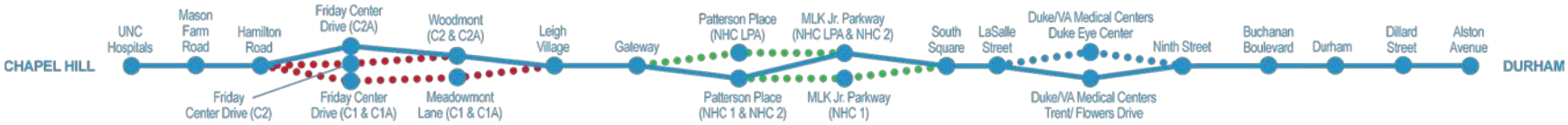
Characteristic bottomland species observed at Little Creek included red-shouldered hawk, wood duck, otter, mink, muskrat, and beaver. The presence of pileated woodpeckers and red-shouldered hawks is indicative of the extensive nature and relative maturity of the hardwood forest. The most notable animal observed on this tract was the marsh rabbit; this species is one of a suite of essentially Coastal Plain species that occur above the Fall Line only within the extensive floodplains along Triassic Basin streams.

Evidence of Beaver near Little Creek

4.7.2.4 Endangered Species Act - Threatened and Endangered Species

Species with the federal status of endangered (E), threatened (T), proposed endangered (PE), and proposed threatened (PT) are protected under the environmental site assessment (ESA). Any action likely to adversely affect a species classified as federally protected will be subject to review by the USFWS. The USFWS and NCNHP online databases were reviewed for federally listed species potentially occurring in Orange and Durham counties (USFWS 2012; NCNHP 2014).

As of December 2012, the USFWS lists five federally protected species for Orange and Durham counties as listed in **Table 4.7-1**. A brief description of each species' habitat



requirements follows, along with the Biological Conclusion rendered based on survey results in the study area. Habitat requirements for each species are based on the current best available information from the referenced literature. Pedestrian field surveys for threatened and endangered species were conducted between August 2013 and August 2014.

State Endangered Species Act

The North Carolina Endangered Species Act protects all listed species from either taking or possession. All federally-listed species are included on the state list. The NCNHP currently lists 38 species (21 endangered, 17 threatened), which are noted in **Table 4.7-2**.

4.7.3 Environmental Consequences

The following sections describe the environmental consequences of the NEPA Preferred and Project Element Alternatives as compared to the No Build Alternative.

4.7.3.1 NEPA Preferred and Project Element Alternatives

The NEPA Preferred and Project Element Alternatives would impact natural resources within the D-O Corridor. **Table 4.7-3** and **Table 4.7-4** summarize the number and types of biotic communities affected by the NEPA Preferred Alternative and compare the difference to the other Project Element Alternatives (Little Creek Alternatives, New Hope Creek Alternatives, and ROMF location alternatives).

The NEPA Preferred Alternative is comprised of C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

Soils

Under the NEPA Preferred Alternative, no significant adverse impacts to soils are anticipated. Project construction activities would disturb approximately 280 acres. The appropriate permit for land disturbance activities would be obtained from the NC Department of Environment and Natural Resources (NCDENR) Division of Land Quality, and a sediment and erosion control plan would be implemented. Disturbed soils would be re-vegetated as soon as practicable after construction.

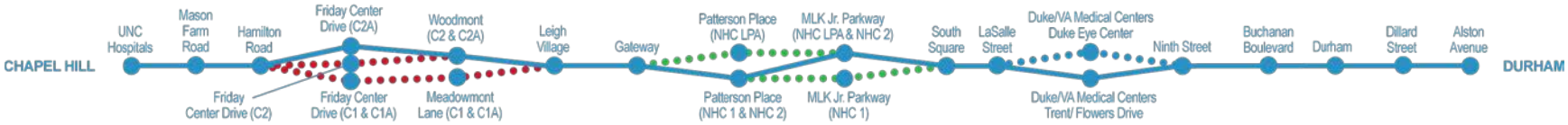
The North Carolina office of the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) was contacted during D-O LRT Project Scoping to determine whether the NEPA Preferred and Project Element Alternatives would be subject to Farmland Protection Policy Act (FPPA) requirements. A response from the USDA NRCS dated July 31, 2014 states the study area meets USDA NRCS criteria to qualify as “non-farmland” (appendix G). Because no land within the study area meets the USDA NRCS qualifications for farmland, no farmland area would be affected or converted with any of the NEPA Preferred and Project Element Alternatives. Therefore, FPPA does not apply.

Habitat

Table 4.7-3 indicates the acreage of each biotic community that falls within the NEPA Preferred Alternative.

The NEPA Preferred Alternative would impact approximately 4 acres of bottomland hardwood forest, 4 acres of alluvial hardwood forest, 88 acres of mixed mesic forest, and 220 acres of maintained/disturbed habitats for a total of 316 acres of total impact as shown in **Table 4.7-3**.

Under the NEPA Preferred and Project Element Alternatives, no significant adverse impacts to terrestrial or aquatic habitat are anticipated. However, the NHC LPA would divide the New Hope Creek Corridor Bottomland Hardwood Forest and not be parallel to an existing transportation corridor. During construction, clearing of vegetation would be minimized as much as possible. Impacted vegetation would consist primarily of flora associated with communities characterized as maintained/disturbed. This would be a permanent loss of vegetation over the life of the project, although some streetscape vegetation may replace some cleared areas.



Wildlife

Under the NEPA Preferred Alternative, significant adverse impacts to terrestrial or aquatic wildlife are not anticipated. Limited wildlife disturbance would occur for the duration of the construction activities (DEIS section 4.16). Wildlife typical of the maintained/disturbed communities adapt to human disturbances. Operations for the NEPA Preferred Alternative would utilize existing roadway corridors in the portions of the study area that pass through large areas of wildlife habitat. Because of this, impacts to wildlife are expected to be limited after construction is completed.

Threatened and Endangered Species

The NEPA Preferred Alternative is not anticipated to result in significant impacts to federal or state-listed threatened or endangered species, or their habitats. Of the five federally protected species for Orange and Durham counties, Michaux's sumac and the Northern long-eared bat have the potential to occur within the study area. A brief description of the habitat requirements (based on the current best available information in the referenced literature) and the biological conclusions for Michaux's sumac and the Northern long-eared bat are presented below. USFWS concurrence of the Biological Conclusions was received June 25, 2015 (appendix G and K.21).

Michaux's sumac

USFWS optimal survey window: May through October

Habitat Description: Michaux's sumac, endemic to the inner Coastal Plain and lower Piedmont, grows in sandy or rocky, open, upland woods on acidic or circumneutral, well-drained sands or sandy loam soils with low cation exchange capacities. The species is also found on sandy or submesic loamy swales and depressions in the fall line Sandhills region as well as in openings along the rim of Carolina bays; maintained railroad, roadside, power line, and utility rights-of-way; areas where forest canopies have been opened up by blowdowns and/or storm damage; small wildlife food plots; abandoned building sites; under sparse to moderately dense pine or pine/hardwood canopies; and in and along edges of other artificially maintained clearings undergoing natural succession.

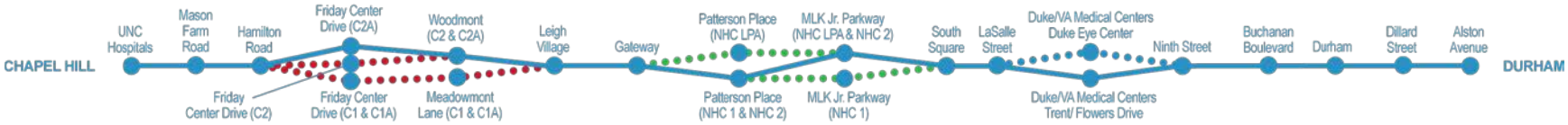
Michaux's sumac

Susan Miller, USFWS

In the central Piedmont, it occurs on clay-like soils derived from mafic rocks. The plant is shade intolerant and, therefore, grows best where disturbance (e.g., mowing, clearing, grazing, and periodic fire) maintains its open habitat. Suitable habitat for Michaux's sumac may exist along the existing power line easements and roadway rights-of-way observed within the study area.

Biological Conclusion: May Affect, Not Likely to Adversely Affect

A survey for Michaux's sumac and its habitat was conducted during the biotic community survey in September 2013. Suitable habitat for Michaux's sumac was present in the study area along the roadside shoulders and utility easements. However, no individual



specimens were found during the survey. A review of the NCNHP records, updated July 2014, indicates no known Michaux's sumac occurrence within 1.0 mile of the study area. In a letter dated June 25, 2015, the USFWS gave concurrence that the proposed project is not likely to affect this species.

Northern long-eared bat

USFWS optimal survey window: May 15 – August 15

Habitat Description: On October 2, 2013, the USFWS proposed listing the northern long-eared bat as endangered after a decline in the bat's numbers caused by white-nose syndrome, a fungal disease that this species is susceptible to. On January 16, 2015, the USFWS began a 60-day public comment period regarding the potential listing of the northern long-eared bat as a threatened species. The USFWS made a final listing determination on April 2, 2015, effective May 4, 2015. Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula. They use areas in various sized caves or mines with constant temperatures, high humidity, and no air currents. During the summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live trees and snags (dead trees). Males and non-reproductive females may also roost in cooler places such as caves and mines.

Northern long-eared bat

Ann Froshauer, USFWS

Biological Conclusion: No Effect

Suitable habitat for the northern long-eared bat was present within the study area's larger undeveloped floodplains. A review of the NCNHP records, updated January 2015, indicates no known northern long-eared bat occurrence within 1.0 mile of the study area. In a letter dated June 25, 2015, the USFWS indicated that a No Effect determination may be made for counties where the USFWS has no records for the northern long-eared bat. Currently, there are no records in Orange and Durham counties. If the species is documented in these counties before tree removal has been completed for the project, additional consultation with the USFWS will be necessary.

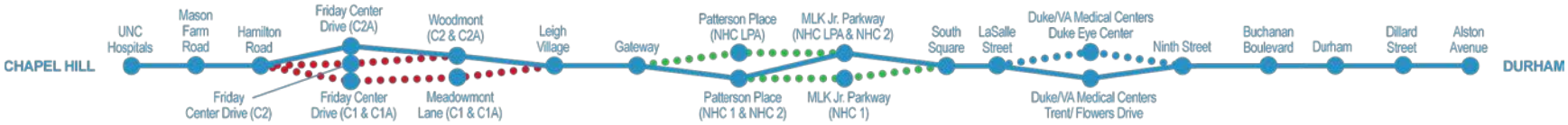
Coordination for potential effects on state-listed species with the NCWRC and the NC Department of Agriculture (NCDA) is pending review of appendix G.

North Carolina Wildlife Resources Commission and North Carolina Natural Heritage Program

The State of North Carolina leases a portion of the Jordan Lake USACE property in the vicinity of Little Creek. This area is managed by the NCWRC as part of its Game Lands. The NEPA Preferred Alternative would cross the USACE property and the NCWRC Jordan Game Lands. The Little Creek Bottomlands and Slopes, a Significant Natural Heritage Area located on both public and private property, would also be impacted by the NEPA Preferred Alternative. The USACE provided its preliminary assessment in letters to Triangle Transit dated January 7, 2015 and May 20, 2015, appendix G.

Rivers and Harbors Act Section 10 Navigable Waters

There are no surface waters identified as "Navigable Waters" under Section 10 of the Rivers and Harbors Act (33 U.S.C. § 403) in the study area. For this reason, no effects to navigable waters would occur because of the NEPA Preferred Alternative.



Bald Eagle and Golden Eagle Protection Act

Foraging habitat for the bald eagle consists primarily of mature forest in proximity to large bodies of open water, used for foraging. Large, dominant trees are utilized for nesting sites, typically within one mile of open water. Habitat within and near the study area does not constitute foraging habitat for the bald eagle.

The Bald Eagle and Golden Eagle Protection Act prohibits the taking of a bald eagle, including any activity that would disturb a bald eagle by interfering with normal breeding, feeding, or sheltering behavior. Because there is no habitat within the study area that might be considered suitable habitat for eagle nesting or foraging, no detailed surveys for eagle nests or nesting habitat are planned within the study area or within a 660-foot buffer. A review of the NCNHP records, updated July 2014, indicates no known bald eagle occurrence within one mile of the study area.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 prohibits one, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention…for the protection of migratory birds…or any part, nest, or egg of any such bird." (16 U.S.C. § 703) A number of observed and expected bird species are located in the study area that fall under the purview of the Migratory Bird Treaty Act of 1918. However, migratory birds are mobile and transient and are not likely to be adversely affected by the proposed project. The USFWS did not indicate any concerns for potential adverse impacts to migratory birds in their June 25, 2015, consultation letter.

Endangered Species Act Candidate Species

As of December 2012, the USFWS identified no candidate species under the ESA for Durham and Orange counties. For this reason, no effects to ESA candidate species would occur because of the NEPA Preferred Alternative.

Essential Fish Habitat

The National Marine Fisheries Service (NMFS) regulates Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265), as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (Public Law 109-479). The NMFS identified no EFH located within Durham or Orange counties (National Oceanic and Atmospheric Administration [NOAA] 2014). For this reason, no effects to EFH would occur because of the NEPA Preferred Alternative.

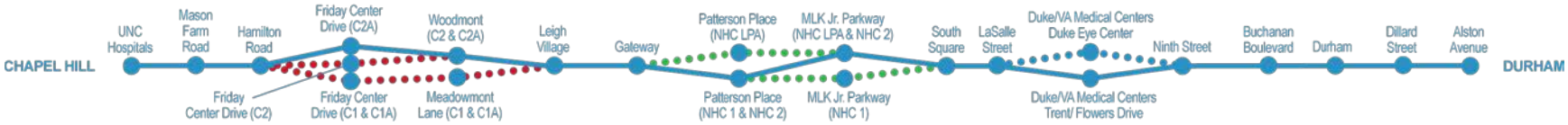
4.7.3.2 Project Element Alternatives

Little Creek Alternatives

For the Little Creek Alternatives, impacts to soils and federally-listed species are not expected to differ substantially from the NEPA Preferred Alternative (C2A). Wildlife are expected to be affected the least by alignment alternatives that utilize existing roadway corridors in the portions of the study area that pass through large areas of wildlife habitat, including. Additional impacts to biotic communities for each of the Little Creek alternatives beyond those identified for the NEPA Preferred Alternative are shown in **Table 4.7-3**.

New Hope Creek Alternatives

For the New Hope Creek Alternatives, impacts to soils and federally-listed species are not expected to differ substantially from the NEPA Preferred Alternative (NHC 2). Wildlife are expected to be affected the least by alignment alternatives that would utilize existing roadway corridors in the portions of the study area that pass through large areas of wildlife habitat, including NHC 1. Impacts to biotic communities for each of the New



Hope Creek alternatives beyond those identified for the NEPA Preferred Alternative are shown in **Table 4.7-3**.

ROMF Sites

Table 4.7-4 indicates the acreage of each community that falls within the project footprints of each of the alternative locations for the ROMF. Impacts to soils, wildlife, and federally-listed species are not expected to differ substantially among the ROMF site alternatives.

4.7.4 Mitigation Measures

4.7.4.1 Soils

Bare soils would be re-vegetated as soon as practicable after construction to minimize erosion. Disturbed land would be re-vegetated with a native seed mix or landscaping in the urban environment.

4.7.4.2 Habitat

Throughout the project development and preliminary engineering design process, efforts have been made to avoid and minimize impacts to wildlife habitat, including streams and wetlands as described in DEIS section 4.8.4.2.

4.7.4.3 Wildlife

Adverse effects to aquatic wildlife would be minimized by bridging wetland and stream areas, and employing sediment and erosion control BMPs. Efforts to avoid, minimize, or mitigate impacts to wildlife and their habitats will continue during final design and construction. Coordination with the NCWRC and the NCDA are pending review of appendix K.21. Mitigation measures, such as nesting surveys if required, will be developed in consultation with these agencies (see DEIS section 4.7.4.8).

4.7.4.4 Threatened and Endangered Species

No mitigation is required for protected species within the study area. USFWS concurrence for the biological conclusion of "No Effect" was granted in their June 25, 2015 Section 7 Determination concurrence letter (appendix G). USFWS recommends that Triangle Transit check the county species list periodically to ensure that the status of the northern long-eared bat has not changed. In the future, if the northern long-eared bat is listed in the county and tree removal has not been completed for the project, then the Triangle Transit will need to consult with USFWS at that time.

4.7.4.5 North Carolina Wildlife Resources Commission and North Carolina Natural Heritage Program

Mitigation associated with the Jordan Game Lands is provided in chapter 6.

4.7.4.6 Rivers and Harbors Act Section 10 Navigable Waters

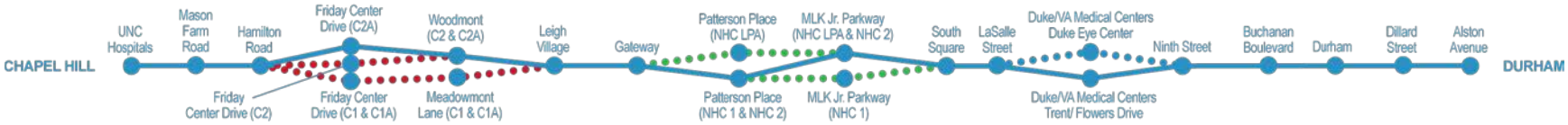
As noted, there are no surface waters identified as "Navigable Waters" under Section 10 of the Rivers and Harbors Act, therefor no mitigation is required.

4.7.4.7 Bald Eagle and Golden Eagle Protection Act

As noted, the project study area was not found to contain nesting sites for bald eagles. If it becomes evident that bald eagles are utilizing the project area, additional surveys will be conducted as warranted.

4.7.4.8 Migratory Bird Treaty Act

The Migratory Bird Treaty Act states that it is unlawful to kill, capture, collect, possess, buy, sell, trade, or transport any migratory bird, nest, young, feather, or egg in part or in whole, without a federal permit issued in accordance with the Act's policies and regulations.



Appropriate measures, including the following, will be taken to avoid adverse impacts on migratory birds. Between October 1 and February 15, the contractor would remove all old migratory bird nests from any structures that would be affected by the proposed project, and complete any necessary construction on existing bridges and/or vegetation clearing. In addition, the contractor would be prepared to prevent migratory birds from building nests between February 15 and October 1, per the Environmental Permits, Issues, and Commitments (EPIC) plan. In the event that migratory birds are encountered on-site during project construction, adverse impacts on protected birds, active nests, eggs, and/or young would be avoided.

4.7.4.9 Essential Fish Habitat

As noted, there is no EFH under the Magnuson-Stevens Fishery Conservation and Management Act and its reauthorization; therefore, no mitigation is required.

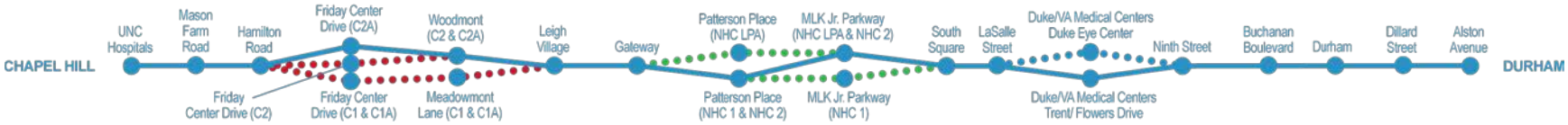


Table 4.7-1: Federally Protected Species Listed for Orange and Durham Counties

Scientific Name	Common Name	Federal Status [a]	Habitat Present	Biological Conclusion
Rhus michauxii	Michaux's sumac	E	Yes	May affect; not likely to adversely affect
Echinacea laevigata	Smooth coneflower	E	No	No effect
Picoides borealis	Red-cockaded woodpecker [b]	E	No	No effect
Alasmidonta heterodon	Dwarf wedgemussel	E	No	No effect
Myotis septentrionalis	Northern long-eared bat	T	Yes	No effect

Source: USFWS 2015.

[a] E – Endangered, T - Threatened

[b] Historical record (the species was last observed in the county more than 50 years ago).

Table 4.7-2: State-listed Endangered and Threatened Species

Scientific Name	Common Name	State Status [a]	Habitat Present	County
Alasmidonta heterodon	Dwarf Wedgemussel	E	No	Orange
Alasmidonta varicosa	Brook Floater	E	Yes	Orange
Anemone berlandieri	Southern Anemone	E	Yes	Orange
Baptisia australis var. aberrans	Prairie Blue Wild Indigo	E	Yes	Durham, Orange
Buchnera americana	American Bluehearts	E	Yes	Durham, Orange
Delphinium exaltatum	Tall Larkspur	E	Yes	Durham
Echinacea laevigata	Smooth Coneflower	E	Yes	Durham, Orange
Fusconaia masoni	Atlantic Pigtoe	E	Yes	Durham, Orange
Gaylussacia brachycera	Box Huckleberry	E	Yes	Durham
Lampsilis cariosa	Yellow Lampmussel	E	Yes	Durham, Orange
Lasmigona subviridis	Green Floater	E	Yes	Durham, Orange
Lindera melissifolia	Pondberry	E	Yes	Orange
Picoides borealis	Red-cockaded Woodpecker	E	No	Durham, Orange
Rhus michauxii	Michaux's Sumac	E	Yes	Durham, Orange
Ruellia humilis	Low Wild-petunia	E	Yes	Durham
Scutellaria australis	Southern Skullcap	E	Yes	Orange
Scutellaria leonardii	Shale-barren Skullcap	E	Yes	Durham, Orange
Scutellaria nervosa	Veined Skullcap	E	Yes	Durham
Toxolasma pullus	Savannah Lilliput	E	Yes	Orange
Trichostema brachiatum	Glad Bluecurls	E	Yes	Orange

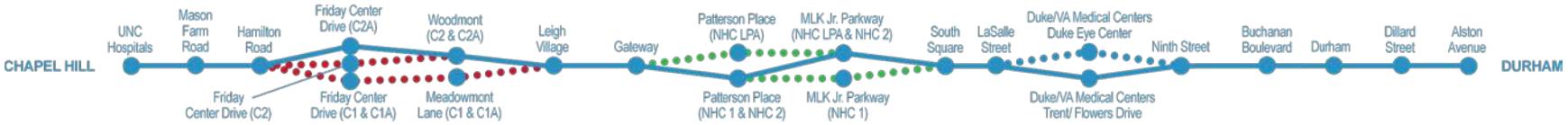


Table 4.7-2: State-listed Endangered and Threatened Species

Scientific Name	Common Name	State Status [a]	Habitat Present	County
Villosa vaughaniana	Carolina Creekshell	E	Yes	Orange
Alasmidonta undulata	Triangle Floater	T	Yes	Durham, Orange
Cardamine douglassii	Douglass's Bittercress	T	Yes	Durham, Orange
Carya laciniosa	Big Shellbark Hickory	T	Yes	Durham
Elliptio roanokensis	Roanoke Slabshell	T	Yes	Durham
Fleischmannia incarnata	Pink Thoroughwort	T	Yes	Durham
Gillenia stipulata	Indian Physic	T	Yes	Durham, Orange
Haliaeetus leucocephalus	Bald Eagle	T	No	Durham, Orange
Lampsilis radiata	Eastern Lampmussel	T	Yes	Durham, Orange
Lithospermum canescens	Hoary Puccoon	T	Yes	Durham
Noturus furiosus	Carolina Madtom	T	No	Durham
Panicum flexile	Wiry Panic Grass	T	Yes	Durham, Orange
Platanthera peramoena	Purple Fringeless Orchid	T	Yes	Durham, Orange
Primula meadia	Shooting Star	T	Yes	Orange
Strophitus undulatus	Creeper	T	Yes	Durham, Orange
Symphyotrichum laeve var. concinnum	Narrow-leaf Aster	T	Yes	Durham, Orange
Tridens chapmanii	Chapman's Redtop	T	Yes	Durham, Orange
Trifolium reflexum	Buffalo Clover	T	Yes	Durham

Source: USFWS 2015.

[a] E – Endangered, T - Threatened

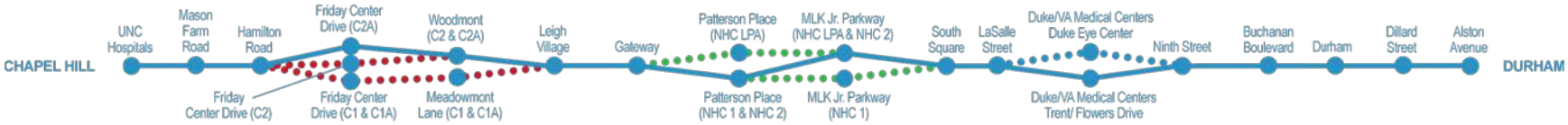


Table 4.7-3: Biotic Communities Affected by the NEPA Preferred and Project Element Alternatives in Acres

Habitat Type	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[b]			New Hope Creek Alternatives[b]		Duke/VA Medical Centers[b]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Bottomland	0	4	+3	+1	+1	+4	+2	0
Alluvial	0	4	+1	+1	+1	0	0	0
Mesic Mixed	0	88	+5	+9	+8	+5	+5	0
Maintained/Disturbed	0	220	+10	+11	+13	+18	+22	0
Total	0	316	+19	+22	+23	+27	+29	0

Source: AECOM 2015.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

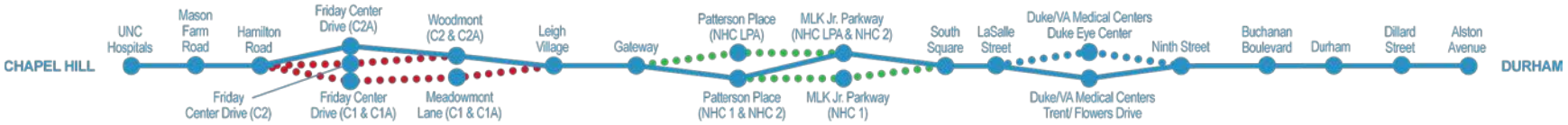
[b] In comparison to the NEPA Preferred Alternative

Table 4.7-4: Biotic Communities Affected by the ROMF Alternatives in Acres

Habitat Type	Leigh Village[b]	Patterson Place[b]	Cornwallis Road[b]	Alston Avenue[b]
Bottomland	0	0	0	0
Alluvial	0	0	+1	0
Mesic Mixed	+17	+16	+12	0
Maintained/Disturbed	+4	0	+7	+21
Total	+21	+16	+20	+21

Note: Farrington Road is the ROMF considered as part of the NEPA Preferred Alternative.

[b] In comparison to the NEPA Preferred Alternative



4.8 Water Resources

This section contains information concerning water resources located within the study area that would have the potential to be affected by the NEPA Preferred and Project Element Alternatives. Water resources information includes physical aspects of the resources, their relationship to the major water systems, the best usage standards, and the water quality of the resources. Potential effects to water resources located in the study area are estimated and summarized for each of the alternatives under study in this DEIS.

Water resources include the features listed below:

- **Groundwater**: waters contained in underground aquifers
- **Surface waters**: waters such as streams and ponds
- **Open Waters (Ponds)**: standing bodies of water
- **Wetlands**: waters that have saturated or inundated land
- **Floodplains**: areas that are prone to flooding
- **Floodways**: channel of a river or stream that must be kept clear to allow a flood to dissipate
- **Water quality**: chemical, physical, biological, and radiological characteristics of water

Additional detail on methodology, reporting, mapping, and agency coordination are included in appendix K.22.

4.8.1 Methodology

Preliminary impact estimates to the jurisdictional features for the NEPA Preferred and Project Element Alternatives are based on design assumptions as shown in the *Basis for Engineering Design* (appendix L). Preliminary cut and fill limits were placed as an overlay on the global positioning system (GPS) mapping of the approximate boundaries of jurisdictional stream and wetland features, riparian buffers, as well as floodplains and floodways mapping, to estimate impacts. Estimated impacts are subject to refinement based on the continuance of the design and further development of the engineering plans.

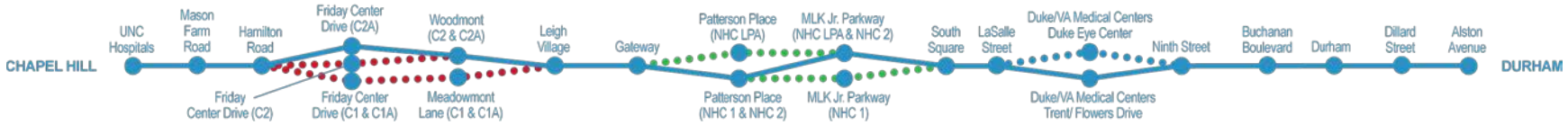
Background research on water resources was done, including groundwater, streams, wetlands, and other water features. Sources consulted include the following:

- U.S. Geological Survey (USGS) 7.5-minute quadrangle maps (Chapel Hill [1981]; Southwest Durham [1987]; Northwest Durham [1987])
- USFWS National Wetlands Inventory Maps
- USDA Soil Conservation Service (SCS) (now known as Natural Resources Conservation Service [NRCS]) *Soil Survey of Durham County, North Carolina* (1976) and *Soil Survey of Orange County, North Carolina* (1977)
- USDA NRCS Web Soil Survey (2013)
- Go MAPS – Durham County NC Public Access
- Orange County, North Carolina Interactive GIS
- NCDENR DWR website

Field reviews were conducted on multiple dates between June 2013 and January 2015. The field investigators walked the following locations, which are defined as the study area:

- A corridor approximately 400 feet wide, centered on each of the NEPA Preferred and Project Element Alternatives
- The proposed locations of stations and park-and ride facilities
- The proposed locations of ROMFs

The current level of design estimates the construction limits. Construction limits, temporary construction easements, and staging areas will be refined in further stages of design prior to completion of any required permitting for water resources. A discussion



of the methodology for data collection and analysis for each resource area is provided below.

4.8.1.1 Groundwater

The USDA SCS *Soil Survey of Durham County, North Carolina*, and the USDA SCS *Soil Survey of Orange County, North Carolina*, data were consulted to identify soil types, water tables, and groundwater levels. Estimated groundwater depths were determined using the SCS soil surveys.

Water supply data were acquired and reviewed for land within 1,500 feet of the study area. In addition, NCDENR Division of Environmental Health (DEH), Public Water Supply Section (PWSS) GIS data from NC OneMap were used to identify the public water supply data. For private water supply, private well data were obtained from the Durham County Environmental Health Division and the Orange County Health Director. Data received included a list of parcels located within 1,500 feet of the study area whose owners have applied for well permits. This 1,500 feet area surrounding the study area is defined as the Drinking Water Supply Study Area. The Drinking Water Supply Study Area is larger than the study area in order to fully evaluate potential indirect effects of the NEPA Preferred and Project Element Alternatives to groundwater resources.

4.8.1.2 Surface Waters and Wetlands

Surveys of the study area and park-and-ride facility locations were conducted between June 2013 and January 2015. Wetlands were identified in accordance with the methods prescribed in the U.S. Army Corps of Engineers (USACE) *Wetlands Delineation Manual* (USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (USACE 2012). Potential waters of the United States identified within the study area were delineated and subsequently flagged in the field with blue and white striped surveyor's tape. The boundaries were approximated with a Trimble GeoXH hand-held GPS unit capable of sub-foot accuracy and mapped using ArcGIS 10.1 software. Streams were identified and assessed in the study area and photographs were taken. Each stream and wetland was assigned a unique name for the purposes of this project.

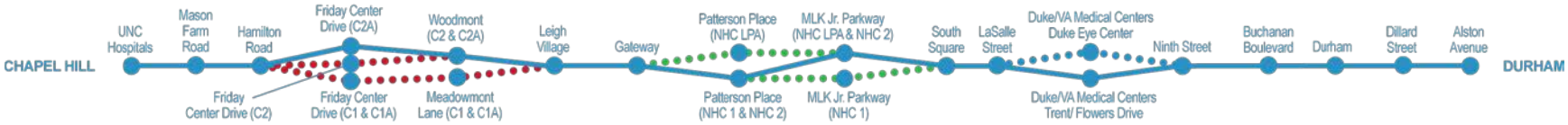
A wetland with 50 percent coverage of trees over a shrub layer with 60 percent coverage would be classified as Forested Wetland; an area with 20 percent coverage of trees over the same (60 percent) shrub layer would be classified as Scrub-Shrub Wetland. When trees and shrubs cover less than 30 percent of the area but the total cover of vegetation is 30 percent or greater, the wetland is classified as emergent. Several wetland areas possess characteristics of both forested and emergent.

Jurisdictional stream and wetland boundaries have been verified by the USACE and a revised Notification of Jurisdictional Determination from the USACE was issued on November 7, 2014.

4.8.1.3 Floodplains and Floodways

The Federal Emergency Management Agency (FEMA), in cooperation with federal, state, and local governments, has developed floodway boundaries and Flood Insurance Rate Maps (FIRMs) for Durham and Orange counties. Floodplains are land areas adjacent to rivers and streams that are subject to recurring flooding. Owing to their changing nature, floodplain areas and other flood-prone areas need to be continually reexamined in light of how they might affect or be affected by development.

Rivers and streams where FEMA has prepared detailed engineering studies may include designated floodways. A floodway is the channel of a river or other watercourse and the adjacent land areas that must be kept clear, or "reserved," in order to discharge the flood waters without increasing the upstream water surface elevation more than a designated height. For most waterways, the floodway is where the water is likely to be deepest and fastest. As such, the area of the floodway should be



kept clear of obstructions like buildings to allow floodwaters to flow downstream. Placing fill or buildings in a FEMA floodway may block the flow of water and increase flood elevations.

The FEMA engineering studies were reviewed to identify floodplains and floodways located near the NEPA Preferred and Project Element Alternatives, stations, park and rides, and ROMFs. Floodways, 100-year floodplains, and 500-year floodplains were identified and mapped along with an overlay of the *Basis for Engineering Design* (appendix L), to identify where the proposed D-O LRT Corridor would potentially encroach into the floodways and floodplains.

4.8.1.4 Water Quality

DWR data were reviewed to identify the North Carolina Water Quality Classifications by North Carolina River Basin. The DWR stream classifications for the project area streams are either Water Supply (WS)-IV, Nutrient Sensitive Waters (NSW), or WS-V. By definition, WS-IV streams are streams that drain to water supply reservoirs that are located in highly developed areas, and WS-V streams are streams that drain to water supply reservoirs in upstream areas. The DWR Water Quality Data Assessment 2012 303(d) [Section 303(d) of the Clean Water Act] list of impaired waters was consulted to identify 303(d)-listed impaired waters located within the study area. The term "303(d) list" is short for the list of impaired and threatened waters (stream/river segments, lakes) all states must identify where required pollution controls are not sufficient to attain or maintain applicable water quality standards.

4.8.1.5 Agency Jurisdiction

Groundwater Regulatory Framework

The North Carolina Environmental Management Commission has established groundwater standards for the protection of water supplies. Groundwater standards are listed in the N.C.A.C. Title 15A – Environment and Natural Resources, Subchapter 2L as directed by N.C.G.S. § 143-214.1. These standards are intended to maintain and preserve the quality of groundwater, prevent and abate pollution and contamination of the waters of the state, protect public health, and permit management of the groundwater for its best usage by the citizens of North Carolina. In North Carolina, the NCDENR DWR is responsible for administering several groundwater programs and carrying out enforcement actions for violations of environmental regulations. NCDENR DWR regulates groundwater by preventing pollution, managing and restoring degraded groundwater, and protecting groundwater resources.

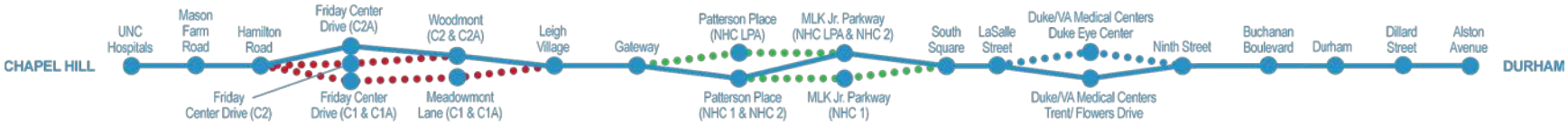
Surface Waters and Wetlands Regulatory Framework

The Clean Water Act (CWA) (33 U.S.C. §§ 1251 et seq.) establishes the basic framework for regulating discharges of pollutants into waters of the United States. “Jurisdictional waters of the United States," including wetlands, streams, and open waters, are defined in 33 C.F.R. § 328.3 and are protected by Section 404 of the CWA (33 U.S.C. § 1344), which is administered and enforced in North Carolina by the USACE, Wilmington District. Section 404 regulates the discharge of dredged or fill material in waters of the United States through the USACE permitting program. Fill material can be pipes, culverts, soil, rock, concrete, riprap, asphalt, brick, or other building materials. Section 401 regulates water quality through the NCDENR DWR water quality certification program. The permit review and issuance process first encourages avoidance of impacts, followed by minimizing impacts, and lastly through mitigating unavoidable impacts.

Jurisdictional waters of the United States: wetlands, streams, and open water ponds

Floodplains and Floodways Regulatory Framework

Floodplain management ordinance requirements are listed in 44 C.F.R. §§ 9.1-



9.18. These regulations establish how Executive Order 11988, *Floodplain Management* (1977), and Executive Order 11990, *Protection of Wetlands* (1977), are implemented and enforced. These regulations apply to all federal agency actions that have the potential to affect or harm floodplains or wetlands. FEMA, in cooperation with federal, state, and local governments, has developed floodway and floodplain boundaries and FIRMs for Durham and Orange counties.

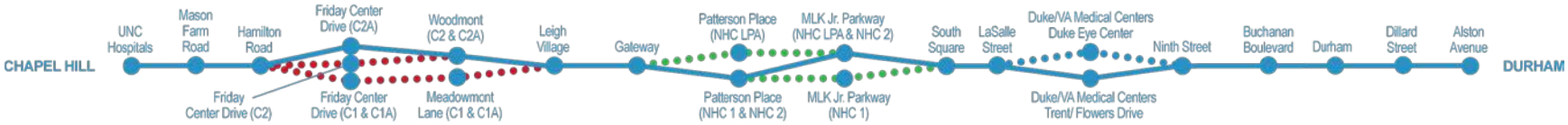
United States Department of Transportation (USDOT) Order 5650.2, *Floodplain Management and Protection* (1979), prescribes additional policies and procedures for transportation projects. The intent of Order 5650.2 is to ensure that a detailed floodplain analysis is included in the environmental documents and that proper consideration is given to the avoidance and mitigation of adverse floodplain effects. This analysis discusses any risk to, or resulting from, the proposed project, including the impacts on mutual and beneficial floodplain values, the degree to which the proposed project provides direct or indirect support for development in the floodplain, and measures to minimize harm, or restore or preserve the natural and beneficial floodplain values affected by the project.

Riparian buffers: vegetated stream corridors extending 50 feet perpendicular from the stream bank

4.8.1.6 Agency Coordination

As discussed above, the agencies with jurisdiction for water resources, impacts, and mitigation within the study area are the USACE and the NCDENR DWR. The USACE is a Cooperating Agency for the D-O LRT Project. The DWR is also the agency with jurisdiction for the Jordan Lake Water Supply Watershed Buffer Rules (15A N.C.A.C. § 02B.0267), which protects water quality provided by riparian buffers within the Jordan Lake watershed. The study area is located largely within the Jordan Lake drainage basin and all waters described in this section drain to Jordan Lake, which is part of the Haw River Watershed. Beginning at project Scoping and continuing through Project Development, Triangle Transit, the FTA, USACE, and DWR have worked together to identify water resources within the study area; discuss the potential impacts to water resources, water quality, and riparian buffers; and determine appropriate mitigation for unavoidable impacts within the study area. The letters received from these agencies during Scoping are included in appendix G. These agencies are included on the Technical Advisory team assembled to provide input throughout the NEPA process regarding technical, environmental, and regulatory issues. The outcome of this coordination has resulted in the avoidance and minimization of impacts through development of project alternatives, particularly in the vicinities of Little Creek and New Hope Creek. Coordination with natural resource and regulatory agencies will continue through the Engineering, Permitting, and Construction phases of the project.

Surface water features, or drainages, within the study area were evaluated to determine the hydrology of the streams (e.g., perennial streams, intermittent streams, or ephemeral channels) according to USACE and DWR guidelines. Each feature was evaluated as to whether it was defined as a "water of the United States" by the USACE or whether it was included in the jurisdiction of the DWR. Stream jurisdictional boundaries, as well as the hydrologic classification, were field-verified by the USACE on April 8, 2014. Subsequent to this agency field review, the USACE was provided additional Jurisdictional Determination requests to include additional areas to the study area. The USACE issued a Notification of Jurisdictional Determination dated May 12, 2014. A revised Notification of Jurisdictional Determination from the USACE was issued on November 7, 2014 (appendix G).



Perennial stream: contains flowing water year round

Intermittent stream: contains flowing water for part of the year

Ephemeral channels: contains flowing water only after storm events

4.8.2 Affected Environment

The following sections summarize the existing conditions for the water resources located within the study area.

4.8.2.1 Groundwater

Groundwater levels and flow in the study area vary widely, largely due to urban development, topography, and geology. According to the USDA SCS *Soil Survey of Durham County, North Carolina*, and the USDA SCS *Soil Survey of Orange County, North Carolina*, the soil types with the highest water tables are located in multiple areas along the study area. The crossings of Meeting of the Waters, Little Creek, New Hope Creek, and Sandy Creek have the largest areas of these soil types within the study area.

A review of information obtained in the NC One Map showed that no public water supply groundwater wells lie within approximately 1,500 feet of the study area in Durham or Orange counties (i.e., Drinking Water Supply Study Area). Information obtained from the Orange County Health Director and the Durham County Environmental Health Division indicates that 16 private well locations in Orange County and 100 in Durham County are located within the Drinking Water Supply Study Area found in appendix K.22.

4.8.2.2 Surface Waters and Wetlands

The study area is located in the Cape Fear USGS Basin and the Neuse River USGS Basin. The majority of the study area is located within the Haw Watershed of the Cape Fear River Basin. A small portion of the most northeastern study area is located within the Upper Neuse watershed of the Neuse River Basin. Major streams in the project region (Meeting of the Waters, Sandy Creek, New Hope Creek, and Little Creek) generally flow in a southerly direction. All of the jurisdictional waters of the United States within the study area drain into B. Everett Jordan Lake (Jordan Lake). Jordan Lake, encompassing approximately 46,768 acres, is located in Chatham, Wake, Durham, and Orange counties. Jordan Lake provides flood damage reduction, water supply, water quality control, fish and wildlife conservation, as well as outdoor recreational opportunities.

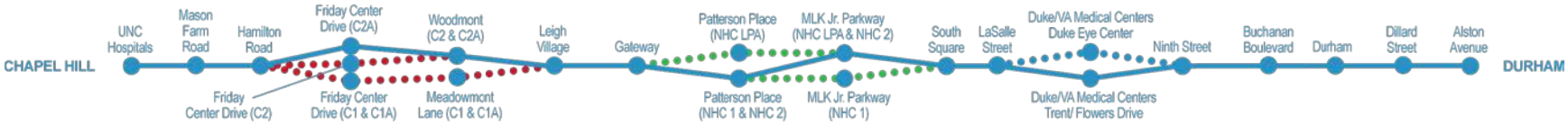
The results of the on-site field reviews indicate that there are 57 jurisdictional streams and 47 jurisdictional wetland areas located within the study area. The 57 jurisdictional streams within the study area, as determined by the USACE, are listed in **Table 4.8-1** roughly from south to north. Streams were assigned a unique name for the purposes of this project. Streams identified as intermittent contain water for only part of the year, while streams identified as perennial contain water year round.

Table 4.8-2 summarizes the areas of wetlands that are located within the study area. The jurisdictional wetlands within the study area are listed in **Table 4.8-2** roughly from south to north.

In addition to the jurisdictional wetlands, nine jurisdictional open water features (i.e., ponds) are located within the study area. These features are listed in **Table 4.8-3** roughly from south to north. Ponds were assigned a unique name for the purposes of the proposed D-O LRT Project.

4.8.2.3 Floodplains and Floodways

According to the FIRMs for Durham and Orange counties, the study area falls within the FEMA 100-year floodplain in multiple areas along the D-O Corridor. The crossings of Meeting of the Waters (Stream YY), Little Creek (Stream Y), New Hope Creek (Stream T), and Sandy Creek (Stream J) have the largest areas of floodplains within the study area.



4.8.2.4 Water Quality

The streams within the study area drain into Jordan Lake. According to the DWR Water Quality Data Assessment 2012 303(d) list, Stream Y (Little Creek) is the only project area stream that is listed on the 303(d) impaired waters list, and is located in the study area for all the NEPA Preferred and Project Element Alternatives. Little Creek received a poor bioclassification for aquatic life.

4.8.3 Environmental Consequences

Anticipated impacts to water resources, notably jurisdictional streams and wetlands as well as regulated floodplain areas, are described in the following subsections. The potential effects to the existing water resources are detailed for the NEPA Preferred and Project Element Alternatives in comparison to the No Build Alternative. The impacts to wetlands, streams, riparian buffers, ponds, and floodplains and floodways by the NEPA Preferred and Project Element Alternatives are depicted on **Figures 4.8-1** to **4.8-19**. The potential effects to water resources are summarized in **Table 4.8-4** (streams), **Table 4.8-5** (wetlands), **Table 4.8-6** (riparian buffers), **Table 4.8-7** (ponds), and **Table 4.8-8** (floodplains). Under the No Build Alternative, there will be no project-related impacts to the water resources.

Larger direct impacts to potential jurisdictional waters would consist of construction of new bridges and replacement and/or extension of existing bridges and culverts along the rail alignment. Smaller impact areas associated with station footprints would be from placement of fill. Final Design for proposed structures would provide more definite impacts to these waters based upon the size and number of support columns, culverts, or amount of fill placed. In addition, indirect impacts to these waters may occur due to an increase in surface water runoff. Appendix K.22 contains more detail on the jurisdictional waters impacted by the NEPA Preferred and Project Element Alternatives.

4.8.3.1 NEPA Preferred Alternative

The NEPA Preferred Alternative would impact water resources within the D-O Corridor. The following sections summarize the NEPA Preferred Alternative's impacts to surface water (streams), wetlands, riparian buffers, open water, floodplains and floodways, and water quality.

Groundwater

Because construction of the NEPA Preferred Alternative would not involve extensive excavation, and no public water supply wells are located within 1,500 feet of the NEPA Preferred Alternative, no groundwater impacts would be anticipated by the implementation of the proposed D-O LRT Project. The 116 privately-owned wells that are within 1,500 feet of the D-O Corridor would not be affected by the operation of the light rail vehicles because the vehicles do not have gasoline or oils that could spill and contaminate the groundwater. In addition, the use of concrete ties avoids the environmental issue of leaching creosote from wood ties. The addition of impervious surfaces, particularly at the park-and-rides lots, ROMF, and stations, would require the implementation of best management practices for the collection and treatment of stormwater runoff.

Surface Waters (Streams)

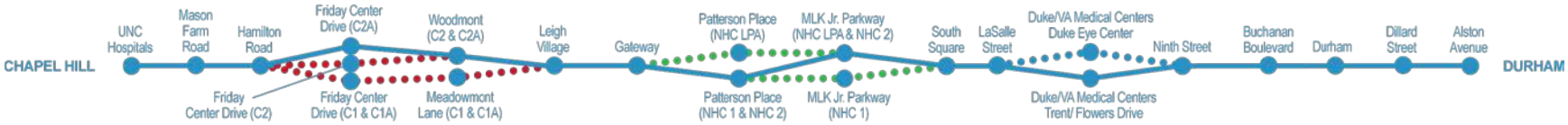
The NEPA Preferred Alternative's impacts on surface waters is anticipated to be approximately 3,413 linear feet (0.438 acre), which includes 638 linear feet (0.066 acre) associated with the Farrington Road ROMF, as shown in **Table 4.8-4**.

Wetlands

The NEPA Preferred Alternative is anticipated to impact 0.558 acre of wetlands including 0.325 acre associated with the Farrington Road ROMF, as shown in **Table 4.8-5**

Riparian Buffer

The NEPA Preferred Alternative's impacts to riparian buffers are anticipated to be 4.97



acres to Zone One and 4.10 acres to Zone Two, as summarized in **Table 4.8-6**.

Stream buffers based on the Jordan Lake Water Supply Watershed Buffer Rules apply to the majority of the project area streams for the NEPA Preferred Alternative. Regulated 50 foot wide riparian buffers required by the Jordan Lake Water Supply Watershed Buffer Rules have been established parallel to the top of bank of these surface waters. Impacts to stream buffers associated with the NEPA Preferred Alternative would include the at-grade alignments and the bridge piers/abutments, and the Gateway Station park-and-ride.

Additional details of estimated impacts to jurisdictional riparian buffers for each project area stream can be found in appendix K.22.

Riparian buffer impacts need to be evaluated based on the combination of impacts to Zone One (0 to 30 feet) and Zone Two (30 to 50 feet) as established by the Jordan Lake Water Supply Watershed Buffer Rules. When evaluating the impacts to the Jordan Lake water supply riparian buffers, it should be noted that the areas are measured in square feet for mitigation determinations. Impacts to Zone One are multiplied by three and impacts to Zone Two are multiplied by one and one-half to determine mitigation needs. These mitigation needs are discussed in DEIS section 4.8.5.

Open Water (Ponds)

Impacts to open waters (ponds) associated with the NEPA Preferred Alternative are anticipated to be 0.005 acre, as summarized in **Table 4.8-7**.

Floodplains and Floodways

Table 4.8-8 provides estimates of impacts to FEMA floodways, 100-year floodplains, and 500-year floodplains for the NEPA Preferred Alternative. **Figure 4.8-14** through **Figure 4.8-19** show the locations of encroachment into the floodways and floodplains. Based on the *Basis for Engineering Design* (appendix L), it is anticipated that crossings of Meetings of the Waters (Stream YY), Little Creek (Stream Y), New Hope Creek (Stream T), and Sandy Creek (Stream J) would require the construction of bridges to minimize impacts to regulated floodways and floodplains. A detailed table of estimated impacts to floodplain and floodway for each project area stream can be found in the *Water Resources Technical Report* (appendix K).

The NEPA Preferred Alternative is anticipated to impact 6.420 acres of the 100-year floodplain, 0.378 acre of 500-year floodplain and 0.880 acre of floodway.

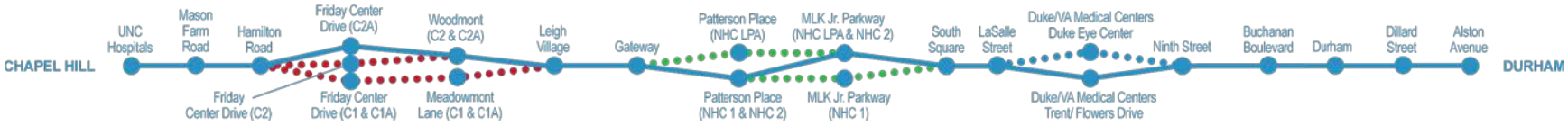
During design, consideration of floodplain and floodway impacts were considered and minimized through various design approaches included using aerial structures where appropriate.

Water Quality

The streams in the study area are classified as either water supply watersheds WS-IV or WS-V according to NCDENR DWR. By definition, WS-IV areas are located in highly developed areas and WS-V areas are located in upstream areas.

There are no designated trout waters, anadromous fish waters (fish that migrate from salt water to fresh water to spawn), or primary nursery areas present in the study area for the NEPA Preferred Alternative. There are no designated Outstanding Resource Waters, High Quality Waters, or water supply watersheds (WS-I or WS-II) within one mile downstream of the study area for the NEPA Preferred Alternative. WS-I waters are High Quality Waters located in natural areas with maximum protection of water supplies; WS-II waters are High Quality Waters located in undeveloped areas. The North Carolina 2012 Final 303(d) list of impaired waters identifies Stream Y (Little Creek) as impaired. No benthic samples (sampling to determine the types of macroinvertebrates in the waters) or fish surveys have been conducted on the study area streams as part of this assessment.

Major National Pollutant Discharge Elimination System (NPDES) wastewater facilities near the study area include the



Mason Farm Wastewater Treatment Plant (NC0025241) located in Orange County south of Old Mason Farm Road, and the South Durham Water Reclamation Facility (NC0047597) located in Durham County south of NC 54 and east of Farrington Road. The Mason Farm Wastewater Treatment Plant is located approximately one-half mile downstream of the study area. The South Durham Water Reclamation Facility is located approximately one mile downstream of the study area. There would be no impacts to major NPDES wastewater facilities from the NEPA Preferred Alternative.

4.8.3.2 Project Element Alternatives

The Project Element Alternatives would impact water resources within the D-O Corridor. **Table 4.8-4** through **Table 4.8-7** summarize the number and types of aquatic resources affected by the Project Element Alternatives and compare the differences to the NEPA Preferred Alternative.

Little Creek Alternatives

Groundwater

Similar to the NEPA Preferred Alternative (C2A), there would be no groundwater impacts anticipated by the implementation of the C1, C1A, or C2 Alternatives.

Surface Waters (Streams)

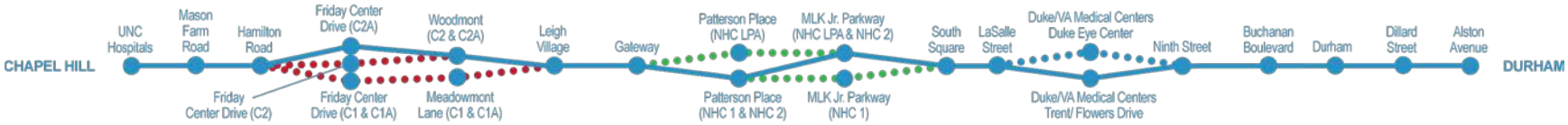
In comparison to the NEPA Preferred Alternative (C2A), the C1 Alternative would impact 110 linear feet less of stream while C1A and C2 Alternatives would impact 98 and 94 more linear feet of stream, respectively. The Little Creek Alternatives' impacts on streams are show in **Table 4.8-4** with the differences among the alternatives discussed below.

The Little Creek Alternatives would avoid impacts to Streams KKK (23 linear feet) and LLL (90 linear feet), but would impact the following streams. Stream SS is an unnamed seasonal RPW with intermittent flow that is a tributary to Stream RR and is located south of NC 54 and east of Finley Golf Course Road in the C1, C1A, C2, and NEPA Preferred Alternative (C2A). Approximately 210 linear feet (0.019 acre) of Stream SS would be impacted by the placement of a corrugated metal pipe (CMP) pipe in the C1, C1A, and C2 Alternatives. Comparatively, approximately 352 linear feet (0.032 acre) of Stream SS would be impacted by the placement of a 30 inch CMP in the NEPA Preferred Alternative (C2A).

Stream RR is an unnamed RPW with perennial flow that is located south of NC 54 and east of Finley Golf Course Road. Stream RR begins off site to the north of the project corridor and flows south for approximately 540 linear feet through C1, C1A, and C2 Alternatives and for approximately 333 linear feet through the NEPA Preferred Alternative (C2A) before it flows off-site to the south. Approximately 173 linear feet (0.018 acre) of Stream RR would be impacted by the placement of a pipe in the C1, C1A, and C2 Alternatives. Approximately 28 linear feet (0.004 acre) of Stream RR would be impacted by the placement of a 30 inch CMP in the NEPA Preferred Alternative (C2A).

Stream QQ is an unnamed RPW with perennial flow that is located south of NC 54 and west of Friday Center Drive. Stream QQ begins at a culvert south of NC 54 in the northern portion of the project corridor and flows south for approximately 272 linear feet through the C1, C1A, and C2 Alternatives and for 176 linear feet through the NEPA Preferred Alternative (C2A) before it flows off-site to the south. Approximately 51 linear feet (0.004 acre) of Stream QQ would be impacted by the placement of a pipe in the C1 and C1A Alternatives. Approximately 90 linear feet (0.011 acre) of Stream QQ would be impacted by the placement of a pipe in the C2 Alternative. Approximately 26 linear feet (0.004 acre) of Stream QQ would be impacted by the placement of a 30 inch CMP in the NEPA Preferred Alternative (C2A).

Stream MMM, an unnamed seasonal RPW with intermittent flow that begins from a



culvert connected to Pond H, is located east of Friday Center Drive and south of NC 54. Stream MMM flows south for approximately 208 linear feet before entering a pipe culvert under Finley Forest Drive. Approximately 114 linear feet (0.010 acre) of Stream MMM would be impacted by the placement of a pipe in the C2 Alternative.

Wetlands

In comparison to the NEPA Preferred Alternative (C2A), the C1, C1A, and C2 Alternatives would impact 0.05 acre less of wetlands. Although the total acres of impacts would be less, the C1 and C1A Alternatives would impact one or two more wetlands, respectively, than the NEPA Preferred Alternative (C2A). The Little Creek Alternatives' impacts on wetlands are shown in **Table 4.8-5** with the differences among the alternatives discussed below.

Wetland GG (approximately 0.37 acre) is a palustrine forested wetland located south of NC 54 and east of UNC Finley Golf Course Road. Approximately 1,682 square feet (0.039 acre) of Wetland GG would be affected by two new pipes and fill in the C1, C1A, and C2 Alternatives compared to 4,062 square feet (0.093 acre) in the NEPA Preferred Alternative (C2A).

Wetland BBB (approximately 0.35 acre) is a palustrine emergent wetland located east of Meadowmont Lane and south of Helmsdale Drive in the C1A Alternative. Approximately 50 square feet (0.001 acre) of Wetland BBB would be affected by bridge piers in the C1A Alternative.

Wetland AA (approximately 0.57 acre in the C1A Alternative; approximately 2.40 acres in the C1 Alternative) is a palustrine forested/emergent wetland located east of Meadowmont Lane and south of Helmsdale Drive in the C1A and C1 Alternatives. Approximately 150 square feet (0.003 acre) of Wetland AA would be affected by bridge piers in the C1 Alternative.

Wetland HHH (approximately 0.05 acre in the C1A Alternative) is a palustrine emergent wetland located west of George King Road in the C1A Alternative. Approximately 46 square feet (0.001 acre) of Wetland HHH would be affected by fill in the C1A Alternative.

Riparian Buffer

The Little Creek Alternatives' impact on riparian buffers is shown in **Table 4.8-6** with the differences among the alternatives discussed below.

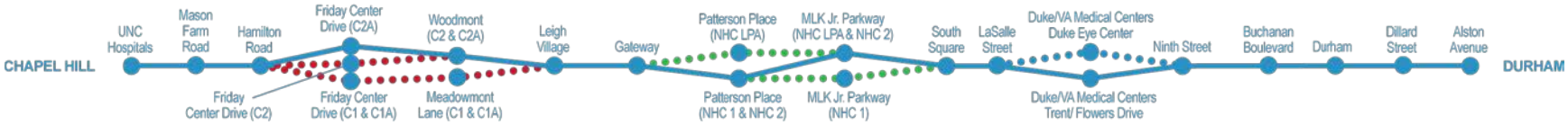
The C1 Alternative would impact fewer acres of Zone One (0.04 acre) and Zone Two (0.15 acre) riparian buffers. The C1A Alternative would impact more acres of Zone One (0.24 acre) and Zone Two (0.04 acre) riparian buffers. The C2 Alternative would impact more acres of Zone One (0.09 acre) riparian buffer, but fewer acres of Zone Two (0.06 acre) riparian buffer.

Open Water (Ponds)

In comparison to the NEPA Preferred Alternative (C2A), the C1 and C1A Alternatives would impact 0.016 acre more of open water (ponds). The C2 Alternative would impact 0.069 acre more of open water (ponds). The Little Creek Alternatives' impact on open water (ponds) is shown in **Table 4.8-7** with the differences among the alternatives discussed below.

Pond D is an unnamed open water that is located east of UNC Finley Golf Course Road and south of NC 54. Pond D has a fountain to help maintain water quality and has a fringe of emergent wetland vegetation. Pond D is approximately 0.185 acre in size within the C1, C1A, and C2 Alternatives. Approximately 898 square feet (0.021 acre) of Pond D would be affected by fill for the rail embankment in the C1, C1A, and C2 alternatives.

Pond G is an unnamed open water that is located east of Friday Center Drive and south of NC 54. Pond G is unmaintained which has resulted in a shoreline fringe of palustrine scrub-shrub/emergent wetlands in addition to being covered by a thick layer of duckweed (*Lemna sp.).* Pond G is approximately 0.146 acre in size within C2 Alternative. Approximately 2,288 square feet



(0.053 acre) of Pond G would be affected by fill for the rail embankment in the C2 Alternative.

Floodplains and Floodways

In comparison to the NEPA Preferred Alternative (C2A), the C1 Alternative would impact 0.838 acre more of 100-year floodplain and the C1A Alternative would impact 0.325 acre less of 100-year floodplain. The C2 Alternative's impacts to the 100-year floodplain would be the same as the NEPA Preferred Alternative (C2A).

Impacts to the 500-year floodplain and floodway are the same between the Little Creek Alternatives and the NEPA Preferred Alternative (C2A).

Water Quality

Similar to the NEPA Preferred Alternative (C2A), there are no designated trout waters, anadromous fish waters (fish that migrate from salt water to fresh water to spawn), or primary nursery areas present in the study area for any of the Little Creek Alternatives. There are no designated Outstanding Resource Waters, High Quality Waters, or water supply watersheds (WS-I or WS-II) within one mile downstream of the study area for any of Little Creek Alternatives.

There would be no impacts to major NPDES wastewater facilities from any of the Little Creek Alternatives.

New Hope Creek Alternatives

Groundwater

Similar to the NEPA Preferred Alternative (NHC 2), there would be no groundwater impacts anticipated by the implementation of the NHC LPA or NHC 1 Alternatives.

Surface Waters (Streams)

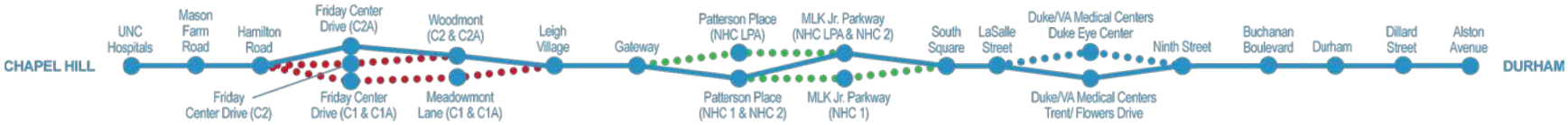
In comparison to the NEPA Preferred Alternative (NHC 2), the NHC LPA Alternative would impact 11 more linear feet of stream. The NHC 1 Alternative would not impact any streams. The New Hope Creek Alternatives' impacts on streams are show in **Table 4.8-4** with the differences among the alternatives discussed below.

Stream J, named Sandy Creek, is an RPW with perennial flow and is located west of Garrett Road in the NHC LPA. Stream J begins off-site to the north and flows southwest through the project corridor. Stream J is approximately 1,492 linear feet within the NHC LPA. Approximately 8 linear feet (0.001 acre) of Stream J would be impacted by the placement of a pier in the NHC LPA.

Stream I is an unnamed RPW with perennial flow that is located in the forested area east of Garrett Road in the NHC LPA. Stream I begins north of the NEPA Preferred Alternative (NHC 2) and flows southwest through the project corridors where it joins Stream J (Sandy Creek). Stream I is approximately 1,430 linear feet within the NHC LPA. Approximately 3 linear feet (less than 0.001 acre) of Stream I would be impacted by the placement of a pier in the NHC LPA.

Stream H is an unnamed seasonal RPW with intermittent flow located west of University Drive in the NHC LPA and NEPA Preferred Alternative (NHC 2). Stream H begins at Pond A adjacent to the apartment complex to the north and flows south through the project corridors toward University Drive. Stream H is approximately 276 linear feet within the NHC LPA and NEPA Preferred Alternative (NHC 2). Approximately 157 linear feet (0.017 acre) of Stream H would be impacted by the placement of a pipe in both the NHC LPA and NEPA Preferred Alternative (NHC 2).

Stream G is an unnamed seasonal RPW with intermittent flow located east and west of University Drive in the NHC LPA and NEPA Preferred Alternative (NHC 2). Stream G begins in the forested area west of University Drive and south of the apartment complex and flows southeast through the project corridors under University Drive where it joins with Stream F. Stream G is approximately 198 linear feet within the NHC LPA and NEPA Preferred Alternative (NHC 2). Approximately 53 linear feet (0.004 acre) of Stream G would be impacted by the extension of culverts under University Drive



in both the NHC LPA and NEPA Preferred Alternative (NHC 2).

Wetlands

The difference in wetland impacts between the NEPA Preferred Alternative (NHC 2) and the NHC 1 Alternative is less than 0.01 acre. The NHC LPA Alternative would impact the same acreage of wetlands as the NEPA Preferred Alternative (NHC 2), but would impact different wetlands.

The New Hope Creek Alternatives' impacts on wetlands are shown in **Table 4.8-5** with the differences among the alternatives discussed below.

Wetland O (approximately 2.21 acres) is a palustrine forested wetland located east of SW Durham Drive and south of US 15-501 in the NHC LPA Alternative. Approximately 226 square feet (0.005 acre) of Wetland O would be affected by bridge piers in the NHC LPA Alternative.

Wetland N (approximately 2.3 acre) is a palustrine forested wetland located east of SW Durham Drive and south of US 15-501 in the NHC LPA. Approximately 80 square feet (0.002 acre) of Wetland N would be affected by bridge piers in the NHC LPA.

Wetland J (approximately 0.71 acre) is a palustrine forested wetland located west of Garrett Road and south of US 15-501 in the NHC LPA. Approximately 150 square feet (0.003 acre) of Wetland J would be affected by bridge piers in the NHC LPA.

Wetland K (approximately 0.04 acre) is a palustrine forested wetland located west of Garrett Road and south of US 15-501 in the NHC LPA. Approximately 30 square feet (0.001 acre) of Wetland K would be affected by bridge piers in the NHC LPA.

Wetland W (approximately 0.77 acre) is a palustrine forested/emergent wetland located west of Garrett Road and south of US 15-501 in the New Hope Creek 1 (NHC 1) and NEPA Preferred Alternatives (NHC 2). Similar to the NEPA Preferred Alternative (NHC 2), approximately 40 square feet (0.001 acre) of Wetland W would be affected by bridge piers in the NHC 1 Alternative.

Wetland V (approximately 0.45 acre) is a palustrine forested wetland located west of Garrett Road and south of US 15-501 in the NHC 1 and NEPA Preferred Alternatives (NHC 2). Similar to the NEPA Preferred Alternative (NHC 2), approximately 289 square feet (0.007 acre) of Wetland V would be affected by bridge piers in the NHC 1 Alternative.

The NHC LPA and NHC 1 Alternatives would avoid impacts (0.003 acre) to Wetland E, which is a palustrine forested wetland located east of Garrett Road and south of US 15-501.

Riparian Buffer

The New Hope Creek Alternatives' impact on riparian buffers is shown in **Table 4.8-6** with the differences among the alternatives discussed below.

The NHC LPA Alternative would impact more acres of Zone One (0.06 acre) and Zone Two (0.12 acre) riparian buffers in comparison to the NEPA Preferred Alternative (NHC 2). The NHC 1 Alternative would impact fewer acres of Zone One (0.32 acre) and Zone Two (0.42 acre) riparian buffers.

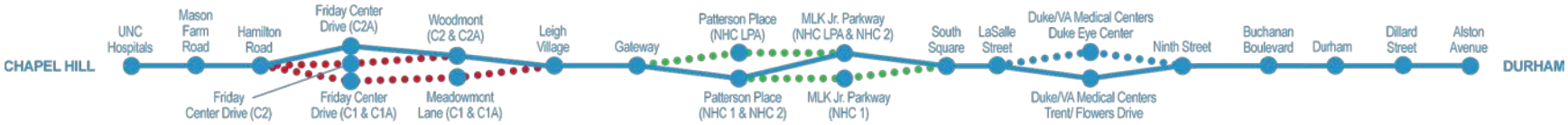
Open Water (Ponds)

The New Hope Creek Alternatives would not impact open waters (ponds), as shown in **Table 4.8-7**

Floodplains and Floodways

In comparison to the NEPA Preferred Alternative (NHC 2), the NHC LPA Alternative would impact 0.085 acre more of 100-year floodplain, 0.622 acre more of 500-year floodplain, and 0.075 acre more of floodway.

The NHC 1 Alternative would impact 0.482 acre more of 100-year floodplain, 0.157 acre more of 500-year floodplain, and 0.029 acre less of floodway in comparison to the NEPA Preferred Alternative (NHC 2).



Water Quality

Similar to the NEPA Preferred Alternative (NHC 2), there are no designated trout waters, anadromous fish waters (fish that migrate from salt water to fresh water to spawn), or primary nursery areas present in the study area for any of the New Hope Creek Alternatives. There are no designated Outstanding Resource Waters, High Quality Waters, or water supply watersheds (WS-I or WS-II) within one mile downstream of the study area for any of New Hope Creek Alternatives.

There would be no impacts to major NPDES wastewater facilities from any of the New Hope Creek Alternatives.

Duke/VA Medical Centers Alternative

The Duke/VA Medical Centers Alternative would not have direct impacts on groundwater, surface waters (streams), wetlands, open water, floodplains and floodways, or water quality.

ROMF Alternatives

Groundwater

Similar to the NEPA Preferred Alternative (Farrington Road ROMF), there would be no groundwater impacts anticipated by the implementation of the other ROMF locations.

Surface Waters (Streams)

The ROMF Alternatives would have less stream impacts than the NEPA Preferred Alternative (Farrington Road ROMF) as shown in **Table 4.8-4**. The Patterson Place ROMF and Alston Avenue ROMF would not impact any streams. The Leigh Village ROMF and Cornwallis ROMF would impact 51 and 484 linear feet less of stream, respectively, in comparison to the NEPA Preferred Alternative (Farrington Road ROMF). The differences among the alternatives are discussed below.

Stream N is an unnamed seasonal RPW with intermittent flow located west of I-40. Stream N begins at Wetland NNN and flows northeast through the project corridor under I-40. Approximately 499 linear feet (0.052 acre) of Stream N would be impacted by the placement of a pipe in the Leigh Village ROMF. Approximately 499 linear feet (0.052 acre) of Stream N would be impacted by the placement of a pipe in the NEPA Preferred Alternative - Farrington Road ROMF.

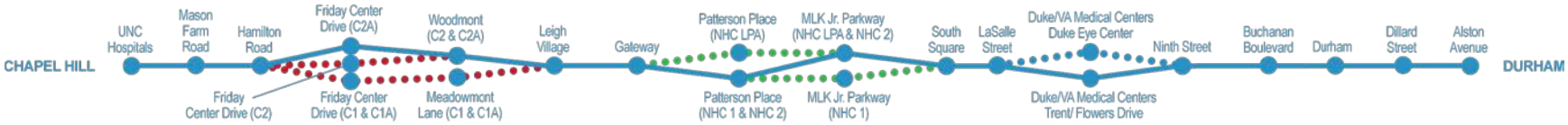
Stream NN is an unnamed RPW with perennial flow that is located east of Farrington Road and flows under I-40. Approximately 88 linear feet (0.008 acre) of Stream NN would be impacted by the placement of a pipe in the Leigh Village ROMF. Approximately 139 linear feet (0.014 acre) of Stream NN would be impacted by the placement of a pipe in the NEPA Preferred Alternative - Farrington Road ROMF.

Stream GG is an unnamed seasonal RPW with intermittent flow located east of US 15-501 and south of West Cornwallis Road in the Cornwallis Road ROMF east of Stream J (Sandy Creek). Stream GG begins at a head cut south of West Cornwallis Road and flows north through Wetland TTT into a culvert under Western Bypass to Stream J (Sandy Creek). Stream GG is approximately 268 linear feet within the Cornwallis Road ROMF. Approximately 154 linear feet (0.012 acre) of Stream GG would be impacted by the placement of a pipe under the Cornwallis Road ROMF.

Wetlands

The ROMF Alternatives would impact fewer acres of wetlands than the NEPA Preferred Alternative (Farrington Road ROMF) as shown in **Table 4.8-5**. The Patterson Place ROMF and Alston Avenue ROMF would not impact any wetlands. The Leigh Village ROMF and Cornwallis ROMF would impact 0.096 and 0.250 acre less of wetlands, respectively, in comparison to the NEPA Preferred Alternative (Farrington Road ROMF). The differences among the alternatives are discussed below.

Wetland NNN (approximately 0.325 acre) is a palustrine emergent wetland located east of Farrington Road and serves as



headwaters to Stream N within the NEPA Preferred Alternative (Farrington Road ROMF). Approximately 14,139 square feet (0.325 acre) of Wetland NNN would be affected by fill in the NEPA Preferred Alternative (Farrington Road ROMF). Approximately 9,975 square feet (0.229 acre) of Wetland NNN would be affected by fill in the Leigh Village ROMF.

Wetland TTT (approximately 0.21 acre) is a palustrine forested wetland located east of US 15-501 and south of West Cornwallis Road in the Cornwallis ROMF. Approximately 3,254 square feet (0.075 acre) of Wetland TTT would be affected by fill in the Cornwallis ROMF.

Riparian Buffer

The ROMF Alternatives' impacts on the riparian buffer are shown in **Table 4.8-6**. The Patterson Place ROMF and Alston Avenue ROMF would not impact any riparian buffers. The Leigh Village ROMF and Cornwallis ROMF would impact 0.47 and 1.05 acres less of Zone One riparian buffers and 0.41 and 0.84 acre less of Zone Two riparian buffers, respectively, in comparison to the NEPA Preferred Alternative (Farrington Road ROMF).

Open Water (Ponds)

The Leigh Village ROMF is the only ROMF alternative that would impact open water (ponds) (0.182 acre) as shown in **Table 4.8-7**.This resource is described below.

Pond Z is an unnamed open water that is located east of Farrington Road and west of I-40. Pond Z is an agricultural pond within an existing pasture and has a shoreline fringe of vegetation including willow and dogwood. Pond Z is approximately 0.182 acre in size and is located in the Leigh Village ROMF. Approximately 7,928 square feet (0.182 acre) of Pond Z would be affected by fill for the Leigh Village ROMF. Pond Z has not yet been verified by the USACE and is not included in the Jurisdictional Determination. An updated Jurisdictional Determination is anticipated and Pond Z will be verified before publication of the FEIS.

Floodplains and Floodways

The ROMF Alternatives, with the exception of Cornwallis Road ROMF, would not impact the 100-year or 500-year floodplain. The Cornwallis Road ROMF would impact 0.065 acre of 100-year floodplain and 0.190 acre of 500-year floodplain. None of the ROMF Alternatives would have an impact to a floodway.

Water Quality

Similar to the NEPA Preferred Alternative (Farrington Road ROMF), there are no designated trout waters, anadromous fish waters (fish that migrate from salt water to fresh water to spawn), or primary nursery areas present in the study area for any of the ROMF Alternatives. There are no designated Outstanding Resource Waters, High Quality Waters, or water supply watersheds (WS-I or WS-II) within one mile downstream of the study area for any of ROMF Alternatives.

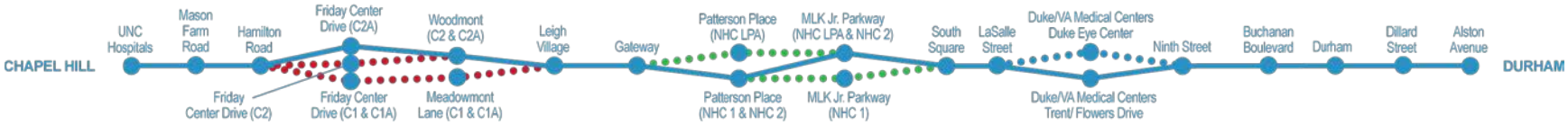
There would be no impacts to major NPDES wastewater facilities from any of the ROMF Alternatives.

4.8.4 Mitigation Measures

This section describes measures that would be used to reduce the adverse impacts to water resources, as well as mitigation that may be required for groundwater, surface waters, wetlands, floodplains, and regulated floodways and riparian buffer impacts.

Under the No Build Alternative, there would be no impacts to water resources due to the proposed D-O LRT Project. As such, project-related mitigation would not be warranted.

Water resources within the study area intersect the NEPA Preferred and Project Element Alternatives, thereby making impacts to waters of the United States and floodplains because of the NEPA Preferred and Project Element Alternatives unavoidable. Efforts have been made to minimize the potential impacts to water resources during the preliminary design phase. Specific mitigation measures that



would be implemented to compensate for unavoidable impacts will be refined and presented in the Final EIS. The following sections describe the mitigation currently identified for the groundwater, surface waters, wetlands, floodplains, floodways, and water quality resource impacts described in this section.

Because of the identified impacts, it is anticipated that a Section 404/401 permit application will be required and that a permit will need to be issued by the USACE and NCDENR DWR before construction activities may begin. **Table 4.8-8** displays all of the potentially jurisdictional waters of the United States and wetlands within the NEPA Preferred Alternative and Project Element Alternatives and the anticipated Section 404 permitting. The permit application will include the proposed D-O LRT Project's measures taken to avoid and minimize impacts to waters of the United States and includes a compensatory mitigation proposal to offset the unavoidable impacts.

After a permit application has been submitted it will undergo a review at which time the USACE may decide to alter the permit type, make additional data requests, or determine whether mitigation is needed. Ongoing coordination with the USACE will assist with minimizing the time frame for the permit application review. Due to the nature of the project, the USACE may issue either a Nationwide Permit (NWP) or an Individual Permit. Activities that do not qualify for authorization under the Nationwide Permit Program may qualify for authorization under an Individual Permit. Individual Permits are issued for activities that have more than minimal adverse impacts to waters of the United States. Conditions of these permits would require a compensatory mitigation plan for unavoidable adverse impacts to the aquatic environment.

The impact types used for stream mitigation are listed in **Table 4.8-4**.

4.8.4.1 Groundwater

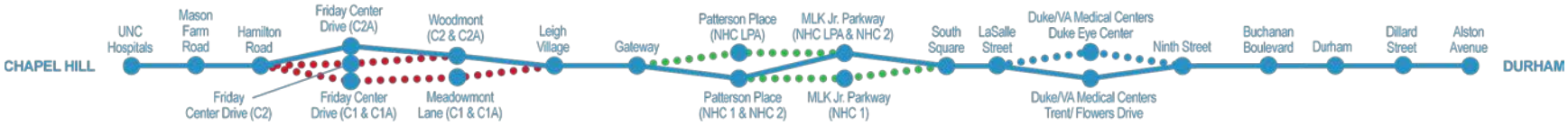
Efforts will be implemented to reduce the effects of the proposed D-O LRT Project on groundwater resources. The *Erosion and Sediment Control Planning and Design Manual* (NCDENR 2009) and the NCDOT design specifications will be used to minimize the impacts to land and water resources. Local standards set by the City of Durham and the Town of Chapel Hill may also need to be considered when designing erosion and sediment controls. These sediment and erosion control measures will help to protect aquatic resources that may contribute to groundwater recharge within the study area. In addition, each station location and park-and-ride facility would implement BMPs for the collection and treatment of stormwater runoff such as riparian buffers, soil amendments, and grassed swales.

4.8.4.2 Surface Waters and Wetlands

On February 6, 1990, the DA and the EPA signed a MOA establishing procedures to determine the type and level of mitigation necessary to comply with the Clean Water Act Section 404(b)(1) Guidelines. This MOA provides for first, avoiding impacts to waters and wetlands through the selection of the least damaging, practical alternative; second, taking appropriate and practical steps to minimize impacts on waters and wetlands; and finally, compensating for any remaining unavoidable impacts to the extent appropriate and practical.

Avoidance and Minimization of Impacts

Throughout the Project Development and preliminary engineering design process, efforts have been made to avoid and minimize impacts to wildlife habitat, including streams and wetlands. This is exemplified by the development of several alternative alignments in the vicinity of Little Creek and New Hope Creek that follow existing travel corridors, and the shifting of sections of alternative alignments to avoid wetland impacts. Further, several measures were incorporated in the design to avoid and minimize impacts to wetlands and streams, such as using aerial structures on piers to cross larger wetland areas. The placement of the piers would be located outside of wetlands and streams to the greatest extent practicable. For wetland crossings where it



is not feasible to use aerial structures, impacts to these resources would be minimized by using retaining walls or similar structures and 2:1 side slopes. Bottomless culverts would be used to minimize stream crossing impacts. Specific design measures can be found in the *Basis for Engineering Design* (appendix L) and the Design Criteria documents prepared for this project.

Construction activities would be conducted in accordance with local, state, and federal regulations, as well as BMPs, including the NCDENR *Stormwater Best Management Practices Manual* (2007), the *Erosion and Sediment Control Planning and Design Manual* (NCDENR 2009), and the Design Standards in Sensitive Watersheds (15A N.C.A.C. § 04B.0124). Construction staging areas would be located away from wetlands, and preserved wetland areas would be demarcated prior to construction. Wetlands anticipated to be temporarily affected by construction would be restored to their original condition as much as possible and would be planted with an appropriate native wetland seed mix. More information on construction impacts and mitigation are presented in DEIS section 4.16.

Compensatory Mitigation of Impacts

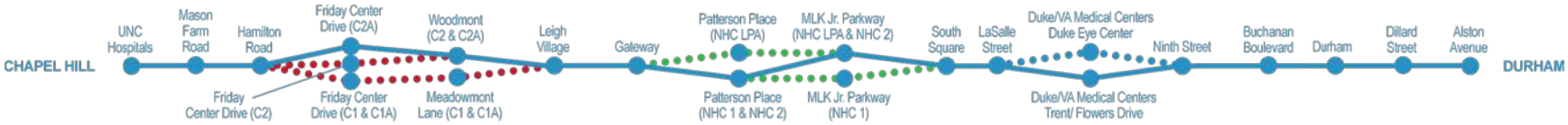
Per the USACE 2008 Regulatory Guidance Letter 08-03, the preferred method of compensatory mitigation is through the purchase of credits at a USACE approved mitigation bank. Other forms of Jordan Lake water supply riparian buffer impact mitigation that Triangle Transit may utilize include: (1) payment of a compensatory mitigation fee into the Riparian Buffer Restoration Fund; (2) the donation of real property or an interest in real property if the property is maintained as a riparian buffer; (3) restoration or enhancement of an existing riparian buffer that is not otherwise required to be protected or the creation of a new riparian buffer; and (4) construction of an alternative measure that reduces nutrient loading as well or better than the riparian buffer that is lost in the same river basin. Triangle Transit will develop specific compensatory mitigation measures in consultation with the USACE and NCDWR as part of the Section 404/401 permitting process during the Engineering phase.
Floodplains and Floodway

If hydraulic studies during the Engineering phase determine that the NEPA Preferred and Project Element Alternatives would cause an increase in the 100-year flood elevation, the following applies: (1) any increase of less than 0.1 feet is considered negligible and does not require mitigation; (2) a 1-foot maximum increase in the 100-year flood elevation is permissible provided that Triangle Transit purchases the additional potentially flooded property from any private landowner; or (3) Triangle Transit may make floodplain modifications to decrease the 100-year flood elevation to within 0.1 feet to avoid purchasing property (the authority from which these criteria derive is FEMA). If the preferred alternative involves significant encroachment of the floodplain, the final environmental document must include (1) FTA's finding that the proposed action is the only practicable alternative and (2) supporting documentation reflecting consideration of alternatives to avoid/reduce adverse impacts on the floodplain.

The *Basis for Engineering Design* (appendix L) calls for bridging over the major streams of the study area that include Meeting of the Waters (Stream YY), Little Creek (Stream Y), New Hope Creek (Stream T), and Sandy Creek (Stream J) in an effort to minimize impacts to 100-year floodplains, 500-year floodplains, and the FEMA floodways. These bridges will be designed to minimize impacts to floodplains and regulated floodways.

4.8.4.3 Water Quality

BMPs would be implemented as engineering controls along the NEPA Preferred and Project Element Alternatives, station park-and-ride facilities, and ROMF for stormwater runoff collection and treatment. BMPs that are installed would help to minimize water quality impacts resulting from pollutants carried by stormwater runoff. Continued maintenance of these stormwater BMPs would ensure that these controls are



functioning properly for the protection of area water quality. The use of BMPs would help to mitigate potential impacts to jurisdictional waters of the United States by avoiding impacts to jurisdictional areas.

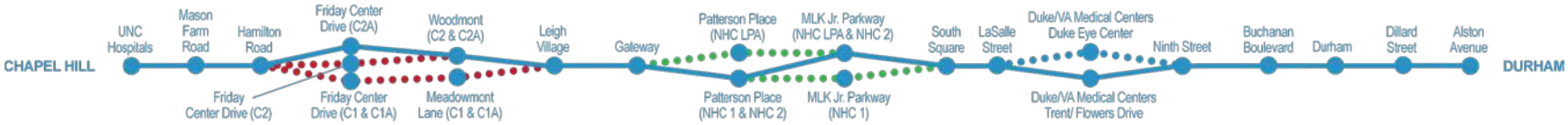


Table 4.8-1: Jurisdictional Streams in the Study Area

Stream Designation (Stream Name)	Figure Number	Hydrology	Channel Bottom Width (feet)	Bank Height (feet)	Substrate	Description of Drainage
YY (Meeting of the Waters)	Appendix K - 4B	Perennial	20	3	Sand, silt, cobble, rock	Flows southeast under US 15-501
XX	Appendix K - 4B	Intermittent	8	3	Sand, silt, cobble	Tributary to Stream YY (Meeting of the Waters)
UU	Appendix K - 4B	Intermittent	6	4	Sand, silt	Tributary to Stream WW (Chapel Branch)
WW (Chapel Branch)	Appendix K - 4B	Perennial	12	3	Sand, silt, cobble	Flows southeast under US 15-501
TT	Appendix K - 4B	Perennial	18	8	Sand, silt, cobble	Flows south from Prestwick Road toward Stream WW (Chapel Branch)
SS	Appendix K - 4C	Intermittent	2	1	Sand, silt	Flows southeast under Prestwick Road and Finley Golf Course Road into Stream RR
SS	Appendix K - 4C	Intermittent	2	1	Sand, silt	Flows southeast under Prestwick Road and Finley Golf Course Road into Stream RR
RR	Appendix K - 4C	Perennial	5	1	Sand, silt	Flows south through Finley Golf Course
RR	Appendix K - 4C	Perennial	5	1	Sand, silt	Flows south through Finley Golf Course
QQ	Appendix K - 4C	Perennial	5	2	Sand, silt	Flows south under NC 54 (Raleigh Road) toward Finley Golf Course
QQ	Appendix K - 4C	Perennial	5	2	Sand, silt	Flows south under NC 54 (Raleigh Road) toward Finley Golf Course
LLL	Appendix K - 4C	Intermittent	2	1	Sand, silt, cobble	Flows west into Stream QQ
MMM	Appendix K - 4C	Intermittent	4	1-3	Sand, silt, cobble, rock	Flows south under Brookberry Circle
KKK	Appendix K - 4C	Intermittent	2	1	Sand, silt	Flows southwest from NC 54 (Raleigh Road)
EEE	Appendix K - 4C	Intermittent	2	1	Sand, silt, cobble	Flows east from Meadowmont Lane
DD	Appendix K - 4D	Intermittent	6	0.5	Sand, silt	Flows east under NC 54 toward Stream EE
JJJ	Appendix K - 4D	Intermittent	4	1	Sand, silt	Flows east toward Stream Y (Little Creek)
EE	Appendix K - 4D	Perennial	6	0.5	Sand, silt, cobble	Begins at NC 54 and flows southeast toward Stream Y (Little Creek)
Y (Little Creek)	Appendix K - 4D	Perennial	25	4	Sand, silt, cobble, rock	Flows south under NC 54

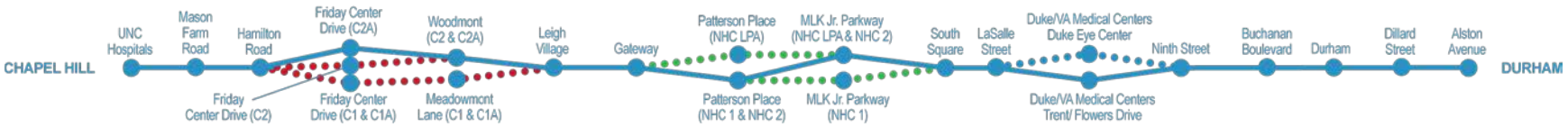


Table 4.8-1: Jurisdictional Streams in the Study Area

Stream Designation (Stream Name)	Figure Number	Hydrology	Channel Bottom Width (feet)	Bank Height (feet)	Substrate	Description of Drainage
OO	Appendix K - 4D	Intermittent	4	2	Sand, silt	Part of a braided stream network connecting Stream Y and Stream CC
CC	Appendix K - 4D	Perennial	20	4	Sand, silt, cobble	Flows southeast from NC 54
AA	Appendix K - 4D	Intermittent	5	1	Sand, silt	Flows southwest into Stream Z
Z	Appendix K - 4D	Perennial	6	1	Sand, silt	Flows south under George King Road and NC 54
Y (Little Creek)	Appendix K - 4E	Perennial	25	4	Sand, silt, cobble, rock	Flows southeast from Meadowmont Park toward NC 54
Y (Little Creek)	Appendix K - 4E	Perennial	25	4	Sand, silt, cobble, rock	Flows southeast from Meadowmont Park toward NC 54
X	Appendix K - 4E	Perennial	20	2	Sand, silt, cobble	Tributary to Stream Y (Little Creek) with southeast flow
W	Appendix K - 4E	Intermittent	6	1	Sand, silt	Flows south into Stream Y (Little Creek)
W	Appendix K - 4F	Intermittent	6	1	Sand, silt	Flows south into Stream Y (Little Creek)
GGG	Appendix K - 4F	Intermittent	4	1	Sand, silt	Flows southwest from George King Road toward Stream Y (Little Creek)
V	Appendix K - 4F	Intermittent	3	0.5	Sand, silt	Flows south from Pond B
V	Appendix K - 4F	Intermittent	3	0.5	Sand, silt	Flows south from Pond B
V	Appendix K - 4F	Intermittent	3	0.5	Sand, silt	Flows south from Pond B
M	Appendix K - 4G	Intermittent	4	2	Sand, silt	Flows north into Stream PP
PP	Appendix K - 4G	Intermittent	4	2	Sand, silt	Flows southeast and crosses under I-40
N	Appendix K - 4G	Intermittent	4	2	Sand, silt	Flows northeast under I-40 from Farrington Road and Wetland NNN
N	Appendix K - 4G	Intermittent	4	2	Sand, silt	Flows northeast under I-40 from Farrington Road and Wetland NNN
N	Appendix K - 4G	Intermittent	4	2	Sand, silt	Flows northeast under I-40 from Farrington Road and Wetland NNN
NN	Appendix K - 4G	Perennial	7	2	Sand, silt, cobble	Flows east-northeast under I-40 from Farrington Road
NN	Appendix K - 4G	Perennial	7	2	Sand, silt, cobble	Flows east-northeast under I-40 from Farrington Road
NN	Appendix K - 4G	Perennial	7	2	Sand, silt, cobble	Flows east-northeast under I-40 from Farrington Road.

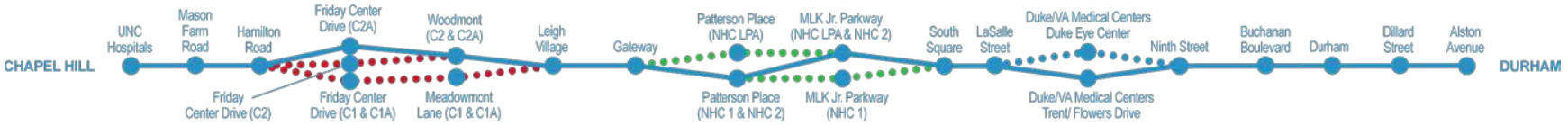


Table 4.8-1: Jurisdictional Streams in the Study Area

Stream Designation (Stream Name)	Figure Number	Hydrology	Channel Bottom Width (feet)	Bank Height (feet)	Substrate	Description of Drainage
MM	Appendix K - 4H	Perennial	12	3	Sand, silt, cobble, rock	Flows northeast under I-40
LL	Appendix K - 4H	Perennial	8	2	Sand, silt, cobble	Flows east under I-40
R	Appendix K - 4I	Intermittent	3	2	Sand, silt	Flows east under I-40 from Wetland S
Q	Appendix K - 4J	Intermittent	3	1	Sand, silt	Flows northeast from Wetland Q into Stream P
QQQ	Appendix K - 4J	Intermittent	3	1	Sand, silt, cobble	Flows southeast toward Wetland O
P	Appendix K - 4J	Intermittent	3	1	Sand, silt	Flows east into Wetland P
O	Appendix K - 4J	Perennial	20	2	Sand, silt, cobble	Tributary to Stream T (New Hope Creek) with southeast flow
OOO	Appendix K - 4J	Intermittent	3	1	Sand, silt	Flows northeast toward New Hope Creek
XXX	Appendix K - 4J	Intermittent	8	2	Sand, silt	Flows southeast from Wetland N toward New Hope Creek
T (New Hope Creek)	Appendix K - 4J	Perennial	30	6	Sand, silt, cobble, rock	Flows southeast and is located west of Garrett Road
J (Sandy Creek)	Appendix K - 4J	Perennial	30	4	Sand, silt, cobble, rock	Tributary to New Hope Creek; flows southwest under Garrett Road
K	Appendix K - 4J	Perennial	6	2	Sand, silt, cobble	Flows west into Sandy Creek
UUU	Appendix K - 4J	Perennial	20	3	Sand, silt, cobble, rock	Flows west under Garrett Road and into New Hope Creek
T (New Hope Creek)	Appendix K - 4K	Perennial	30	6	Sand, silt, cobble, rock	Flows southwest under US 15-501
S	Appendix K - 4K	Perennial	15	5	Sand, silt, cobble, rock	Flows south under US 15-501
L	Appendix K - 4K	Perennial	6	2	Sand, silt	Flows east into Wetland E
J (Sandy Creek)	Appendix K - 4K	Perennial	30	4	Sand, silt, cobble, rock	Flows south-southwest under US 15-501 and Larchmont Road toward New Hope Creek
I	Appendix K - 4K	Perennial	6	2	Sand, silt	Flows southwest into Sandy Creek
I	Appendix K - 4K	Perennial	6	2	Sand, silt	Flows southwest into Sandy Creek
J (Sandy Creek)	Appendix K - 4K	Perennial	30	4	Sand, silt, cobble, rock	Flows south-southwest under US 15-501 and Larchmont Road toward New Hope Creek
H	Appendix K - 4L	Intermittent	5	1	Sand, silt	Flows southeast toward University Drive

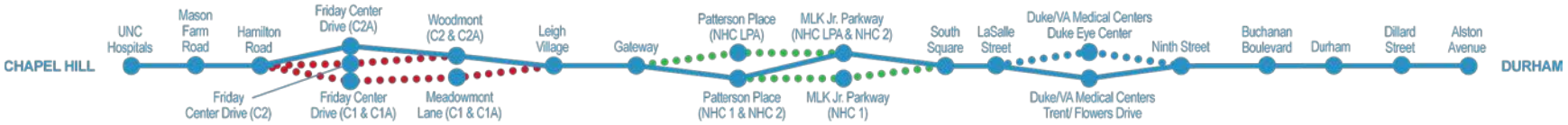


Table 4.8-1: Jurisdictional Streams in the Study Area

Stream Designation (Stream Name)	Figure Number	Hydrology	Channel Bottom Width (feet)	Bank Height (feet)	Substrate	Description of Drainage
G	Appendix K - 4L	Intermittent	4	2-3	Sand, silt	Flows southeast under University Drive and into Stream F
F	Appendix K - 4L	Perennial	25	6	Sand, silt, cobble, rock	Located south of University Drive. Stream flows southwest toward Sandy Creek
E	Appendix K - 4M	Intermittent	4	0.5	Sand, silt	Flows south-southwest toward Tower Boulevard
D	Appendix K - 4M	Intermittent	3	0.5	Sand, silt	Tributary to Stream E with southwestern flow
C	Appendix K - 4M	Perennial	3	0.5	Sand, silt	Flows north into Wetland C
B	Appendix K - 4M	Perennial	4	0.5	Sand, silt	Flows north into Wetland A toward Stream A
A	Appendix K - 4M	Perennial	10	4	Sand, silt, cobble, rock	Flows west under US 15-501 towards Sandy Creek
J (Sandy Creek)	Appendix K - 4N	Perennial	30	4	Sand, silt, cobble, rock	Flows south under W. Cornwallis Road and east of US 15-501
GG	Appendix K - 4N	Intermittent	4	2-3	Sand, silt	Flows west into Sandy Creek
HH	Appendix K - 4N	Perennial	25	4-5	Sand, silt, cobble, rock	Flows southwest into Sandy Creek
J (Sandy Creek)	Appendix K - 4O	Perennial	30	4	Sand, silt, cobble, rock	Flows south from Cameron Boulevard
II	Appendix K - 4O	Intermittent	4	1-2	Sand, silt	Flows west into Sandy Creek
JJ	Appendix K - 4O	Perennial	10	3	Sand, silt, cobble, rock	Flows west under Erwin Road and into Sandy Creek
J (Sandy Creek)	Appendix K - 4P	Perennial	30	4	Sand, silt, cobble, rock	Flows south on the west side of Erwin Road
KK	Appendix K - 4P	Perennial	12	4	Sand, silt, cobble, rock	Flows southwest under Erwin Road and into Sandy Creek

Source: AECOM 2015.

Note: Based on field surveys conducted between June 2013 and January 2015 and the USACE Jurisdictional Determination dated November 7, 2014 (appendix G). All stream dimensions are approximate.

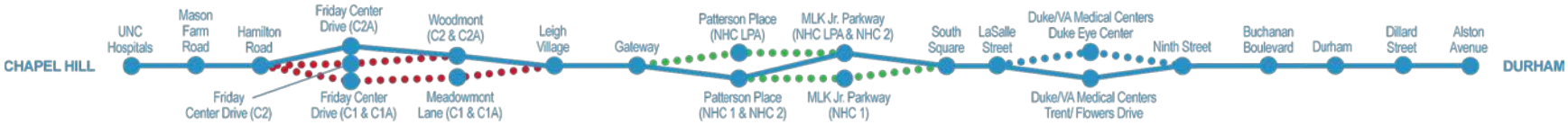


Table 4.8-2: Jurisdictional Wetlands in the Study Area

Wetland Name	Figure Number	Wetland Type	Description of Drainage
ZZ	Appendix K - 4B	Forested/Emergent	Located west of Carmichael Street. Drains north toward Chapel Branch
WW	Appendix K - 4B	Forested/Emergent	Located adjacent to Chapel Branch
YY	Appendix K - 4C	Emergent	Linear wetland adjacent to Finley Golf Course Road. Connected to Stream SS
GG	Appendix K - 4C	Forested	Drains to Stream RR
GG	Appendix K - 4C	Forested	Drains to Stream RR
EE	Appendix K - 4D	Forested	Drains to Little Creek
FF	Appendix K - 4D	Forested/Emergent	Located south of NC 54; drains to Little Creek
DD	Appendix K - 4D	Forested	Located north of NC 54; drains to Little Creek
CC	Appendix K - 4D	Forested	Located south of NC 54; drains to Little Creek
CCC	Appendix K - 4E	Emergent	Located east of Park Bluff Drive; drains to Little Creek
CCC	Appendix K - 4E	Emergent	Located east of Park Bluff Drive; drains to Little Creek
BBB	Appendix K - 4E	Forested/Emergent	Located east of Park Bluff Drive; drains to Little Creek
DDD	Appendix K - 4E	Forested	Located east of Park Bluff Drive; drains to Little Creek
AA	Appendix K - 4E	Forested/Emergent	Located east of Park Bluff Drive and west of George King Road; drains to Little Creek
AA	Appendix K - 4E	Forested/Emergent	Located east of Park Bluff Drive and west of George King Road; drains to Little Creek
BB	Appendix K - 4E and 4F	Forested/Emergent	Located west of George King Road; drains to Little Creek
Z	Appendix K - 4F	Forested/Emergent	Located west of George King Road and east of Little Creek; drains to Little Creek
HHH	Appendix K - 4F	Emergent	Located west of George King Road; drains directly to Stream GGG
III	Appendix K - 4F	Forested	Located west of George King Road; drains directly to Stream GGG
Y	Appendix K - 4F	Forested	Located adjacent to George King Road on the east side
Y	Appendix K - 4F	Forested	Located adjacent to George King Road on the east side
NNN	Appendix K - 4G	Emergent	Located adjacent to Farrington Road on the east side; drains directly into Stream N
S	Appendix K - 4I	Forested	Located west of White Oak Drive; drains directly into Stream R
T	Appendix K - 4I	Scrub-Shrub	Located east of White Oak Drive and adjacent to Stream R
R	Appendix K - 4I	Forested	Located east of I-40 and south of US 15-501. Drains stormwater from I-40 to the east under the parking lots shared by the Comfort Inn University and the Habitat for Humanity Restore
Q	Appendix K - 4J	Forested	Located southeast of Colonial Grand at Patterson Place Apartments; drains northeast into Stream Q
OOO	Appendix K - 4J	Forested/Emergent	Former detention basin; drains to the northeast
P	Appendix K - 4J	Forested	Linear wetland connected to Stream P; drains to Stream P
O	Appendix K - 4J	Forested	Located south of US 15-501 and east of Southwest Durham Drive; drains toward Wetland N
N	Appendix K - 4J	Forested	Located south of US 15-501 and east of Southwest Durham Drive; drains directly into Stream XXX
WWW	Appendix K - 4J	Forested	Located adjacent to Wetland N; drains to Wetland YYY

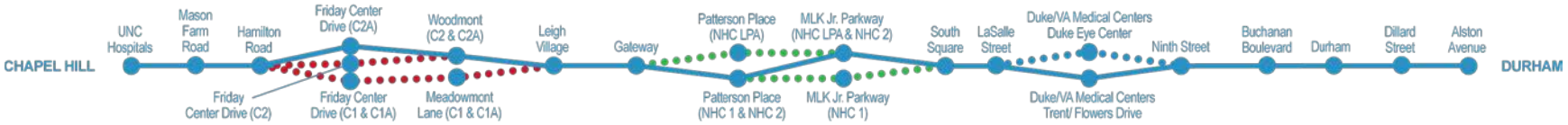


Table 4.8-2: Jurisdictional Wetlands in the Study Area

Wetland Name	Figure Number	Wetland Type	Description of Drainage
YYY	Appendix K - 4J	Forested	Located south of Wetland N; drains toward New Hope Creek
ZZZ	Appendix K - 4J	Forested	Located south of Wetland N; drains toward New Hope Creek
XX	Appendix K - 4J	Forested	Drains south directly into Stream XXX
J	Appendix K - 4J	Forested	Located east of New Hope Creek and north of Sandy Creek; drains into New Hope Creek
K	Appendix K - 4J	Forested	Located west of Garrett Road; drains into Sandy Creek
I	Appendix K - 4J	Forested	Located south of Sandy Creek and east of New Hope Creek
H	Appendix K - 4J	Emergent	Linear wetland draining directly into Stream K
VVV	Appendix K - 4J	Forested	Located south of Sandy Creek and West of Garrett Road; drains into Sandy Creek
UUU	Appendix K - 4J	Forested	Located west of Garrett Road and adjacent to Stream UUU; drains into Stream UUU
G	Appendix K - 4J	Forested	Located west of Garrett Road; drains directly into Sandy Creek
W	Appendix K - 4K	Forested/Emergent	Located directly adjacent to US 15-501 on the south side; drains into New Hope Creek
V	Appendix K - 4K	Forested	Located directly adjacent to US 15-501 on the south side; drains into Stream S
VV	Appendix K - 4K	Emergent	Located adjacent to US 15-501 on the north side; drains into Stream S
U	Appendix K - 4K	Forested	Located south of US 15-501; drains into Stream S
E	Appendix K - 4K	Forested	Located east of Garrett Road and south of US 15-501; drains into Sandy Creek
F	Appendix K - 4K	Emergent	Linear wetland east of Garrett Road; drains into Stream I
C	Appendix K - 4M	Forested/Emergent	Located east of US 15-501; drains directly into Stream B
A	Appendix K - 4M	Forested	Located east of US 15-501; drains directly into Stream B
TTT	Appendix K - 4N	Forested	Located east of Western Bypass Road and south of W. Cornwallis Road; drains into Stream GG
TTT	Appendix K - 4N	Forested	Located east of Western Bypass Road and south of W. Cornwallis Road; drains into Stream GG

Source: AECOM 2015.

Note: Based on the field surveys conducted between June 2013 and January 2015 and Jurisdictional Determination dated November 7, 2014 (appendix G).

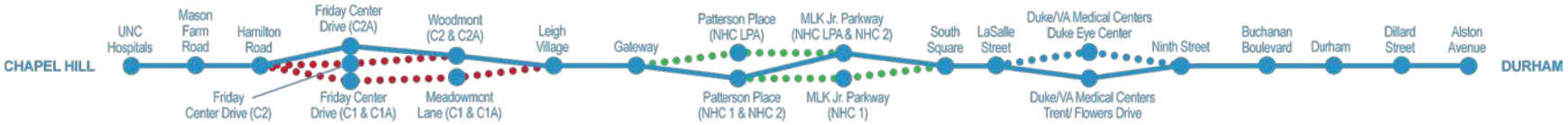


Table 4.8-3: Jurisdictional Ponds in the Study Area

Pond Designation	Figure Number	Approximate Acreage in Study Area
C	Appendix K – 4B	0.107
D	Appendix K – 4C	0.185
E	Appendix K – 4C	0.016
F	Appendix K – 4C	0.173
H	Appendix K – 4C	0.129
G	Appendix K – 4C	0.146
B	Appendix K – 4F	0.335
Z [a]	Appendix K – 4G	0.182
A	Appendix K – 4L	0.264

Source: AECOM 2015.

Note: Based on the field surveys conducted between June 2013 and January 2015 and Jurisdictional Determination dated November 7, 2014 (appendix G).

[a] Indicates a potentially jurisdictional feature subject to verification that was added in January 2015 and is not included in the Jurisdictional Determination.

Table 4.8-4: Summary of Estimated Stream Impacts

Jurisdictional Area	Stream Type	No Build Alternative	Impact Type	NEPA Preferred Alternative [a] LF (acre)	Little Creek Alternatives			New Hope Creek Alternatives		ROMF LF (acre)
					C1 LF (acre)	C1A LF (acre)	C2 LF (acre)	NHC LPA LF (acre)	NHC 1 LF (acre)	
Stream WW (Chapel Branch)	Perennial	--	culvert extension	85 (0.024)	--	--	--	--	--	--
Stream TT	Perennial	--	culvert and riprap	258 (0.068)	--	--	--	--	--	--
Stream SS	Intermittent	--	pipe	352 (0.032)	210 (0.019)	210 (0.019)	210 (0.019)	--	--	--
Stream RR	Perennial	--	pipe	28 (0.004)	173 (0.018)	173 (0.018)	173 (0.018)	--	--	--
Stream QQ	Perennial	--	pipe	--	--	--	90 (0.011)	--	--	--
Stream LLL	Intermittent	--	pipe	90 (0.004)	--	--	--	--	--	--
Stream MMM	Intermittent	--	pipe	--	--	--	114 (0.01)	--	--	--
Stream KKK	Intermittent	--	culvert extension	23 (0.002)	--	--	--	--	--	--
Stream W	Intermittent	--	pipe	--	--	121 (0.008)	--	--	--	--

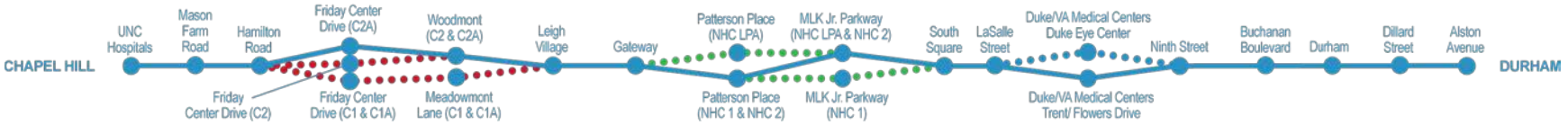


Table 4.8-4: Summary of Estimated Stream Impacts

Jurisdictional Area	Stream Type	No Build Alternative	Impact Type	NEPA Preferred Alternative [a] LF (acre)	Little Creek Alternatives			New Hope Creek Alternatives		ROMF LF (acre)
					C1 LF (acre)	C1A LF (acre)	C2 LF (acre)	NHC LPA LF (acre)	NHC 1 LF (acre)	
Stream GGG	Intermittent	--	pipe	--	--	87 (0.006)	--	--	--	--
Stream V	Intermittent	--	pipes	322 (0.042)	--	--	--	--	--	--
Stream PP	Intermittent	--	pipe	47 (0.005)	--	--	--	--	--	--
Stream N	Intermittent	--	pipe	566 (0.058)	--	--	--	--	--	499[1] (0.052) 499[2] (0.052)
Stream NN	Perennial	--	pipe	186 (0.018)	--	--	--	--	--	88[1] (0.008) 139[2] (0.014)
Stream MM	Perennial	--	culvert extension	138 (0.029)	--	--	--	--	--	--
Stream LL	Perennial	--	culvert extension	74 (0.023)	--	--	--	--	--	--
Stream R	Intermittent	--	culvert	766 (0.06)	--	--	--	--	--	
Stream J (Sandy Creek)	Perennial	--	bridge pier	--	--	--	--	8 (0.001)	--	--
Stream I	Perennial	--	bridge pier	--	--	--	--	3 (0.001)	--	--
Stream H	Intermittent	--	pipe	157 (0.017)	--	--	--	157 (0.017)	--	--
Stream G	Intermittent	--	culvert extension	53 (0.0041)	--	--	--	53 (0.0041)	--	--
Stream E	Intermittent	--	pipe	15 (0.001)	--	--	--	--	--	--
Stream D	Intermittent	--	pipe	42 (0.004)	--	--	--	--	--	--
Stream B	Perennial	--	culvert	53 (0.004)	--	--	--	--	--	--
Stream A	Perennial	--	culvert	51 (0.011)	--	--	--	--	--	--
Stream GG	Intermittent	--	pipe	--	--	--	--	--	--	154[3] (0.012)
Stream JJ	Perennial	--	culvert extension	32 (0.008)	--	--	--	--	--	--
Stream KK	Perennial	--	culvert extension	73 (0.019)	--	--	--	--	--	--

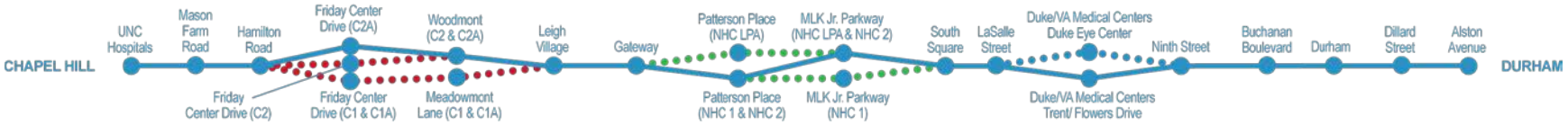


Table 4.8-4: Summary of Estimated Stream Impacts

Jurisdictional Area	Stream Type	No Build Alternative	Impact Type	NEPA Preferred Alternative [a] LF (acre)	Little Creek Alternatives			New Hope Creek Alternatives		ROMF LF (acre)
					C1 LF (acre)	C1A LF (acre)	C2 LF (acre)	NHC LPA LF (acre)	NHC 1 LF (acre)	
Stream J (Sandy Creek)	Perennial	--	culvert extension	2 (0.001)	--	--	--	--	--	--
Totals:		--	--	3,413 (0.438)	383 (0.037)	591 (0.051)	587 (0.058)	221 (0.023)	0 (0.0)	587[1] (0.06) 638[2] (0.066) 154[3] (0.012)
Difference from NEPA Preferred Alternative		--	--	--	-110 (-0.005)	98 (0.009)	94 (0.016)	11 (0.002)	-210 (-0.021)	-51[1] (-0.006) -484[3] (-0.054)

Note: The alignment alternatives impacts are based on the *Basis for Engineering Design* (appendix L) and the Jurisdictional Determination dated November 7, 2014 (appendix G). Jurisdictional areas outside of the NEPA Preferred and Project Element Alternatives are designated with "--" to indicate that impacts are not applicable. All impacts are anticipated to be permanent. All types of impacts are not fully defined at this stage of the design.

Note: 1 = Leigh Village ROMF; 2 = Farrington Road ROMF; 3 = Cornwallis Road ROMF.

[a] NEPA Preferred Alternative ROMF included in the ROMF column for comparison purposes. The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

Table 4.8-5: Summary of Estimated Wetland Impacts

Wetland Name	Wetland Type	No Build Alternative	NEPA Preferred Alternative [a] (acre)	Little Creek Alternatives			New Hope Creek Alternatives		ROMF (acre)
				C1 (acre)	C1A (acre)	C2 (acre)	NHC LPA (acre)	NHC 1 (acre)	
YY	Emergent	--	0.031	0.031	0.031	0.031	--	--	--
GG	Forested	--	0.093	0.039	0.039	0.039	--	--	--
BBB	Emergent	--	--	--	0.001	--	--	--	--
AA	Forested	--	--	0.003	--	--	--	--	--
HHH	Emergent	--	--	--	0.001	--	--	--	--
Y	Forested	--	0.009	--	--	--	--	--	--
NNN	Emergent	--	0.325	--	--	--	--	--	0.325[1] 0.229[2]
T	Scrub/ shrub	--	0.077	--	--	--	--	--	
O	Forested	--	--	--	--	--	0.005	--	--
N	Forested	--	--	--	--	--	0.002	--	--

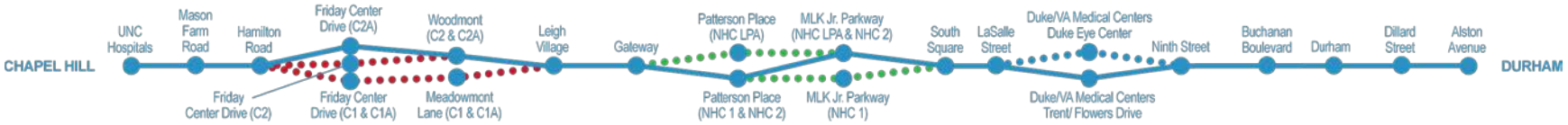


Table 4.8-5: Summary of Estimated Wetland Impacts

Wetland Name	Wetland Type	No Build Alternative	NEPA Preferred Alternative [a] (acre)	Little Creek Alternatives			New Hope Creek Alternatives		ROMF (acre)
				C1 (acre)	C1A (acre)	C2 (acre)	NHC LPA (acre)	NHC 1 (acre)	
J	Forested	--	--	--	--	--	0.003	--	--
K	Forested	--	--	--	--	--	0.001	--	--
W	Forested	--	0.001	--	--	--	--	0.001	--
V	Forested	--	0.007	--	--	--	--	0.007	--
E	Forested	--	0.003	--	--	--	--	--	--
A	Forested	--	0.011	--	--	--	--	--	--
TTT	Forested	--	--	--	--	--	--	--	0.075[3]
XXX	Emergent	--	0.001	--	--	--	--	--	--
Totals:		--	0.558	0.073	0.072	0.070	0.011	0.008	0.325[1] 0.229[2] 0.075[3]
Difference from NEPA Preferred Alternative:		--	--	-0.051	-0.052	-0.054	--	-0.003	0.096[2] 0.250[3]

Source: AECOM 2015.

Note: The alignment alternatives impacts are based on the *Basis for Engineering Design* (appendix L) and the Jurisdictional Determination date November 7, 2014 (appendix G). Jurisdictional areas outside of the NEPA Preferred and Project Element Alternatives are designated with "--" to indicate that impacts are not applicable. All impacts are approximate and are anticipated to be permanent. All types of impacts are not fully defined at this stage of the design.

Note: 1 = Farrington Road ROMF; 2 = Leigh Village ROMF; 3 = Cornwallis Road ROMF.

[a] NEPA Preferred Alternative ROMF included in the ROMF column for comparison purposes. The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

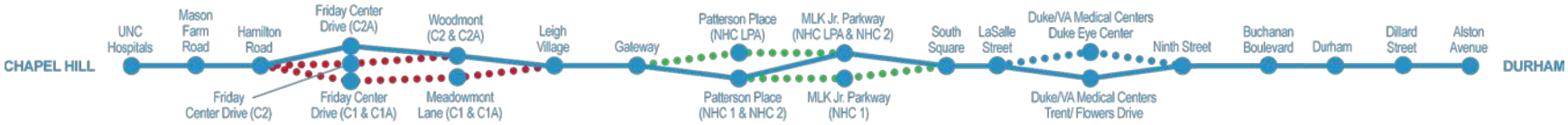


Table 4.8-6: Summary of Estimated Riparian Buffer Impacts

Type of Impact Area	NEPA Preferred Alternative [a] feet² (acre)	Little Creek Alternatives			New Hope Creek Alternatives		ROMF feet² (acre)
		C1 feet² (acre)	C1A feet² (acre)	C2 feet² (acre)	NHC LPA feet² (acre)	NHC 1 feet² (acre)	
Zone One	216,455 (4.97)	9,853 (0.23)	21,924 (0.50)	15,434 (0.35)	19,611 (0.45)	2,995 (0.07)	25,405[1] (0.58) 45,713[2] (1.05)
Zone Two	178,517 (4.10)	5,808 (0.13)	13,885 (0.32)	9,525 (0.22)	24,642 (0.57)	1,449 (0.03)	19,909[1] (0.46) 37,767[2] (0.87) 1,461[3] (0.03)
Difference from NEPA Alternative: Zone One	--	-1,647 (-0.04)	10,424 (0.24)	3,934 (0.09)	2,565 (0.06)	-14,051 (-0.32)	-20,308[1] (-0.47) -45,713[3] (-1.05)
Difference from NEPA Alternative: Zone Two	--	-6,322 (-0.15)	1,755 (0.04)	-2,605 (-0.06)	5,083 (0.12)	-18,110 (-0.42)	-17,858[1] (-0.41) -36,306[3] (-0.84)

Source: AECOM 2015.

Note: The alignment alternatives impacts are based on the *Basis for Engineering Design* (appendix L) and the Jurisdictional Determination dated November 7, 2014 (appendix G).

Note: 1 = Leigh Village ROMF; 2 = Farrington Road ROMF; 3 = Cornwallis Road ROMF

[a] NEPA Preferred Alternative ROMF included in the ROMF column for comparison purposes. The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

Table 4.8-7: Summary of Estimated Open Water/Pond Impacts

Jurisdictional Area	Type of Jurisdictional Area	NEPA Preferred Alternative (acre) [a]	Little Creek Alternatives			ROMF
			C1 (acre)	C1A (acre)	C2 (acre)	
Pond C	Open Water	0.005	--	--	--	--
Pond D	Open Water	--	0.021	0.021	0.021	--
Pond G	Open Water	--	--	--	0.053	--
Pond Z [b]	Open Water	--	--	--	--	0.182 [c]
Totals:		0.005	0.021	0.021	0.074	0.182 [c]
Difference from NEPA Preferred Alternative:		--	0.016	0.016	0.069	0.182 [c]

Source: AECOM 2015.

Note: The alignment alternatives impacts are based on the *Basis for Engineering Design* (appendix L) and the Jurisdictional Determination dated November 7, 2014 (appendix G). Jurisdictional areas outside of the NEPA Preferred and Project Element Alternatives are designated with "--" to indicate that impacts are not applicable.

[a] NEPA Preferred Alternative ROMF included in the ROMF column for comparison purposes. The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] Indicates a potentially jurisdictional feature subject to verification that was added in January 2015 and is not included in the Jurisdictional Determination.

[c] Leigh Village ROMF.

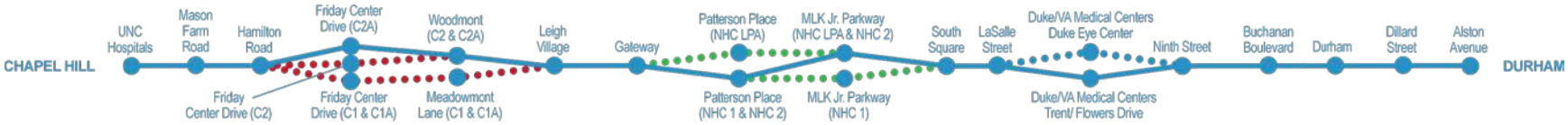


Table 4.8-8: Summary of Estimated Floodway and Floodplain Impacts

Stream Name (Figure#)	Type of Impact Area	No Build Alternative	NEPA Preferred Alternative [a] (acre)	Little Creek Alternatives			New Hope Creek Alternatives		ROMF (acre)
				C1 (acre)	C1A (acre)	C2 (acre)	NHC LPA (acre)	NHC 1 (acre)	
YY Figure 4.8-12	100-Year Floodplain	--	0.007	--	--	--	--	--	--
WW Figure 4.8-12	100-Year Floodplain	--	0.360	--	--	--	--	--	--
TT Figure 4.8-12	500-Year Floodplain	--	0.079	--	--	--	--	--	--
Y Figure 4.8-13	100-Year Floodplain	--	0.603	--	--	0.603	--	--	--
Y Figure 4.8-14	100-Year Floodplain	--	--	1.441	0.278	--	--	--	--
T Figure 4.8-15	Floodway	--	0.013	--	--	--	0.084	0.013	--
T Figure 4.8-15	100-Year Floodplain	--	0.015	--	--	--	0.022	0.015	--
T Figure 4.8-15	500-Year Floodplain	--	0.001	--	--	--	0.031	0.001	--
J Figure 4.8-15	Floodway	--	0.008	--	--	--	0.012	0.165	--
J Figure 4.8-15	100-Year Floodplain	--	0.009	--	--	--	0.087	0.607	--
J Figure 4.8-15	500-Year Floodplain	--	0.005	--	--	--	0.597	0.206	--
F Figure 4.8-15	Floodway	--	0.186	--	--	--	0.186	--	--
F Figure 4.8-15	100-Year Floodplain	--	0.116	--	--	--	0.116	--	--
F Figure 4.8-15	500-Year Floodplain	--	0.044	--	--	--	0.044	--	--

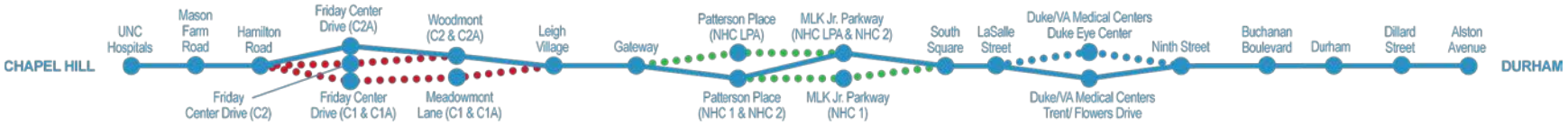


Table 4.8-8: Summary of Estimated Floodway and Floodplain Impacts

Stream Name (Figure#)	Type of Impact Area	No Build Alternative	NEPA Preferred Alternative [a] (acre)	Little Creek Alternatives			New Hope Creek Alternatives		ROMF (acre)
				C1 (acre)	C1A (acre)	C2 (acre)	NHC LPA (acre)	NHC 1 (acre)	
J Figure 4.8-16	Floodway	--	0.006	--	--	--	--	--	--
J Figure 4.8-16	100-Year Floodplain	--	0.008	--	--	--	--	--	0.065[1]
J Figure 4.8-16	500-Year Floodplain	--	0.001	--	--	--	--	--	0.190[1]
J Figure 4.8-17	Floodway	--	0.667	--	--	--	--	--	--
J Figure 4.8-17	100-Year Floodplain	--	5.302	--	--	--	--	--	--
J Figure 4.8-17	500-Year Floodplain	--	0.248	--	--	--	--	--	--
Totals: 100-Year Floodplain 500-Year Floodplain Floodway		-- -- --	6.420 0.378 0.880	1.441 -- --	0.278 -- --	0.603 -- --	0.225 0.672 0.282	0.622 0.207 0.178	0.065[1] 0.190[1] --
Differences from NEPA Preferred Alternative: 100-Year Floodplain 500-Year Floodplain Floodway		 -- -- --	 -- -- --	 0.838 -- --	 -0.325 -- --	 -- -- --	 0.085 0.622 0.075	 0.482 0.157 -0.029	 0.065[1] 0.190[1] --

Source: AECOM 2015.

Note: The Light Rail Alternative impacts are based on the *Basis for Engineering Design* (appendix L) and FEMA FIRM map data. FEMA FIRM map data areas outside of the NEPA Preferred and Project Element Alternatives are designated with "--" to indicate that impacts are not applicable. All impacts are anticipated to be permanent

Note: 1 = Cornwallis Road ROMF

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

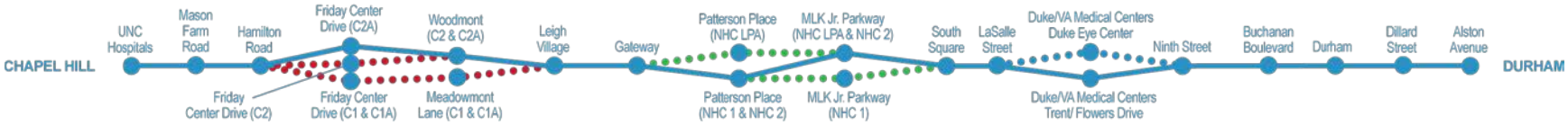


Figure 4.8-1: Jurisdictional Waters Impacts

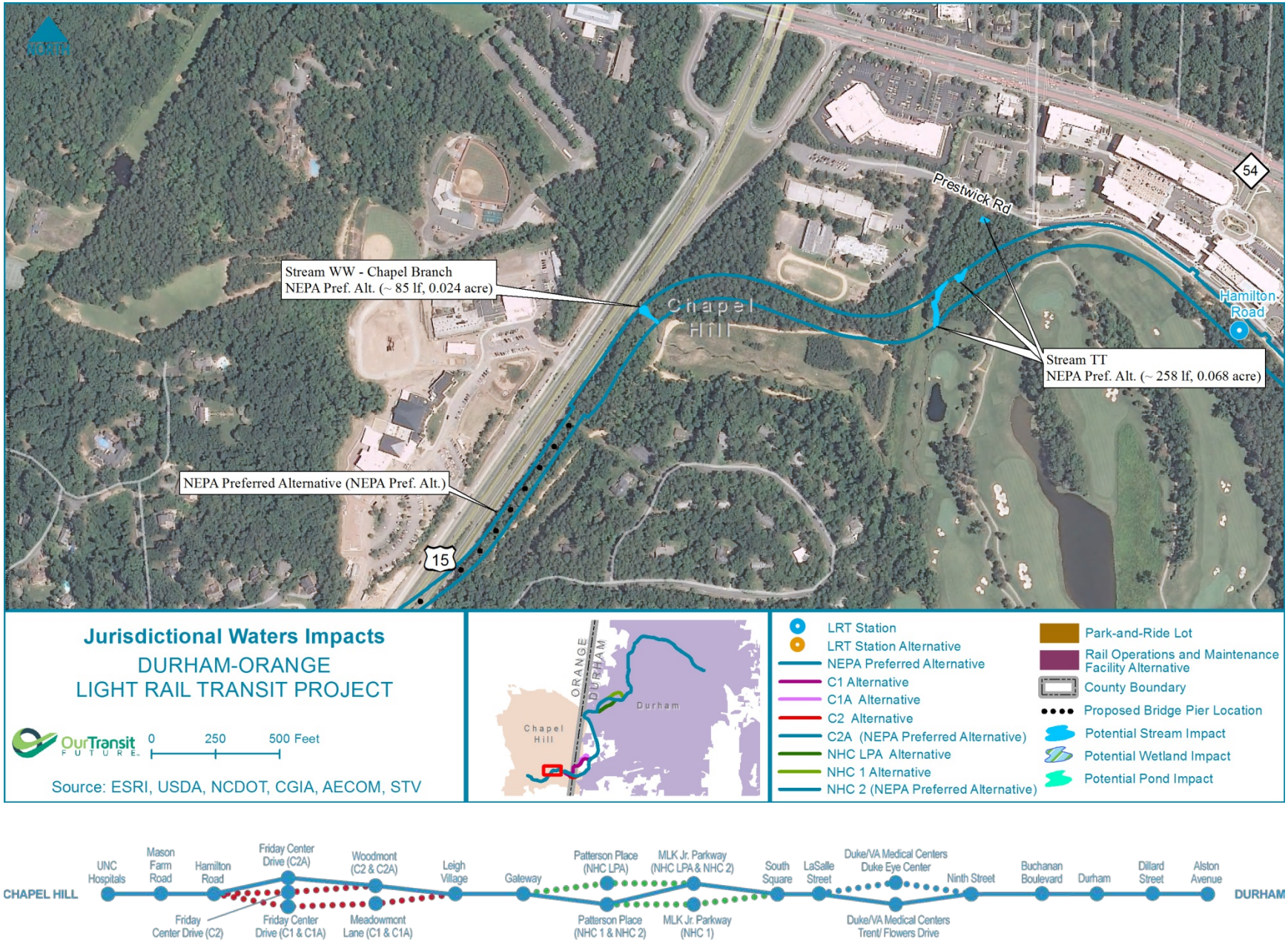


Figure 4.8-2: Jurisdictional Waters Impacts

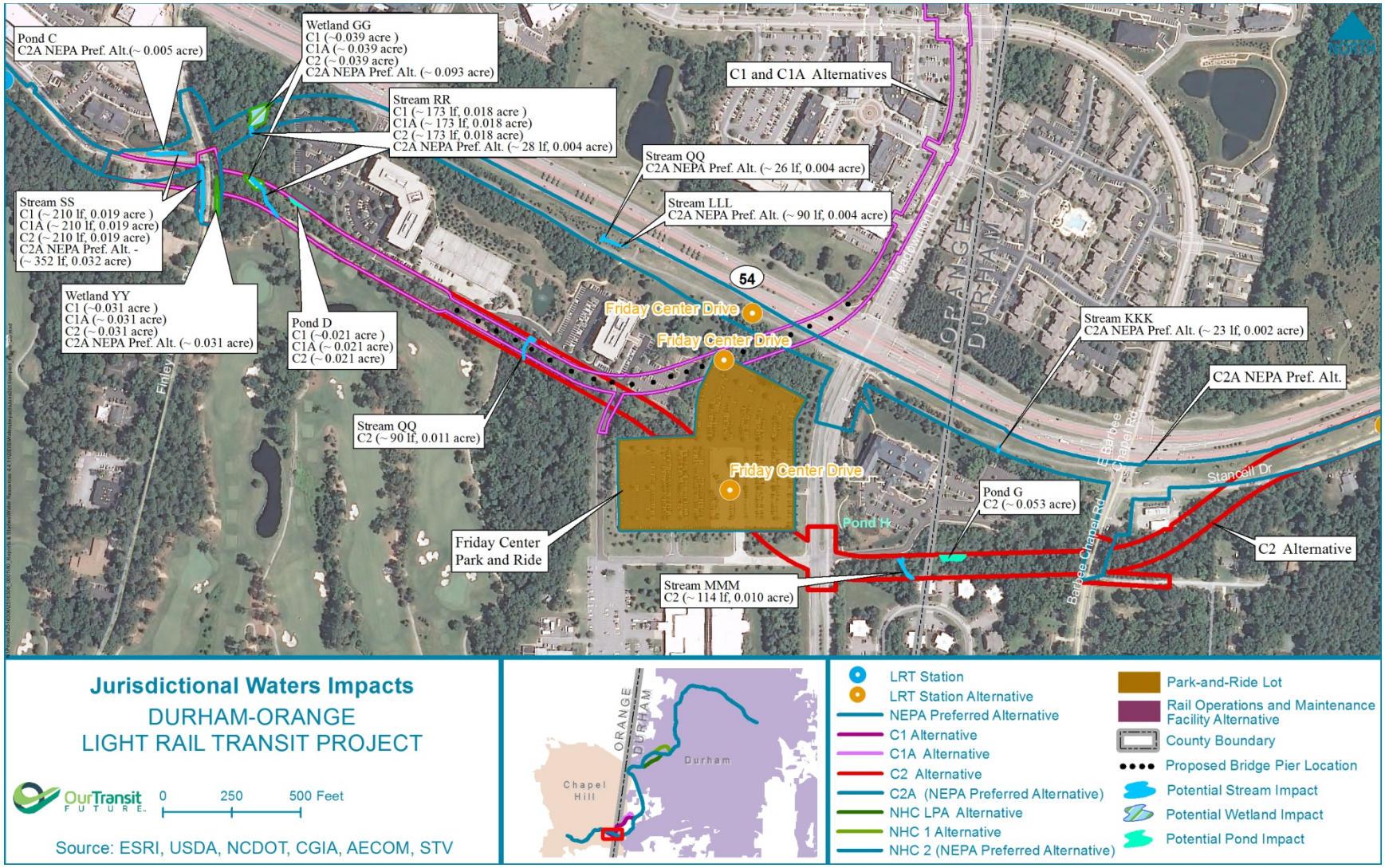


Figure 4.8-3: Jurisdictional Waters Impacts

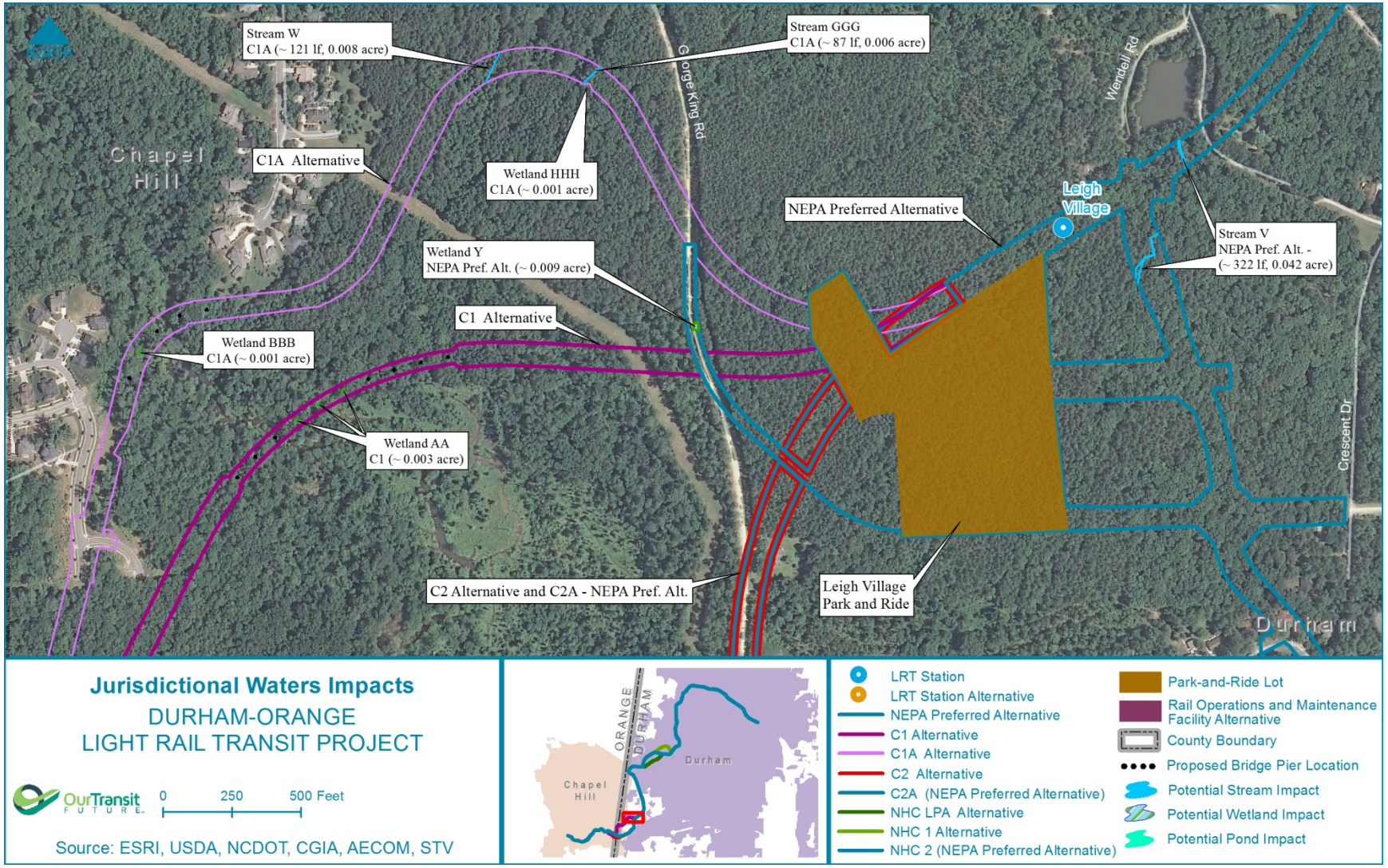


Figure 4.8-4: Jurisdictional Waters Impacts

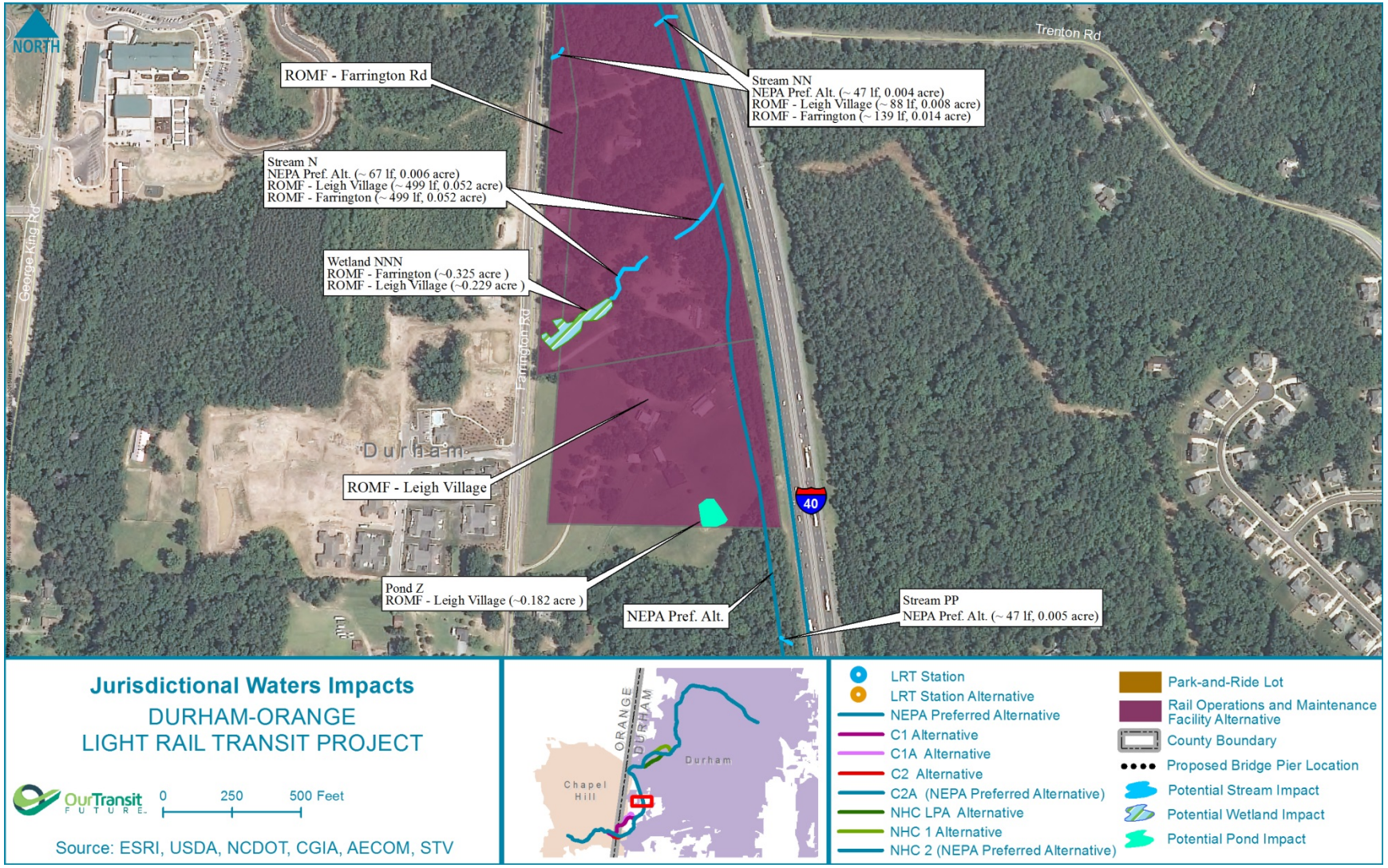


Figure 4.8-5: Jurisdictional Waters Impacts

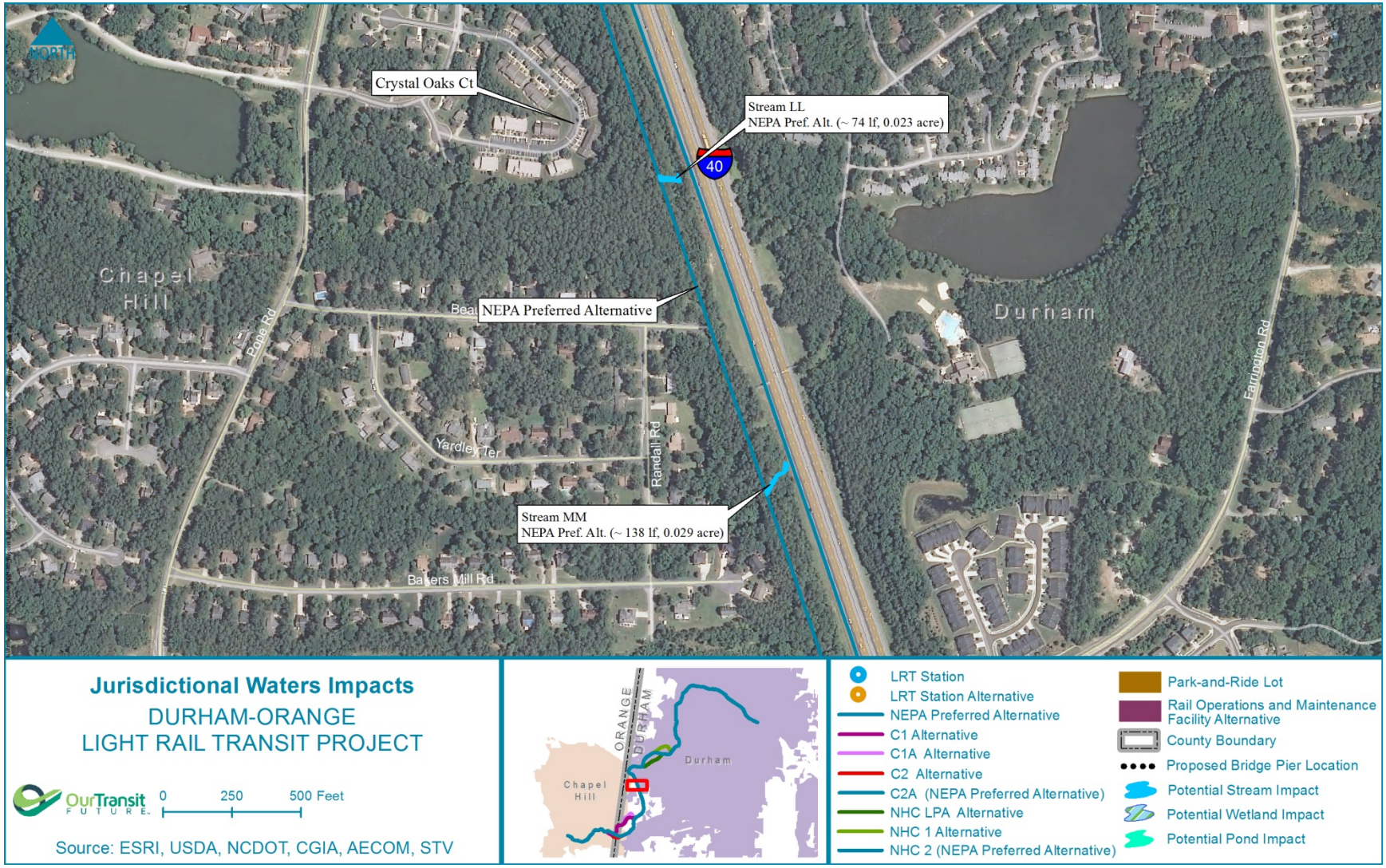


Figure 4.8-6: Jurisdictional Waters Impacts

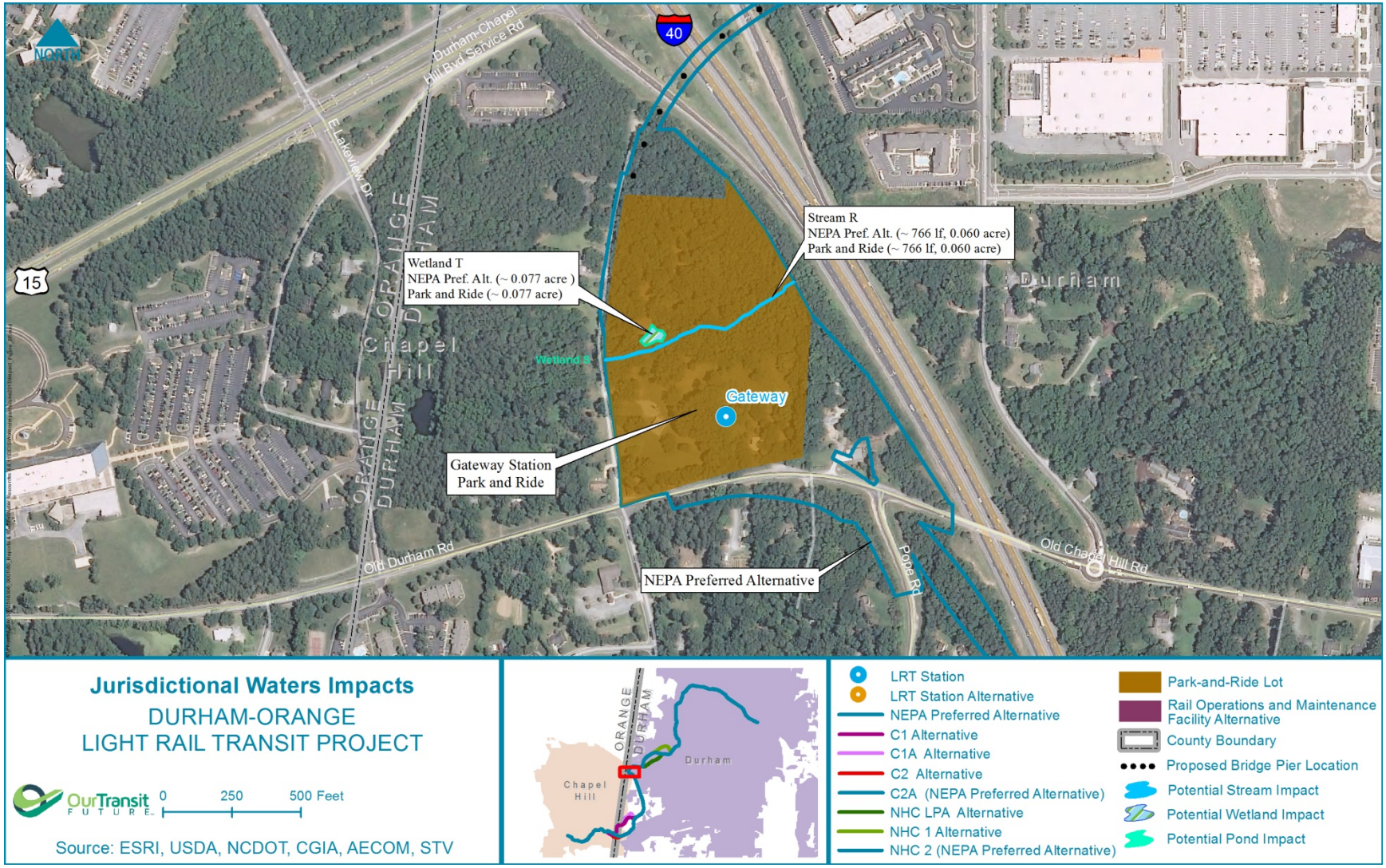


Figure 4.8-7: Jurisdictional Waters Impacts

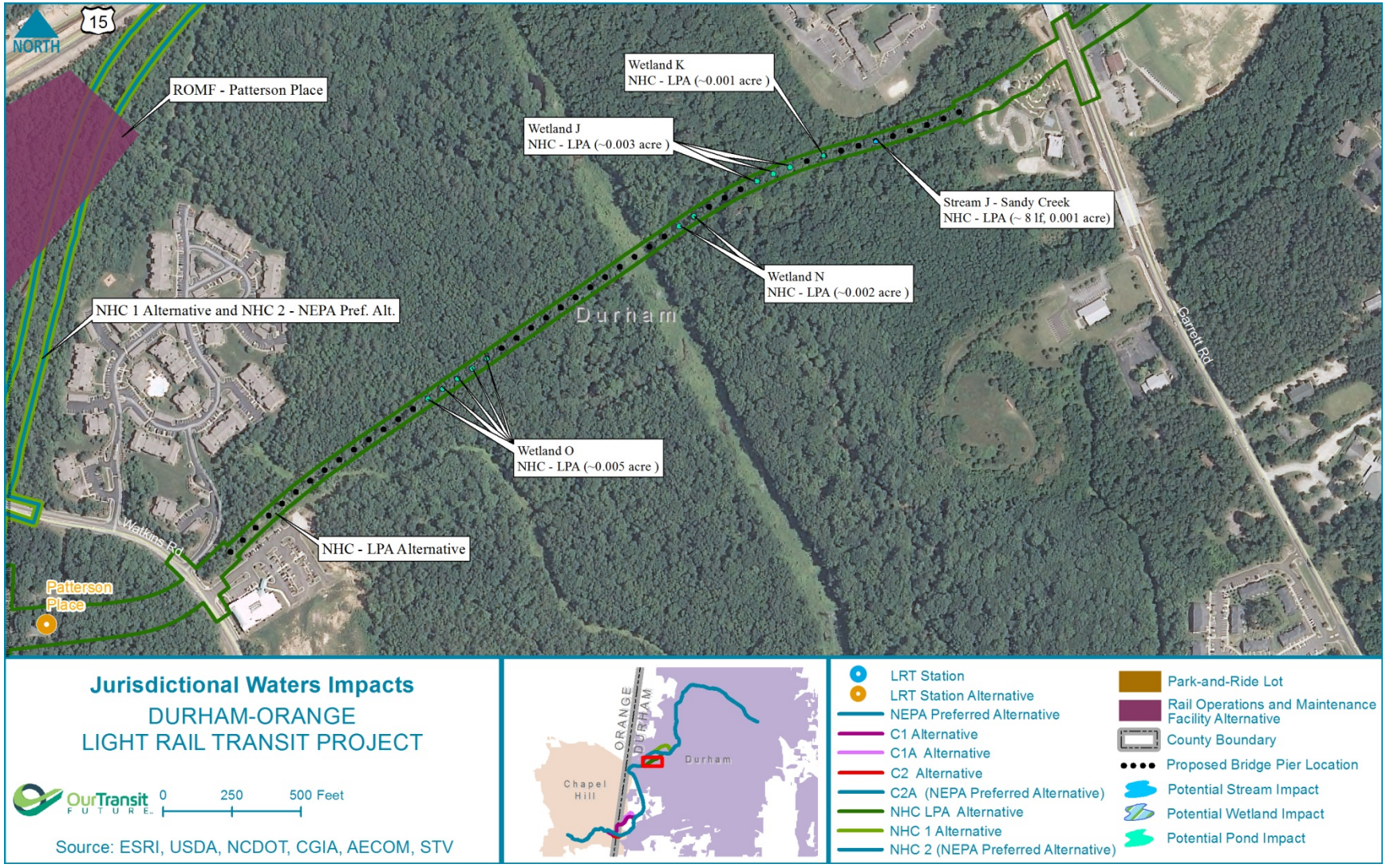
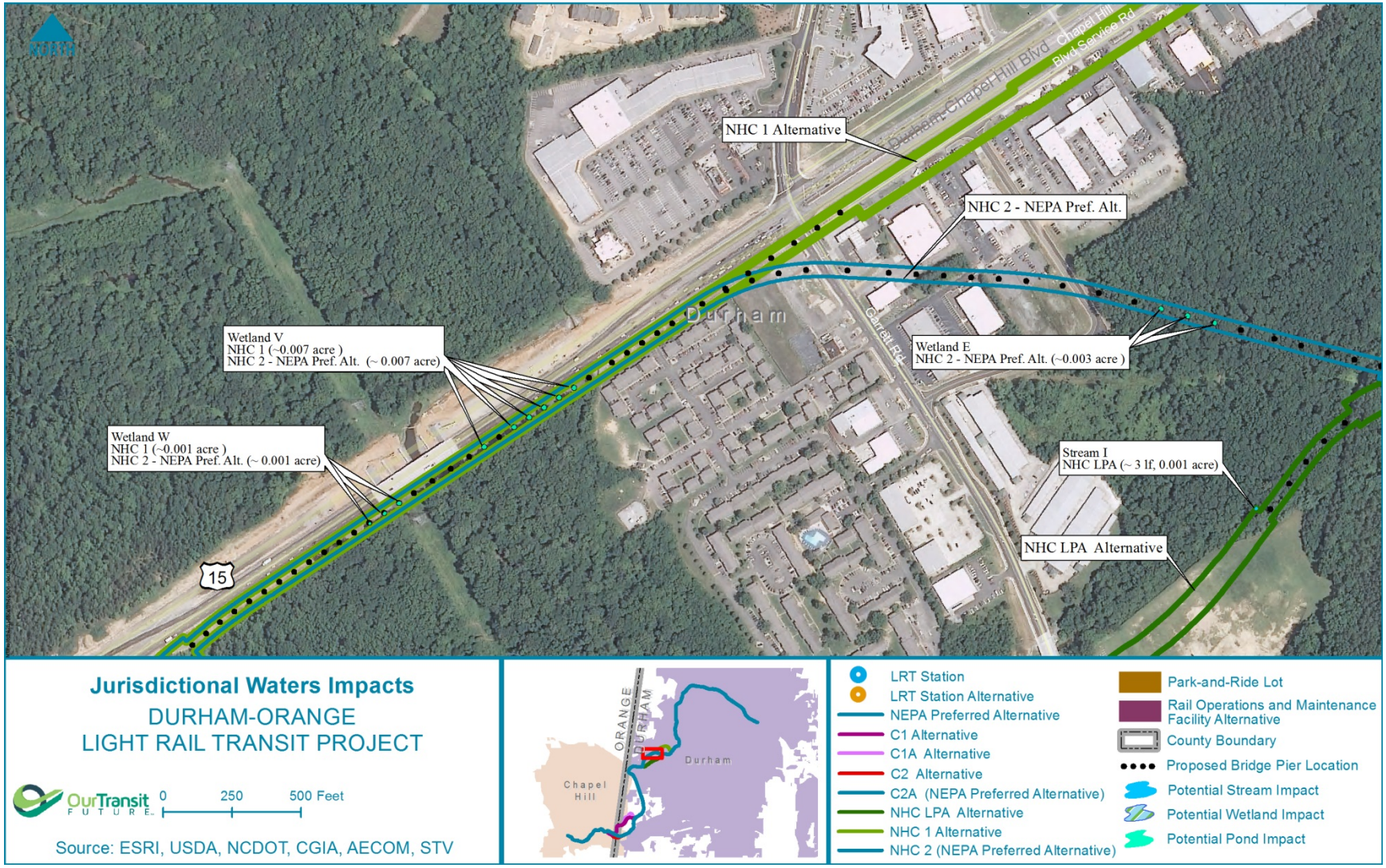


Figure 4.8-8: Jurisdictional Waters Impacts



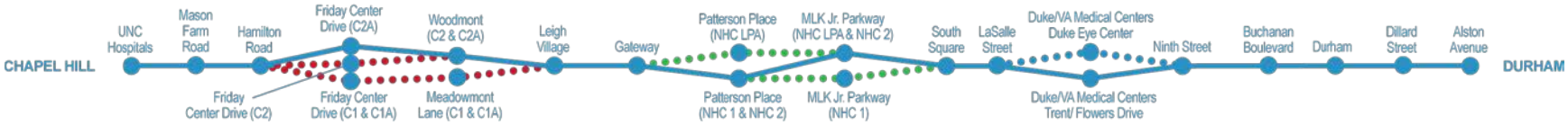


Figure 4.8-9: Jurisdictional Waters Impacts

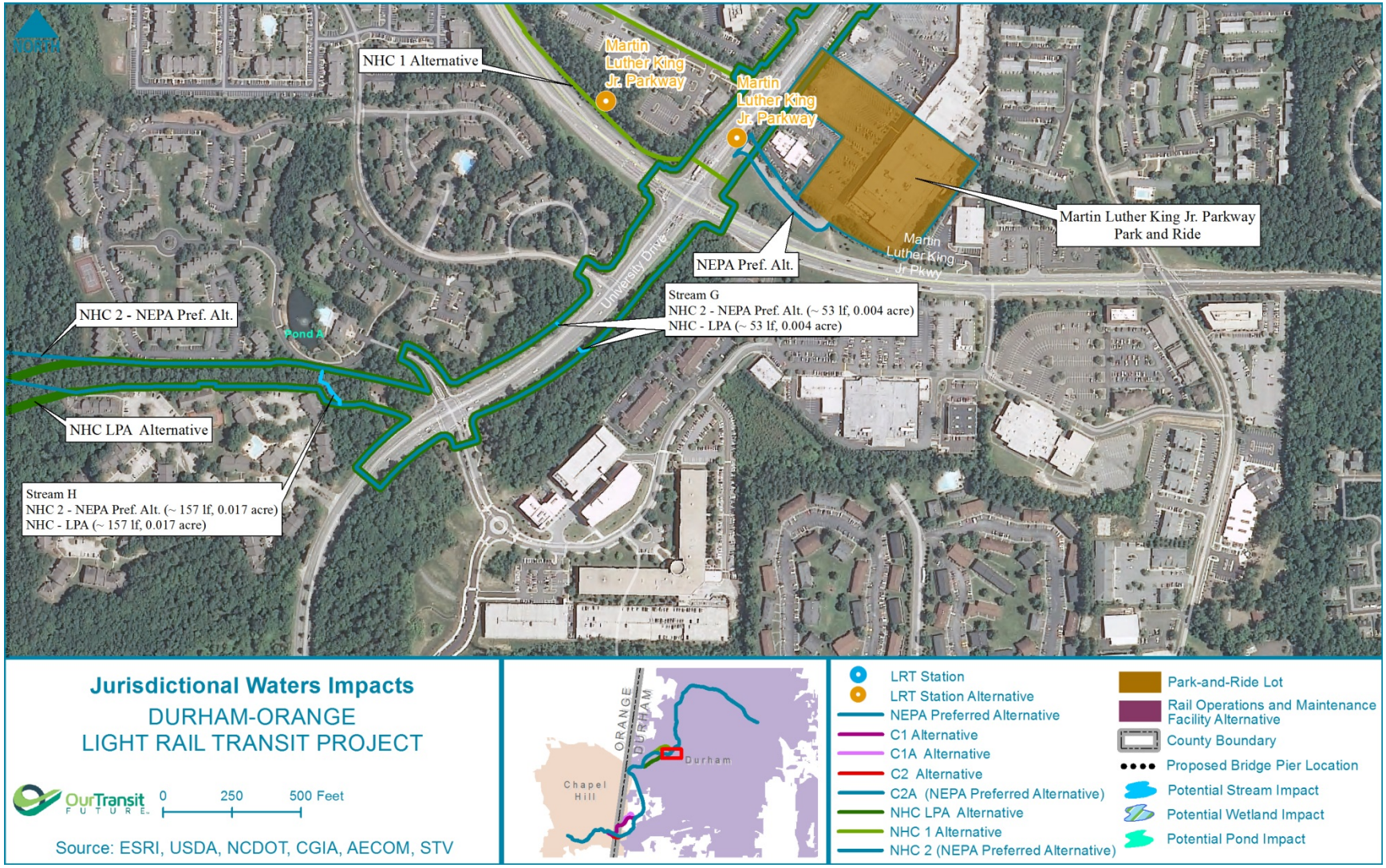


Figure 4.8-10: Jurisdictional Waters Impacts

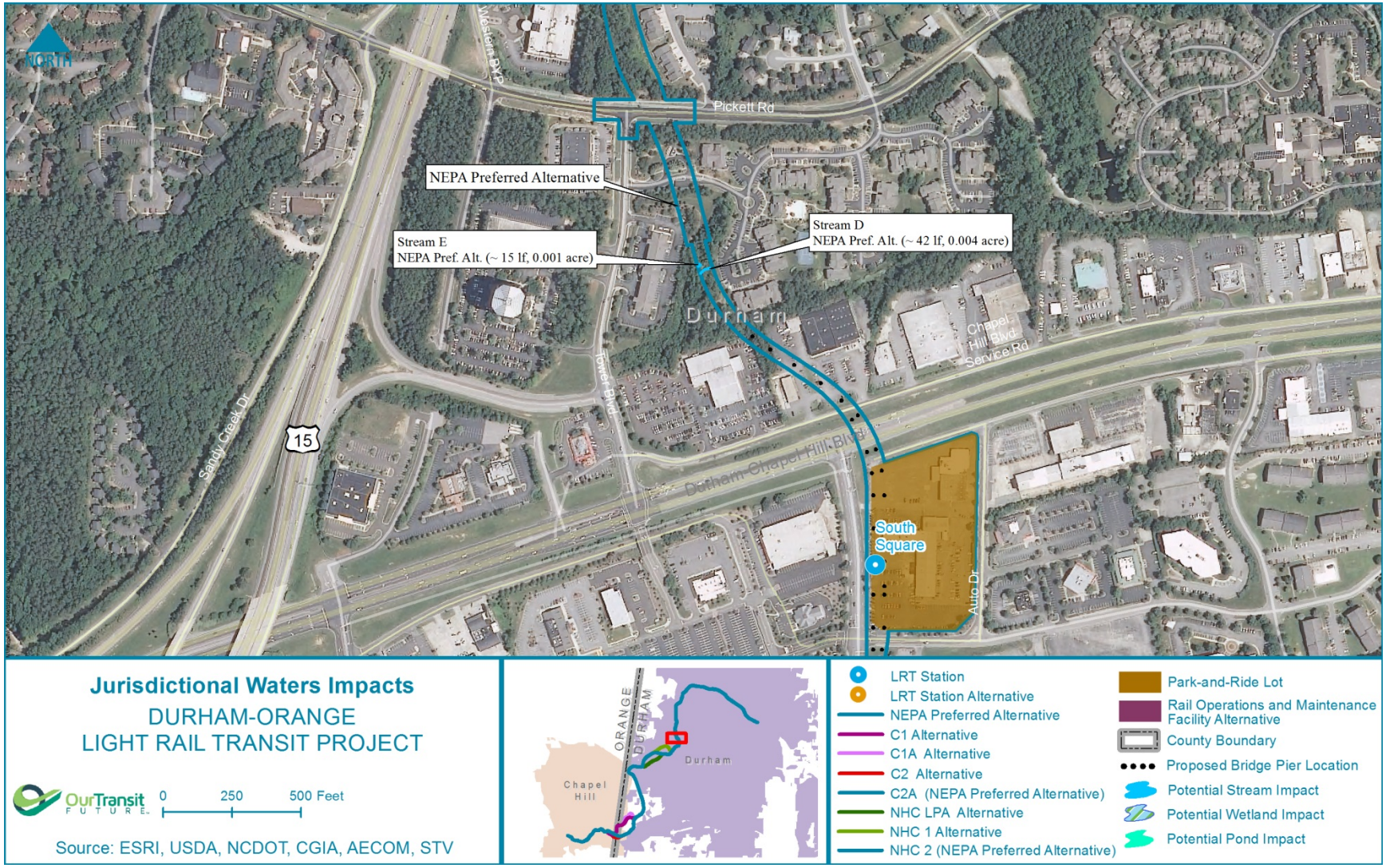


Figure 4.8-11: Jurisdictional Waters Impacts

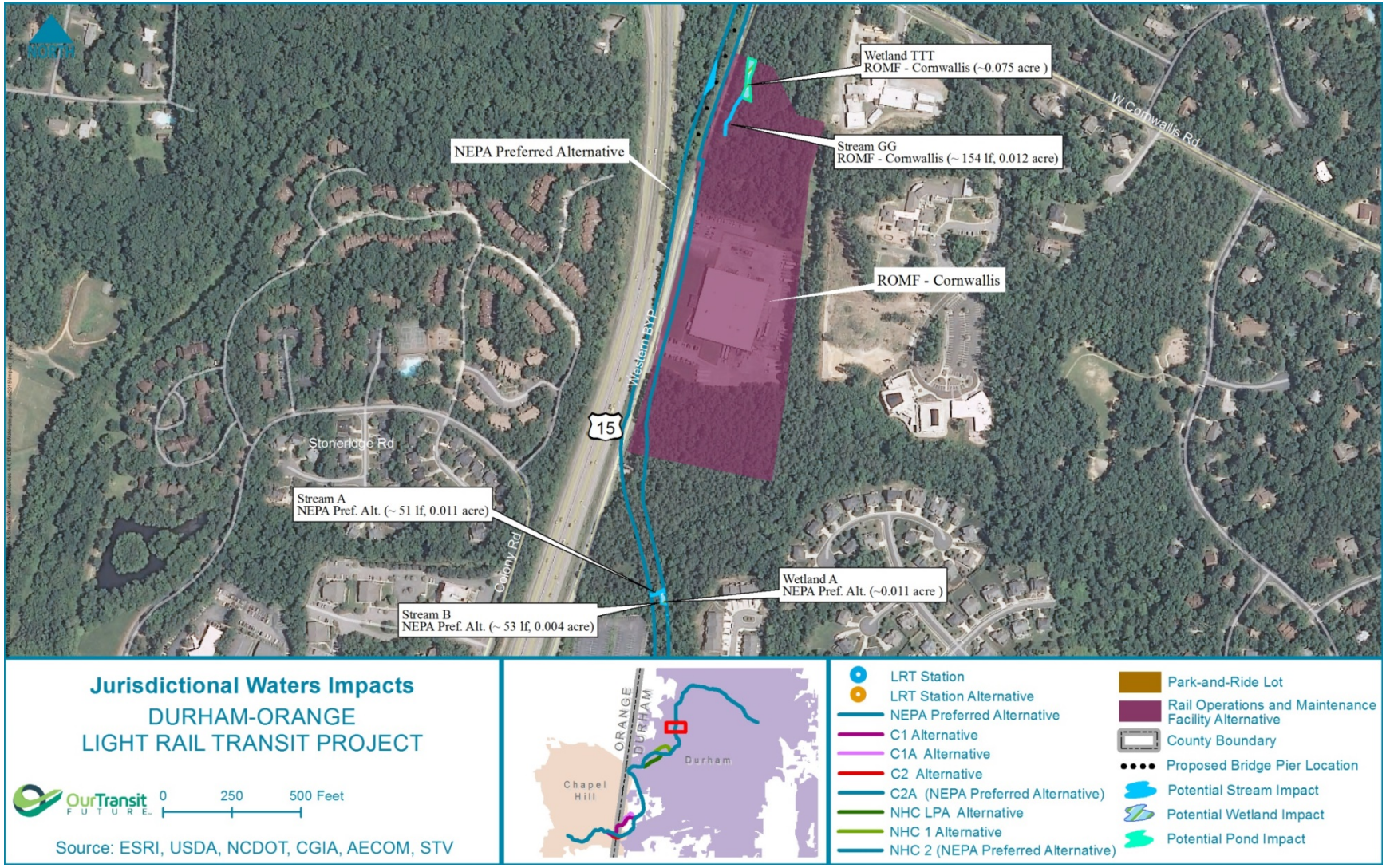


Figure 4.8-12: Jurisdictional Waters Impacts

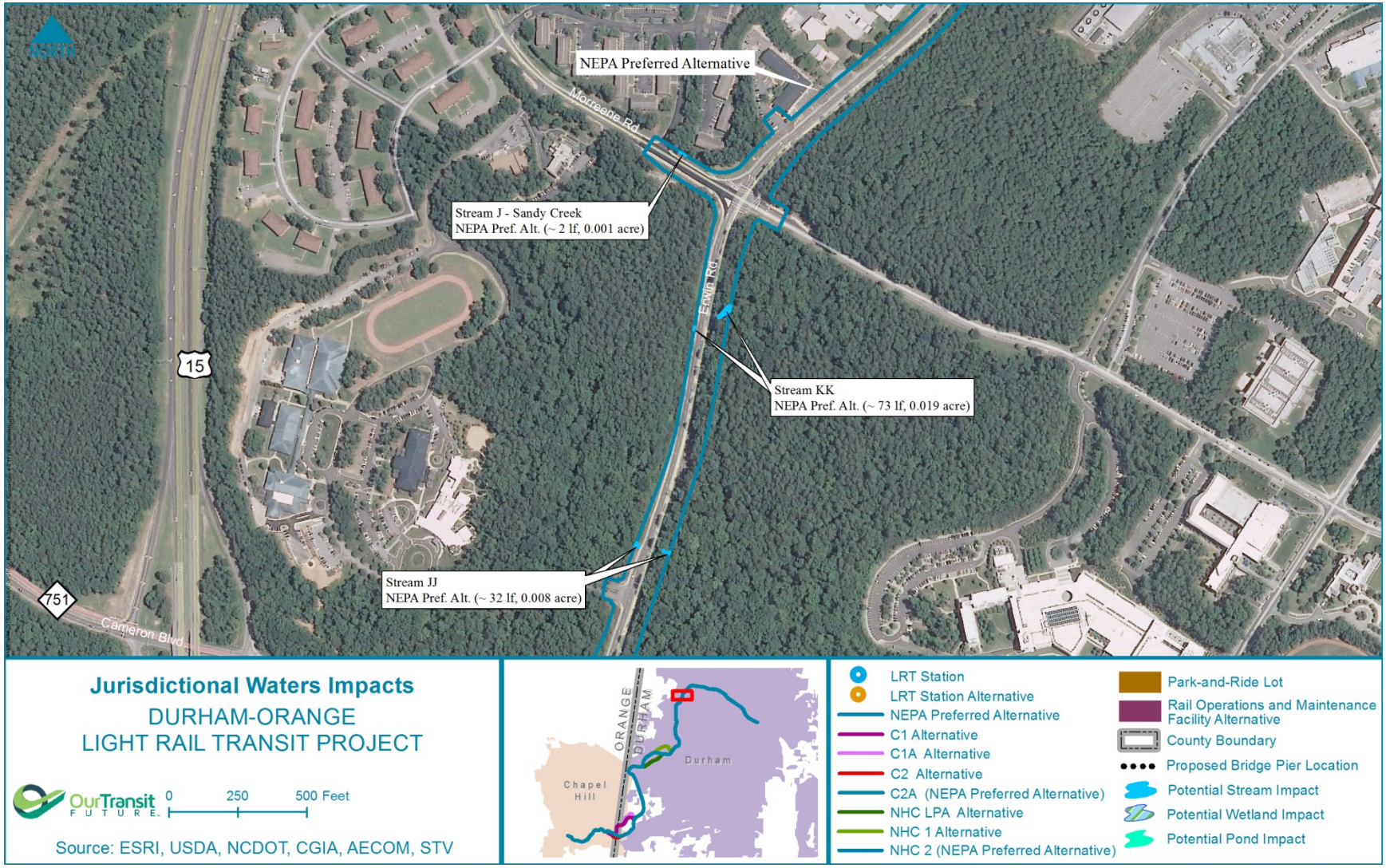


Figure 4.8-13: Jurisdictional Waters Impacts

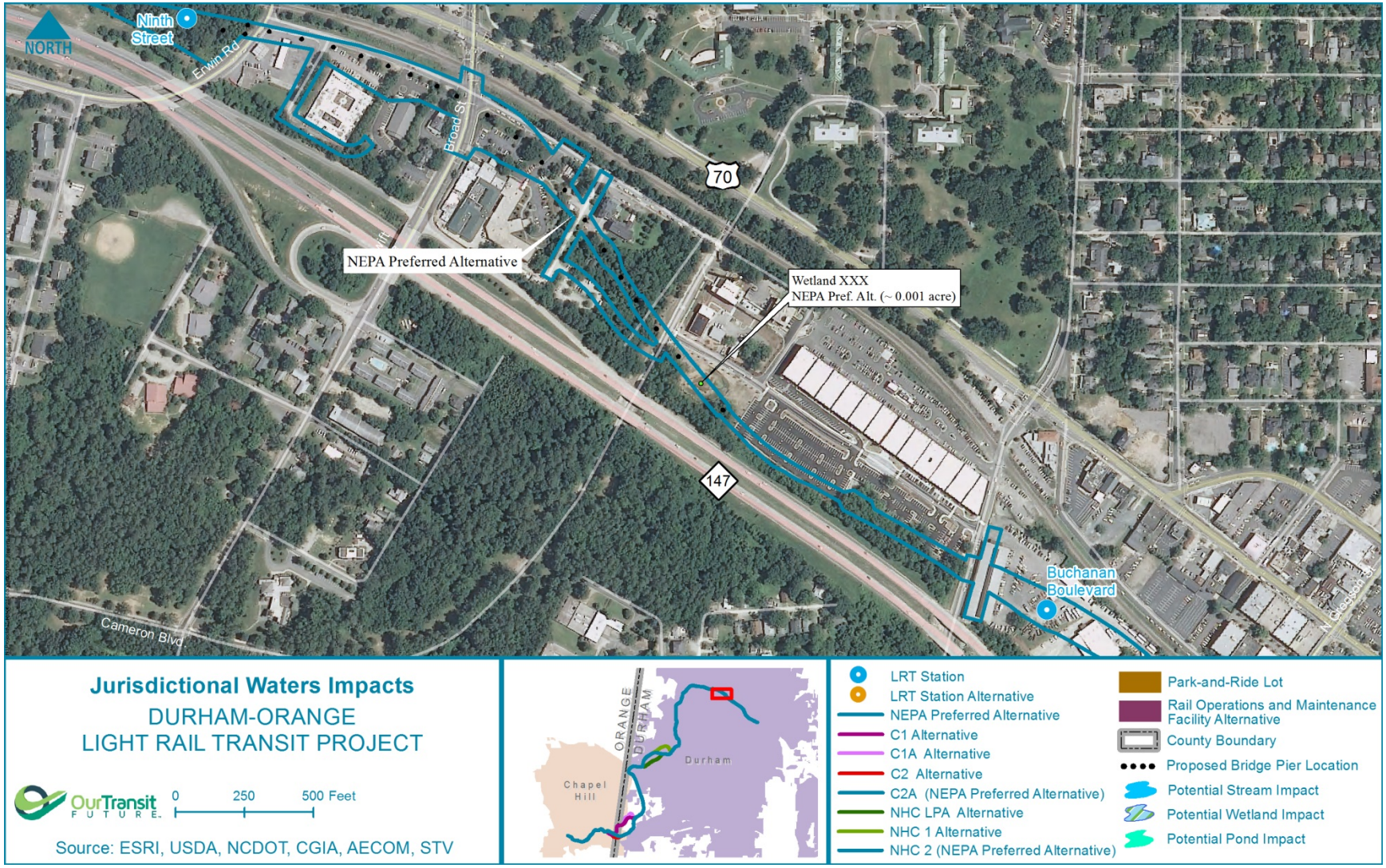


Figure 4.8-14: Floodplains and Floodways

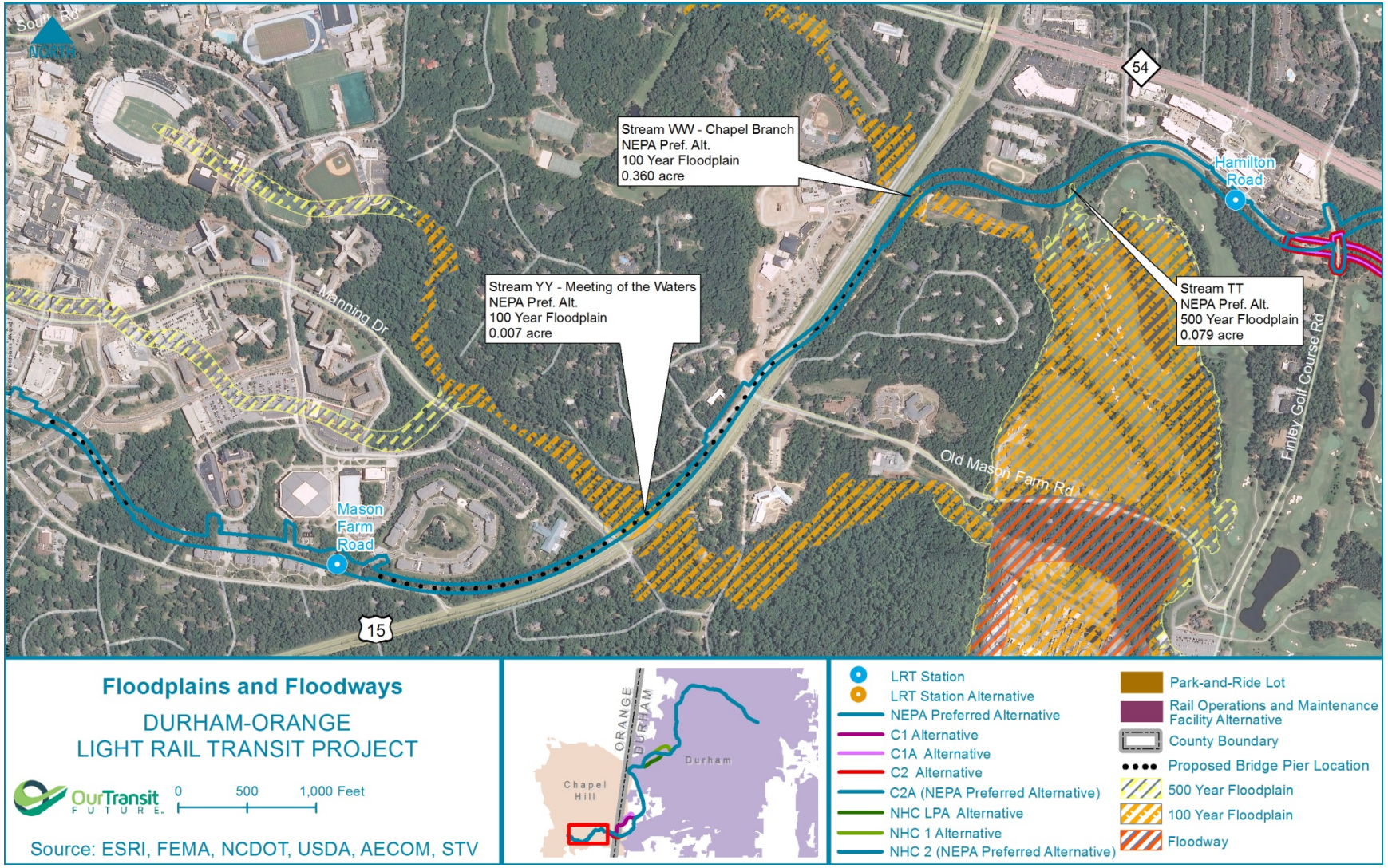


Figure 4.8-15: Floodplains and Floodways

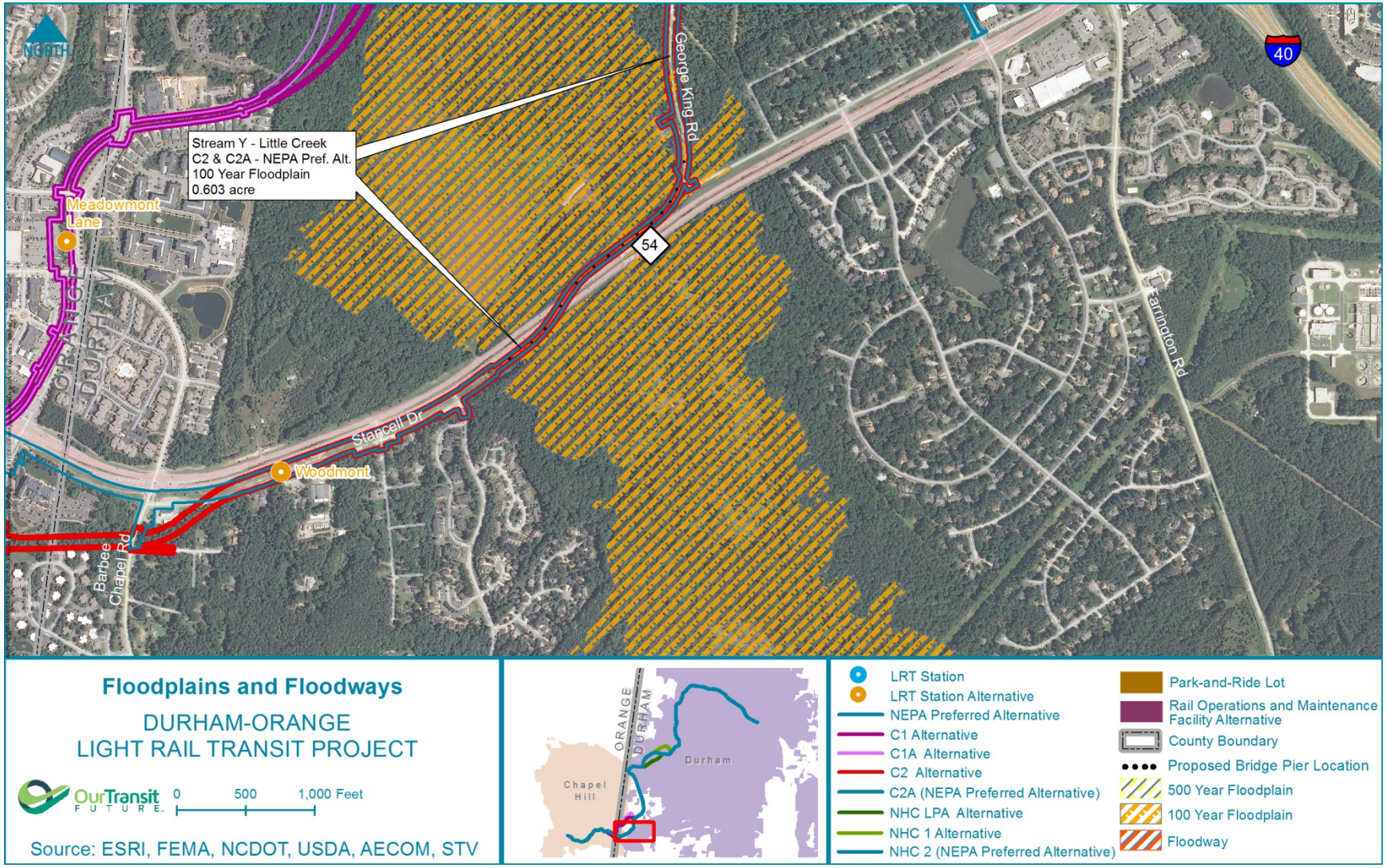


Figure 4.8-16: Floodplains and Floodways

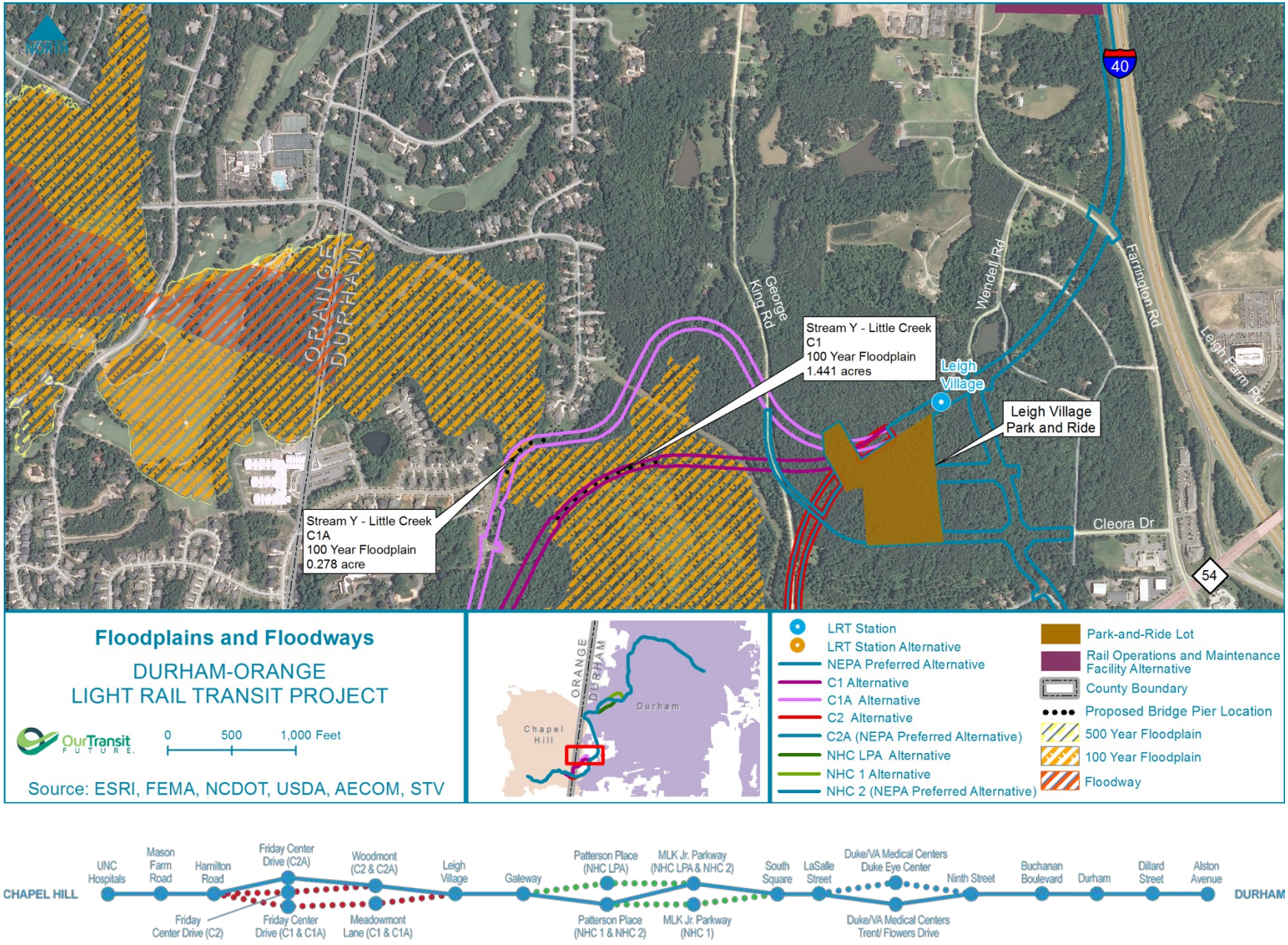


Figure 4.8-17: Floodplains and Floodways

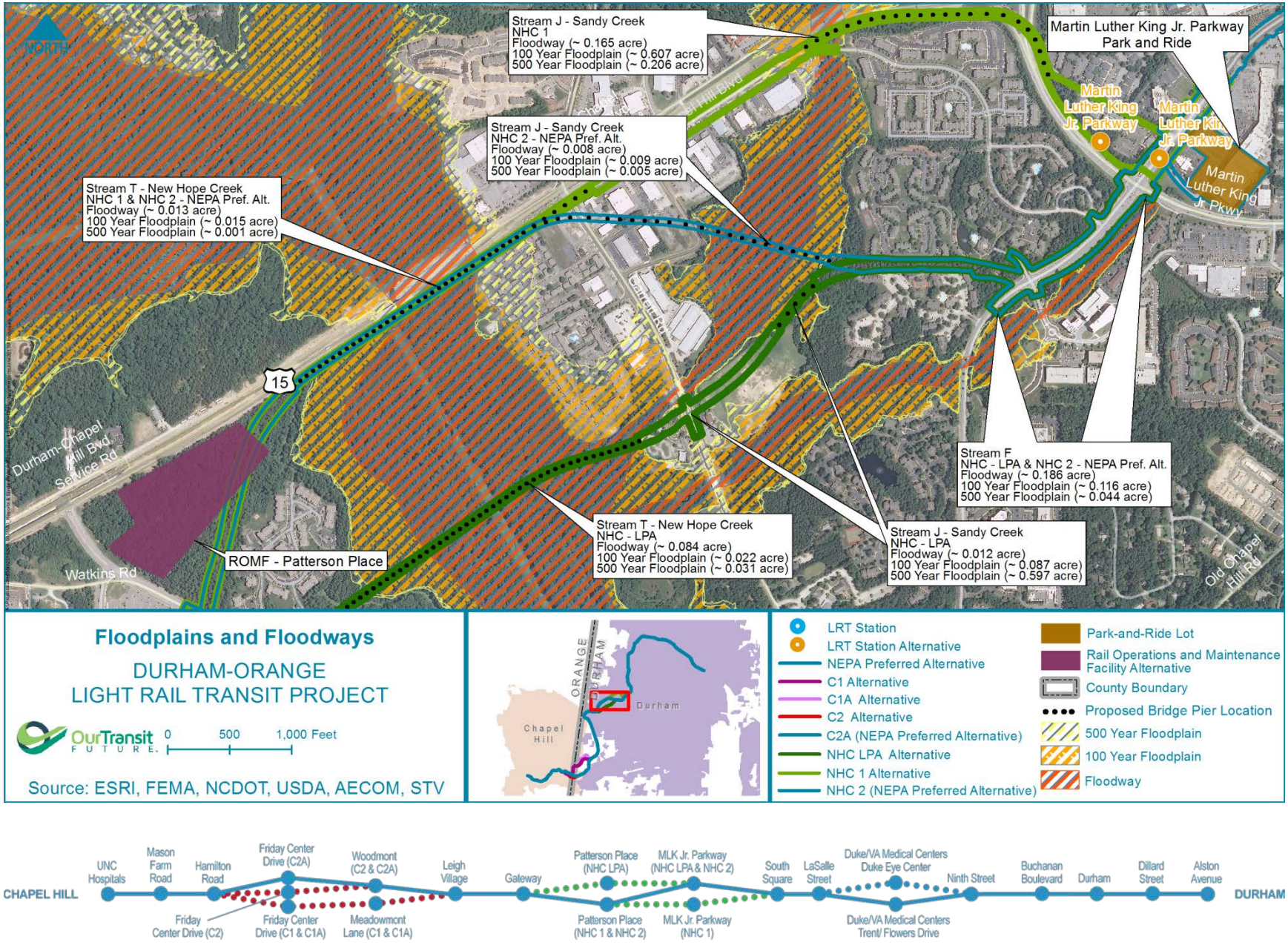


Figure 4.8-18: Floodplains and Floodways

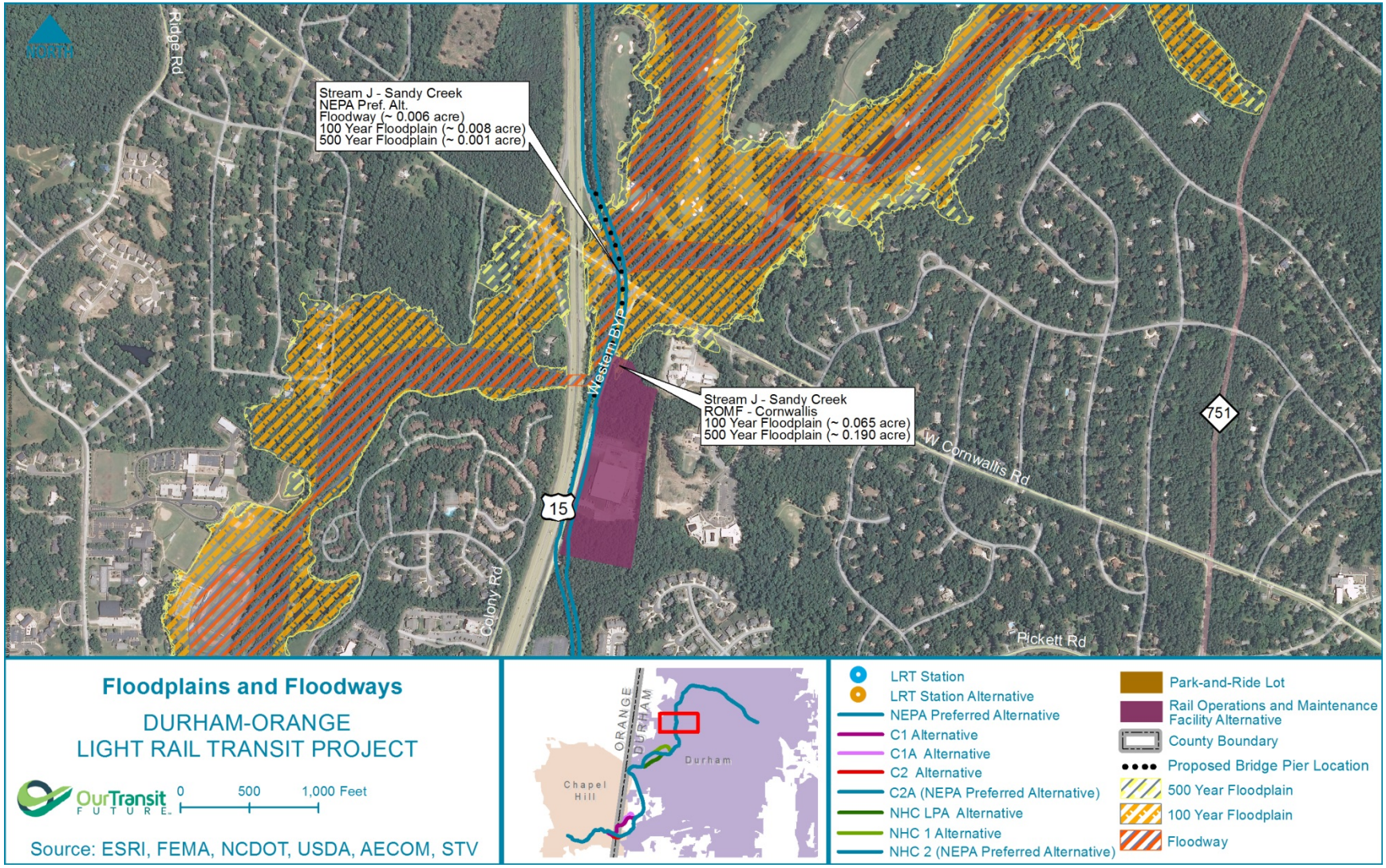
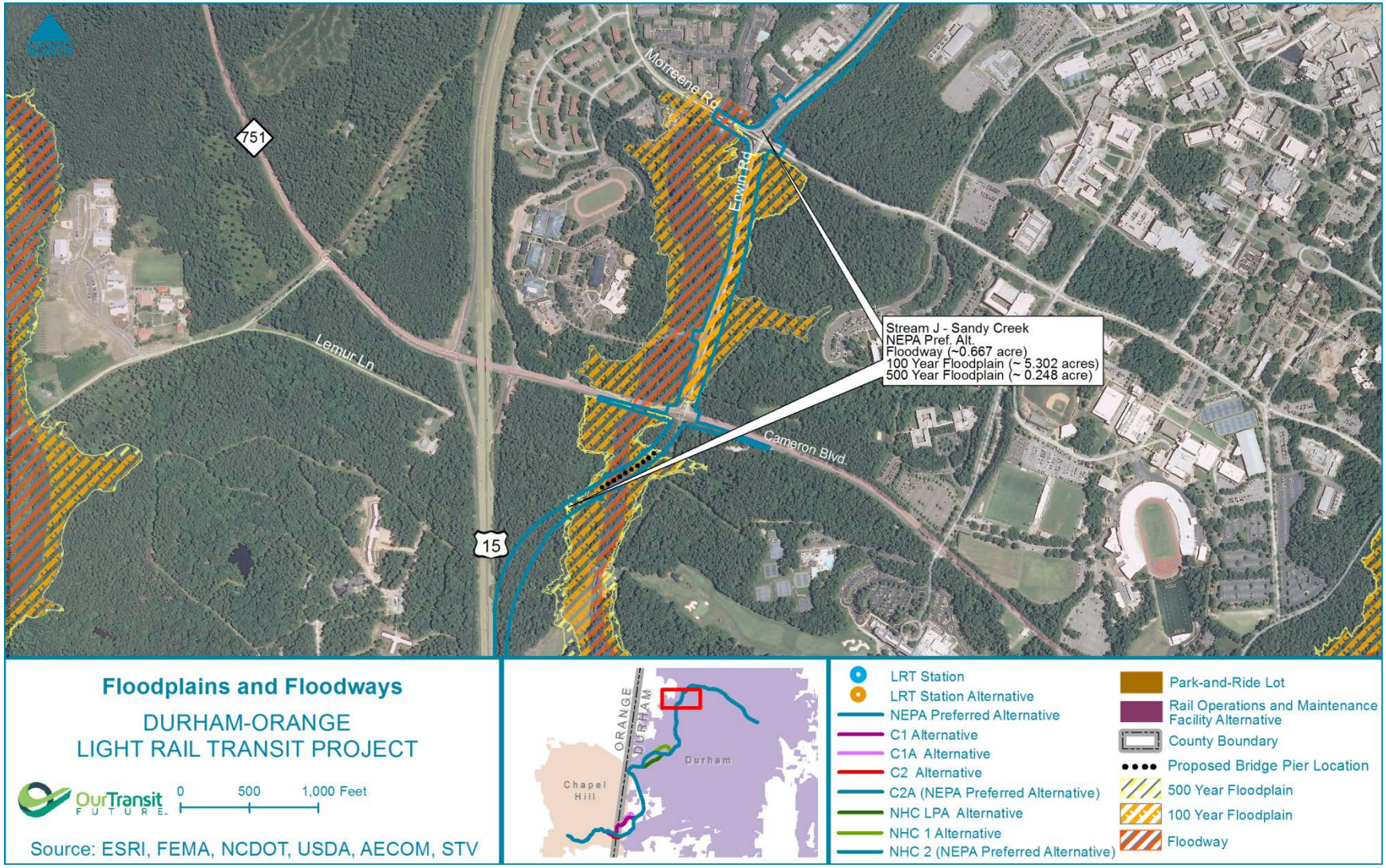
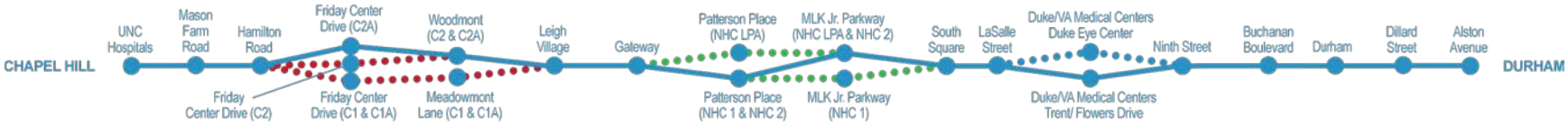


Figure 4.8-19: Floodplains and Floodways





4.9 Air Quality

This section discusses the effects on air pollutant concentrations that would potentially occur because of implementation of the NEPA Preferred and Project Element Alternatives. Air pollution is a general term that refers to one or more chemical substances that degrade the quality of the atmosphere. Air quality describes the amount of pollution in the air. Individual air pollutants degrade the atmosphere by reducing visibility, damaging property, reducing the productivity of natural vegetation, or damaging human or animal health.

This section also describes the existing air quality conditions and pollutant levels within Durham and Orange Counties. For more information, legal and regulatory context, and additional references, see appendix K.23.

4.9.1 Methodology

This section provides an overview of the modeling methodology. More detail, as well as the model input and output files, may be found in appendix K.23.

Durham and Orange counties are currently classified as attainment for all National Ambient Air Quality Standards (NAAQS). Durham County is additionally classified as a maintenance area for carbon monoxide (CO). Modeling analyses are only required for areas that are in nonattainment or maintenance for a particular pollutant.

The first step of the air quality analysis is to select intersections to model. The intersection selection process followed guidance found in the *Guideline for Modeling Carbon Monoxide from Roadway Intersections* (EPA 1992).

The second step is to estimate emissions for the selected intersections. The EPA-approved Motor Vehicle Emission Simulator 2014 (MOVES2014) model was used to estimate emissions at the selected intersections following the guidance found in *Using MOVES2014 in Project Level Carbon Monoxide Analyses* (EPA 2015).

The final step is to estimate CO concentrations at the selected intersections. The CAL3QHC version 2.0 model was used to estimate CO concentrations at the selected intersections following the guidance found in the *Guideline for Modeling Carbon Monoxide from Roadway Intersections* (EPA 1992).

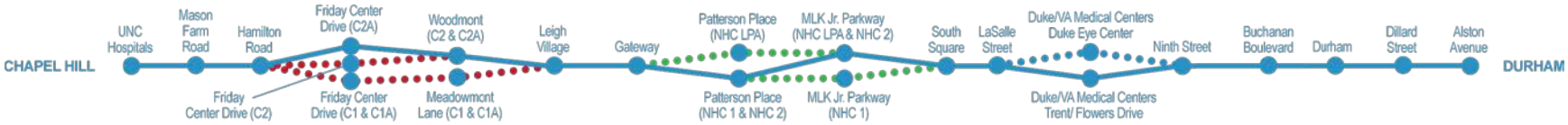
4.9.2 Affected Environment

This section discusses the existing NAAQS compliance-attainment status for the six criteria pollutants within Durham and Orange Counties. The affected environment section also reviews the model results for the existing CO concentrations.

4.9.2.1 Project-Level Conformity Determination

The Clean Air Act requires each state to develop a plan to ensure that transportation projects in that state will meet federal air quality standards. This is known as a State Implementation Plan (SIP), and the process for demonstrating that projects comply with the SIP is known as “transportation conformity.” The USDOT is required to ensure that transportation projects conform to the state’s air quality plan in nonattainment and maintenance areas. Conformity to a SIP requires that a proposed project not cause a violation in or delay timely attainment of the NAAQS requirements. As a division of USDOT, the FTA is required to make a transportation conformity determination each time it approves a plan, program, or project in a nonattainment or maintenance area.

Transportation conformity is regulated under North Carolina Administrative Code, Title 15A, chapter 2, Section .2000 (15A N.C.A.C. 02D.2000) and requires planned transportation projects to be included in the MTP that covers the area of the project. The proposed D-O LRT Project is an element of the CAMPO and DCHC MPO 2040 MTP, and is included in the conformity document. Therefore, the NEPA Preferred and Project Element Alternatives are included in a



transportation program that conforms to the SIP.

The two documents that demonstrate transportation conformity are as follows:

- *2040 Metropolitan Transportation Plans* (CAMPO and DCHC MPO 2013)
- *Research Triangle Region Conformity Determination Report* (Triangle J Council of Governments 2013)

The transit and roadway improvements encompassing the NEPA Preferred and Project Element Alternatives were included in the conformity analysis. The conformity report concluded that the CAMPO and DCHC MPO Transportation Plans conform to the purpose of the North Carolina SIP and therefore should not cause or contribute to a violation of the NAAQS.

All FHWA and/or FTA projects included in a conforming transportation plan are required to perform modeling to ensure that the project will not cause or contribute to violations of the NAAQS (40 C.F.R. 93.114-93.116).

4.9.2.2 Existing Attainment Status

Durham and Orange counties are currently classified as attainment for all NAAQS. Durham County is additionally classified as a maintenance area for CO, therefore only intersections in Durham County were considered for the CO modeling analysis. Intersections selected for analysis were determined based on a review of anticipated traffic operations and level of service (LOS) characteristics. Detailed information on the intersection selection process is provided in appendix K.23.

4.9.2.3 Existing D-O Corridor Carbon Monoxide Concentrations

The results of the air quality modeling analysis under existing conditions (2012) are provided in **Table 4.9-1**. The values shown are the maximum CO concentrations estimated near each modeled intersection during the peak traffic period.

One of the selected intersections, Falconbridge Road and NC 54, is not currently signalized and was not modeled for existing conditions.

As shown in **Table 4.9-1**, no violations of the 1-hour or 8-hour NAAQS for CO are estimated under existing conditions.

Air quality modeling analyses are only required for areas that are in nonattainment or maintenance for NAAQS for a particular pollutant.

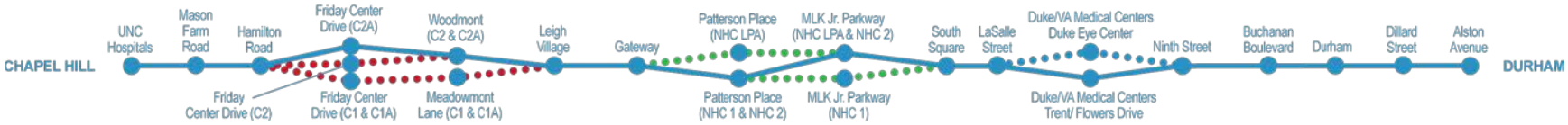
Durham County is currently in a maintenance area for CO.

4.9.3 Environmental Consequences

Under the No Build Alternative, there would be no project-related impacts to air quality. As the NEPA Preferred and Project Element Alternatives would not be constructed under the No Build Alternative, the region would not benefit from a reduction in regional pollutant emissions.

Modeling was performed for the No Build Alternative for the selected intersections to provide a basis for comparison with the NEPA Preferred and Project Element Alternatives. The results of the air quality modeling analysis under No Build, 2040 conditions are provided in **Table 4.9-2**. The values shown are the maximum CO concentrations estimated near each intersection during the peak traffic period. No violations of the 1-hour or 8-hour NAAQS for CO are expected under the No Build Alternative.

The results of the mobile source air quality modeling analysis are provided in appendix K.23 and summarized in **Table 4.9-2**. No violations of the 1-hour or 8-hour NAAQS for CO are projected under the NEPA Preferred Alternative, Little Creek Alternatives, New Hope Creek Alternatives, Duke Eye Center Station Alternative, or the ROMF Alternatives.



4.9.4 Mitigation Measures

Modeled concentrations for the worst intersections are well below the NAAQS requirements; therefore, mitigation measures are not warranted.

4.9.5 Greenhouse Gas and Climate

In November 2013, Executive Order 13653 was enacted in order to prepare the nation for the impacts of climate change by undertaking actions to enhance climate preparedness and resilience. The FTA has been working with other federal agencies, including the EPA and the Department of Energy, to evaluate effective approaches consistent with our national goals for greenhouse gas emission reduction. However, no national approach has yet been set in law or regulations, nor has the EPA established criteria or thresholds for greenhouse gas emissions. Because a national strategy to address greenhouse gas emissions from transportation – and all other sectors – is still being developed, the FTA believes that it is premature to implement policies that attempt to incorporate consideration of greenhouse gas emissions into transportation planning.

From a NEPA perspective, it is analytically problematic to conduct a project-level cumulative effects analysis of greenhouse gas emissions on a problem that is global in nature. It is technically unfeasible to accurately model how negligible increases or decreases of CO_2 emissions at a project scale would add or subtract to the carbon emissions from around the world. Given the level of uncertainty involved, the results of such an analysis would not be likely to inform decision-making at the project level, while adding considerable administrative burdens to the NEPA process. The scope of any such analysis, with any results being purely speculative, goes far beyond the disclosure of impacts needed to make sound transportation decisions. The FTA believes this approach meets the stated purpose of NEPA, in accord and with the Council on Environmental Quality (CEQ) regulations, to concentrate on the analyses of issues that can be truly meaningful to the project decision, rather than simply amassing data.

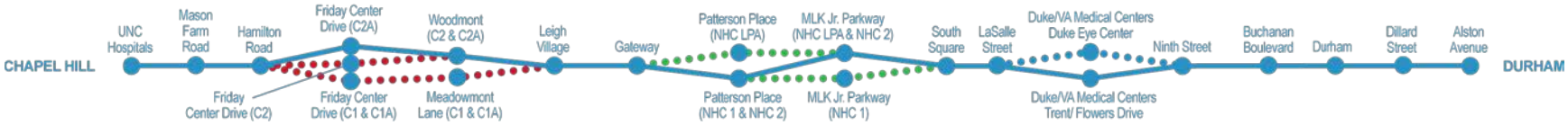


Table 4.9-1: Existing Maximum Carbon Monoxide Concentrations at Intersections (2012)

Intersection	Maximum CO Concentration (ppm)		Location of Maximum CO Concentration
	1-Hour Average [NAAQS = 35 ppm]	8-Hour Average [NAAQS = 9 ppm]	
University Drive and Martin Luther King Jr. Parkway	3.6	2.7	Receptor 3 – Southeast of University Drive and about 115 feet southwest of Martin Luther King Jr. Parkway
University Drive and Westgate Drive	3.0	2.3	Receptor 2 – Southeast of University Drive and about 120 feet southwest of Westgate Drive
Mangum Street and Main Street	3.4	2.6	Receptor 17 – East of Mangum Street and about 180 feet northeast of Main Street
Morreene Road/Towerview Road and Erwin Road	3.6	2.7	Receptor 31 – West of Erwin Road and about 75 feet northeast of Morreene Road

Source: AECOM 2015.

Table 4.9-2: Maximum Carbon Monoxide Concentrations at Intersections by Alternative (2040)

Intersection	1-Hour Average [NAAQS = 35 ppm]		8-Hour Average [NAAQS = 9 ppm]		Location of Maximum Concentration	
	No Build	NEPA Preferred Alternative [a]	No Build	NEPA Preferred Alternative [a]	No Build	NEPA Preferred Alternative [a]
Falconbridge Road and NC 54	2.2	2.2	1.6	1.6	Receptor 6 – South of NC 54 and about 190 feet east of Falconbridge Road	Receptor 6 – South of NC 54 and about 190 feet east of Falconbridge Road
Mangum Street and Main Street	2.0	2.0	1.5	1.5	Receptor 2 – East of Mangum Street and about 115 feet south of Main Street	Receptor 2 – East of Mangum Street and about 115 feet south of Main Street
Morreene Road/Towerview Road and Erwin Road	2.0	2.0	1.5	1.5	Receptor 56 – West of Erwin Road and about 700 feet south of Morreene Road	Receptor 56 – West of Erwin Road and about 700 feet south of Morreene Road

Source: AECOM 2015.
[a] - The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

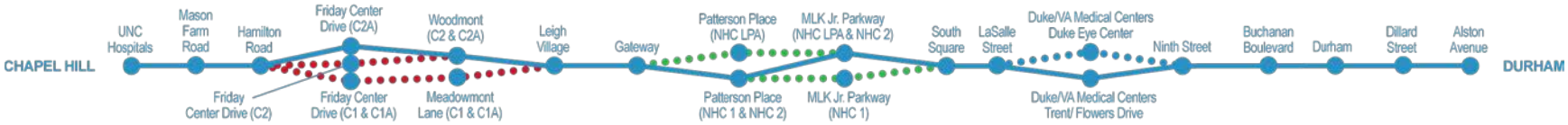
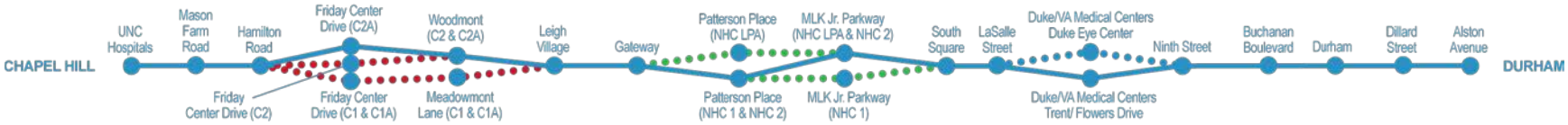


Table 4.9-3: Maximum Carbon Monoxide Concentrations at Intersections by Alternative (2040)

Intersection	1-Hour Average [NAAQS = 35 ppm]			8-Hour Average [NAAQS = 9 ppm]			Location of Maximum Concentration		
	No Build	NHC LPA/ NHC 2 [a]	NHC 1	No Build	NHC LPA/ NHC 2 [a]	NHC 1	No Build	NHC LPA/NHC 2 [a]	NHC 1
University Drive and Martin Luther King Jr. Parkway	2.0	2.0	2.0	1.5	1.5	1.5	Receptor 2 – Southeast of University Drive and about 35 feet southwest of Martin Luther King Jr. Parkway	Receptor 2 – Southeast of University Drive and about 50 feet southwest of Martin Luther King Jr. Parkway	Receptor 2 – Southeast of University Drive and about 35 feet southwest of Martin Luther King Jr. Parkway
University Drive and Westgate Drive	2.0	2.0	2.0	1.5	1.5	1.5	Receptor 9 – Southeast of University Drive and about 25 feet northeast of Westgate Drive	Receptor 9 – Southeast of University Drive and about 15 feet northeast of Westgate Drive	Receptor 9 – Southeast of University Drive and about 20 feet northeast of Westgate Drive

Source: AECOM 2015.

[a] – NHC 2 is included in the NEPA Preferred Alternative



4.10 Noise and Vibration

The section focuses on the potential effects to resources sensitive to noise and vibration. These resources are generally referred to as sensitive receptors for the purpose of this analysis.

Potential noise and vibration-sensitive receptors located within the D-O Corridor are identified. Existing noise and vibration levels are measured at each receptor. Noise and vibration levels are estimated for the NEPA Preferred and Project Element Alternatives under consideration in this DEIS and compared to the thresholds defined in the FTA *Transit Noise and Vibration Impact Assessment* (2006).

Noise and vibration projections take into account the operations of the proposed light rail including the speed of the trains, headways, train consists, the use of audible warning devices, and the track design including at-grade crossings, special trackwork (crossovers and turnouts), track curvature, adjustments for elevated guideways, terrain, building rows, and other features that may affect sound propagation conditions. Other sources included in the projections are noise from park-and-ride facilities, traction power sub-stations, and noise and vibration from the ROMF.

This analysis documents the potential short-term and long-term impacts to the sensitive receptors. Mitigation measures are proposed where noise or vibration impacts are anticipated to exceed the impact thresholds. Additional technical information may be found in appendix K.24.

Sensitive receptors: resources sensitive to noise and vibration such as parks, residences, hospitals, hotels/motels, schools, libraries, churches, natural areas/wildlife habitats, and historic properties

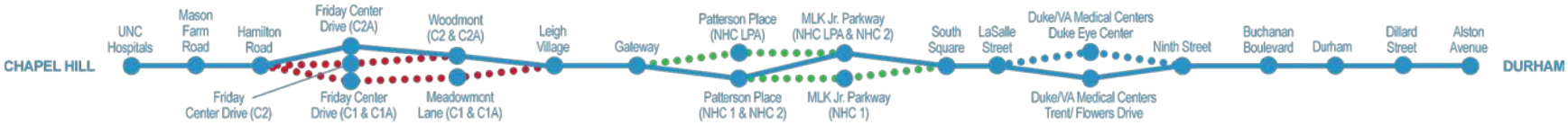
4.10.1 General Noise Concepts

"Noise" is defined as "unwanted sound." Sounds are described as noise if they interfere with an activity or disturb the person hearing them. Sound is measured in a logarithmic unit called a decibel (dB). The basic noise unit used for measuring transit noise is the A-weighted sound level (dBA). A-weighted sound levels are used because they can be easily measured and they approximate the human ear's sensitivity to sounds of different frequencies. **Figure 4.10-1** lists the typical sound levels for common noise sources. The level of noise impact is based on the intensity of noise that originates from the source and the distance between the source and the receptor. Other factors that may increase or reduce the perceived impact of noise are as follows:

- **Topography/intervening buildings**: noise can be modified, dampened, or interrupted by buildings, structures, or topography standing between the noise source and the sensitive receptor.
- **Time of day**: the degree of annoyance with noise sensed by a listener can vary by time of day (e.g., at night).
- **Other sounds in the environment**: the degree of annoyance with noise sensed by a listener can vary based on the other sounds occurring in the environment (e.g., city noises).
- **Listener's other activities**: the degree of annoyance with noise sensed by a listener can vary based on the activity that the listener is doing at the time the sound is sensed (e.g., sleeping).

4.10.1.1 Measurements Used When Noise is Affected by Other Factors

- **L_{eq} – "equivalent continuous noise level"**: an average noise level collected for a defined period of time. L_{eq} is used to describe sound levels that vary over time, resulting in a single decibel value that takes into account the total sound energy over the defined period of time. For example, the L_{eq} measures noise at peak traffic hour when noise levels are expected to be the highest.
- **L_{dn} – "Day-night equivalent level"**: an average of "day" and "night" sound. L_{dn} is an L_{eq} sound level, measured over a



24-hour period, with a 10 dBA penalty added to nighttime levels to account for a listener's heightened noise sensitivity. L_{dn} is typically used in areas where sleep takes place, such as residences, hotels, and hospitals.

4.10.1.2 Transit Noise

Transit noise includes noise from moving vehicles and supporting services such as maintenance facilities. The perceptible transit noise from a light rail system is generated by (1) light rail operations, (2) a ROMF location, (3) associated feeder bus service, and (4) park-and-ride lots at transit stations. **Table 4.10-1** identifies some of the most common noises generated by light rail operations.

4.10.2 Methodology

The FTA Guidance Manual describes the general process for assessing the potential effects of transit noise and vibration. This process involves the following three levels of assessment:

- **Screening**: involves locating the alternatives within the D-O Corridor and identifying any sensitive receptors along the D-O Corridor.
- **General assessment**: identifies the existing noise levels, the sensitive receptors, and the projected noise and vibration levels for the NEPA Preferred and Project Element Alternatives under consideration. The general assessment then estimates the anticipated impacts by comparing the existing levels to projected levels, and comparing projected levels and the allowable thresholds described in the FTA Guidance Manual. The thresholds vary by category for each type of sensitive receptor.
- **Detailed assessment**: identifies advanced design and operational details, such as the effects of track curve radii on noise levels and the location of special track work and geotechnical data on vibration levels. The FTA Guidance Manual provides details on how to incorporate design and operational details into overall project level assessments. Detailed vibration assessments are typically conducted during final design if warranted by anticipated adverse impacts.

Noise is defined as unwanted sound from a source that travels along a path to a receiver.

Sound is measured in decibels (dB). Amplitude is the loudness of a sound.

Frequency is the number of times the sound is observed.

A-weighted decibels (dBA) are used to measure sounds in the spectrum that the human ear is more sensitive to hearing.

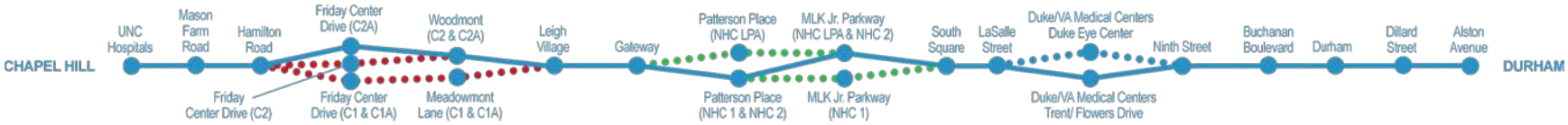
4.10.2.1 Noise Methodology

The noise analysis for this DEIS adhered to the following steps:

Noise Screening

Identify representative noise-sensitive receptors near the light rail elements that would potentially be adversely affected by operating light rail.

- Consistent with FTA guidance, the following geographic areas were examined for the presence of noise-sensitive receptors for each alternative:
  - 350 feet from the center of the proposed track and stations



  - 225 feet from the center of the proposed park-and-ride lots
  - 1,000 feet from the center of the five ROMF alternatives
- If intervening buildings exist between the source (the proposed light rail) and the receptor (building or land use), the following geographic areas were examined for each alternative:
  - 175 feet from the center of the proposed track and stations
  - 150 feet from the center of the proposed park-and-ride lots
  - 650 feet from the center of the five ROMF alternatives

Maps, photographs, and field studies were used to identify noise-sensitive land uses within the appropriate screening distances.

Noise General Assessment

After noise-sensitive land uses were identified, receptor sites were established to judge the noise- and vibration-related impact that the NEPA Preferred and Project Element Alternatives might have. The following process was adhered to:

- Measure existing noise levels at each representative noise-sensitive receptor location
- Estimate the anticipated future project-related noise exposure levels at each receptor location and compare with FTA impact criteria
- Assess the noise impacts by comparing the estimated levels to the applicable FTA impact thresholds
- Identify reasonable and feasible design refinements that would reduce project-related noise and incorporate them into the project

As part of the assessment, the following two types of noise impacts were evaluated:

- Airborne noise is noise transmitted through the air, see **Figure 4.10-2**
- Ground-borne noise is noise transmitted through the ground

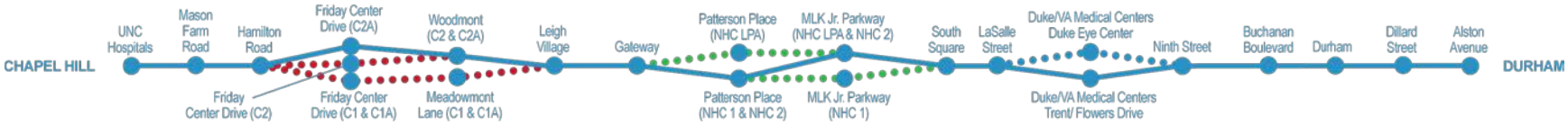
FTA Noise Impact Criteria for Transit Noise

To assess the effects of transit noise, the FTA Guidance Manual provides criteria for assessing noise impacts, shown on **Figure 4.10-3**. These criteria are based on a comparison of existing noise levels with future project-related noise levels. The criteria are defined by two curves that designate three different levels of project noise — (1) no impact, (2) moderate impact, and (3) severe impact conditions.

The basis of noise impact criteria is the percentage of people who would be highly annoyed by measured noise levels in their living environment. As a result, the criteria reflect a range of annoyance associated with different human activities that occur in areas such as homes, businesses, and parks.

The noise criteria and descriptors used in an impact analysis depend on whether the land use is designated within one of the following three categories of noise-sensitive land use:

- **Category 1**: This category includes buildings and parks, where quiet is an essential element in the intended land use purpose. Land uses include open space set aside for serenity and quiet (e.g., wilderness areas) and areas for outdoor concert pavilions.
- **Category 2**: This category includes residences and buildings where people normally sleep. Land uses include homes, hospitals, nursing homes, and hotels where nighttime sensitivity to noise is assumed to be of utmost importance.
- **Category 3**: This category includes institutional land uses with primary daytime and evening use. Land uses include schools, libraries, places of worship, museums, historically significant sites, and active parks where it is important to avoid interference with



such activities as speech, meditation, and concentration on reading material. For Category 3 uses, however, the entire use may not be designated as a sensitive receptor; rather, only those areas typically used for quiet activities are designated as sensitive receptor areas. Buildings with interior spaces where quiet is important, such as medical offices and conference rooms, recording studios, and concert halls, are also included in this category.

The criteria do not apply to most commercial and industrial uses, as these types of land uses generally are compatible with higher noise levels. The criteria apply to business uses that depend on quiet as an important part of operations, such as sound and motion picture recording studios.

Detailed Noise Assessment

In accordance with the FTA Guidance Manual, a detailed noise analysis is required for new rail transit projects. This analysis follows the General Noise Assessment methodology, but utilizes the best available project details including engineering design and operational details, such as hourly operational schedules during day and night, speed profiles, plans and elevation profiles of guideway, and location of grade crossings, curved track data, horn and bell inputs, and size and facilities of park-and-rides and ROMF.

4.10.2.2 Vibration Methodology

The vibration analysis for this DEIS followed the following steps.

Vibration Screening

Identify representative vibration-sensitive receptors that would potentially be adversely affected by the operation of light rail.

Establish screening distances based on the FTA Guidance Manual (widths vary by FTA-defined land use categories).

- **Residential land uses**: 150 feet on either side of the proposed NEPA Preferred and Project Element Alternatives
- **Institutional land uses**: 100 feet on either side of the proposed NEPA Preferred and Project Element Alternatives
- **Special uses**, such as concert halls and recording studios, which may be particularly sensitive to vibration - 450 feet on each side of the proposed NEPA Preferred and Project Element Alternatives

Vibration-sensitive receptors: buildings in which vibration could be perceived by occupants or equipment

Data Sources for Vibration Screening

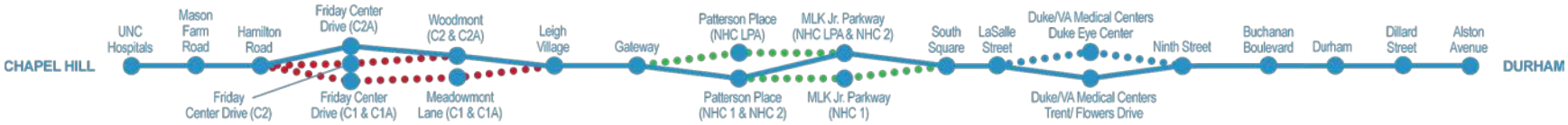
Maps, photographs, and field studies were used to identify noise-sensitive land uses within the appropriate screening distances.

General Vibration Assessment

- Estimate the anticipated future project-related vibration levels at each receptor using generalized ground-borne vibration curves provided in the FTA Guidance Manual.
- Assess the vibration impacts by comparing the estimated vibration levels to applicable FTA criteria to identify areas of impact.
- Identify the possible refinements (mitigation) that would dampen project-related vibration.

Types of Vibration Measured

- **Ground-borne vibration**: vibration that is transmitted through the earth that can be perceived (**Figure 4.10-4**).
- **Ground-borne noise**: although not directly a type of vibration, ground-borne noise is the low-pitched, rumbling noise that can result from ground-borne vibration.



Common vibration terminology

- Vibration is the transfer of energy resulting from the motion of a mechanical system.
- Lv is the vibration velocity level. Also written as Vdb.
- VdB is the measurement of vibration decibels.

Figure 4.10-5 illustrates typical ground-borne vibration levels for common sources as well as criteria for human and structural responses to ground-borne vibration. As shown, the range of interest is approximately 50 to 100 VdB, from imperceptible background vibration to the threshold of damage. Although the approximate threshold of human perception to vibration is 65 VdB, annoyance is usually not significant unless the vibration exceeds 70 VdB.

Transit Vibration

In its guidance manual, the FTA establishes criteria for assessing vibration impacts related to light rail transit projects. The extent of ground-borne noise and vibration from light rail operations depends substantially on local geology and structural details of associated buildings. When light rail vehicle (LRV) speeds are moderate (less than 30 mph), vibration impacts are usually limited to buildings within 50 feet of light rail. When LRV speeds are higher, the zone of ground-borne noise and vibration impacts may extend farther. A significant proportion of complaints about both ground-borne vibration and noise can be attributed to the proximity of track switches where LRVs can cross from one track to another, rough or corrugated track, or wheel flats.

The criteria are based on community reaction to transit-related vibration and the potential for adverse effects on vibration-sensitive activities and processes. The criteria identify intensities of ground-borne vibration and noise that may be considered significant, which would require Triangle Transit to consider ways of abating and mitigating the impact.

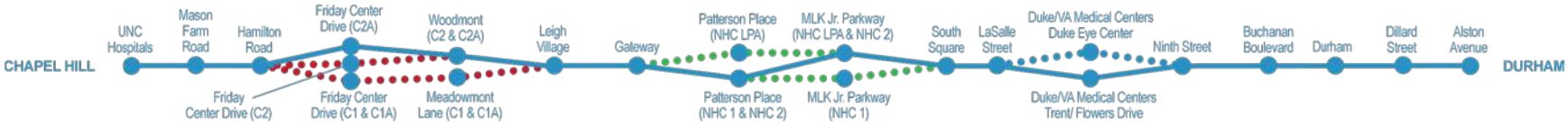
FTA Vibration Impact Criteria

Table 4.10-2 contains the recommended FTA criteria used for the proposed D-O LRT Project. Where vibration is intermittent (e.g., caused by passage of an LRV) human annoyance from ground vibration and noise depends on the number of vibration events that occur during a typical 24-hour period. The FTA Guidance Manual presents two categories of criteria for infrequent and frequent events, respectively. The category "frequent events" is defined as more than 70 vibration events per day. The FTA impact criteria for "frequent events" are 65 VdB, 72 VdB, and 75 VdB for land use Categories 1, 2, and 3, respectively.

As shown in **Table 4.10-2**, some land use activities are more sensitive to vibration than others. The FTA assigns sensitive land uses to the following three categories:

- **Vibration Category 1**: High Sensitivity - Buildings where low ambient vibration is essential for the interior operations in the building, such as certain research and fabrication facilities. Vibration levels may be below the level of human perception.
- **Vibration Category 2**: Residential - Residences and buildings where people normally sleep. This includes private dwellings, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance. It also includes some special uses such as auditoriums or theaters.
- **Vibration Category 3**: Institutional - Land uses with primarily daytime use including schools, churches, and other institutions and quiet offices that do not have vibration-sensitive equipment.

It is extremely rare for vibration from light rail operations to cause any sort of building damage, even minor cosmetic damage. The FTA Guidance Manual (Table 12-3) suggests that damage to historic structures is not likely unless vibration levels exceed 90 VdB.



4.10.3 Affected Environment

4.10.3.1 Noise

Noise-Sensitive Receptors

115 noise-sensitive receptors near the NEPA Preferred and Project Element Alternatives, including stations, park-and-ride lots, and ROMF alternatives are identified in **Table 4.10-3** and **Table 4.10-4**. The Project Element Alternatives include the other Little Creek alternatives (C1, C1A, and C2), and the other New Hope Creek alternatives (NHC 1 and NHC LPA). Sensitive receptors identified within the study area include residences, university buildings and other schools, churches, hotels, and golf courses. Multiple similar land uses that are approximately the same distance from the proposed project were grouped together. Appendix K.24 illustrates the locations of each noise-sensitive receptor.

Noise Measurements

Existing noise measurements, shown in **Table 4.10-5**, were performed at 24 representative locations near sensitive receptor areas in November 2013. Monitoring was conducted for approximately 20 minute periods at each site during the morning peak hours (6:00 a.m. to 9:00 a.m.), midday (10:00 a.m. to 3:00 p.m.), evening peak hours (3:30 p.m. to 6:30 p.m.), and late night (10:00 p.m. to 2:00 a.m.) periods during the week. This was extrapolated to 1 hour for the L_{eq} and to 24 hours for the L_{dn} equivalents.

4.10.3.2 Vibration

59 vibration-sensitive receptors were identified along the NEPA Preferred and Project Element Alternatives. Sensitive receptors identified within the study area include single and multi-family residential uses, educational and religious institutions, medical equipment, and a performing arts center. **Table 4.10-3** identifies the vibration-sensitive receptors.

4.10.4 Environmental Consequences

The noise and vibration impacts of the NEPA Preferred and Project Element Alternatives are described in the following sections. **Table 4.10-6** provides a summary of the noise and vibration impacts for the alternatives. Severe noise impacts would occur at one location and moderate noise impacts would occur at four locations with the NEPA Preferred Alternative. Vibration impacts would occur at 8 receptors and ground-borne noise impacts would occur at 13 receptors with the NEPA Preferred Alternative. Other alternative alignments would result in some additional impacts at receptors, but the number of additional impact locations is not substantial. None of the ROMF sites would result in noise or vibration impacts.

Figures 4.10-6 through **4.10-9** illustrate the locations of receptors that would be impacted by the NEPA Preferred and Project Element Alternatives. Additional detail on the impacted receptors is provided in appendix K.24.

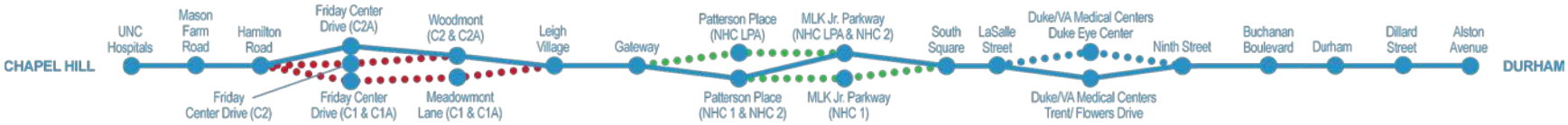
4.10.4.1 NEPA Preferred Alternative

Noise

Receptors that would be impacted by noise with the NEPA Preferred Alternative are identified in **Table 4.10-7**. All noise impacts would be at residential locations. No parks or historic properties would be impacted. In some cases, properties identified as noise-sensitive would be displaced by the NEPA Preferred Alternative. Descriptions of all property displacement and acquisitions are provided in DEIS section 4.14.

Vibration

The ground-borne noise and vibration impacts associated with the NEPA Preferred Alternative are detailed in **Table 4.10-8**. Detailed analyses of each vibration receptor are included in appendix K.24. The NEPA Preferred Alternative would result in ground-borne vibration impacts to 13 receptors, and ground-borne noise impacts to 19 receptors.



4.10.4.2 Potential Vibration-related Impacts to Historic Structures

The FTA Guidance Manual, Table 12-3 defines an impact criteria for buildings that are extremely susceptible to vibration damage of 90 VdB. Evaluation of the project shows a maximum possible vibration level of 88 VdB with a wooden structure located 10 feet from the tracks and with vehicles traveling at 55 mph. There are no historic structures within 10 feet of the project alignment except for the NRHP-listed Southern Railway Bridge Overpass. This bridge currently has freight and passenger trains operating on it daily. As a result, vibration from the operation of the NEPA Preferred Alternative would not adversely affect historic structures.

4.10.4.3 Project Element Alternatives

Little Creek Alternatives

Receptors that would be impacted by noise for the Little Creek Alternatives are detailed in **Table 4.10-9**. Each of the alternatives would impact different receptor locations from the NEPA Preferred Alternative. Alternative C1 would result in one additional severe noise impact and one less moderate noise impact in comparison to the NEPA Preferred Alternative.

Receptors that would be impacted by vibration and/or ground-borne noise for the Little Creek Alternatives are detailed in **Table 4.10-10**. Alternative C1 would impact different receptor locations from the NEPA Preferred Alternative. In comparison to the NEPA Preferred Alternative, Alternative C1 would result in two additional vibration and ground-borne noise impacts, while Alternatives C1A and C2 would result in one additional impact in each category.

New Hope Creek Alternatives

Receptors that would be impacted by noise for the New Hope Creek Alternatives are detailed in **Table 4.10-11**. Only Alternative NHC LPA would impact one additional receptor location in comparison to the NEPA Preferred Alternative.

Receptors that would be impacted by vibration and/or ground-borne noise for the New Hope Creek Alternatives are detailed in **Table 4.10-12**. In comparison to the NEPA Preferred Alternative, Alternatives NHC 1 and NHC LPA would each result in one less ground-borne noise impact, and one less vibration impact would occur for Alternative NHC LPA.

4.10.5 Mitigation Measures

Potential measures to mitigate noise and vibration impacts are described in the following sections. According to the FTA Guidance Manual, mitigation for noise impacts should be considered if the project falls within an "impact" range and should be implemented if the project would result in a severe impact.

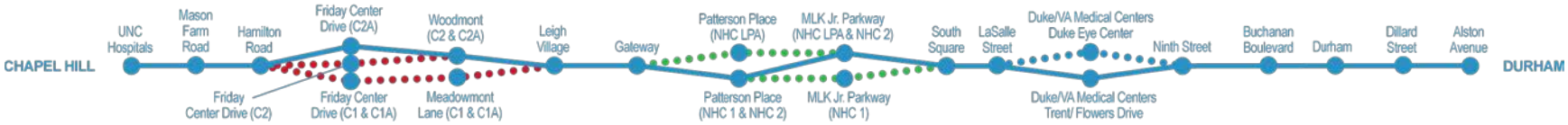
4.10.5.1 Noise Mitigation Measures

Table 4.10-13 identifies proposed mitigation measures for the NEPA Preferred Alternative and the Project Element Alternatives. Sites 2, 7, and 8 (Odum Village) are part of a larger redevelopment area sponsored by UNC. The remaining residential buildings that would be impacted, depending upon the selected alternative, are within the right-of-way for the project elements and would be acquired as part of the project. The remaining noise impact is the New Hope Creek Trail, under the NHC LPA Alternative. The alignment would pass directly over the trail in two locations. As a result, mitigation measures would be limited to noise barriers on the elevated track. The NEPA Preferred Alternative would result in no noise impacts beyond the properties to be acquired for the project.

Triangle Transit will coordinate design and policies related to audible warning devices with NCDOT and local jurisdictions in accordance with applicable regulations, guidance, municipal policies, and best management practices.

4.10.5.2 Vibration Mitigation Measures

All the vibration impacts, with the exception of the residence at George King Road



designated for acquisition under the NEPA Preferred and C2 Alternatives, would result from the conservative assumption that the soil conditions are conducive to noise propagation, which increases vibration levels by 10 VdB. As such, it is a "worst-case scenario." Therefore, and in accordance with the FTA Guidance Manual, a detailed vibration analysis will be conducted during the Engineering phase to further evaluate geotechnical conditions and more precisely predict the vibration effects of the proposed light rail system on area receptors.

Upon completion of the detailed geotechnical evaluation, vibration sensitive receptors that remain impacted by project vibration will be mitigated through one or more of the following special track support systems.

Special Track Support Systems: When the vibration assessment indicates that vibration levels will be excessive, usually the track support system is changed to reduce the vibration levels. Floating slabs, resiliently supported ties, high-resilience fasteners, and ballast mats have all been used to reduce the levels of ground-borne vibration. To be effective, all of these measures must be optimized for the frequency spectrum of the vibration. Most of these relatively standard procedures have been successfully used on transit projects.

Each of the major vibration control measures for track support is discussed below.

- **Resilient fasteners**: Resilient fasteners are used to fasten the rail to concrete track slabs. Standard resilient fasteners are very stiff in the vertical direction, usually in the range of 200,000 lb/in., although they do provide vibration reduction compared to some of the rigid fastening systems used on older systems (e.g., wood half-ties embedded in concrete). Special fasteners with vertical stiffness in the range of 30,000 pounds per inch will reduce vibration by as much as 5 to 10 dB at frequencies above 30 to 40 Hz.
- **Ballast mats**: A ballast mat consists of a rubber or other type of elastomer pad that is placed under the ballast. The mat generally must be placed on a concrete pad to be effective. They will not be as effective if placed directly on the soil or the sub-ballast. Consequently, most ballast mat applications are in elevated structures. Ballast mats can provide 10 to 15 dB attenuation at frequencies above 25 to 30 Hz.
- **Resiliently supported ties**: The resiliently supported tie system consists of concrete ties supported by rubber pads. The rails are fastened directly to the concrete ties using standard rail clips. Existing measurement data indicate that resiliently supported ties may be very effective in reducing low-frequency vibration in the 15 to 40 Hz range. This makes them particularly appropriate for transit systems with vibration problems in the 20 to 30 Hz range.
- **Floating slabs**: Floating slabs can be very effective at controlling ground-borne vibration and noise. They consist of a concrete slab supported on resilient elements, usually rubber or a similar elastomer. Floating slabs are effective at frequencies greater than their single-degree-of-freedom vertical resonance frequency.

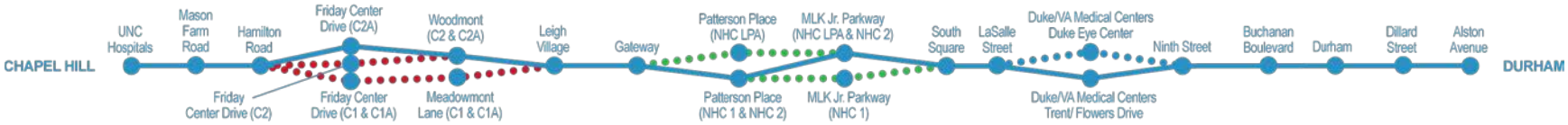


Table 4.10-1: Sources of Transit Noise for Light Rail

Transit Component	Source of Noise	Comments
Light rail vehicle in motion	Wheel rolling on rail	Increases with speed. Depends upon condition of wheels and rails. Can be controlled by regular system maintenance.
	Vehicle propulsion system	Increases somewhat while accelerating and at higher speeds. Can be controlled by vehicle procurement specification. Force ventilated system is generally quieter than self-ventilated system when operating on embedded track.
	Auxiliary equipment for vehicle and ventilation	Usually not significant source of noise. Can be controlled by vehicle procurement specification.
	Wheel squeal	Can occur on tight curves of less than 1,000 feet radii. Can be controlled by wheel and rail treatments.
	Special trackwork	Impact noises occur when wheels encounter discontinuity in tracks such as rail joints, turnouts, or switches used at crossovers.
	Brakes	Occasional squeal when stopping.
	Horns and whistles	Used infrequently as warning device for pedestrians and at intersections.
	Bells	Used sometimes as warning device at grade crossings.
Light rail vehicle stopped	Auxiliary equipment for vehicle and ventilation	Dominant source for stationary vehicle. Controlled by vehicle procurement specification.
ROMF	Auxiliary equipment for vehicle and ventilation	Dominant source for stationary vehicle. Controlled by vehicle procurement specification.
Traction power substation	Transformers	Usually not significant source of noise for light rail.

Source: Wilson, Ihrig & Associates, Inc. 1995.

Table 4.10-2: Criteria for Human Annoyance Impact and Interference with Use of Vibration-Sensitive Equipment

		Ground-borne Vibration (VdB re 1 micro in/sec)		Ground-borne Noise (dBA re 20 micro Pa)	
Land Use Category	Category Comment	Events [a]			
		Frequent	Infrequent	Frequent	Infrequent
1	Low interior ambient is essential	65	65	N/A	N/A
2	Residential & sleep	72	80	35	43
3	Institutional & daytime	75	83	40	48
1	Concert hall, TV/Recording Studio [b]	65	65	25	25
2	Auditorium [b]	72	80	30	38
2	Theater [b]	72	80	35	43

Source: FTA Guidance Manual.

[a] Frequent is defined as greater than or equal to 70 events per day.

[b] See section 12.2.2 of the FTA Guidance Manual regarding the potential for structural damage to fragile structures if operational during transit events.

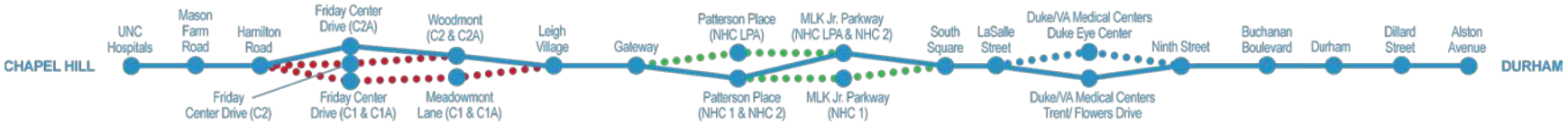


Table 4.10-3: Noise- and Vibration-Sensitive Receptors

Site # (Figure Reference)	Alternative	Name/Location of Receptor Sites	Station Proximity	FTA Noise Category (Land Use)	Distance from Receptor to Tracks (feet)	Noise Receptor	Vibration Receptor
1	NEPA Preferred Alternative	Branson Street & Hibbard Drive 1	UNC Hospitals	2	200 [a]	X	
1A	NEPA Preferred Alternative	UNC Marcico Hall - Equipment	UNC Hospitals	1	430		X
2	NEPA Preferred Alternative	Branson Street & Hibbard Drive 2	UNC Hospitals	2	55 [a]	X	X
3	NEPA Preferred Alternative	Branson Street & Hibbard Drive 3	UNC Hospitals	2	65 [a]	X	X
4	NEPA Preferred Alternative	Branson Street & Hibbard Drive 4	UNC Hospitals	2	80 [a]	X	X
5	NEPA Preferred Alternative	Branson Street & Hibbard Drive 5	UNC Hospitals	2	40 [a]	X	X
6	NEPA Preferred Alternative	Branson Street & Hibbard Drive 6	UNC Hospitals	2	130 [a]	X	X
7	NEPA Preferred Alternative	Branson Street & Hibbard Drive 7	UNC Hospitals	2	10 [a]	X	X
8	NEPA Preferred Alternative	Branson Street & Hibbard Drive 8	UNC Hospitals	2	20 [a]	X	X
9	NEPA Preferred Alternative	Mason Farm Road North 1	UNC Hospitals	2	200	X	
10	NEPA Preferred Alternative	UNC Business School	UNC Hospitals	3	250	X	
11	NEPA Preferred Alternative	Mason Farm Road North 2	UNC Hospitals	2	70	X	X
12	NEPA Preferred Alternative	Mason Farm Road North	Mason Farm	2	40	X	X
13	NEPA Preferred Alternative	Batty Hill Drive	Mason Farm	2	220 [a]	X	
14	NEPA Preferred Alternative	Batty Hill Drive	Mason Farm	2	75 [a]	X	X
15	NEPA Preferred Alternative	Batty Hill Drive	Mason Farm	2	150 [a]	X	X
16	NEPA Preferred Alternative	East of Fordham Road	Mason Farm	2	270 [a]	X	
17	NEPA Preferred Alternative	Carmichael Street	Mason Farm	2	130 [a]	X	X
18	NEPA Preferred Alternative	Aldersgate Methodist Church	Mason Farm	3	120 [a]	X	
19	NEPA Preferred Alternative	NC Botanical Gardens	Mason Farm	1	130 [a]	X	
19A	NEPA Preferred Alternative	Coker Pinetum	Mason Farm	3	20 [a]	X	
20	NEPA Preferred Alternative	Fordham Road South	Mason Farm	2	250 [a]	X	
21	NEPA Preferred Alternative	Glenwood Elementary School	Mason Farm	3	200	X	
22	NEPA Preferred Alternative	Condos	Hamilton Road	2	100	X	X
23	NEPA Preferred Alternative	Finley Golf Course Tee Boxes	Hamilton Road	3	50	X	
24	C1, C1A	Meadowmont Lane East	Friday Center	2	180 [a]	X	
25	C1, C1A	Sprunt Street East	Meadowmont	2	230	X	
26	C1, C1A	Cedar Berry Lane	Meadowmont	2	60	X	X
27	C1A	Park Bluff Drive	Leigh Village	2	150	X	X
27A	C1, C1A	Iron Mountain Road 1	Leigh Village	2	310/15	X	X

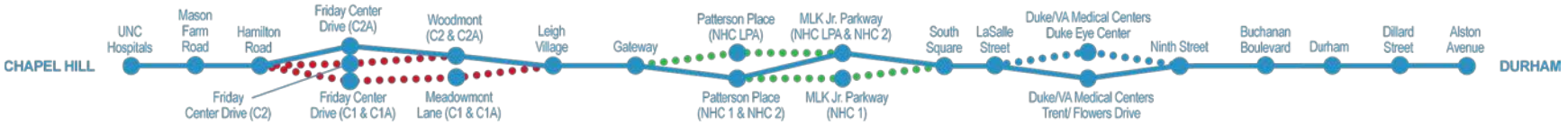


Table 4.10-3: Noise- and Vibration-Sensitive Receptors

Site # (Figure Reference)	Alternative	Name/Location of Receptor Sites	Station Proximity	FTA Noise Category (Land Use)	Distance from Receptor to Tracks (feet)	Noise Receptor	Vibration Receptor
27B	C1, C1A	Iron Mountain Road 2	Leigh Village	2	180/120	X	X
27C	C1, C1A	Iron Mountain Road 3	Leigh Village	2	65/210	X	X
27D	C1, C1A	Iron Mountain Road 4	Leigh Village	2	0/290	X	X
28	C1A	Millingport Court	Leigh Village	2	120 [a]	X	X
28A	C1A	Helmsdale Drive	Leigh Village	2	100	X	X
29	C2, NEPA Preferred Alternative	Courtyard Chapel Hill	Friday Center	2	190/260	X	
30	C2	Brookberry Circle	Woodmont	2	50	X	X
31	C2, NEPA Preferred Alternative	Pearl Lane	Woodmont	2	160/250	X	
32	C2, NEPA Preferred Alternative	Stancell Drive	Woodmont	2	120	X	X
33	NEPA Preferred Alternative	Village Crossing	Friday Center	2	280	X	
34	C2, NEPA Preferred Alternative	Woodmont Station South	Woodmont	2	250	X	
35	C2, NEPA Preferred Alternative	Little John Road	Woodmont	2	100	X	X
36	C2, NEPA Preferred Alternative	Downing Creek	Woodmont	2	180	X	
37	C2, NEPA Preferred Alternative	George King Road	Woodmont	2	20	X	X
37A	C2, NEPA Preferred Alternative	Jordan Game Lands	Woodmont	2	100	X	
38	NEPA Preferred Alternative	Hudson Road	Leigh Village	2	80	X	X
39	NEPA Preferred Alternative	Crescent Drive South	Leigh Village	2	55	X	X
40	NEPA Preferred Alternative	Farrington Road South	Leigh Village	2	320	X	
41	NEPA Preferred Alternative	Farrington Road North	Leigh Village	2	70	X	X
42	NEPA Preferred Alternative	Leigh Farm	Leigh Village	2	180	X	
43	NEPA Preferred Alternative	Farrington Road	Leigh Village	2	260	X	
44	NEPA Preferred Alternative	Farrington Road	Leigh Village	2	230	X	

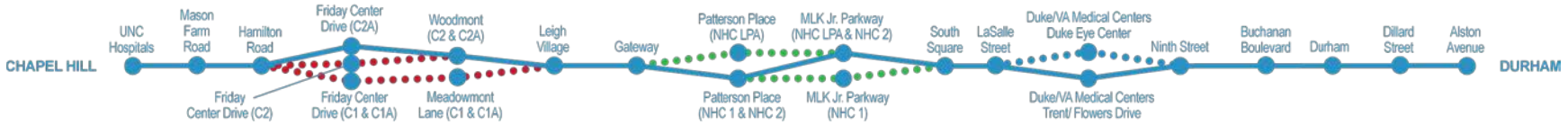


Table 4.10-3: Noise- and Vibration-Sensitive Receptors

Site # (Figure Reference)	Alternative	Name/Location of Receptor Sites	Station Proximity	FTA Noise Category (Land Use)	Distance from Receptor to Tracks (feet)	Noise Receptor	Vibration Receptor
45	NEPA Preferred Alternative	Baker Mill Road	Leigh Village	2	170	X	
46	NEPA Preferred Alternative	Beaumont Drive	Leigh Village	2	210	X	
47	NEPA Preferred Alternative	Crystal Oaks Court	Leigh Village	2	190	X	
48	NEPA Preferred Alternative	Old Coach Road	Leigh Village	2	300	X	
49	NEPA Preferred Alternative	Old Coach Road	Leigh Village	2	150	X	X
50	NEPA Preferred Alternative	Old Coach Road	Leigh Village	2	80	X	X
51	NEPA Preferred Alternative	Old Chapel Hill Road	Leigh Village	2	315	X	
52	NEPA Preferred Alternative	N. White Oak Drive	Gateway	2	100	X	X
53	NEPA Preferred Alternative	N. White Oak Drive	Gateway	2	80	X	X
54	NEPA Preferred Alternative	Comfort Inn University Drive	Gateway	2	130 [a]	X	X
55	NHC 1, NEPA Preferred Alternative	East Sayward Drive	Patterson Place	2	140	X	X
56	NHC 1, NEPA Preferred Alternative	Northcreek Drive 1	Patterson Place	2	150	X	X
57	NHC 1, NEPA Preferred Alternative	West Garrett Road	Patterson Place	2	50 [a]	X	X
58	NHC 1	North Larchmont Road	Martin Luther King Jr. Parkway	2	140 [a]	X	X
59	NHC 1	Lyckan Parkway	Martin Luther King Jr. Parkway	2	75 [a]	X	X
60	NHC 1	Melstone Turn	Martin Luther King Jr. Parkway	2	275 [a]	X	
61	NHC 1	University Drive	Martin Luther King Jr. Parkway	2	300	X	
62	NHC LPA	North Sayward Drive	Patterson Place	2	150	X	X
63	NHC LPA	South Sayward Drive	Patterson Place	2	180	X	
64	NHC LPA	SW Durham Drive 1	Patterson Place	2	150	X	X
65	NHC LPA	Hopedale Avenue	Patterson Place	2	310	X	
66	NHC LPA	Garrett Road	Patterson Place	2	250	X	
66A	NHC LPA	New Hope Creek Trails	Patterson Place	1	20 [a]	X	

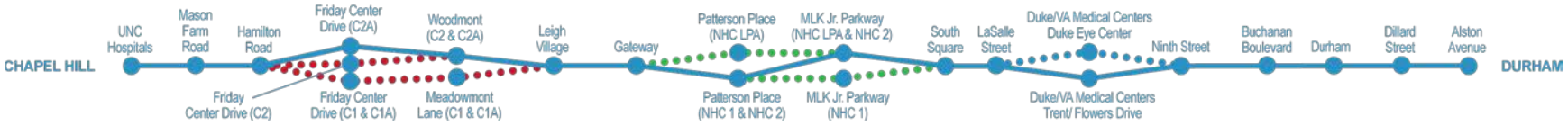


Table 4.10-3: Noise- and Vibration-Sensitive Receptors

Site # (Figure Reference)	Alternative	Name/Location of Receptor Sites	Station Proximity	FTA Noise Category (Land Use)	Distance from Receptor to Tracks (feet)	Noise Receptor	Vibration Receptor
67	NHC LPA, NEPA Preferred Alternative	Snow Crest Trail 1	Martin Luther King Jr. Parkway	2	50	X	X
68	NHC LPA, NEPA Preferred Alternative	Snow Crest Trail 2	Martin Luther King Jr. Parkway	2	70	X	X
69	NHC LPA, NEPA Preferred Alternative	Snow Crest Trail 3	Martin Luther King Jr. Parkway	2	150	X	X
70	NHC LPA, NEPA Preferred Alternative	Larchmont Road	Martin Luther King Jr. Parkway	2	70	X	X
71	NEPA Preferred Alternative	Pickett Rd South	South Square	2	50	X	X
72	NEPA Preferred Alternative	Pickett Rd South	South Square	2	200	X	
73	NEPA Preferred Alternative	Pickett Rd South	South Square	2	90	X	X
74	NEPA Preferred Alternative	Pickett Rd North	South Square	2	60	X	X
75	NEPA Preferred Alternative	US 15/501 West	South Square	2	270	X	
76	NEPA Preferred Alternative	Golf Course Greens	South Square	3	150	X	
77	NEPA Preferred Alternative	VA Medical Center North	Duke/VA Medical Centers	2/3	200	X	X
78	NEPA Preferred Alternative	Duke Medical Center South	Duke/VA Medical Centers	2/3	260	X	X
79	NEPA Preferred Alternative	John Hope Franklin Center	Duke/VA Medical Centers	3	130	X	
80	NEPA Preferred Alternative	Anderson Street Apartments	Duke/VA Medical Centers	2	130	X	X
81	NEPA Preferred Alternative	St. Joseph's Episcopal Church	Ninth Street	3	325 [a]	X	
81A	NEPA Preferred Alternative	Hilton Garden Inn	Ninth Street	2	250	X	
82	NEPA Preferred Alternative	Powe House - Counseling	Ninth Street	3	100 [a]	X	X
82A	NEPA Preferred Alternative	Pettigrew Rehab Center	Ninth Street	3	60 [a]	X	X
82B	NEPA Preferred Alternative	W. Pettigrew Dialysis	Ninth Street	3	80 [a]	X	X
82C	NEPA Preferred Alternative	Hillcrest Convalescent Center	Ninth Street	2	100 [a]	X	X
83	NEPA Preferred Alternative	Duke Center Documentary Studies	Buchanan Boulevard	3	45 [a]	X	X

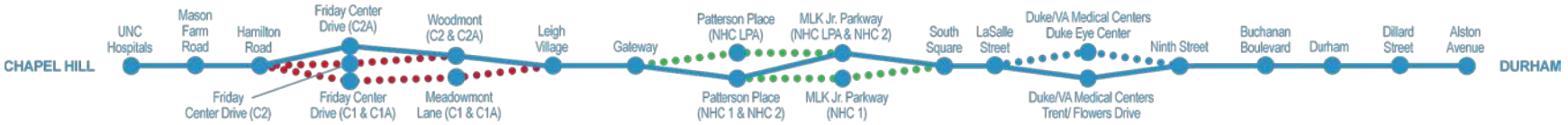


Table 4.10-3: Noise- and Vibration-Sensitive Receptors

Site # (Figure Reference)	Alternative	Name/Location of Receptor Sites	Station Proximity	FTA Noise Category (Land Use)	Distance from Receptor to Tracks (feet)	Noise Receptor	Vibration Receptor
84	NEPA Preferred Alternative	Smith Warehouse	Buchanan Boulevard	3	275	X	
85	NEPA Preferred Alternative	Duke Memorial United Methodist	Durham	3	165	X	
86	NEPA Preferred Alternative	West Village Apts.	Durham	2	215	X	
87	NEPA Preferred Alternative	Old Bull Bldg Apartments	Durham	2	40	X	X
87A	NEPA Preferred Alternative	Durham Performing Arts	Durham	3/4	245	X	X
87B	NEPA Preferred Alternative	Venable Center	Durham	3	30	X	
88	NEPA Preferred Alternative	Avery Boys & Girls Club	Alston Avenue	3	120	X	X
89	NEPA Preferred Alternative	Colfax House 1	Alston Avenue	2	160	X	
90	NEPA Preferred Alternative	Colfax House 2	Alston Avenue	2	160	X	
91	NEPA Preferred Alternative	Murphy Street House West	Alston Avenue	2	160	X	
92	NEPA Preferred Alternative	Murphy Street House East	Alston Avenue	2	260	X	

Source: *Noise and Vibration Technical Report* (appendix K.24).

[a] Distance to elevated light rail alignment.

Table 4.10-4: Noise-Sensitive Receptors (ROMFs)

Site No.	Alternative	Name/Location of Receptor Sites [a]	Land Use Category	Distance to Receptors (feet)
42	Farrington Road	Farrington Road	2	1200
44	Leigh Village	Farrington Road	2	1200
93	Leigh Village	Leigh Farm Homes	2	880
94	Leigh Village + Farrington Road	Farrington Road North	2	200
95	Leigh Village + Farrington Road	Farrington Road North 1	2	920/1200
96	Leigh Village + Farrington Road	Farrington Road North 2	2	1080/1500
97	Leigh Village	Farrington Road North	2	800
98	Patterson Place	North Creek Drive Apartments	2	640
99	Cornwallis Road	Maureen Joy Charter School	3	480
100	Cornwallis Road	Lerner Jewish Community School	3	400

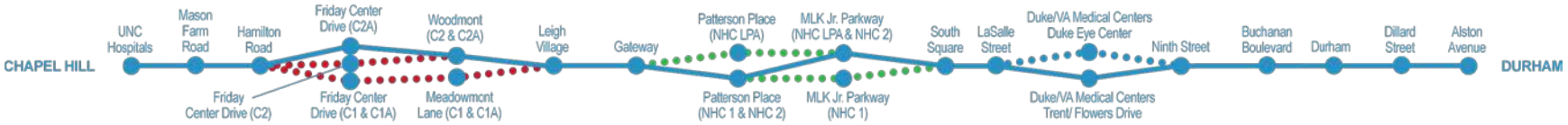


Table 4.10-4: Noise-Sensitive Receptors (ROMFs)

Site No.	Alternative	Name/Location of Receptor Sites [a]	Land Use Category	Distance to Receptors (feet)
101	Alston Avenue	W. Bacon Street	2	685

Source: *Noise and Vibration Technical Report* (appendix K.24).

[a] Distance measured from center of ROMF site.

Table 4.10-5: Monitored Existing Noise Levels (dBA)

Monitoring Sites	Peak Hour (L_{eq})				L_{dn}
	AM	Midday	PM	Night	
M1A. N. Mason Farm Road & Hibbard Drive	46	63	46	44	58
M2. N. Mason Farm Road	53	45	48	46	50
M3. Woodbine Drive & Manning Drive	74	73	71	69	74
M4. Glenwood Elementary School	50	52	59	50	55
M5. Finley Golf 17th Hole Tee Box	53	62	55	50	59
M6. Meadowmont Lane & Green Cedar Lane	57	59	54	49	57
M7. Crescent Drive south of Wendell Road	55	49	56	55	59
M8. Courtyard Chapel Hill –Friday Center Drive	64	59	60	56	61
M9. Stancell Drive & Little John Road	62	64	64	59	64
M10. E. Ephesus Church Road & Farrington Road	63	61	63	59	64
M11. N. White Oak Drive	56	53	55	55	59
M12. Sayward Drive	57	46	48	50	54
M12A. 600' west of Garrett Road	67	67	66	67	71
M12B. West side Lyckan Parkway	61	59	61	57	62
M12C. North Creek Drive	52	46	47	47	51
M13. Snow Crest Trail	49	50	49	44	50
M14. Tower Boulevard & Picket Road	55	52	51	51	56
M14A. Maureen Joy Charter School	57	51	54	51	56
M14B. Cornwallis Rd Golf Course	59	59	57	n/a	59
M14C. Levin Jewish Community Center	52	52	48	49	54
M15. Erwin Road & Trent Road	67	67	70	65	70
M16. Durham Performing Arts Center	66	66	65	61	67

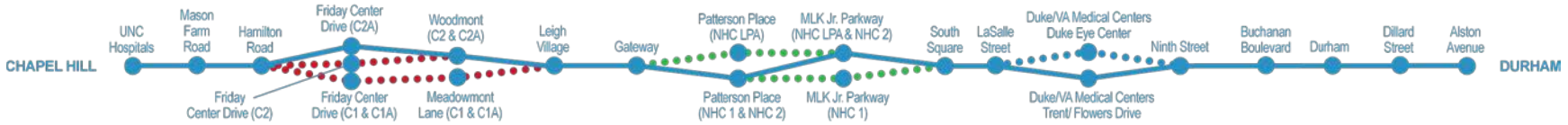


Table 4.10-5: Monitored Existing Noise Levels (dBA)

Monitoring Sites	Peak Hour (L_{eq})				L_{dn}
	AM	Midday	PM	Night	
M17. N. Alston Avenue & E. Pettigrew Street	74	72	69	66	72
M17A. Joplin & Bernice Streets	62	61	63	61	65

Source: *Noise and Vibration Technical Report* (appendix K.24).

Table 4.10-6: Summary of Noise and Vibration Impacts by Alternative

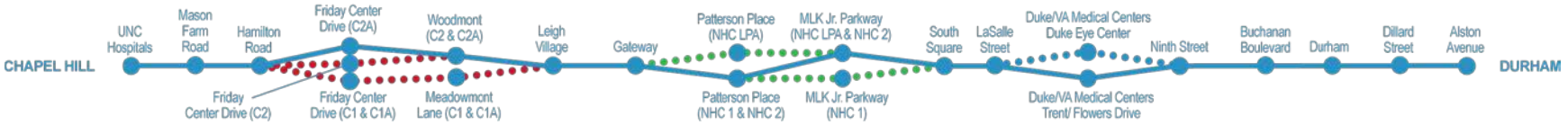
	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives			New Hope Creek Alternatives		Duke/VA Medical Centers
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Noise - Severe	0	1	+1	0	0	+1	0	0
Noise- Moderate	0	4	-1	0	0	0	0	0
Vibration Impact	0	8	+2	+1	+1	-1	0	0
Ground-Borne Noise Impact	0	13	+2	+1	+1	-1	-1	0

Source: *Noise and Vibration Technical Report* (appendix K.24).

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

Table 4.10-7: Noise Impacts NEPA Preferred Alternative

Site No.	Name/Location of Receptor Site	Project Noise	Ambient Noise	Impact Range dBA	Impact	Impact Source
2	UNC Odum Village Branson Street & Hibbard Drive 2	57	58	57-62	Moderate	LRT, Bell
7	UNC Odum Village Branson Street & Hibbard Drive 7	64	58	57-62	Severe	LRT, Bells
8	UNC Odum Village Branson Street & Hibbard Drive 8	61	58	57-62	Moderate	LRT
37	Residence George King Road	60	59	58-63	Moderate	LRT



Site No.	Name/Location of Receptor Site	Project Noise	Ambient Noise	Impact Range dBA	Impact	Impact Source
52	Residence N. White Oak Drive	60	59	58-63	Moderate	Park-and-Ride Lot

Source: *Noise and Vibration Technical Report* (appendix K.24).

Table 4.10-8: Vibration and Ground-Borne Noise Impacts for NEPA Preferred Alternative

Site No.	Receptor Site	Vibration Impact	Ground-Borne Noise Impact
2	Branson Street & Hibbard Drive 2	No	Yes
7	Branson Street & Hibbard Drive 7	No	Yes
37	George King Road	Yes	Yes
38	Hudson Road	Yes	Yes
39	Crescent Drive South	Yes	Yes
41	Farrington Road North	Yes	Yes
50	Old Coach Road	Yes	Yes
53	N. White Oak Drive	No	Yes
56	Northcreek Drive 1	Yes	Yes
67	Snow Crest Trail 1	No	Yes
74	Pickett Road North	No	Yes
83	Ctr. Documentary Studies	Yes	Yes
87	Old Bull Bldg. Apartments	Yes	Yes

Source: *Noise and Vibration Technical Report* (appendix K.24).

Table 4.10-9: Noise Impacts Little Creek Alternatives

Site No.	Name/Location of Receptor Site	Alternative	Project Noise	Ambient Noise	Impact Range dBA	Impact	Impact Source
27A	Residence Iron Mountain Road 1	C1A	59	57	57-62	Moderate	LRT
27D	Residence Iron Mountain Road 4	C1	80	57	57-62	Severe	LRT
37	Residence George King Road	C2	60	59	58-63	Moderate	LRT

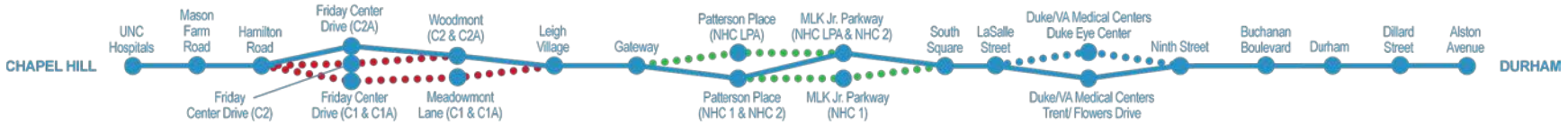


Table 4.10-10: Vibration and Ground-Borne Noise Impacts Little Creek Alternatives

Site No.	Receptor Site	Alternative	Vibration Impact	Ground-Borne Noise Impact
26	Cedar Berry Lane	C1, C1A	Yes	Yes
27A	Iron Mountain Road 1	C1A	Yes	Yes
27C	Iron Mountain Road 3	C1	Yes	Yes
27D	Iron Mountain Road 4	C1	Yes	Yes
30	Brookberry Circle	C2	Yes	Yes
37	George King Road	C2	Yes	Yes

Table 4.10-11: Noise Impacts New Hope Creek Alternatives

Site No.	Name/Location of Receptor Site	Alternative	Project Noise	Ambient Noise	Impact Range dBA	Impact	Impact Source
66A	New Hope Creek Trail	NHC LPA	65	50	59-64	Severe	LRT

Table 4.10-12: Vibration and Ground-Borne Noise Impacts New Hope Creek Alternatives

Site No.	Receptor Site	Alternative	Vibration Impact	Ground-Borne Noise Impact
56	Northcreek Drive 1	NHC 1	Yes	Yes
67	Snow Crest Trail 1	NHC LPA	No	Yes

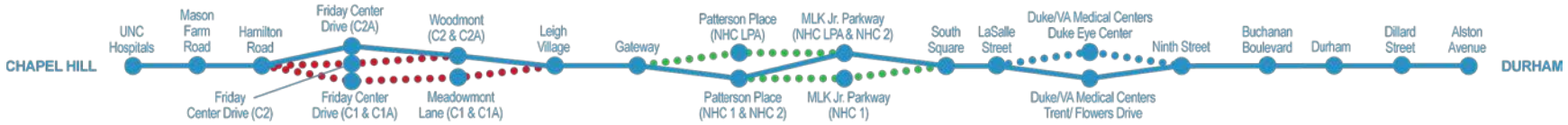


Table 4.10-13: Mitigation of Noise Impacts

Site No.	Receptor Site	Mitigation [a]
NEPA Preferred Alternative		
2	UNC Odum Village Branson Street and Hibbard Drive	Demolition by UNC per Campus Master Plan, Project Acquisition
7	UNC Odum Village Branson Street and Hibbard Drive	Demolition by UNC per Campus Master Plan, Project Acquisition
8	UNC Odum Village Branson Street and Hibbard Drive	Demolition by UNC per Campus Master Plan, Project Acquisition
37	Residence George King Road	Project Acquisition
52	Residence N. White Oak Drive	Project Acquisition
C1A Alternative		
27A	Residence Iron Mountain Road 1	Project Acquisition
C1 Alternative		
27D	Residence Iron Mountain Road 4	Project Acquisition
C2 Alternative		
37	Residence George King Road	Project Acquisition
NHC LPA Alternative		
66A	Trail	Elevated Track Barriers

Source: *Noise and Vibration Technical Report* (appendix K.24).

[a] FTA Guidance Manual, Table 6-12. Transit Noise Mitigation Measures.

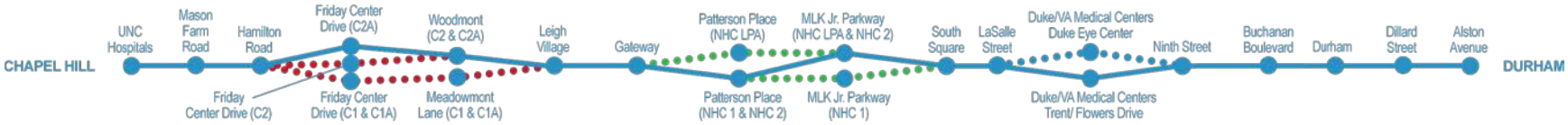
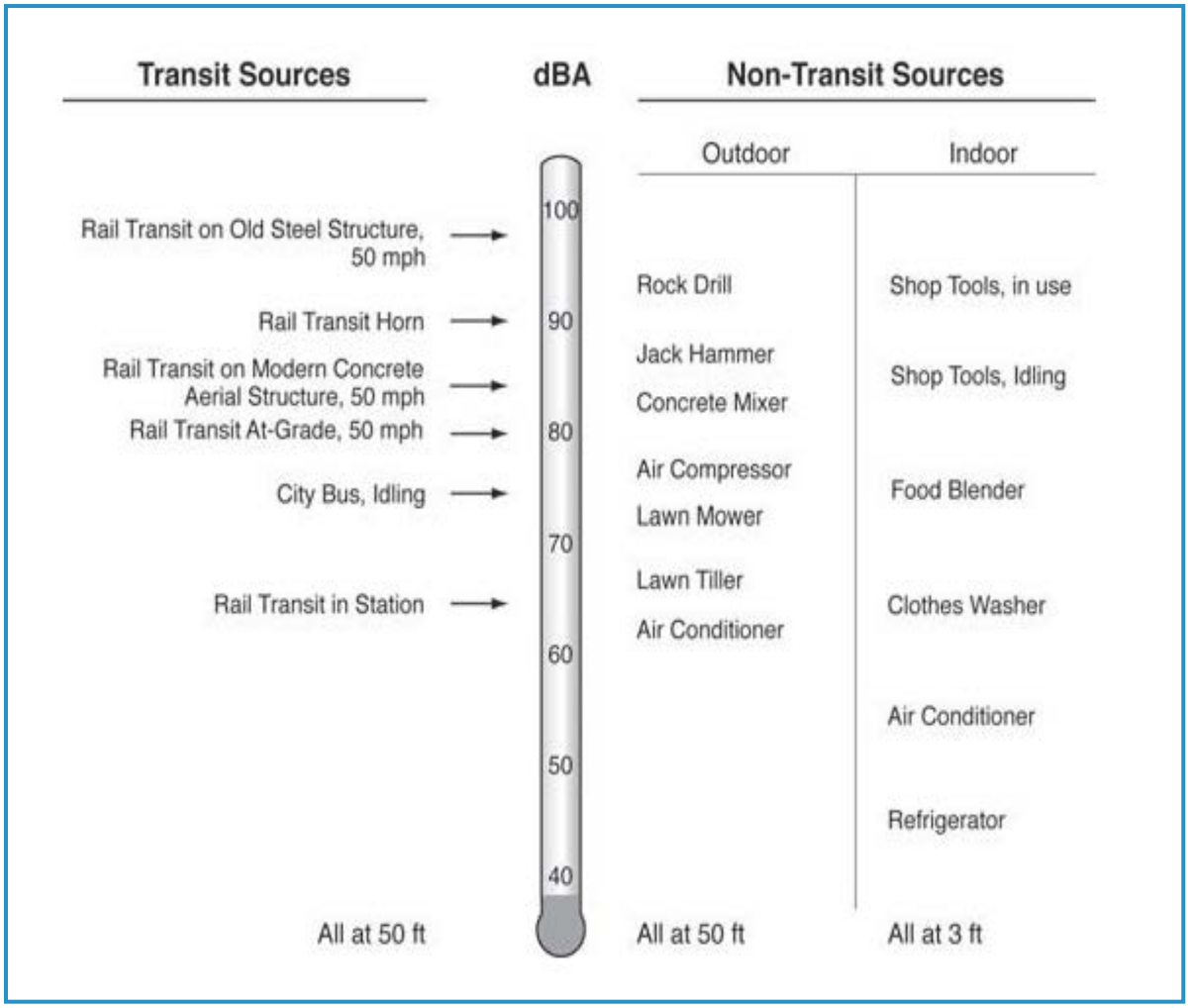


Figure 4.10-1: Typical Sound Levels for Common Noise Sources (measured in dBA)



Source: FTA Guidance Manual.

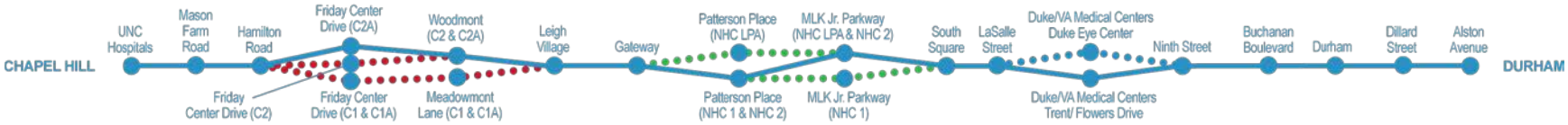
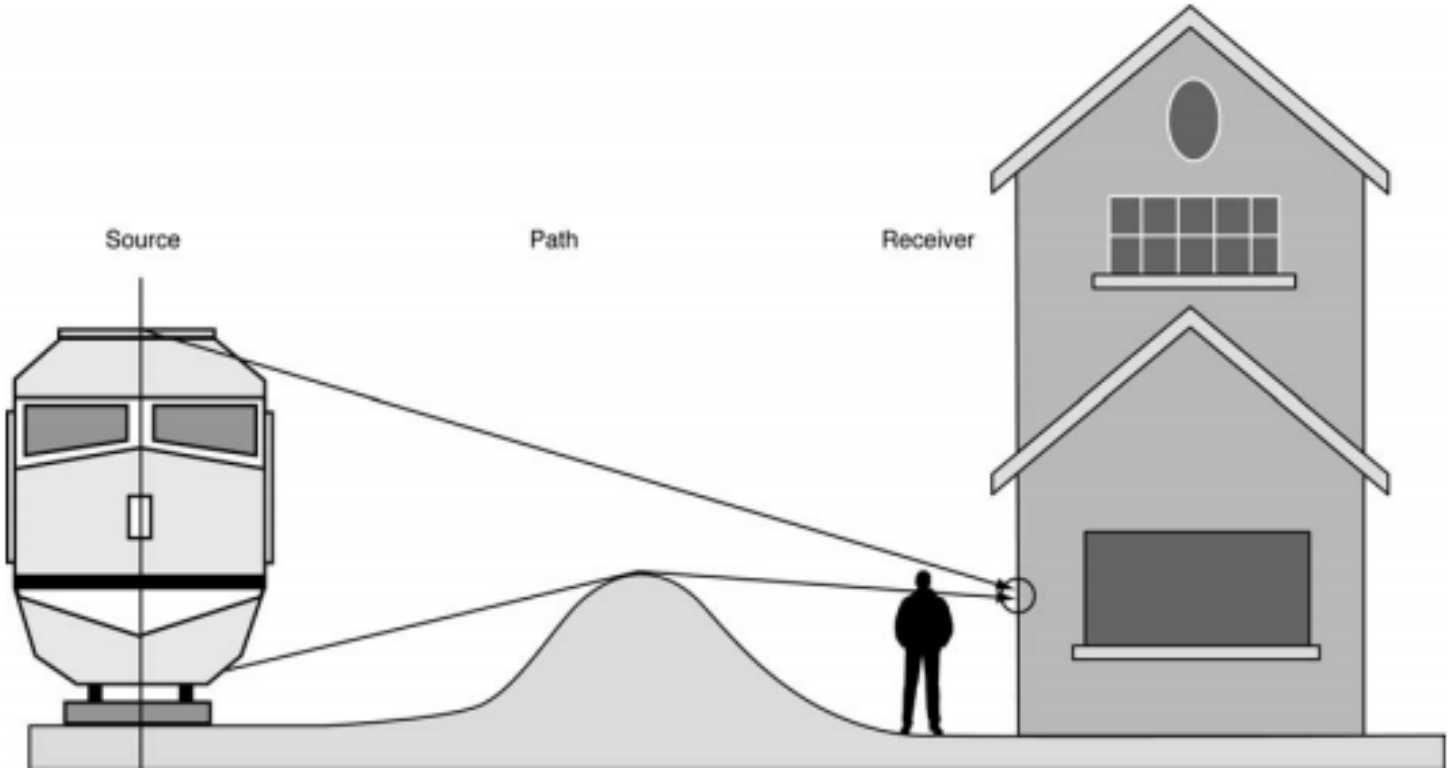


Figure 4.10-2: Path of Airborne Noise



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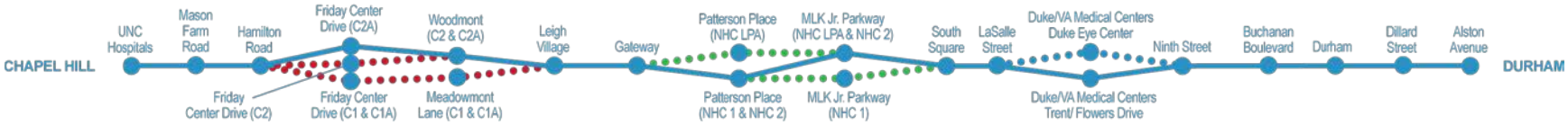
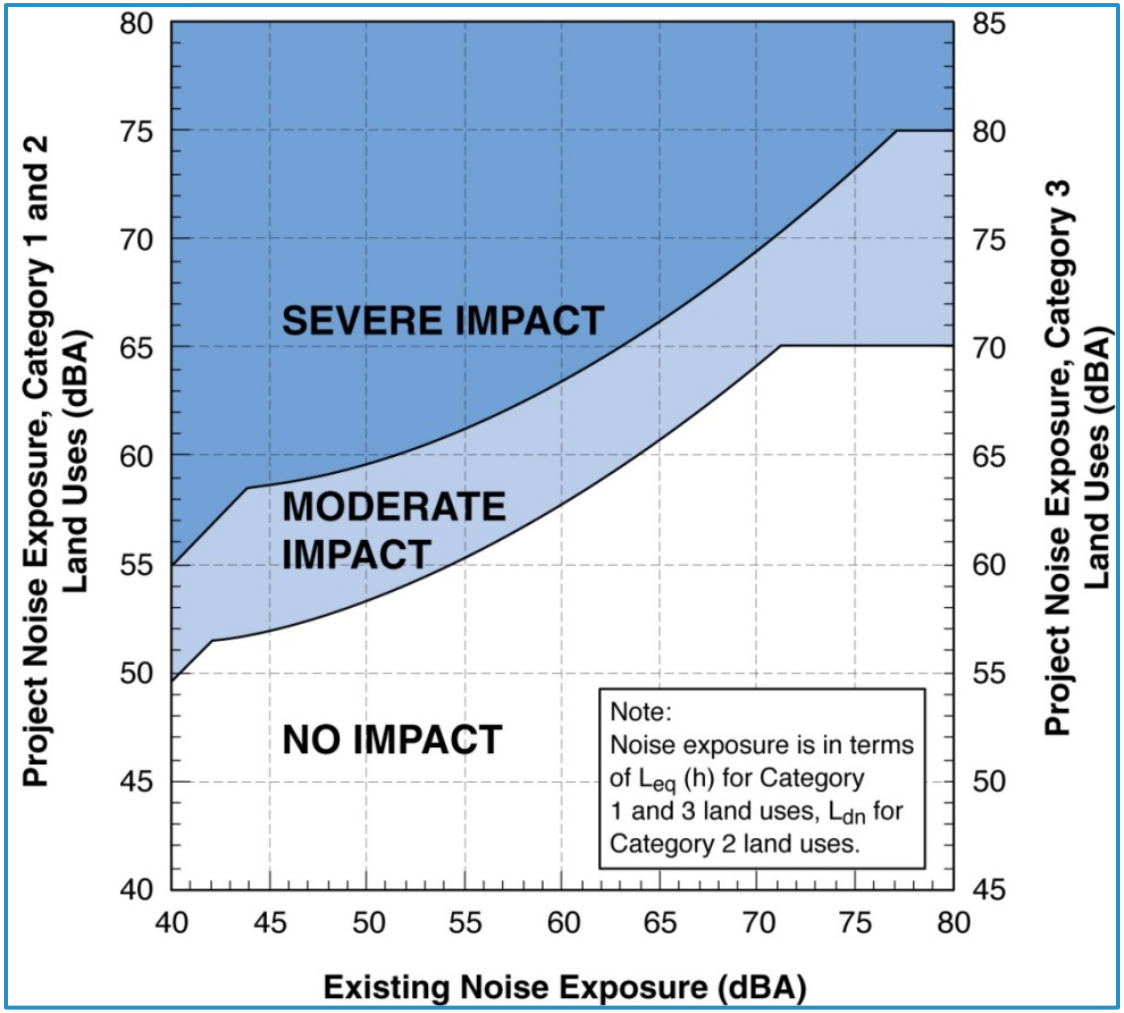


Figure 4.10-3: FTA Noise Impact Criteria



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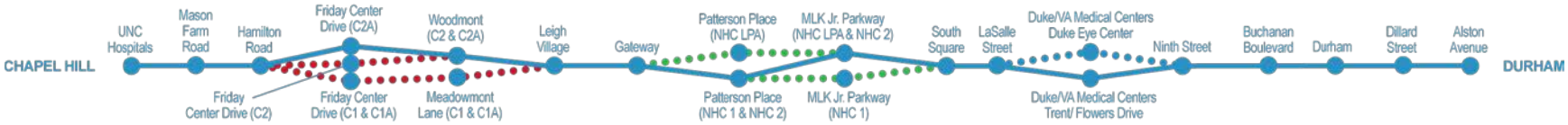
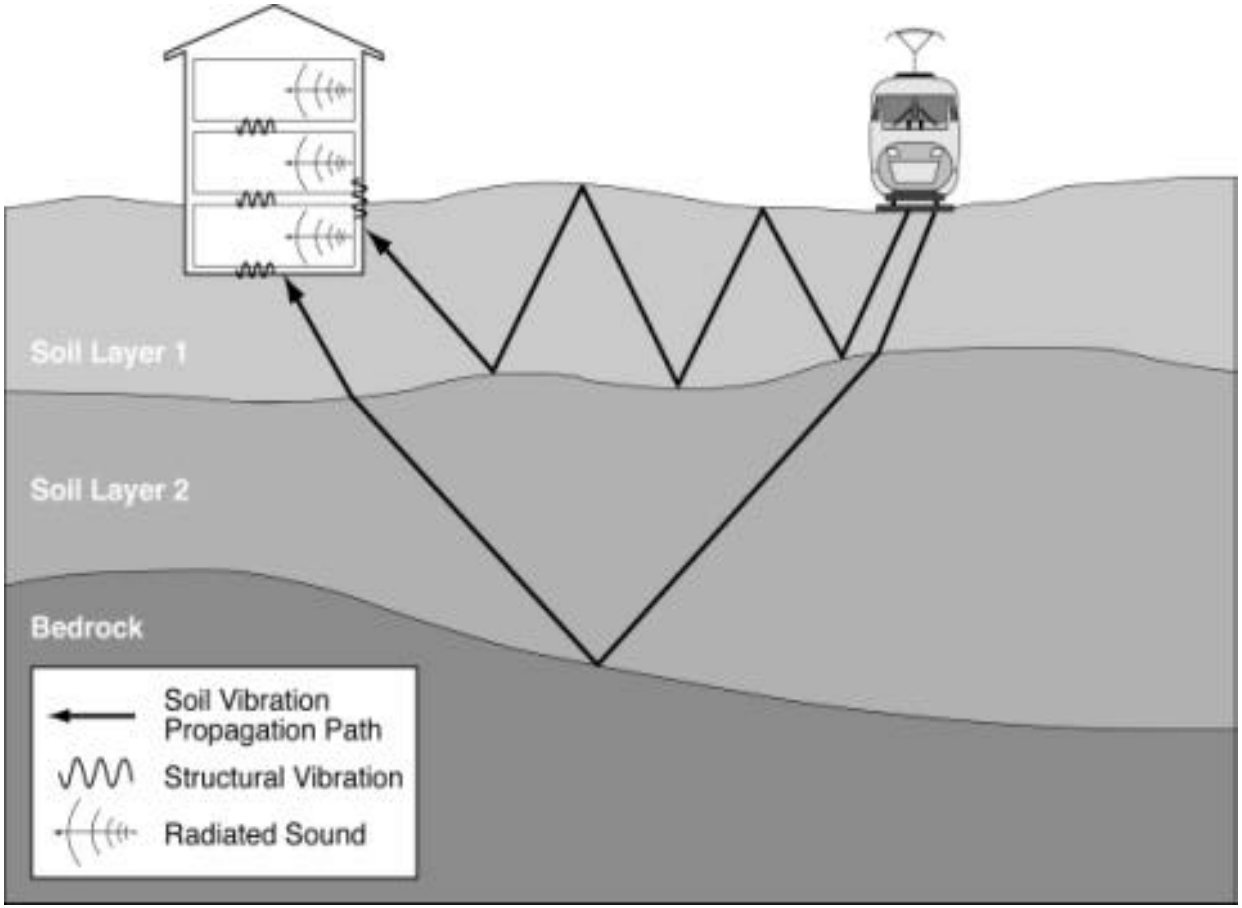


Figure 4.10-4: Path of Vibration



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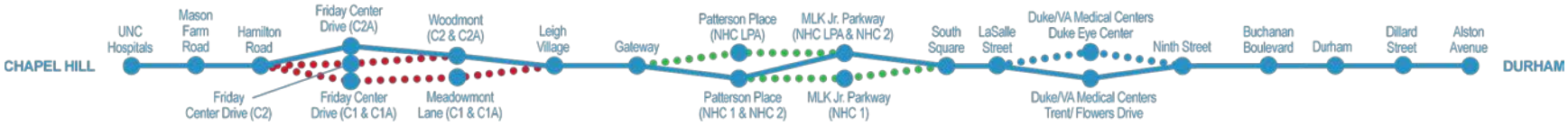
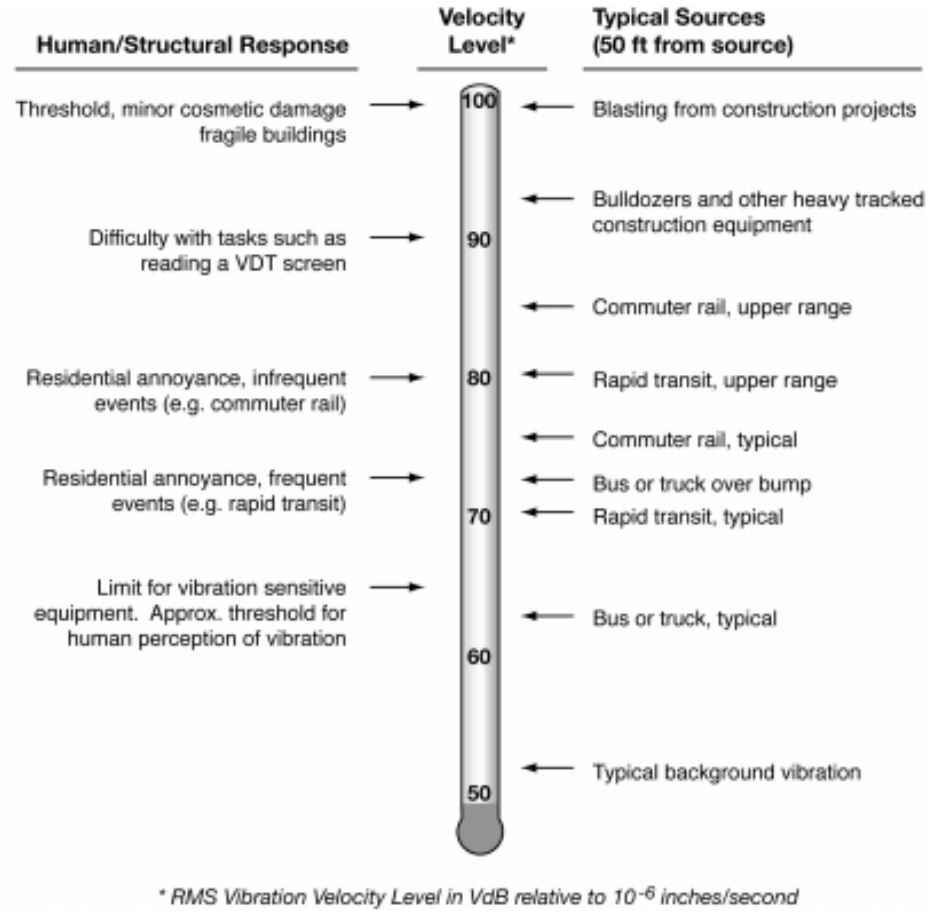


Figure 4.10-5: Typical Levels of Ground-Borne Vibration



Source: FTA Guidance Manual.

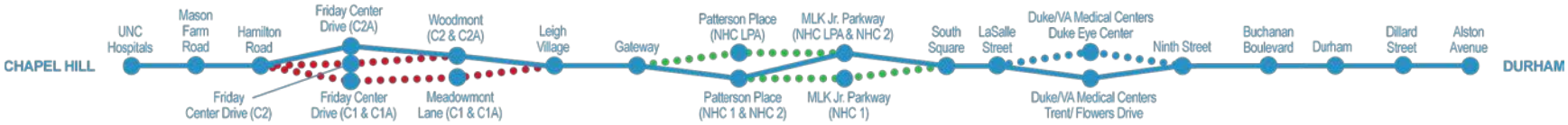


Figure 4.10-6: Noise, Vibration, and Ground-Borne Noise Impacted Receptor Locations

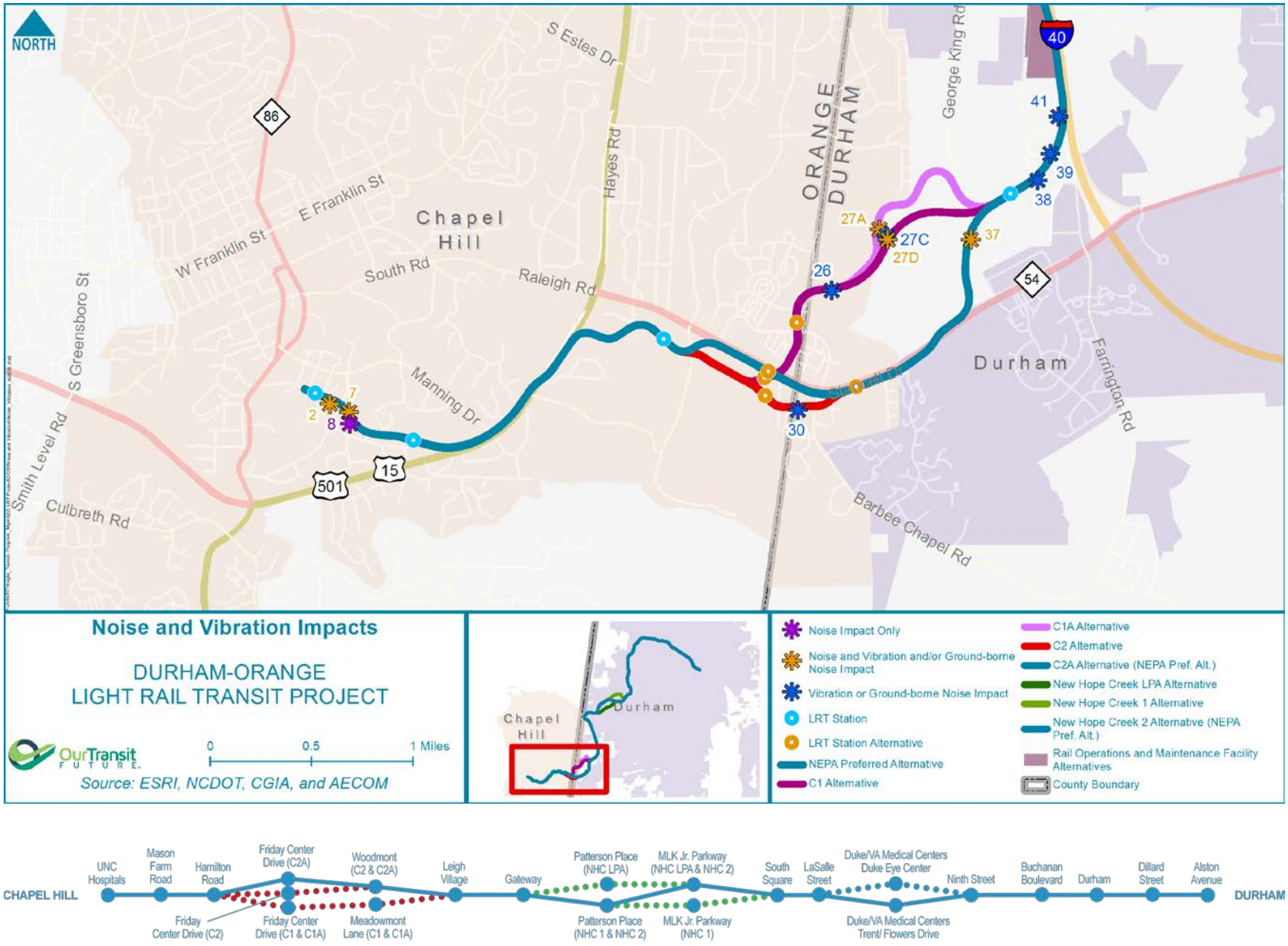


Figure 4.10-7: Noise, Vibration, and Ground-Borne Noise Impacted Receptor Locations

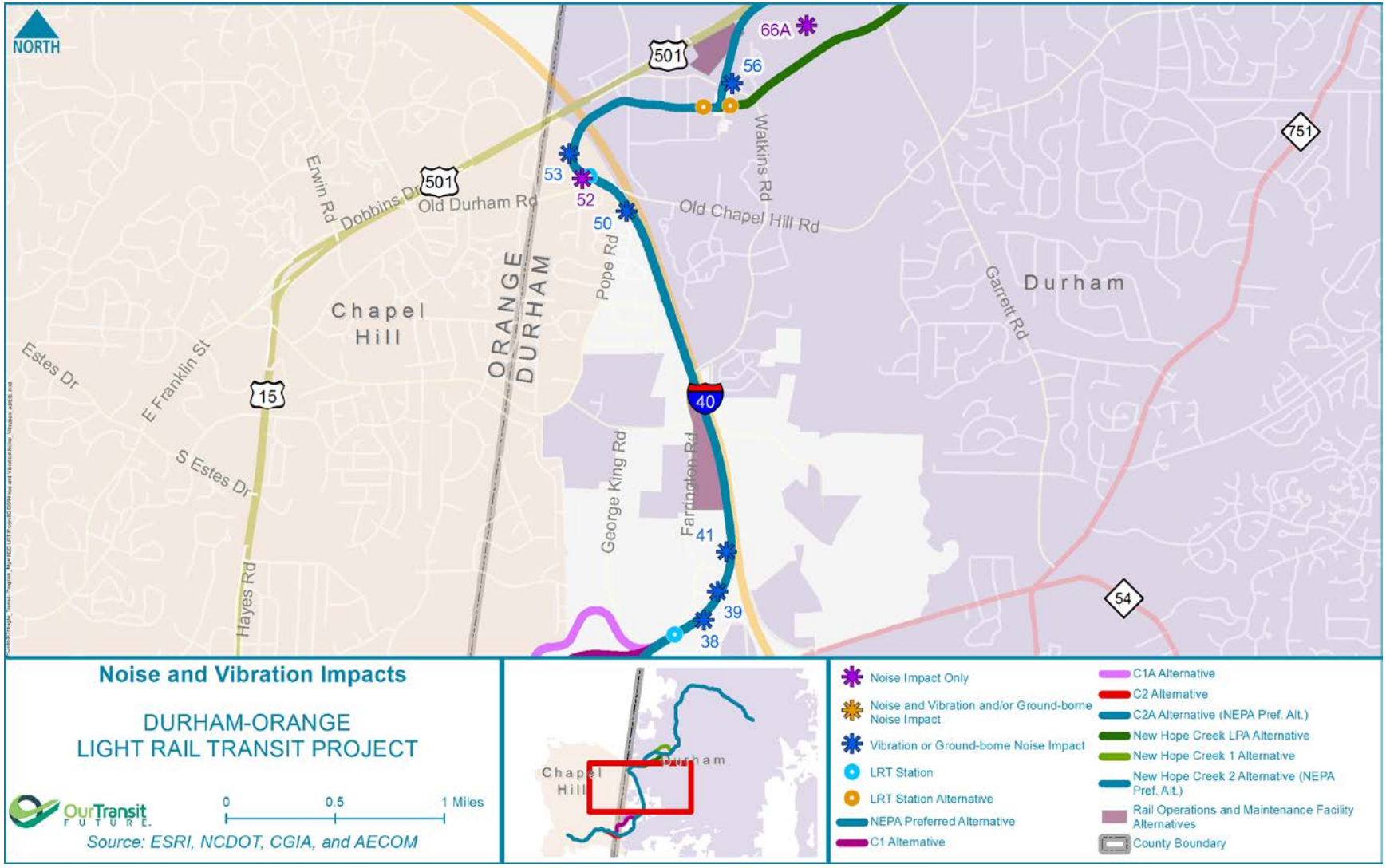


Figure 4.10-8: Noise, Vibration, and Ground-Borne Noise Impacted Receptor Locations

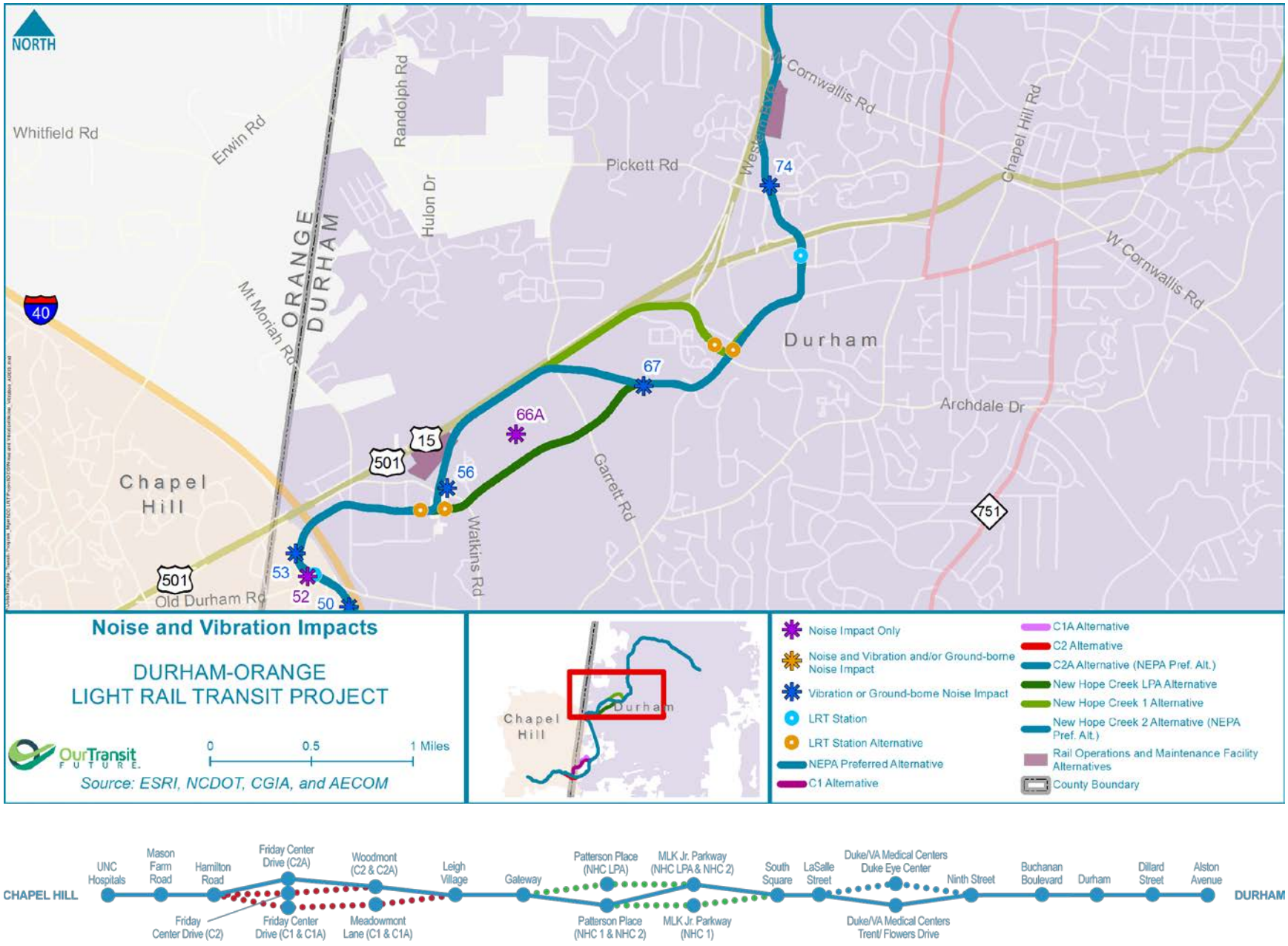
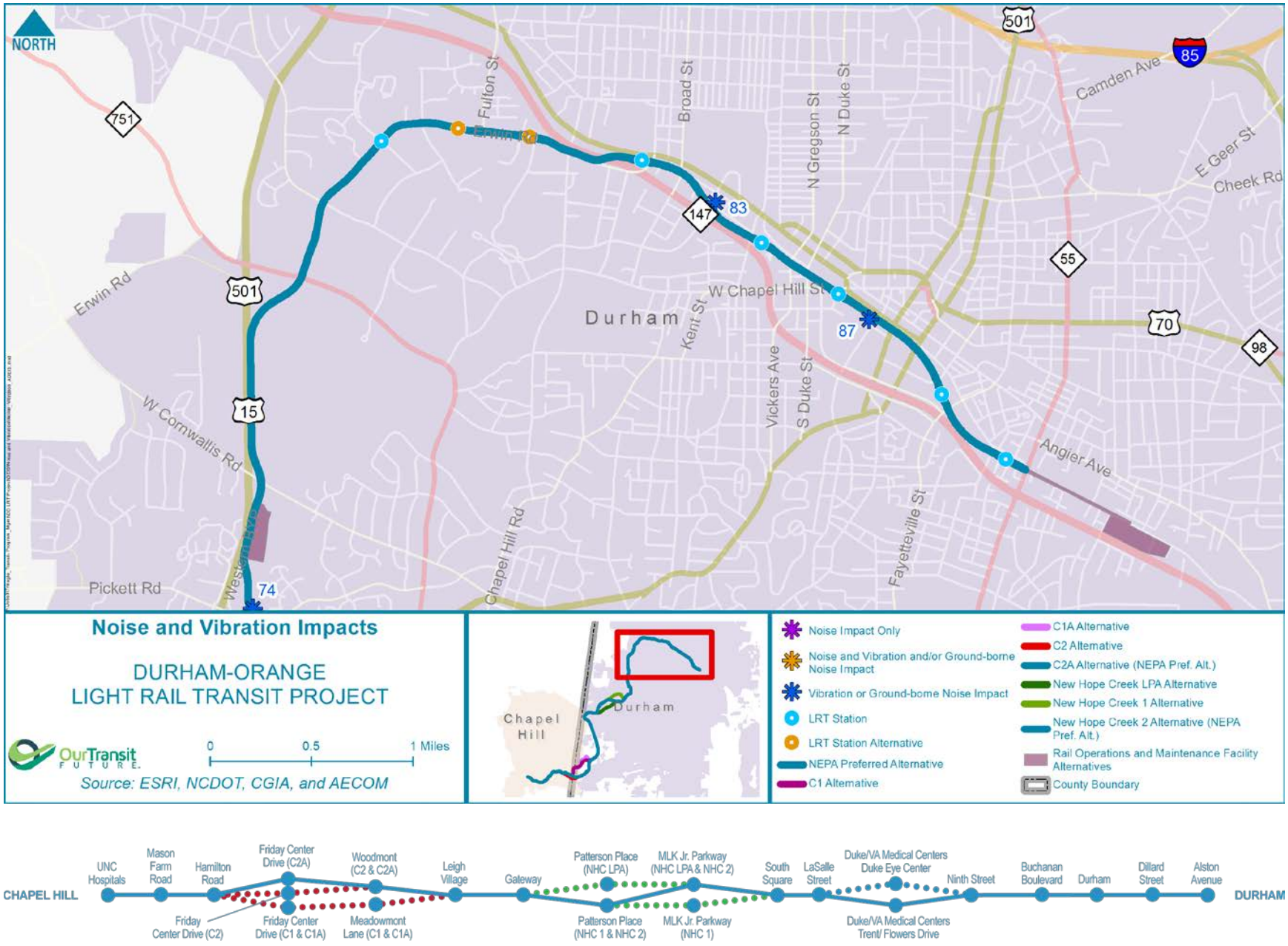


Figure 4.10-9: Noise, Vibration, and Ground-Borne Noise Impacted Receptor Locations



4.11 Hazardous, Contaminated, and Regulated Materials

The presence of potentially contaminated properties is a concern in the development of transit projects for the following reasons:

- Potential liabilities associated with ownership of such properties
- Migration of contaminated materials off the properties
- Potential cleanup costs
- Potential impact on public health
- Safety concerns associated with construction personnel encountering unsuspected wastes or contaminated soil or groundwater

This section describes the procedures used to search for hazardous and contaminated materials within the study area. In addition, this section presents the results of a corridor-level field review and a search of local, state, and federal databases of known hazardous, contaminated, or regulated materials sites, which may be impacted by the proposed D-O LRT Project. Mitigation measures to minimize impacts are also described. Properties were evaluated for risk potential and were summarized by risk categories of low, medium, and high.

Information included within this section is based on the detailed information provided in appendix K.25.

Recognized environmental condition (REC) is defined as "the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, ground water, or surface water of the property."

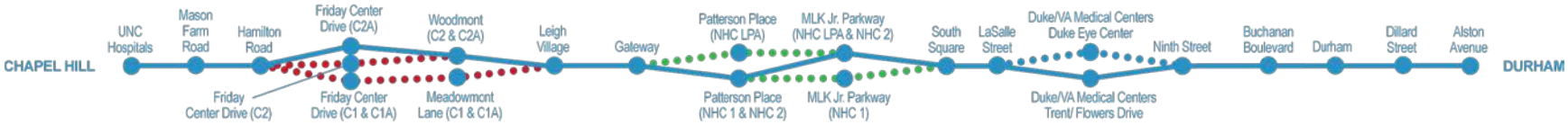
American Society for Testing and Materials (ASTM) Standard E1527-05, *Standard Practice for Environmental Site Assessment: Phase I Environmental Site Assessment Process*, 2005

4.11.1 Methodology

A database search provided by the Environmental Data Resources Inc. (EDR) DataMap Environmental Atlas report, dated May 13, 2013, identified possible recognized environmental conditions (REC) for properties occurring within the study area for hazardous, contaminated, and regulated materials, which is one mile on either side of the proposed D-O LRT Project. Field personnel examined properties along and adjacent to the NEPA Preferred and Project Element Alternatives between July and October 2013 to determine the presence of hazardous material as defined by the Environmental Protection Agency's (EPA) list of Hazardous and Toxic Wastes (40 C.F.R. § 261 et seq.) and petroleum handling facilities.

The following methods were used to prepare appendix K.25 for the proposed D-O LRT Project, in accordance with ASTM Standard E 1527-05, *Standard Practice for Environmental Site Assessment: Phase I Environmental Site Assessment Process*:

- Identification, primarily using the EDR report, of any known hazardous waste or contamination within areas to be affected by potential construction
- Assessment of the presence of environmental concerns or contamination due to past or current practices or land use in properties to be acquired
- Compilation of list of activities of other industries/commercial areas in the immediate area(s)
- Search of known contaminated sites adjacent to or on the route of the proposed alignment
- Identification of sites requiring further analysis



Field visits to the D-O Corridor were conducted over the course of several weeks between July and October 2013. During the site visits, assessments were made of any signs of release or other mishandling of stored or used hazardous materials, as well as evidence of past releases of hazardous materials such as soil stains or impacted vegetation. These observations were used to supplement information available from government records of past release of hazardous materials, and to identify any previously unrecorded releases not evident in existing records.

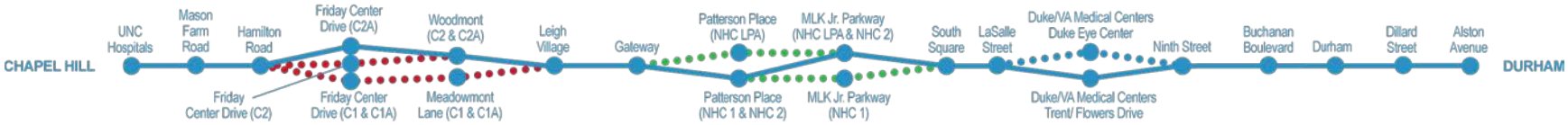
Properties were assigned a degree of low, medium, or high risk for potential soil and/or groundwater contamination. These risk rankings are described below:

- **Low**: Based on the geological information available for the area, it was concluded that properties that are greater than 500 feet away from the NEPA Preferred and Project Element Alternatives have the lowest risks of causing environmental impacts. This is because groundwater and subsurface contamination is significantly minimized at such a distance. In addition, hazardous waste generators or facilities with general listing database records indicating no real recorded incidents (e.g., the Facility Index System [FINDS] database record as indicated by the EDR report) are classified as low risk.
- **Medium**: Properties that are within 500 feet of the NEPA Preferred and Project Element Alternatives and are closed leaking underground storage tank (LUST) sites, aboveground storage tank/underground storage tank (AST/UST) sites, vehicle repair sites or junk yards, or have closed spill incidents.
- **High**: Properties that are within 500 feet of the NEPA Preferred and Project Element Alternatives and are closed LUST sites with no documented cleanup; are active LUST sites, historic dry cleaners, or auto stations (i.e., gas stations); or have open spill incidents.

In addition to environmental database searches, two documentations from previous investigations were available for review for Bob's Service Garage, the Former Graybar Building, and Former Flintom Services Site and are referenced in appendix K.25. From the *Phase I Regional Rail System, Durham and Wake Counties, North Carolina, Final Environmental Impact Statement and Section 4(f) Evaluation* (Triangle Transit Authority 2002), 13 sites that were identified with known or potential environmental contamination are located within the screening distance of the proposed D-O LRT Project. All 13 sites have also been identified in appendix K.25 with either a medium or a high risk with the exception of Worth Chemical, which is located greater than 500 feet from the proposed D-O LRT Project.

The types of regulatory listings and regulatory agency files used in this process are often incomplete. They only include sites that agencies are aware of at the time of publication, or those sites known to be contaminated or possessing a potential for contamination because of the presence of hazardous materials and/or petroleum products.

102 geotechnical borings were conducted as part of the structural soil boring program from April to October 2014 along the entire length of the proposed D-O LRT Project at distances approximately 200 to 500 feet apart, to depths ranging from 1 to 76 feet below existing grades. The soil in these borings was tested for contaminants.



Database Definitions

- **FINDS**: Facility Index System
- **IMD**: Incident Management Database
- **LAST**: leaking aboveground storage tank
- **LUST**: leaking underground storage tank
- **LUST TRUST**: leaking underground storage tank state trust funds
- **NPDES**: National Pollutant Discharge Elimination System
- **RCRA**: Resource Conservation and Recovery Act
- **SHWS**: state hazardous waste sites
- **UIC**: underground injection wells/controls
- **UST**: underground storage tank

4.11.2 Affected Environment

The limited Phase I ESA identified 426 properties of concern, as described in more detail in DEIS section 4.11.3 and in appendix K.25.

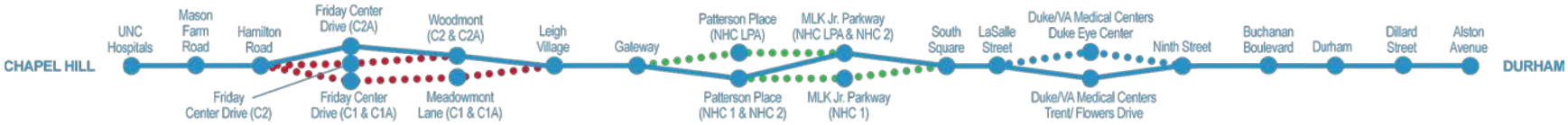
4.11.3 Environmental Consequences

Hazardous/regulated material related impacts of the proposed D-O LRT Project are primarily dictated by past activities or practices at the site and/or adjacent properties. Secondary potential impacts of the proposed project could include the deposit of hazardous material on the site during construction or the release of hazardous material from the site by construction activities.

The NEPA Preferred and Project Element Alternatives would involve excavation and construction activities along the proposed alignment, the proposed station areas and layover facilities, and some adjacent properties. These activities have the potential to uncover or disturb existing hazardous or toxic materials as well as fill from unknown sources. For locations that have yet to be determined, sampling and testing of these potential sources would need to be conducted before the removal and disposal of material, as contact with contaminants in the project area could have adverse effects on workers, the public, and environmental health and safety. If a contaminated site is found, delineation of the site is required to determine whether there is a true threat to citizens and workers, or if the sites contamination levels are not exceeding any harmful levels.

Delineating the site requires a variety of tasks including soil sampling, mapping, and groundwater sampling to determine the direction, depth, and what threats there are to receptors, if any at all. If the site is determined to threaten the health and wellbeing of workers or citizens in and around the area, then the necessary steps and scenarios will be planned to resolve the contaminated area. If contaminants are found and removal is required, certain steps will be taken to ensure the safety of any citizens living in or passing through the contaminated area. For example, barricades or fencing will be placed around the perimeter of the area allowing no entrance into the contaminated site. Signage will be placed in areas warning citizens to keep out. Numerous types of BMPs would be in pace to help with items such as dust suppression and storm water runoff from the site.

The proposed D-O LRT project would include a ROMF where light rail vehicles would be stored and maintained. This facility would have the indirect effect of generating regulated materials associated because of maintenance activities. These materials would include oils, greases, solvents, and other waste materials. All regulated materials generated as part of maintenance would be disposed of in accordance with state and local guidelines and no substantial indirect impacts are anticipated.



Under the No Build Alternative, there would be no impacts to hazardous, contaminated, and regulated materials due to the proposed D-O LRT Project.

4.11.3.1 NEPA Preferred and Project Element Alternatives

Table 4.11-1 summarizes the number of high and medium risk sites within 500 feet of the NEPA Preferred Alternative and the difference between the number of sites within 500 feet of the Project Element Alternatives and the NEPA Preferred Alternative. The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

High risk sites ranged from 41 sites to 42 sites depending on the alignment alternative. Medium risk sites ranged from 83 sites to 89 sites. There is no substantial difference between the alignment alternatives. It should be noted that there was no contaminated soil observed in the 102 geotechnical soil borings performed along the NEPA Preferred and Project Element Alternatives.

Overall, Triangle Transit identified 42 sites with a high risk potential for contamination from hazardous material uses and/or activities, 89 sites with a medium risk, and 295 sites with a low risk. **Table 4.11-2** lists the high risk sites and their locations are shown on **Figure 4.11-1**. A full listing of risk rankings for all properties can be found in appendix K.25.

4.11.3.2 ROMF

The NEPA Preferred Alternative (Farrington Road), Leigh Village, and Patterson Place ROMF alternatives have no high or medium risk sites. The Cornwallis Road ROMF Alternative has one medium risk site. The Alston Avenue ROMF Alternative has substantially more with 10 total high or medium risk sites on or adjacent to the site, as noted in **Table 4.11-3**. For more information on high and medium risk sites, refer to appendix K.25.

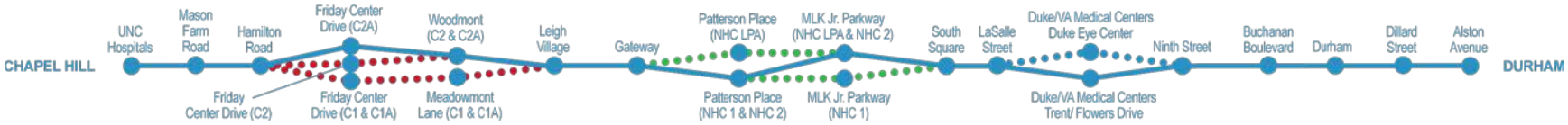
4.11.4 Mitigation Measures

Construction waste will be disposed of at approved sites. The contractor will comply with all applicable federal and state regulations. Handling and storage of fuels and other materials will follow Occupational Safety and Health Administration, state, and local standards.

Preventive measures will be taken to protect the safety of the public, community residents, and construction workers to minimize exposure to hazardous materials. Provisions will also be made for the identification and management of known and unexpected buried tanks or contaminated materials that might be encountered during soil disturbance activities associated with construction. In addition to contaminated soil and groundwater, the potential exists for structures on acquired lands to contain asbestos, lead paint, or other hazardous materials.

As part of the Engineering phase, when additional information such as final rights-of-way determinations are made, the proposed D-O LRT Project will be reevaluated for potential contamination issues and additional environmental site assessment(s) will be completed. The following recommendations for that process correspond to the findings described in the previous subsections:

- High risk properties will undergo a full Phase I or Phase II ESA following ASTM standards. This will ensure that any RECs are accurately identified for properties likely to be impacted by the NEPA Preferred and Project Element Alternative.
- Medium risk properties will have their closure status or current site status reviewed with the North Carolina Department of Environment and Natural Resources (NCDENR) before starting construction. This will ensure that no new activities have occurred that may elevate the risk level and that the current activities are still indicative of minimal potential for contamination from hazardous material use and/or activities.



- For the three high risk properties where previous investigations exist (Flintom Services Inc. [former], Bob's Service Garage, and Graybar Building Site [former]), their current site status will be reviewed with NCDENR prior to any construction activities to determine whether any cleanup activities have occurred. If cleanup has occurred, Phase II sampling will be conducted again to determine whether remediation of the site has been performed to acceptable standards.
- Engineering and construction crews will be trained to be alert for signs of apparent contamination during excavations or pre-construction borings, even if the Phase I assessment indicates low probability of contamination at a given location.
- Engineering and construction crews will be trained to immediately report apparent contamination to their supervisor. Upon discovery of contamination, supervisors will be aware of whom to contact at Triangle Transit, the managing contractor's office, NCDENR, and EPA, if necessary.
- Spill Prevention Control and Countermeasure Plan will be developed prior to demolition, excavation, and construction activities.
- Potentially hazardous materials will be handled and managed in compliance with applicable regulatory standards and would be disposed of in accordance with an approved remediation plan or within an approved disposal site. Sampling will be conducted for hazardous materials intended for disposal.
- Asbestos surveys will be conducted at all locations where demolition and renovations may occur at proposed stations or properties being purchased for right-of-way access.

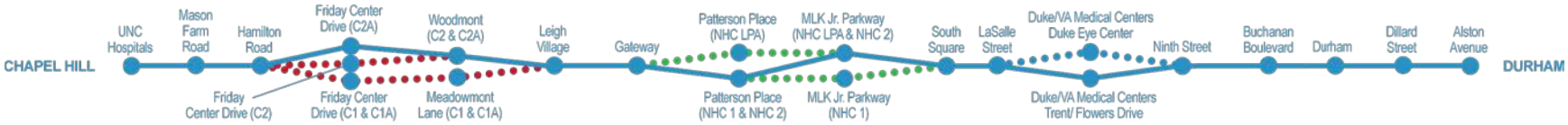


Table 4.11-1: Summary of High and Medium Risk Sites by Alternative Alignment

Site Risk	NEPA Preferred Alternative [a]	Little Creek Alternatives			New Hope Creek Alternatives		Duke/VA Medical Centers
		C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
High Risk	41	+0	+0	+0	+0	+1	+0
Medium Risk	83	+0	+0	+0	+0	+6	+0

Source: AECOM 2015, EDR 2015.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

Table 4.11-2: Summary of High Risk Sites

Figure ID	Site Name	Address	Category
NEPA Preferred Alternative [a]			
1	Durham Dry Cleaning	2526 Erwin Road, Durham	RCRA Generator
2	Kelsie Compton Metro Express	2501 Erwin Road, Durham	LUST
3	Exxon 4-4015	2437 Erwin Road, Durham	Historic Auto Station, LUST
4	Erwin Road 66 Service Station	2710 Erwin Road, Durham	Historic Auto Station
5	Clean Flo Laundromat	633 Broad Street, Durham	Historic Dry Cleaners
6	Lloyds 66	1802 West Main Street, Durham	LUST
7	NCDSCA (White Star Laundry)	637 Broad Street, Durham	Dry Cleaner, RCRA Generator
8	West Durham BP 450 (prior owner is MM Power, Inc.)	1922 West Main Street, Durham	LUST
9	1601 03 Esso Mart	1601 Erwin Road, Durham	Historic Auto Station
10	Erwin Road Amoco	1615 Erwin Road, Durham	Historic Auto Station
11	ALS Auto Repair	607 Broad Street, Durham	Historic Auto Station
12	Claude May	1101 West Main Street, Durham	LUST
13	MCE Co, Inc. & Durham Dry Cleaners and Laundry	113 South Gregson Street, Durham	Historic Dry Cleaners, RCRA Generator
14	Brightleaf Square	800 West Main Street, Durham	SHWS
15	Transportation Services, Duke University Transit (later Duke University "surplus bldg.")	712 Wilkerson Avenue, Durham	IMD, UIC
16	Arthur West Lemons	611 Wilkerson Avenue, Durham	Historic Auto Station
17	Flintom Services Inc.	404 West Chapel Hill Street, Durham	LUST
18	Mechanics and Farmers Bank	116 West Parrish Street, Durham	LUST
19	Webster's Cleaners	112 West Parrish Street, Durham	Historic Dry Cleaners
20	Durham Transportation Center	500 Willard Avenue, Durham	LUST

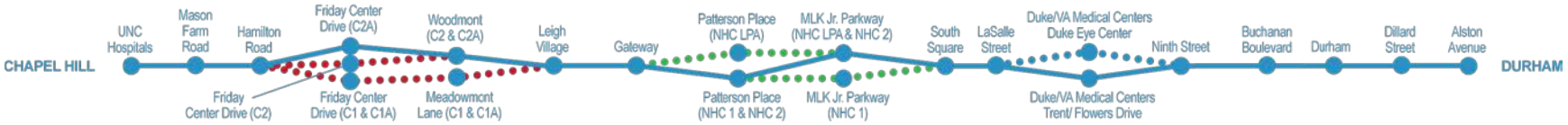


Table 4.11-2: Summary of High Risk Sites

Figure ID	Site Name	Address	Category
21	American Tobacco	Blackwell & Pettigrew Street, Durham	LAST
22	Precision Tune Durham	3910 Chapel Hill Boulevard, Durham	Historic Auto Station, LUST
23	RPM Nissan (also Michael Jordan Nissan)	3930 Chapel Hill Boulevard, Durham	LUST, RCRA Generator
24	Regency Plaza Cleaners	3912 University Drive, Durham	RCRA Generator
25	H & S Cleaners	4015-H University Drive, Durham	Historic Auto Station, Historic Dry Cleaners, RCRA Generator
26	Former DATA	111 Vivian Street, Durham	IMD, LAST, LUST TRUST, RCRA Generator
27	Transportation Center – Durham	111 Vivian Street, Durham	LUST
28	Durham Housing Authority	337 East Peabody Street, Durham	LUST
29	601 Ramsuer Street	601 Ramsuer Street, Durham	Historic Auto Station
30	Quality Janitor Service & Seaboard Coastline RR	815 & 816 Ramsuer Street, Durham	Historic Dry Cleaners, Historic Locomotive Facility
31	Schwartz and Sons Inc.	217 South Holman Street, Durham	FINDS, LUST, NPDES
32	Don C. Christian Co. Inc.	South Goley & Cross Street, Durham	UST
33	Bob's Service Garage	309 South Alston Avenue, Durham	LAST
34	Freeway BP, Bob's Service Garage	308 & 309 South Alston Avenue, Durham	LUST
35	Hudson Automotive	1003 Gillette Avenue, Durham	Historic Auto Station
38	Garrett Road BP (also known as Starvin Marvin)	4525 Chapel Hill Boulevard, Durham	Historic Auto Station, LUST
40	Circle K (former)	4212 Garrett Road, Durham	UST
41	Historic Cleaner (Cleaner World, Carolina Cleaners)	1210 Raleigh Road, Chapel Hill	Historic Dry Cleaners
42	Graybar Building Site (former)	303 South Duke Street, Durham	from previous investigation
New Hope Creek Alternative 1			
39	Classic Toyota, Inc.	4513 Chapel Hill Boulevard, Durham	Historic Auto Station, LUST
Alston Avenue ROMF			
36	Benchmark Materials	311 South Plum Street, Durham	LAST, LUST
37	Brenntag Southeast Inc.	2000 East Pettigrew Street, Durham	LAST, LUST, RCRA Generator

Source: AECOM 2015, EDR 2015, appendix K.25.

[a] NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and Farrington Road ROMF.

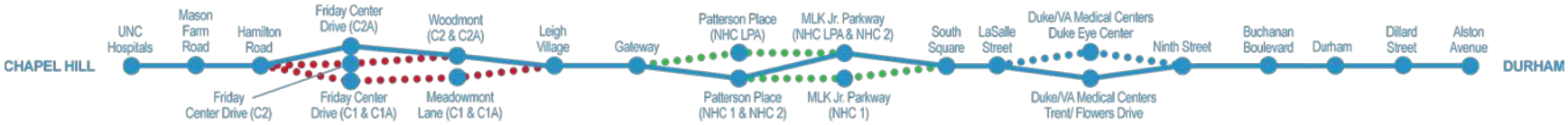


Table 4.11-3: Summary of High and Medium Risk Sites by ROMF Alternative

Site Risk	Rail Operations and Maintenance Facility Sites			
	Leigh Village	Patterson Place	Cornwallis Road	Alston Avenue
High Risk	0	0	0	2
Medium Risk	0	0	1	8

Source: AECOM 2015, EDR 2015.

Note: Farrington Road included in the NEPA Preferred Alternative – no medium or high risk sites.

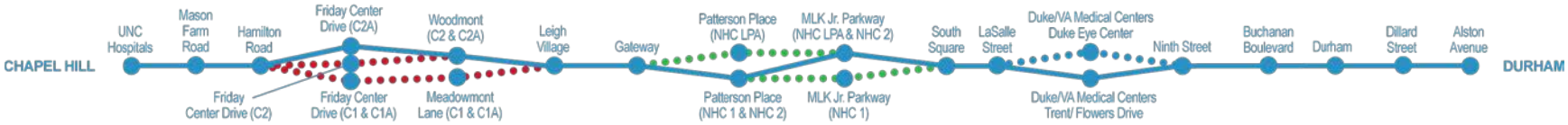
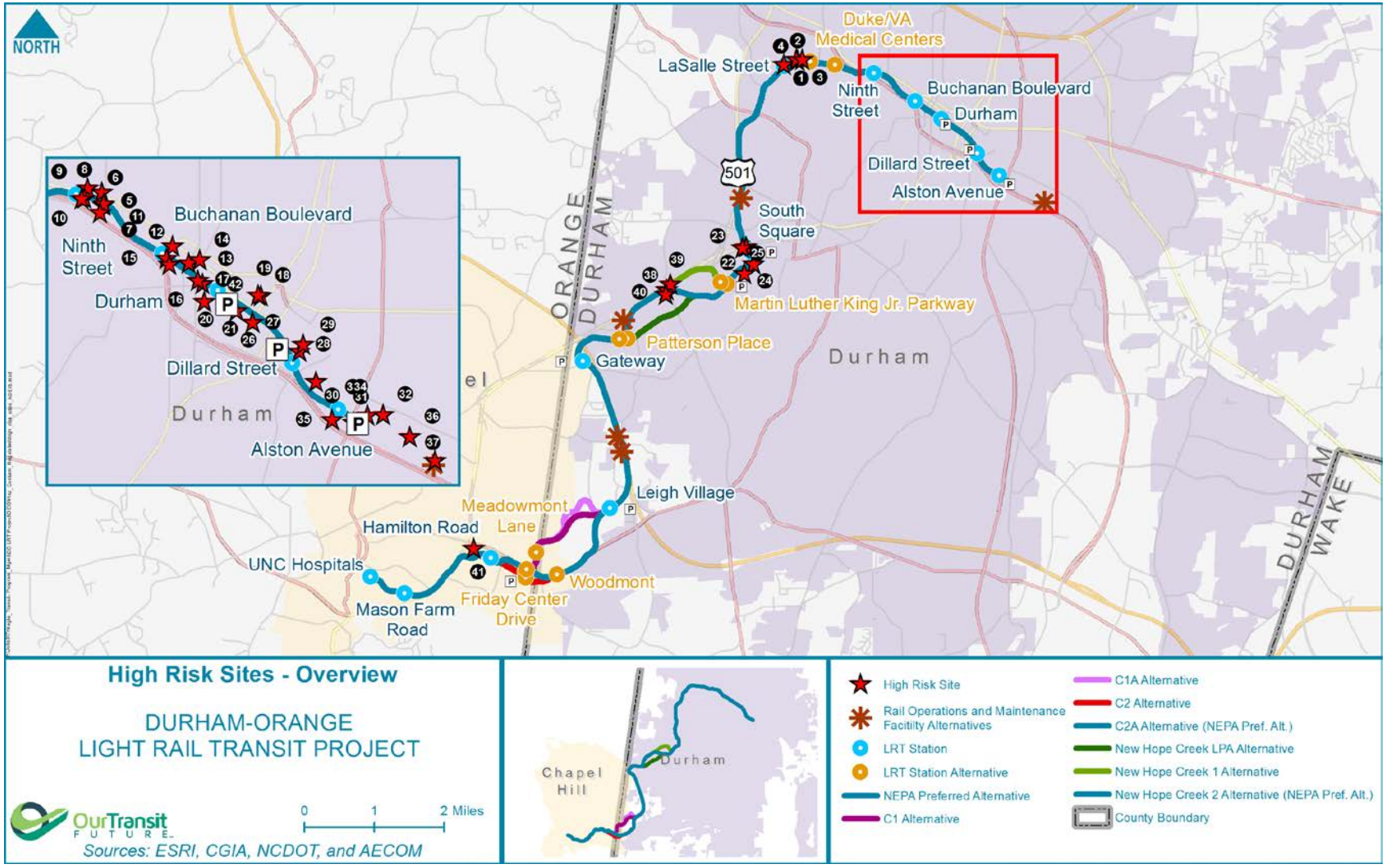
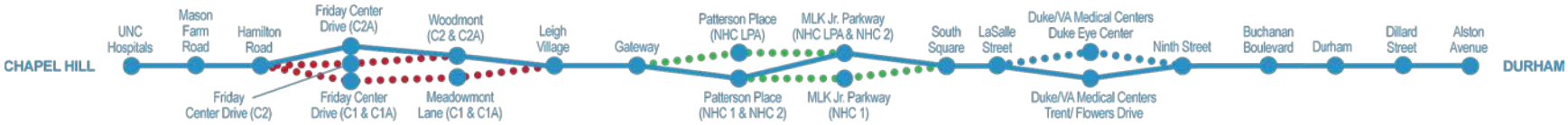


Figure 4.11-1: Overview Map of High Risk Sites





4.12 Safety and Security

This section describes the general safety and security considerations related to the design and operation of the proposed D-O LRT Project. Where applicable, it includes a discussion of proposed transit services, vehicles, transit centers, park-and-ride lots, track alignment, at-grade crossings, stations, bridges, rights-of-way, ROMF, and administrative facilities that would be associated with alternatives considered in this DEIS. The proposed project would feature current safety and security systems and procedures to protect passengers, workers, and adjacent communities.

During the Engineering and Construction phases, prior to operations, the project will be guided by a Project Management Plan (PMP). The PMP will set forth requirements to be met for the design and construction process and results. The PMP will be supported by a Safety and Security Management Plan (SSMP) prepared specifically for the project. The SSMP will detail the steps to be taken during design and construction to ensure safety and security concerns are addressed adequately through proper design and operational planning. This will include the development of safety and security design criteria, and a subsequent certification process to confirm the criteria are met.

Triangle Transit will work with FTA to provide regular updates to the PMP, project safety and security activities, organizational updates, work scope changes, and changes to the assignments of responsibilities among project participants based on FTA feedback. Triangle Transit will continue to assess whether adequate provisions have been made for safe and secure operations and what design features would be included to avoid, minimize, or mitigate vehicular, transit, and pedestrian accidents.

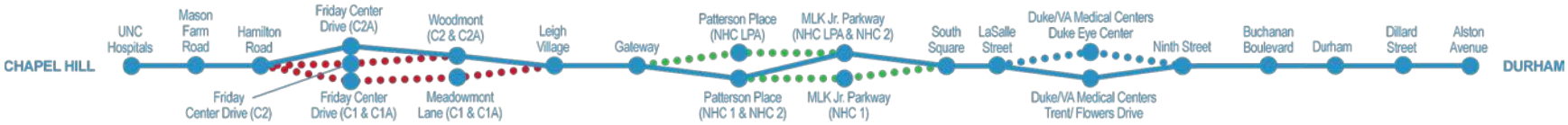
4.12.1 Methodology

The following documents were reviewed to describe the existing safety and security procedures that are currently in place for the analysis of the affected environment and No Build Alternative, as well as new documents that will guide the design for the NEPA Preferred and Project Element Alternatives:

- Triangle Transit Safety and Health Policy (February 2013)
  - Accident and Illness Investigation Plan
  - Emergency Action, Fire Prevention and Severe Weather Plan
  - Ergonomics Plan
  - Fall Protection Plan
  - Hazard Communication Plan
  - Hearing Conservation Plan
  - Lockout and Tagout Plan
  - Pandemic Influenza Plan
  - Personal Protective Equipment Plan
  - Power Tool and Hand Safety Plan
  - Powered Industrial Trucks (Fork Lift) Plan
  - Security Management and Protective Measures
  - Tire Safety Plan
  - Welding Safety Plan
- Triangle Transit System Security and Emergency Preparedness Plan (August 2014)
- D-O LRT Project Management Plan (September 2012)

Potential effects for the NEPA Preferred and Project Element Alternatives are assessed in this section by identifying the following:

- Whether adequate provisions for safe and secure operations would be made with the introduction of a project alternative
- Whether the NEPA Preferred and Project Element Alternatives would be expected to alter existing patterns of vehicular, transit, and/or pedestrian accidents and what design features



would be included to avoid, minimize, or mitigate these accidents

- Whether the NEPA Preferred and Project Element Alternatives would improve safety and security compared to the existing conditions in the corridor

4.12.2 Affected Environment

The existing safety and security plans, policies, and procedures address safety and security for current transit operations. These documents integrate safety into operations and services, establish mechanisms for identifying and addressing hazards associated with operations and services, and provide a means for ensuring that proposed system modifications are thoroughly evaluated for their potential effect on safety before being implemented. The safety and security areas addressed are discussed in the following paragraphs.

4.12.2.1 Passenger Safety

Triangle Transit's System Security and Emergency Preparedness Plan states that at all times personnel must understand and adopt their specific roles and responsibilities, thereby increasing their own personal safety and the safety of Triangle Transit passengers. In addition, Triangle Transit promotes safety and security through passenger on-board announcements and public awareness programs.

4.12.2.2 Transit Facilities

Triangle Transit's System Security and Emergency Preparedness Plan provides the framework for ensuring passenger and employee safety on Triangle Transit property and leased facilities. The plan details functional entrances/exits for members of the public and employees. These facilities can only be accessed by employees using their ID badge, or by members of the public when permitted entrance by a Triangle Transit employee. Furthermore, buildings and parking lots are under 24 hour camera surveillance.

In addition, Triangle Transit uses Crime Prevention Through Environmental Design (CPTED) concepts to assist in deterring criminal activity in the design of its facilities. The basic principle of CPTED is to increase natural surveillance by providing good sight-lines and avoiding conditions such as tall landscaping that could potentially provide individuals with areas to hide or obstruct mechanical methods of surveillance, such as closed-circuit television (CCTV) cameras.

4.12.2.3 Transit Vehicles

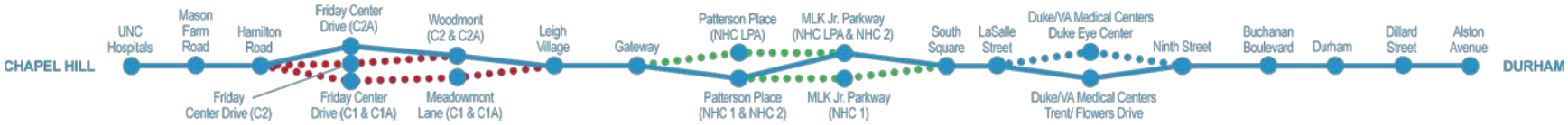
Triangle Transit buses are equipped with physical safety and security measures to support the overall operation of the transportation system, including, but not limited to, CCTV equipment and automatic vehicle locators (AVL) that use a global positioning system to provide the location of an operating vehicle at any time. In addition, all Triangle Transit vehicles are regularly inspected for unsafe or unhealthy items or situations.

4.12.2.4 Employees and Contractors

Triangle Transit's System Security and Emergency Preparedness Plan includes a wide range of occupational safety and health, injury and illness prevention, hazard communication, industrial hygiene, fire and life safety, emergency preparedness, operational safety, environmental programs, and security programs. These programs have been developed in accordance with federal, state, and local regulatory requirements, and are implemented by Triangle Transit and its contractors. The plan specifically details the division of responsibilities for potential personnel including the General Manager, supervisors, operators, and other members of the Agency. It includes the System Security and Emergency Preparedness Program point of contact, the Vehicle Accident Prevention Committee, and responsibility matrices.

4.12.2.5 Pedestrians and Motorists

To the extent practicable, Triangle Transit seeks to reduce or eliminate pedestrian and motorist conflicts with transit vehicles at Triangle Transit facilities. However, conflicts



can occur, particularly in locations where the light rail tracks cross or run adjacent to roadways, and locations where a pedestrian must cross streets to access light rail stations. Refer to chapter 3, Transportation, for additional discussion of the interface between the proposed D-O LRT Project and the transportation network including roadways and bicycle and pedestrian facilities. Many safety measures, including crosswalks, signals, lighting, and fencing in certain locations, are used to help reduce the number of conflicts and incidents. In addition, basic design elements are used to enhance safety, including the use of facility siting and parking lot layouts that avoid pedestrian/vehicle and vehicle/vehicle conflicts, as well as the careful use of landscaping to eliminate blind spots and provide openness for security surveillance. Furthermore, Triangle Transit facilities are designed to comply with the Americans with Disabilities Act (ADA) to improve safety and ease of movement for disabled individuals.

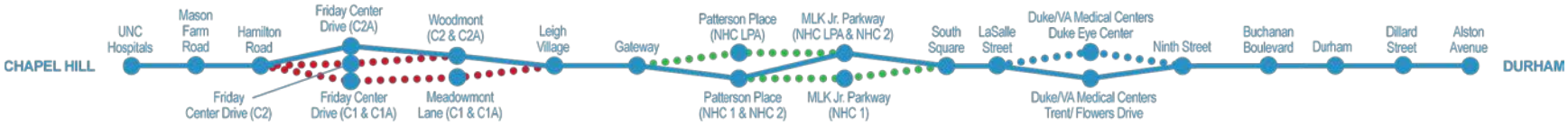
4.12.2.6 Police, Security, and Emergency Service Operations

Police departments serving the different parts of the study area include the Town of Chapel Hill, UNC Department of Public Safety, Durham County Sheriff's Office, Durham Police Department, Duke University Police Department, and NCCU Police Department. Among them, 11 facilities serve the study area (facilities that serve the study area but are located outside the study area are indicated by an asterisk):

- 828 Martin Luther King Jr. Boulevard, Chapel Hill (Chapel Hill Police Department)*
- 285 Manning Drive, Chapel Hill (UNC Department of Public Safety)
- 8 Consultant Place, Durham (Durham Police Department – District 3)
- 502 Oregon Street, Durham (Duke University Police & Security Services)
- 505 West Chapel Hill Street, Durham (Durham Police Department Headquarters)
- 516 Rigsbee Avenue, Durham (Durham Police Department – District 5)
- 510 South Dillard Street, Durham (Durham County Sheriff)
- 2010 Fayetteville Street, Durham (NCCU Police Department)
- 921 Holloway Street, Durham (Durham Police Department - District 1)*
- 5825 North Roxboro Road, Durham (Durham Police Department - District 2)*
- 2945 South Miami Boulevard, Durham (Durham Police Department - District 3)*

Fire protection and prevention services are provided by the Durham Fire Department, Chapel Hill Fire Department, and New Hope and Parkwood volunteer fire departments. Among them, 15 fire stations serve the study area (facilities that serve the study area but are located outside the study area are indicated by an asterisk):

- 100 Bennett Road, Chapel Hill (Chapel Hill Fire Department - Station 5)*
- 403 Martin Luther King Jr. Boulevard, Chapel Hill (Chapel Hill Fire Department - Station 1)*
- 1003 South Hamilton Road, Chapel Hill (Chapel Hill Fire Department - Station 2)
- 4012 Whitfield Road, Chapel Hill (New Hope Volunteer Fire Department - Station 1)*
- 6303 Farrington Road, Durham (Durham Fire Department - Station 16)
- 4200 Farrington Road, Durham (Durham Co. - Parkwood Station 2)*
- 3700 Swarthmore Road, Durham (Durham Fire Department - Station 6)*
- 1230 Carpenter Fletcher Road, Durham (Durham Fire Department - Station 12)*
- 1818 Riddle Road, Durham (Durham Fire Department - Station 4)*



- 2800 West Cornwallis Road, Durham (Durham Fire Department - Station 11)*
- 2112 Chapel Hill Road, Durham (Durham Fire Department - Station 5)*
- 1001 Ninth Street, Durham (Durham Fire Department - Station 2)
- 139 East Morgan Street, Durham (Durham Fire Department - Station 1)
- 1409 Deaton Road, Durham (Durham Co. - Parkwood Station 1)*
- 822 North Miami Boulevard, Durham (Durham Fire Department - Station 3)*

Emergency Medical Service (EMS) services are provided by Orange County EMS, South Orange Rescue Squad, Parkwood EMS, Durham County EMS, Duke University, and Durham Emergency Communication Center. Among them, eight facilities serve the study area (facilities that serve the study area but are located outside the study area are indicated by an asterisk):

- 202 Roberson Street, Carrboro (Orange County EMS/South Orange Rescue Squad)*
- 4200 Farrington Road, Durham (Parkwood EMS - Station 2)*
- 2212 Chapel Hill Road, Durham (Durham County EMS - Station 5)*
- 2400 Pratt Street, Durham (Durham County EMS - Station 3)
- 301 Swift Avenue, Townhouse #3, Durham (Duke University EMS)
- 505 West Chapel Hill Street, Durham (Durham Emergency Communications Center)
- 615 Old Lafayette Street, Durham (Durham County EMS - Station 2)
- 2725 Holloway Street, Durham (Durham County EMS - Station 4)*

Additional detail on the affected environment for safety and security is included in DEIS section 4.3.

4.12.3 Environmental Consequences

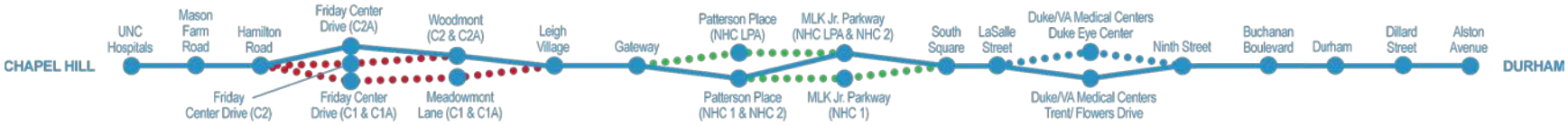
The impacts to safety and security of the NEPA Preferred and Project Element Alternatives in comparison to the No Build Alternative are discussed in the following sections. The No Build Alternative currently assumes that there would be no changes to the existing safety and security policies. For this reason, the No Build Alternative would have no effect on safety and security within the corridor.

The proposed D-O LRT Project would be designed and operated in accordance with Triangle Transit's current safety and security plans. These plans would be updated to include specific requirements for the NEPA Preferred and Project Element Alternatives, reviewed by FTA, and submitted through the NCDOT State Safety Oversight process for approval prior to revenue service. The project would be designed in accordance with the *D-O LRT Design Criteria Manual*, which is being prepared for the proposed D-O LRT Project.

Design of the D-O LRT Project has been responsive to community service and facility concerns, particularly those related to safe access for emergency vehicles. Coordination has occurred and will continue with the public and representatives from emergency service, medical, fire protection, and police services. Coordination with Duke Hospital resulted in the recognition that the proposed elimination of left turns on Erwin Road would restrict access for ambulances to the hospital. Designs were altered in order to maintain the access from both directions for emergency vehicles at Duke Hospital.

Coordination with emergency management and emergency services representatives will continue throughout Project Development and the Engineering Phase to assist with the development of education and training plans for emergency personnel and the public that can be implemented prior to operation.

Future design would be based, in part, on a preliminary hazard analysis and a threat and vulnerability analysis, which would be used



to help determine risk mitigation and implementation priorities. Triangle Transit would prioritize risks and select sets of countermeasures that would provide the best overall risk reduction.

The basis of the design is predicated on compliance with federal, state, and local design standards and requirements, as referenced in the *D-O LRT Design Criteria Manual*. These design standards mitigate and reduce potential safety and security hazards and risks to an acceptable level in accordance with transit industry best practices and experiences from similar light rail transit systems in the United States.

In compliance with the National Fire Protection Association (NFPA) 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems*, the proposed D-O LRT Project would incorporate fire and life safety requirements into all aspects of the project design and operation.

Strategies such as CPTED and the use of police, private security patrols, proper lighting, and security cameras would be employed as appropriate to make the light rail facilities and operations as safe and secure as possible. Design considerations such as platform location and length, pedestrian crossings, and alignment design would be used to facilitate the safe operation of the light rail system.

4.12.3.1 Passenger Safety

The light rail system would introduce a new technology and new set of policies and regulations for passenger safety. Personnel would be required to understand and adopt new policies and procedures to increase awareness for personal safety in addition to that of passengers. Passengers' initial lack of familiarity with the design and operational aspects of the system would pose a potential minor safety hazard.

4.12.3.2 Station Platforms and Park-and-Ride Facilities

Station platforms and park-and-ride facilities would generally be newly constructed facilities. These facilities would have safety and security implications for passengers who use the facilities, transit system employees, and surrounding communities that may have increased pedestrian, transit, and automobile traffic.

4.12.3.3 Transit Vehicles

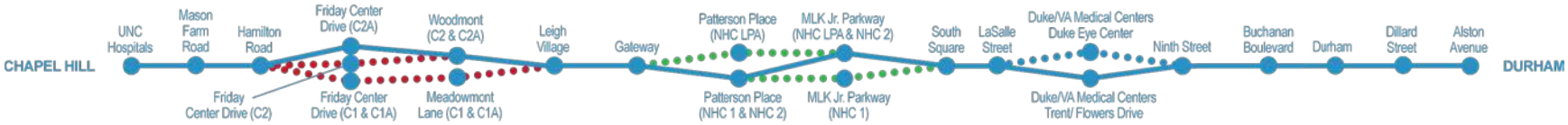
The proposed transit technology for the NEPA Preferred and Project Element Alternatives is modern, low-floor, light rail vehicles, operating on dedicated tracks with electrical power supplied from an overhead catenary system. The light rail vehicles are designed such that they may operate in mixed traffic or in an exclusive right-of-way, either at grade or on an elevated structure, and would have safety and security implications due to potential derailments or conflicts with other modes.

4.12.3.4 Employees and Contractors

The proposed D-O LRT Project would introduce a new mode of transportation, introduce new operational procedures and policies, and add new jobs and responsibilities. Employees and contractors would need to undergo specific training to become familiar with this new mode and relevant safety and security responsibilities.

4.12.3.5 Pedestrians, Bicyclists, and Motorists

The proposed D-O LRT Project would have safety implications for the D-O Corridor as they would introduce a new mode of transit, a 17-mile transit alignment, and light rail transit vehicles that would interact with vehicular, bicycle, and pedestrian traffic. The safety implications are particularly important for higher volume areas where multiple modes of transportation coexist like the UNC campus, University Drive, Erwin Road, and in downtown Durham. Certain populations (e.g., elementary school students and retirement community residents) also pose safety implications. Detailed information regarding the roadways, sidewalks, and trails expected to be affected by the NEPA



Preferred and Project Element Alternatives is provided in DEIS section 3.2, DEIS section 3.6, and the *Basis for Engineering Design* (appendix L).

Potential impacts from the development of light rail systems with exclusive and/or semi-exclusive rights-of-way include risks of injury or fatalities to pedestrians, bicyclists, vehicle occupants, light rail passengers, and employees due to light rail operations, collisions between light rail and road vehicles, increased street and alignment crossings, and incidents on/or around light rail facilities. Members of the public expressed concern for some of these risks through comments submitted as part of the Scoping meetings and subsequent public involvement as summarized in chapter 9, Public Involvement and Agency Coordination. Design of the project acknowledges these concerns and includes provisions for safe operation and appropriate connectivity for pedestrians, bicyclists, and motorists. To avoid the potential for incidents at at-grade intersections, crossings would be signalized or equipped with gates with bells to warn of oncoming trains. The trains will also have bells and horns. Bells, gates, and horns would be activated according to Triangle Transit operating procedures and safety guidelines.

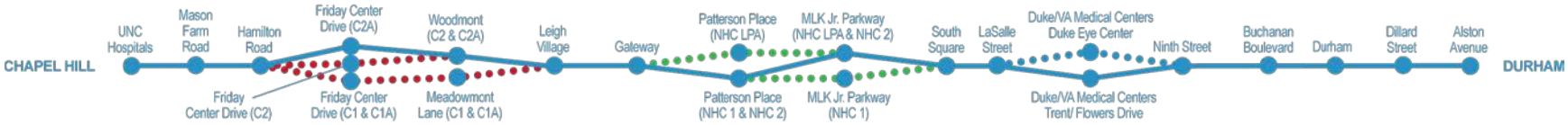
The NEPA Preferred and Project Element Alternatives propose various infrastructure alterations that would impact street and sidewalk traffic. DEIS section 3.2 provides a list of proposed infrastructure alterations associated with the alternatives considered

4.12.3.6 Police, Security, and Emergency Service Operations

Major new transit systems introduce new infrastructure, traffic, business, and other community activities. In response, existing agencies, entities, and the public need to become familiar with, adapt, and respond appropriately to the new mode of transportation. The security of those who interact with the light rail system as a passenger, employee, or passerby needs to be a primary focus that pervades planning and operations. This includes the design of physical systems such as stations, ROMF, communications and control systems, traction power systems, and vehicles, as well as the transit agency's procedures. The various security and emergency management issues that a light rail system typically must address through design include:

- System surveillance, evidence collection, and storage (e.g., CCTV surveillance systems)
- Access controls including credentialing, perimeter fencing, security authorizations, intrusion alarms, and background checks
- Security design of physical system elements such as facilities, vehicles, aerial structures, pedestrian tunnels, catenary, control centers, etc.
- Use of security technologies such as facial recognition software and supervisory control and data acquisition (SCADA)
- Security awareness training and security policies
- Crime
- Planning for emergency situations
- Providing familiarization training to external police departments and other emergency providers on safely engaging with the system such as how to deal with power systems (e.g., de-energizing power systems) and general equipment (e.g., manually opening vehicle doors and instructions to safety knock out windows)

Such systems and infrastructure would add new challenges for public safety and law enforcement departments. The full measure of such impacts will be more fully understood when these transit systems become an engrained and common element of local daily life. Three areas of the NEPA Preferred Alternative involve operation of the LRT between opposing directions of street traffic and adjacent to street traffic, and in



some cases constricting the street and limiting access.

The 11 law enforcement stations that would be affected by the proposed D-O LRT Project may need to be instructed on the following:

- How to understand and respond to safety and security issues related to light rail vehicles, substations and catenary, stations, maintenance facilities, and elevated structures
- How to monitor, prevent, and respond to criminal activity in and around facilities and on vehicles on a day-to-day basis with or without transit system security personnel
- How to provide crowd control and security in and around facilities and vehicles for major local events
- How to address potential negative impacts on response times due to, among other issues, light rail crossings, gates, structures, and station design

Fifteen fire stations that would provide service for the proposed D-O LRT Project may need to be instructed on the following:

- How to understand and respond to safety and security issues related to light rail vehicles, substations and catenary, stations, maintenance facilities, and elevated structures
- How to address potential negative impacts on response times due to, among other issues, light rail crossings, gates, structures, and station design

For the eight EMS stations, impacts may include potential negative impacts on response times due to, among other issues, light rail crossings, gates, structures, and station design.

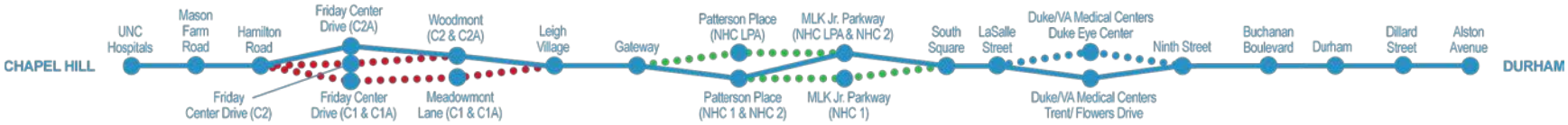
These agencies provide critical services for the public and transit system personnel, and the need to minimize impacts on their ability to provide such services will be considered and addressed in concert with planning representatives of these respective services. The project team coordinated with the Durham Fire Marshal to identify areas of concern regarding vertical clearance under light rail structures for emergency access. As design progresses, Triangle Transit will continue to coordinate with emergency management and operations to develop plans and training to minimize emergency response times.

4.12.4 Mitigation Measures

Under FTA grant rules and safety regulations, the D-O LRT Project Team and the proposed NEPA Preferred and Project Element Alternatives are subject to rigorous review requirements – from light rail design conceptualization through operations and maintenance – to ensure the safety of the public and the D-O LRT personnel. Design and operational system elements must first be evaluated for safety risks. Any such risks must then be accepted, mitigated, or eliminated through design and/or operational changes.

The project management oversight (PMO) process requires the D-O LRT Project Team to engage in rigorous hazard assessments throughout the project to identify potential impacts – and the scope and severity of these impacts – that system infrastructure and operations may have on the public, personnel, and the infrastructure itself. The hazard assessment process and safety systems developed by the D-O LRT Project Team will be documented in a PMP. To this end, the D-O LRT Project Team will assess the safety of systems and engineering of infrastructure and vehicles, operating procedures and training, and the impact of infrastructure and operations on its environment.

Before revenue service begins, the D-O LRT Project Team will develop transit system safety management procedures. This safety program will be documented in the System Safety Program Plan (SSPP), a plan to guide system risk management and a core aspect of the State Safety Oversight program. System security management during revenue service will be guided by the Safety and Emergency Preparedness Plan (SEPP), which will be developed prior to the opening of revenue service. The SEPP is a



plan to guide system security risk management.

4.12.4.1 Passenger Safety

Before revenue operations begin, additional protocols to protect passenger safety near and on the platforms and in the light rail vehicles will be developed as part of the SSPP and SEPP. Security patrols and cameras, lighting, communications systems, as well as public announcements, will be employed as appropriate to increase passenger safety. Clear instructions to passengers will be developed regarding emergency exiting from the light rail vehicles and from tracks that are at ground level or elevated.

Members of the public have made comments regarding safety of light rail passengers in areas where the proposed D-O LRT alignment would be adjacent to railroad operations in the event of a railroad train derailment. As described in section 3.4, Freight and Passenger Railroads, the proposed D-O LRT alignment would be located a minimum of 40' from any potential future railroad track, a safety separation distance required by the North Carolina Railroad (NCRR). A fence with intrusion detection equipment will be installed between the railroad tracks and light rail tracks to automatically alert operations staff in the event of a railroad train derailment. Policies and procedures pertaining to railroad train derailments will be included in the SEPP for the project and will be coordinated with local emergency response agencies.

4.12.4.2 Station Platforms and Park-and-Ride Facilities

The D-O LRT Project Team will consult with local law enforcement and other public agencies to design the project's public facilities to maximize the safety and security of light rail patrons and the transit system's employees.

As part of this effort, station platforms and park-and-ride facilities will be designed using CPTED design principles to increase natural surveillance opportunities. CCTV cameras will be placed on every platform and in park-and-ride locations. Blue light emergency phones will be available at regular intervals on station platforms and in park-and-ride locations. The ticket vending machines will contain passenger assistance telephones to link passengers with a central control center. Security will be provided using roving patrols along the corridor, at stations, and at the proposed park-and-ride facilities. Each station platform will be equipped with a public notification system.

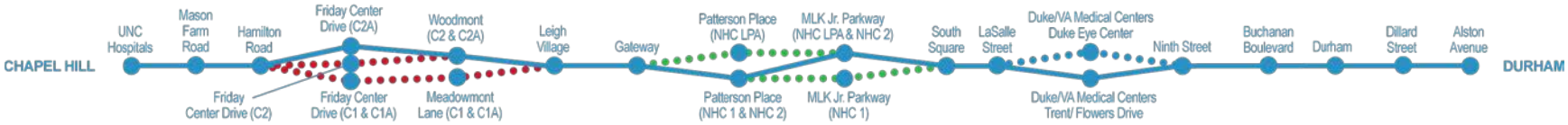
4.12.4.3 Transit Vehicles

The NEPA Preferred and Project Element Alternatives will include light rail vehicles that would be compliant with a number of requirements, codes, and other design criteria. These include, but are not limited to, tamper-resistant equipment, dependable/redundant communication networks, CCTV monitoring, intrusion alarm systems, and relevant fire, life, and safety requirements.

4.12.4.4 Employees and Contractors

The D-O LRT Project Team is responsible for the development of operational manuals and training for frontline transit personnel to use and operate the system (e.g., dispatch, operator, signal, power, scheduling, etc.) that address the safety of passengers, employees, and contractors. Rule books and associated operating procedures will be developed in accordance with industry operational standards from organizations like the APTA, while taking into consideration operational aspects unique to the proposed D-O LRT Project.

Before revenue operations begin, the D-O LRT Project Team will develop operational manuals and establish procedures consistent with the SSPP to ensure the safety of the transit system's employees and contractors.

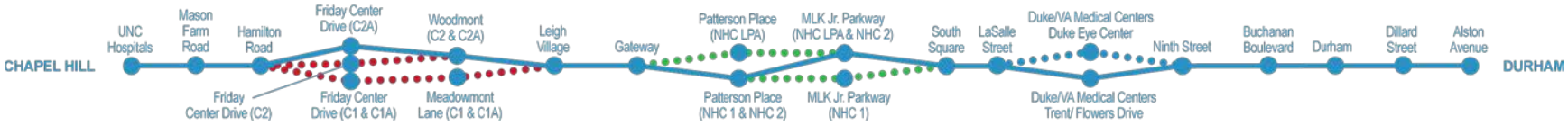


4.12.4.5 Pedestrians, Bicyclists, and Motorists

To mitigate the safety and security impacts of the introduction of light rail, the D-O LRT Project Team has and will continue to review the impact of the system on other transportation modes with the goal of addressing safe access to and across the system for other transportation uses. To mitigate the safety impacts on vehicular, pedestrian, and bicycle traffic, the D-O LRT Project Team has identified various safety measures and parameters to be designed into the proposed D-O LRT Project. These safety measures will be implemented throughout the system as appropriate, and will be incorporated into the design of stations, park and ride sites, and in the direct station areas. The measures include the following:

- Using presently underdeveloped parcels and/or otherwise locating the alignment away from vehicular, pedestrian, and bicycle traffic
- Installing sidewalks and pedestrian paths to provide connectivity to stations
- Installing elevated structures to avoid significant impacts on existing roads and sidewalks
- Reconfiguring or relocating crosswalks to occur at safely controlled intersections
- Reconfiguring the roadway signal and signage network to safely accommodate users in the context of light rail operations
- Installing visible and audible crossing signals and/or gates where appropriate for vehicles and pedestrians
- Segregating and delineating the track area using design elements such as fencing, pylons, road surface markings, rumble strips, unique paving materials, etc.
- Installing illumination and signage at stations and where streets and LRT facilities interface
- Developing public education programs to explain how to use the system safely, and how to respect the operation of the system to ensure safety of the non-user. These education programs would be implemented before revenue operation near the end of the construction period, and would continue during the initial months of revenue operation.
- Building pedestrian bridges and underpasses. Pedestrian bridges over roadways are proposed at the Martin Luther King Jr. Parkway Station (NHC 1 Alternative only) and the UNC Hospitals Station as described in section 3.6, Pedestrian and Bicycle Facilities. A pedestrian underpass is proposed west of the Hamilton Road Station to maintain an existing pedestrian trail as described in section 4.6, Parklands.
- Using best practices in the design of pedestrian and bicycle facilities that interface with LRT facilities, including ensuring adequate sight distance at crossings providing, pedestrian refuge areas where the LRT results in long crosswalks, and installing active warning devices where appropriate.

The design of the NEPA Preferred and Project Element Alternatives also takes into account other transportation improvements being considered by external agencies that are complementary to this project. For example, many improvements for pedestrian and bicyclist traffic have already been programmed into the 2040 MTP (2013) and the ongoing design of the NEPA Preferred and Project Element Alternatives continues to coordinate with such projects. Triangle Transit will follow all national, state and local safety guidelines and best practices, and coordinate with NCRR, Norfolk Southern (NS), CSX Corporation (CSX) (as appropriate), NCDOT, and local jurisdictions regarding pedestrian safety near at-grade crossing of the light rail alignment within the NCRR corridor, and along the alignment of the NEPA Preferred Alternative.



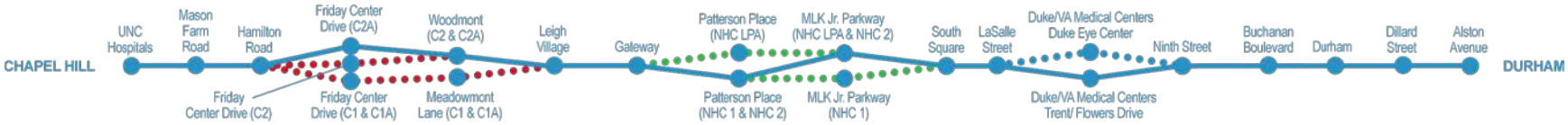
4.12.4.6 Police, Security, and Emergency Service Operations

As the design of the NEPA Preferred and Project Element Alternatives advances, the D-O LRT Project Team will coordinate with law enforcement, emergency and medical personnel, and other public agencies to investigate impacts of the potential light rail system on their day-to-day operations. For example, the D-O LRT Project Team will work with fire departments to determine whether implementation of the NEPA Preferred Alternative warrants changing dispatch locations for emergency services.

Coordination with departments would also be conducted during the Engineering Phase to get input on the development of a SSMP, and to develop plans and materials useful for training of police, security, and emergency service personnel. The training would include methods by which these personnel can assist in informing and educating the public about system safety.

By coordinating with responders early in the risk assessment process, project team members can work with public agencies to develop mitigations, if necessary. Mitigation for restricting or constricting rubber tired vehicular access along an existing roadway includes constructing the guideway in embedded track such that emergency vehicles can bypass other vehicles via use of the embedded track condition. The LRT operation would yield to these infrequent occurrences. Access to emergency and health care facilities would not be compromised by the LRT.

In addition, Triangle Transit will work with local law enforcement and emergency medical personnel to develop a training plan that involves responding to incidents at light rail facilities and on light rail vehicles. This plan will include a schedule for training prior to and during revenue operations.



4.13 Energy

This section quantifies the net expenditure of energy associated with the construction, maintenance, and operation of the NEPA Preferred and Project Element Alternatives in comparison to the No Build Alternative. Energy consumption is measured by calculating the net impact on energy use because of changes in automobile travel offset in part by the energy requirements for operation of the proposed services.

Transportation energy use is evaluated in terms of direct energy and indirect energy.

Direct energy: energy use by mode of travel for personal and commercial vehicles.

Indirect energy: energy necessary to extract raw materials, manufacture and fabricate construction materials, and complete construction.

4.13.1 Methodology

The energy analysis methods and calculations used in this section follow the FTA New and Small Starts Evaluation and Rating Process Final Policy Guidance issued August 14, 2013. The study area for energy use is the Triangle region.

Energy is commonly measured in terms of British thermal units (BTU), or the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. By describing different types of energy use with a single unit of measure, it is feasible to compare the environmental and dollar cost of energy produced from different sources, such as petroleum, coal, nuclear, or wind power.

Direct energy was calculated for each mode:

- Energy use for transit modes was based on the transit vehicle miles traveled (VMT) identified in appendix K.1 developed for the No Build and NEPA Preferred and Project Element Alternatives.
- Energy use for personal and commercial vehicles (except transit) was calculated based on VMT. Estimates of VMT and vehicle hours of travel were provided by the revised TRM, as described in DEIS section 3.2 in both the No Build and NEPA Preferred and Project Element Alternatives.

The personal and commercial vehicles and transit energy use were combined to calculate total transportation system operation direct energy use for each alternative.

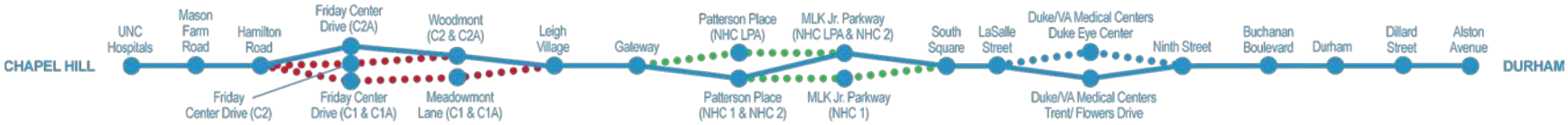
The factors used to convert VMT to BTUs for buses and personal and commercial vehicles are from the New Starts Template (FTA 2014). The factor used to convert light rail VMT to BTUs is from the *Transportation Energy Data Book*, Edition 32 (US Department of Energy [USDOE] 2013).

The indirect energy use of the NEPA Preferred and Project Element Alternatives includes the amount of energy necessary to extract raw materials, manufacture and fabricate construction materials, transport materials to the worksite, and complete the construction activities. The many variables involved in the construction process make it difficult to estimate detailed indirect energy costs. Therefore, indirect energy use was quantified based on miles of track using energy use factors derived from the methodology identified in *Energy and Transportation Systems* (CALTRANS 1983).

4.13.2 Affected Environment

In the United States, the total energy consumption in 2013 was 97.5 quadrillion BTUs according to the US Energy Information Administration (EIA 2014), with transportation accounting for 28 percent of total national energy use. Most of the energy consumed for transportation is from fossil fuels (95 percent).

In North Carolina, the transportation sector is the largest consumer of energy. Energy consumption for transportation in the state represents 27.5 percent of North Carolina's total energy consumption, and 2.6 percent of the nation's total energy consumption for transportation.



Throughout most of the D-O Corridor, energy is provided by Duke Energy. For the section of the LRT alignment on the UNC campus, UNC is the sole supplier of electricity. Coordination is ongoing among Triangle Transit, Duke Energy, and UNC to coordinate the light rail system's power needs.

The Town of Chapel Hill, City of Durham, Durham County, and Orange County have adopted plans to reduce greenhouse gas emissions. These plans, listed below, propose achieving reductions, in part, through energy savings.

- Memorandum of Agreement: Joint Chapel Hill-Carrboro-Orange County Greenhouse Gas Emissions Inventory and Reduction Plan (2005)
- Orange County *Energy Conservation Policy* (2006)
- City of Durham City and Durham County *Greenhouse Gas and Criteria Air Pollutant Emissions Inventory and Local Action Plan for Emission Reductions* (2007)

In addition, Chapel Hill has set a greenhouse gas emission reduction target of 60 percent by 2050 for municipal operations. Durham County's community target is 30 percent by 2030 and its government target is 50 percent by 2030. These policies recommend achieving these targets by expanding energy conservation programs in residential, commercial, and government buildings, as well as through new buildings that are more energy efficient.

4.13.3 Environmental Consequences

The following sections describe the direct and indirect energy conditions for the NEPA Preferred Alternative and the Project Element Alternatives compared to those for the No Build Alternative. The NEPA Preferred Alternative will result in less regional energy consumption than what is anticipated for the No Build Alternative, and differences between the NEPA Preferred and Project Element Alternatives are expected to be minor.

4.13.3.1 Direct Energy

Direct energy expenditures are calculated from estimated VMT by vehicle type for the Triangle region, shown in **Table 4.13-1**. The NEPA Preferred Alternative is similar in VMT to the Project Element Alternatives, but would result in 23 million fewer VMT than the No Build Alternative. Similarly, the NEPA Preferred Alternative is estimated to consume 136,968 billion BTUs annually, a savings of 83 billion BTUs compared to the No Build Alternative. **Table 4.13-1** compares VMT and **Table 4.13-2** compares annual direct energy use between the alternatives.

The differences in direct energy consumption between the NEPA Preferred and Project Element Alternatives are minor (less than one-tenth of one percent higher or lower than the NEPA Preferred Alternative).

The selection of the ROMF is not anticipated to substantially impact the direct transportation energy consumed in any of the alternatives.

4.13.3.2 Indirect Energy

The NEPA Preferred Alternative would include the construction of light rail guideway, vehicles, stations, parking, maintenance facilities, and systems to support the light rail system. The energy consumed for construction and manufacture is estimated in **Table 4.13-3**. Indirect energy consumption ranges from 3,063 to 3,145 billion BTUs. The NEPA Preferred Alternative would consume the least amount of energy at 3,063 billion BTUs. There is not a substantial difference in indirect energy use between the alternatives, nor does selection of the ROMF site result in a substantial difference in indirect energy use.

4.13.4 Mitigation Measures

The NEPA Preferred Alternative would result in an estimated annual energy savings compared to the No Build Alternative. Mitigation measures are not warranted.

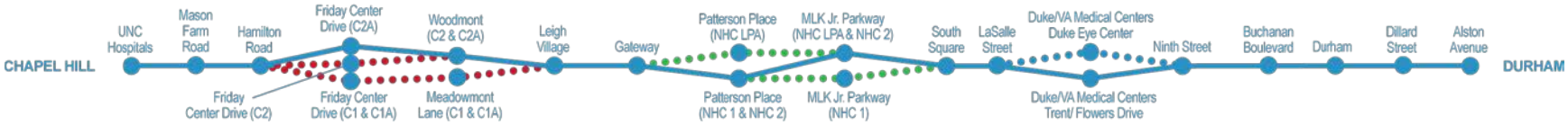


Table 4.13-1: Comparison of Estimated Annual VMT for the Triangle Region (2040) (in millions of miles)

	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[b]			New Hope Creek Alternatives[b]		Duke/VA Medical Centers[b]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Auto VMT	24,290	24,266	+2	+2	+3	-4	-2	+1
Diesel Bus VMT	5.40	5.05	0	0	0	0	0	0
Hybrid Bus VMT	1.60	1.69	0	0	0	0	0	0
Light Rail VMT	0	0.96	-0.01	+0.01	0	-0.01	0	0
Total VMT	24,297	24,274	+1.99	+2.01	+3	-4.01	-2.00	+1.00

Source: AECOM 2015.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] In comparison to the NEPA Preferred Alternative

Table 4.13-2: Comparison of Estimated Direct Transportation Annual Energy Use for the Triangle Region (2040) (in billions of BTUs)

	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[b]			New Hope Creek Alternatives[b]		Duke/VA Medical Centers[b]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Annual transportation-related energy consumption	137,051	136,968	+13	+12	+17	-24	-10	0

Source: AECOM 2015.

Note: The conversion factor from VMT to BTUs is for the 2040 year horizon and is from the New Starts Template (FTA 2014) and from the *Transportation Energy Data Book*, Edition 32 (DOE 2013).

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] In comparison to the NEPA Preferred Alternative

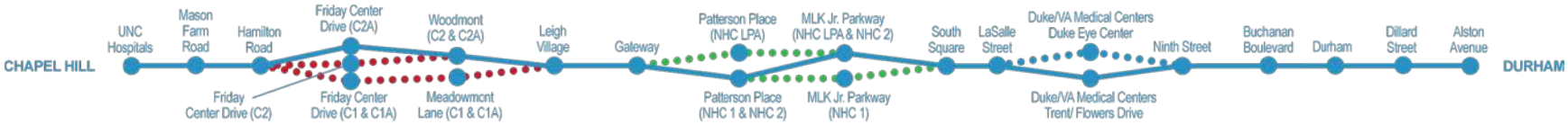


Table 4.13-3: Comparison of Estimated Indirect Energy Use (in billions of BTUs)

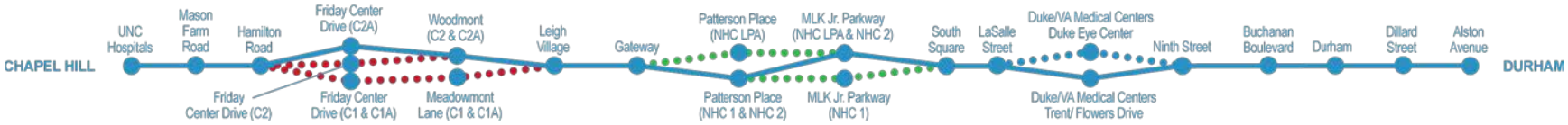
	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[b]			New Hope Creek Alternatives[b]		Duke/VA Medical Centers[b]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Guideway	0	217	-10	-1	0	0	0	0
Systems	0	954	-5	-1	-1	-1	0	0
Stations/Parking	0	1,103	+81	+81	+15	+2	0	0
Facility	0	749	0	0	0	0	0	0
Infrastructure Subtotal	0	3,023	+66	+79	+14	+1	0	0
Vehicles	0	40	0	0	0	0	0	0
Total Energy	0	3,063	+66	+79	+14	+1	0	0

Source: AECOM 2015.

Note: Quantities used in the energy calculation were from the *Durham-Orange Light Rail Transit Project – Capital Cost Estimates*. Energy quantities were developed using methodologies from the *Energy and Transportation Systems* (CALTRANS 1983).

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] In comparison to the NEPA Preferred Alternative



4.14 Acquisitions, Relocations, and Displacements

This section describes the potential property acquisitions, relocations, and displacements for the NEPA Preferred and Project Element Alternatives in comparison to the No Build Alternative.

A complete list of full and partial property acquisitions and corresponding maps for the proposed D-O LRT Project are located in appendix K.

4.14.1 Methodology

The following steps were taken in the displacements and relocation analysis:

- Identification of potential full and partial acquisitions and relocations based on a review of the *Basis for Engineering Design* (appendix L)
- Field reviews to verify current parcel use of affected properties
- Calculations of residential, business/industrial, and institutional displacements due to each of the NEPA Preferred and Project Element Alternatives
- Determination of the type of business/industry or institution that would be displaced
- For acquisitions, estimation of the number of residential and commercial displacements
- Relocation assistance for the proposed D-O LRT Project will follow the relevant procedures set forth in federal and state laws and regulations.

Full acquisitions entail the purchase of an entire parcel, whereas "partial acquisitions" entail the purchase of a portion of a parcel.

Displacements occur when a full acquisition is necessary, or when a partial acquisition would result in an impact that would affect the continued economic viability or use of a property. Owners and renters displaced as a result of the project may be eligible for relocation assistance according to federal, state, and local laws and regulations.

4.14.2 Affected Environment

Development in the D-O Corridor includes residential, commercial, industrial, institutional, agricultural, park, and transportation uses. Existing land uses in the D-O Corridor are described in DEIS section 4.1.

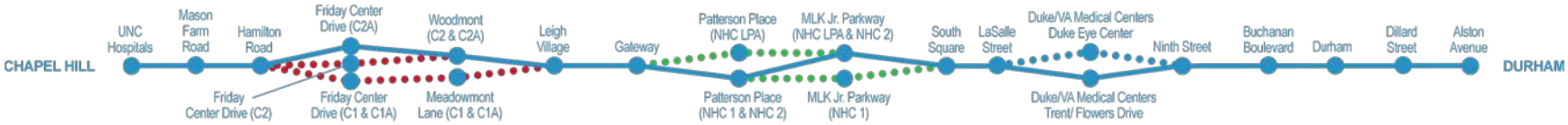
4.14.3 Environmental Consequences

The following sections describe the environmental consequences related to acquisitions, relocations, and displacements from the NEPA Preferred and Project Element Alternatives in comparison to the No Build Alternative.

Under the No Build Alternative, there would be no acquisitions, relocations, and/or displacements due to the proposed D-O LRT Project.

4.14.3.1 NEPA Preferred and Project Element Alternatives

The NEPA Preferred and Project Element Alternatives would require new right-of-way. **Table 4.14-1** and **Table 4.14-2** summarize the number and types of properties to be acquired for the NEPA Preferred Alternative and compare the difference to the Project Element. Some properties would need to be fully acquired (**Table 4.14-1**). Land purchased from some properties may amount to only a portion of the parcel that would not prevent continued use of the property, and are therefore considered partial acquisitions (**Table 4.14-2**). Both full and partial acquisitions of properties have potential to displace businesses and residences (**Table 4.14-3**).



It is estimated that new right-of-way needed for the proposed project alignment, stations, park-and-ride lots, traction power substations, and ROMF would affect between 219 and 250 parcels, depending on the alternative selected.

Coordination

Meetings with affected property owners were initiated in 2014. 14 open houses for affected property owners were held between June 2014 and June 2015. Residential and commercial property owners potentially affected by any portion of the alignment and/or any of the ROMF alternatives were contacted via phone calls and postal mail. Meetings were held at various locations along the proposed alignment including local apartment complexes, local residences, as well as accessible locations close to affected properties. Project staff also provided additional accommodations by offering a webinar session on July 18, 2014 for those that own affected properties along US 15-501, who live out of state. In 2015, meetings with affected property owners along Pettigrew Street in Durham were held on February 21, 2015 and March 7, 2015. All property owners directly affected by potential new right-of-way needs of the proposed D-O LRT Project will be invited to all upcoming public meetings and open houses. During the NEPA process meaningful communication with all affected property owners will continue. Refer to DEIS chapter 9 and appendix J for additional information on outreach efforts.

NEPA Preferred Alternative

The NEPA Preferred Alternative is comprised of the segments common to all Light Rail Alternatives, C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

Acquisitions

The acquisitions and displacements associated with the NEPA Preferred Alternative are predominately residential and commercial, although almost half of the full acquisitions involve vacant land.

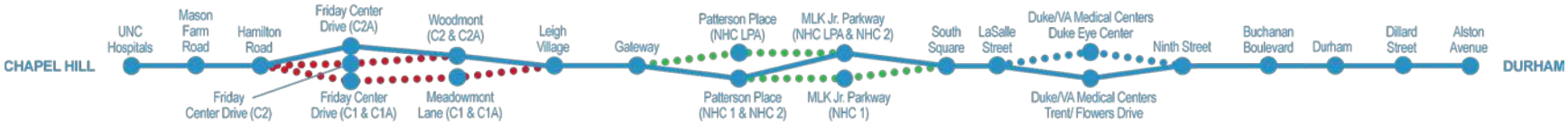
The NEPA Preferred Alternative is estimated to require 92 full parcel acquisitions and 145 partial parcel acquisitions resulting in 65 residential, commercial, or institutional displacements throughout the D-O Corridor.

Displacements

Of the 45 residential displacements listed in **Table 4.14-3**, nine are residence halls in UNC Odum Village that would be directly affected; however, these buildings already are slated to be demolished, according to the UNC *Campus Master Plan*. The Farrington Road ROMF site would displace six single-family residents. The remaining 30 residential displacements are predominately single-family and, to a lesser extent, two-family residences.

The 16 commercial displacements vary in type of business (**Table 4.17.3**). A Frontier Communications facility located near University Drive would be displaced. The park-and-ride lot associated with the Martin Luther King Jr. Parkway Station would displace a large retail store. Several businesses would be displaced along Shannon Road, including a federal credit union, two restaurants, a retail mattress factory, and an eye care center. The placement of the South Square Station along Shannon Road would displace an auto dealership. In downtown Durham, two office buildings, a one story and a three story, and a retail furniture store would be displaced along with an automotive dealership to accommodate the Dillard Street Station. The Alston Avenue Station would displace a restaurant and two downtown warehouse/storage buildings. The Farrington Road ROMF site may displace a cell tower, although the cell tower may be able to be incorporated into the ROMF site during the Engineering phase if this ROMF site is selected.

The four institutional displacements listed in **Table 4.14-3** under the NEPA Preferred Alternative are associated with Duke University. The John Hope Franklin Center and the Duke Family Care Program are neighboring buildings located along Erwin



Road on the Duke University campus. A Duke University warehouse and a transportation service repair garage in downtown Durham would also be displaced.

Project Element Alternatives

Little Creek Alternatives

Acquisitions and displacements associated with the Little Creek Alternatives are similar in number and type of land use/property use to the NEPA Preferred Alternative.

Acquisitions

Compared to the NEPA Preferred Alternative, the C1 Alternative would result in the same number of total full parcel acquisitions, as listed in **Table 4.14-1**. The C1A Alternative would result in two additional full parcel acquisitions and the C2 Alternative would result in one additional full parcel acquisition. For partial parcel acquisitions (**Table 4.14-2**), the C1 Alternative would result in five fewer acquisitions and C1A would result in three fewer acquisitions. Of the Little Creek Alternatives, C2 would also have the highest partial parcel acquisitions resulting in five additional partial parcel acquisitions.

Displacements

The NEPA Preferred Alternative would result in 45 residential displacements (**Table 4.14-3**). Comparatively, the C1A Alternative would result in the same number of residential displacements. The C1 and C2 Alternatives would result in one additional residential displacement.

The C2 Alternative would displace one additional commercial business – a gas/convenience store near Barbee Chapel Road and Stancell Drive, compared to the NEPA Preferred Alternative. The C1 and C1A Alternatives would result in the same number of commercial displacements, compared to the NEPA Preferred Alternative.

New Hope Creek Alternatives

Acquisitions and displacements associated with the New Hope Creek Alternatives are similar in number and type of land use/property use to the NEPA Preferred Alternative.

Acquisitions

Compared to the NEPA Preferred Alternative, the NHC LPA would result in one less full parcel acquisition and NHC 1 Alternative would result in two additional full parcel acquisitions, as listed in **Table 4.14-1**. For partial parcel acquisitions (**Table 4.14-2**), both the NHC LPA and NHC 1 Alternatives would result in one less partial parcel acquisition, compared to the NEPA Preferred Alternative.

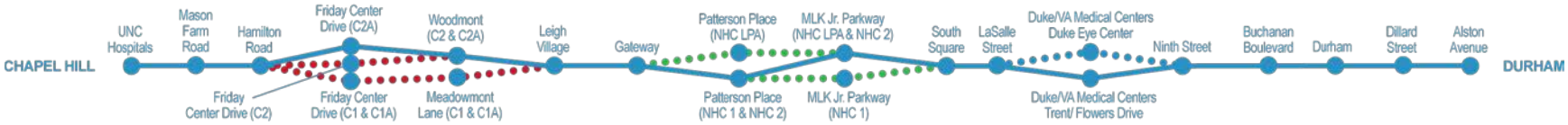
Displacements

The NEPA Preferred Alternative would result in 45 residential displacements. Comparatively, the NHC LPA Alternative would result in one less residential displacement. The NHC 1 Alternative would also result in the same number of residential displacements as the NEPA Preferred Alternative.

The NHC 2 Alternative, as part of the NEPA Preferred Alternative, would result in the displacement of a Frontier Communications facility. The NHC 1 Alternative would avoid the Frontier Communications facility; however, NHC 1 would displace an organ and tissue donor center and a realtors' office building to accommodate the Martin Luther King Jr. Parkway Station, resulting in one more commercial displacement than the NEPA Preferred Alternative.

Duke/VA Medical Centers Station: Duke Eye Center

The widening of Erwin Road to accommodate tracks and a station platform for the Duke/VA Medical Centers Station in the center of the roadway would have a similar effect on adjacent property with either the Duke Eye Center or Trent/Flowers Drive Alternatives. The Duke/VA Medical Centers Station is a proposed walk-up station without parking.



ROMF

Additional right-of-way would also be needed for the ROMF. Five locations are under consideration for the ROMF, ranging from approximately 16 to 25 acres. The numbers of potentially affected parcels for each ROMF alternative are listed in **Table 4.14-4** and **Table 4.14-5**. The considered ROMF Alternatives have been sited to minimize impacts to surrounding properties; however, the locations are subject to change as design advances. The numbers reported for the Farrington Road ROMF are also included in the numbers reported for the NEPA Preferred Alternative in **Table 4.14-1** through **Table 4.14-3**.

The Leigh Village ROMF site would result in five single-family residential displacements and two commercial displacements: Patterson's Mill Country Store and a cell tower. Compared to the NEPA Preferred Alternative, the Leigh Village ROMF site would result in the same number of full and partial acquisitions and displacements. The Patterson Place ROMF site would not displace individuals or businesses, but would require land from undeveloped parcels either in part or in full. The Cornwallis Road ROMF site would displace a commercial/industrial building (former Pepsi plant being redeveloped into a self-storage facility). Two single-family residences and six commercial/industrial businesses, including chemical distributor Brenntag Southeast and distributor of wholesale organic Carolina farm produce, Eastern Carolina Organics, would be displaced with the Alston Avenue ROMF.

4.14.4 Mitigation Measures

This section presents the mitigation measures for the potential acquisitions and displacements that would occur as a result of the project.

4.14.4.1 Acquisitions

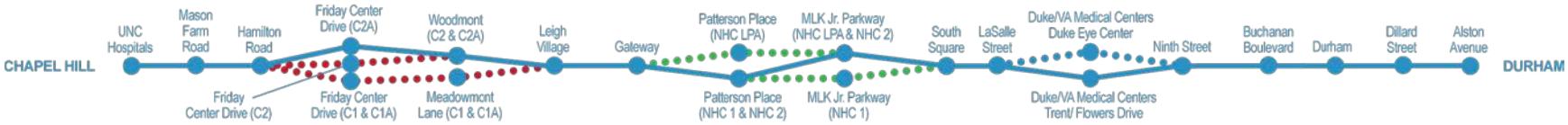
Triangle Transit will conduct the acquisition process in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R. 24), as amended. The act requires that property owners be paid fair market value compensation for the acquired property as well as equitable compensation normally associated with relocating.

It is possible that property acquisitions and displacements would affect some property owners and tenants whose primary language is not English. Accordingly, property acquisition and relocation discussions would be conducted in alternate languages whenever necessary. The specific impact of acquisitions and displacements on Environmental Justice populations are described in DEIS chapter 5.

Following a decision to acquire property, a general overview of the acquisition process is as follows:

- Each real property owner or the owner's representative would be contacted in order to explain the acquisition process, including the right to accompany the appraiser during inspection of the property, and provide the owner with a written notice of Triangle Transit's intent to acquire.
- Owner would be provided with a written offer of the approved estimate of just compensation for the real property to be acquired and a summary statement of the basis for the offer.
- Property owner would be given an opportunity to consider the offer for at least 30 days.
- Negotiations without any attempt to coerce the property owner into reaching an agreement would be conducted.
- Property owner/tenant would be provided at least 90 days written notice to vacate prior to taking possession.

If negotiations with property owners are not successful, Triangle Transit may acquire the property through eminent domain (N.C.G.S § 160A - 619). If eminent domain is necessary, Triangle Transit will follow the procedures set forth under North Carolina



law, including NC Eminent Domain (N.C.G.S. §§ 40-A-1 – 40A-85) and NC Relocation Assistance Act (N.C.G.S. § 133-5 – 133-22).

Pursuant to 23 C.F.R. Part 810 Subpart C, Triangle Transit will request authorization from the Federal Highway Administration (after an assessment by NCDOT) to use federally-owned rights-of-way in conjunction with the proposed D-O LRT Project.

4.14.4.2 Displacements

Any relocation of a displaced use would also be conducted in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R. 24). Ample notice would be given to those being relocated to allow for any planning contingencies that may arise. In accordance with Title VI of the Civil Rights Act of 1964, Triangle Transit would provide relocation advisory assistance to all eligible persons without discrimination.

Displaced persons would be offered to relocate in areas at least as desirable as their original property with respect to public utilities and commercial facilities. Rent and sale prices of replacement property offered to those displaced would be within their financial means, and replacement property would be within reasonable access to displaced individuals' places of employment. Relocations are not expected to remove individuals from their community activities. Currently, plenty of comparable decent, safe, and sanitary (DS&S) housing is available on the real estate market to relocate those who are displaced from their residences. However, if comparable housing cannot be offered, last resort housing assistance would become available to displaced persons.

Additionally, relocation planning and services would be provided to businesses. These relocation services include the following:

- Site requirements, current lease terms, and other contractual obligations
- Providing outside specialists to assist in planning and moving assistance for the actual move, and the reinstallation of machinery and other personal property
- Identification and resolution of personal property/real property issues
- An estimate of time required for the business to vacate the site
- An estimate of the anticipated difficulty in locating replacement property
- An identification of any advance relocation payments required for the move

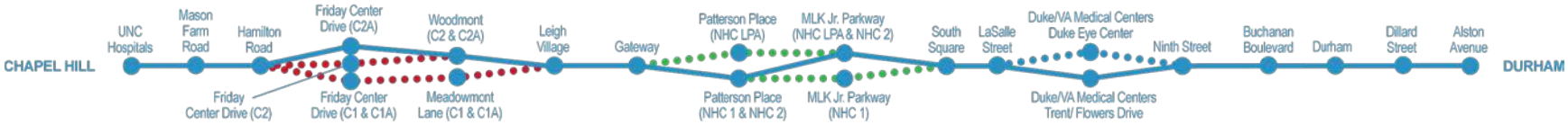


Table 4.14-1: Full Acquisitions

Land Use Category	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[b]			New Hope Creek Alternatives[b]		Duke/VA Medical Centers[b]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Residential	0	31	+1	0	+1	-1	0	0
Commercial	0	15	0	0	+1	0	+1	0
Institutional	0	3	0	0	0	0	0	0
Vacant land	0	43	-1	+2	-1	0	+1	0
Total Potential Full Acquisitions	0	92	0	+2	+1	-1	+2	0

Source: AECOM 2015.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] In comparison to the NEPA Preferred Alternative

Table 4.14-2: Partial Acquisitions

Land Use Category	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[b]			New Hope Creek Alternatives[b]		Duke/VA Medical Centers[b]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Residential	0	44	-6	-5	+5	+1	-3	0
Commercial	0	68	+1	+1	-1	-4	+2	0
Federal Land	0	2	-1	-2	0	0	0	0
Institutional	0	16	+1	+2	+1	0	0	0
Recreation or Forestry	0	3	0	+1	0	+3	0	0
Medical / Hospital	0	5	0	0	0	0	0	0
Religious	0	2	0	0	0	0	0	0
Industrial	0	1	0	0	0	0	0	0
Agricultural	0	2	0	0	0	-1	0	0
Vacant		1	0	0	0	0	0	0
Other	0	1	0	0	0	0	0	0
Total Potential Partial Acquisitions	0	145	-5	-3	+5	-1	-1	0

Source: AECOM 2015.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] In comparison to the NEPA Preferred Alternative

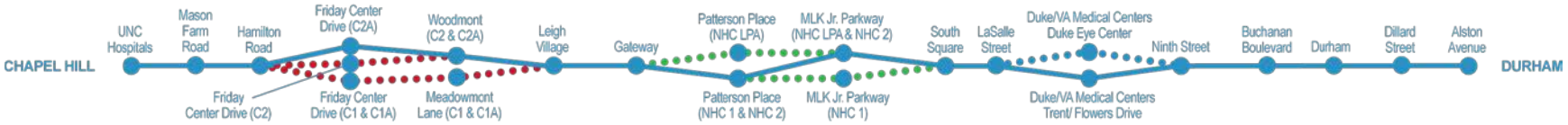


Table 4.14-3: Displacements

Land Use Category	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[b]			New Hope Creek Alternatives[b]		Duke/VA Medical Centers[b]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Residential	0	45	+1	0	+1	-1	0	0
Commercial	0	16	0	0	+1	0	+1	0
Institutional	0	4	0	0	0	0	0	0
Total Displacements	0	65	+1	0	+2	-1	+1	0

Source: AECOM 2015.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] In comparison to the NEPA Preferred Alternative

Table 4.14-4: Full Acquisitions and Displacements for ROMF Sites

Land Use Category	Leigh Village	Farrington Road [a]	Patterson Place	Cornwallis Road	Alston Avenue
Residential displacement	5	6	0	0	2
Commercial displacement	2	1	0	1	6
Vacant Land	4	4	2	0	11
Total Full Acquisitions	11	11	2	1	19

Source: AECOM 2015.

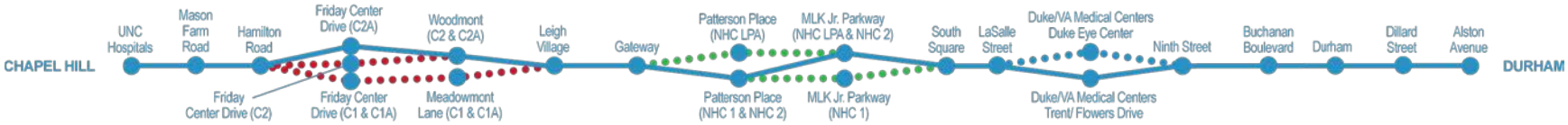
[a] Farrington Road is the ROMF considered as part of the NEPA Preferred Alternative.

Table 4.14-5: Potential Partial Acquisitions for ROMF Sites

Land Use Category	Leigh Village	Farrington Road [a]	Patterson Place	Cornwallis Road	Alston Avenue
Residential	1	0	1	1	0
Commercial	0	1	0	0	0
Agricultural	0	0	1	0	0
Vacant Land	1	1	1	0	0
Total Partial Acquisitions	2	2	3	1	0

Source: AECOM 2015.

[a] Farrington Road is the ROMF considered as part of the NEPA Preferred Alternative.



4.15 Utility Impacts

This section describes the existing utilities, both public and private, located within the study area, identifies the utility owners, and identifies potential effects to utilities that would result from the NEPA Preferred and Project Element Alternatives. It also discusses the strategies to avoid, minimize, or mitigate these impacts. This section also documents coordination activities that will be undertaken during future phases of the proposed D-O LRT Project. . While this section discusses the existing infrastructure that would potentially be impacted by the D-O LRT Project, a discussion of the required energy to operate the project is included in section 4.13.

4.15.1 Methodology

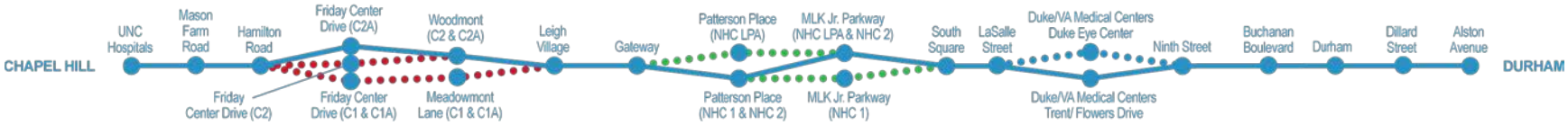
Existing major public and private utilities and utility owners were identified within the study area for the NEPA Preferred and Project Element Alternatives based upon public records, information provided by utility owners, and field surveys. The D-O LRT Project team has facilitated coordination with individual utility owners to gather information on existing facilities and any planned future improvements. This information was used to identify potential conflicts between the NEPA Preferred and Project Element Alternatives and the utilities. The initial study area for utilities was an approximately 200-foot wide corridor along the NEPA Preferred and Project Element Alternatives. This was subsequently refined to the area within the anticipated construction limits of the NEPA Preferred and Project Element Alternatives, plus areas beyond these limits as required to assess potential utility relocation tie-ins to existing facilities.

What are Utilities?

23 C.F.R. §§ 645.207 (2008)

"Privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing

- communications
- cable television
- power
- electricity
- light
- heat
- gas
- oil
- crude products
- water
- steam
- waste
- stormwater not connected with highway drainage
- or any other similar commodity,
- including any fire or police signal system or street lighting system, which directly or indirectly serves the public."



4.15.2 Affected Environment

The study area includes utility infrastructure that connects hospitals, universities, residences, and businesses to essential services. The majority of the existing utilities in the study area are located within or adjacent to the NCDOT state roadway rights-of-way, NCRR rights-of-way, or local street rights-of-way. Utilities are also located within drainage easements and within utility easements that would be crossed by the NEPA Preferred and Project Element Alternatives.

The existing utilities consist of both overhead lines on poles or towers (e.g., electric power, telephone, telecommunications, cable television, and traffic signals) and underground facilities (e.g., water mains, reclaimed water mains, gravity sewer lines, sewer force mains, gas lines, communications and electrical conduits, duct banks, and steam lines).

Utility service providers in the study area include the following:

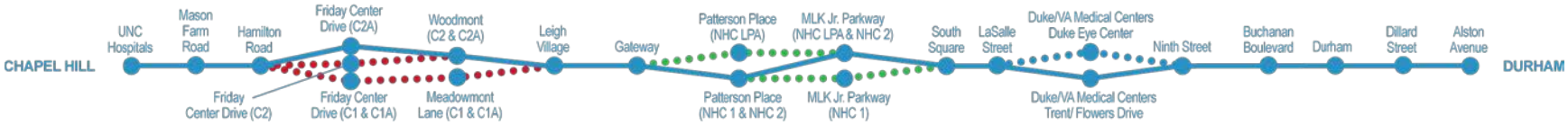
- Water and Sewer
  - Orange Water and Sewer Authority (OWASA)
  - City of Durham
- Electric Power
  - Duke Energy (transmission/distribution/services/lighting)
  - Duke University Utilities and Engineering Services (distribution on campus and hospitals)
  - UNC Energy Services
- Natural Gas – Public Service Company of North Carolina (PSNC Energy)
- Telecommunications
  - AT&T
  - Crown Castle (cell tower)
  - DukeNet Communications
  - Duke University Utilities and Engineering Services (campus and hospitals communications)
  - Frontier Communications
  - Level 3 Communications
  - MCI
  - Interpath
  - Time Warner Telecom
  - UNC campus communications
- Cable Television – Time Warner Cable
- Traffic Signals
  - NCDOT
  - City of Durham
  - Town of Chapel Hill
- Universities and Medical Facilities
  - Duke University Utilities and Engineering Services (includes University and Medical Center)
  - UNC Facilities Operation, Planning, and Design (includes University and Hospitals)

Examples of Potential Conflicts

- Utilities that would cross the proposed NEPA Preferred and Project Element Alternatives
- Utilities that would run within, under, and/or adjacent to the proposed D-O LRT right-of-way
- Utility connections to individual homes and businesses

Substantial existing utility infrastructure within the proposed D-O LRT Project study area includes the following:

- UNC steam and chiller lines near the intersection of Mason Farm Road and Daniels Drive
- UNC utility tunnel along Hibbard Drive



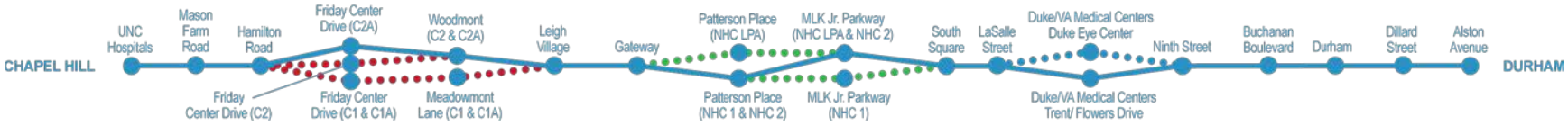
- City of Durham pump station on George King Road
- AT&T remote cabinets on Prestwick Road at Finley Golf Course Road and NC 54 at Friday Center Drive
- PSNC 10-inch high pressure gas transmission line along George King Road
- Crown Castle Cell Tower on Farrington Road
- OWASA pump station on Old Chapel Hill Road
- Duke Energy overhead 244 kilovolt (kV) transmission line between US 15-501 and Old Chapel Hill Road
- Duke Energy double circuit overhead power distribution system along University Drive
- Frontier Communications duct bank system along University Drive
- Level 3 Communications fiber system along University Drive
- City of Durham 30-inch water transmission main along US 15-501
- Duke Energy double circuit overhead power distribution system along Erwin Road
- Duke Energy underground 44 kV transmission line along Erwin Road
- Duke University power and communication system and connections to outside service along Erwin Road
- Duke University steam lines crossing under Erwin Road
- City of Durham 24-inch water transmission main in Pettigrew Street

4.15.3 Environmental Consequences

Under the No Build Alternative, utilities may be added or replaced due to new development and planned schedules for maintenance. Utilities could also be affected by planned transportation or other projects. It is anticipated that each of the utility providers listed in DEIS section 4.15.2 may be affected by the implementation of the NEPA Preferred and Project Element Alternatives. The specific utilities that would be affected and plans for their avoidance, replacement, and/or relocation will be determined with their owners as part of the ongoing coordination effort and the Engineering phase of the project.

These potential effects generally would fall within one of the following situations:

- **Utilities that would cross the NEPA Preferred and Project Element Alternatives**: Existing utilities crossing the alignment may conflict with the proposed construction and would need to be relocated to provide adequate clearances to the proposed light rail facilities. Examples include the following:
  - Rerouting utilities around station areas and bridge foundations.
  - Relocating underground utilities that cannot be safely inspected or maintained under the light rail tracks.
  - Lowering/protecting underground utilities that are too shallow for the proposed construction.
  - Replacing/protecting underground utilities that would be underneath additional depth of earth because of construction.
  - Encasing pressure pipes that cross under the light rail tracks, as permitted by the utility owners.
  - Installing a cathodic protection system to protect metal pipes from potential corrosion from stray currents from the light rail traction power system.
  - Raising/relocating overhead utilities that are directly in conflict or that result in inadequate vertical clearance when the proposed light rail system is constructed below them. Clearances to proposed



overhead catenary lines are evaluated as part of this process.

- **Utilities that would run within, under, and/or adjacent to the proposed D-O LRT Project right-of-way**: Existing utilities running along the NEPA Preferred and Project Element Alternatives would be relocated when they encroach into the designated utility-free zone above, below, and beside the proposed trackway. This utility-free zone would be required for the construction and operation of the light rail system. In addition, stray current considerations may require installation of cathodic protection and/or relocation of metal pipe utilities.

  This situation is prevalent in Durham along University Drive and Erwin Road, where utilities run in and along the edge of the existing roadway pavement. Some of these existing utilities would be relocated as part of widening the roadway to create the median to accommodate the D-O LRT Project trackway.

  This situation also exists in downtown Durham along the NCRR right-of-way and Pettigrew Street where utilities run in, beside, or under the railroad right-of-way that includes Pettigrew Street. Many of the existing utilities in the railroad right-of-way that conflict with the light rail construction would be relocated under the adjacent roadway or the sidewalk/planting area beside the roadway.

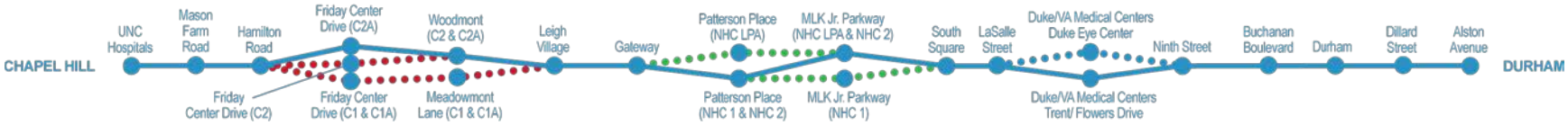
- **Utility connections to hospitals, universities, individual residences, and businesses**: Access points to existing utilities (e.g., manholes, handholes, valve boxes, major utility junctions such as pump stations) may be relocated or adjusted where they would conflict with the construction of the NEPA Preferred and Project Element Alternatives or to allow safe access to these locations. As the existing utilities are relocated, the corresponding service lines to customers would also be adjusted. This could result in temporary service outages during construction in accordance with the utility owner's procedures.

New utility services would be required to operate the D-O LRT Project. These services would include power to traction power substations, signal houses, stations and the maintenance facility; water and sewer services to the end of line crew comfort stations and the maintenance facility; water service to station hose bibs; and communication services at the control center at the maintenance facility. Utility owners have indicated that providing these services do not appear to present unusual challenges. Both UNC and Duke Energy have noted that they have an agreement between them concerning power supplied to third parties that would need to be addressed for the portion of the D-O LRT Project that is located on the University campus.

The approximate potential effects, based upon conceptual plans, preliminary discussion with utility owners and limited field information, of each of the NEPA Preferred and Project Element Alternatives on utilities are described in the sections that follow and **Table 4.15-1**.

4.15.3.1 NEPA Preferred Alternative

Table 4.15-1 shows that across all utilities, the NEPA Preferred Alternative would potentially affect approximately 85 miles of utility lines. While most of the potential effects are of a nature that would normally be expected, the utilities in Erwin Road present a particular challenge due to the presence of the underground 44kV electric transmission line and the Duke University and Hospital power and communication lines. In addition, the NEPA Preferred Alternative would potentially affect the cell tower on the Farrington Road ROMF site.



4.15.3.2 Project Element Alternatives

Little Creek Alternatives

As shown in **Table 4.15-1**, when comparing the Little Creek Alternatives across all utilities, the NEPA Preferred Alternative (C2A) would potentially affect approximately 5 percent more utilities than Alternative C2, and approximately 10 percent more utilities than Alternatives C1 and C1A. The greatest differences would be the potential effects to water mains, sewer lines, electric power distribution, and telecommunications. This is because the NEPA Preferred Alternative runs along NC 54 for a greater distance than the other Little Creek Alternatives. However, Alternatives C1 and C1A would potentially affect utilities along Meadowmont Lane, while the NEPA Preferred Alternative and Alternative C2 would not.

New Hope Creek Alternatives

As shown in **Table 4.15-1**, when comparing the New Hope Creek Alternatives across all utilities, the potential effects on utilities of the NEPA Preferred Alternative (NHC-2) and the NHC LPA Alternative would be similar. The NEPA Preferred Alternative and the NHC LPA Alternative would potentially affect approximately 10 percent more utilities than the NHC 1 Alternative. The greatest differences would be the potential effects to electric distribution and telecommunications. This is because the NEPA Preferred Alternative and the NHC LPA Alternative run along University Drive for a greater distance than the NHC 1 Alternative. In addition, the NHC LPA Alternative would potentially affect four towers to raise an overhead electric transmission line running along New Hope Creek. However, the NHC 1 Alternative would potentially affect more utilities along US 15-501 and Martin Luther King Jr. Parkway than the NEPA Preferred Alternative and the NHC LPA Alternative.

Duke/VA Medical Centers Station: Duke Eye Center

There is little difference between the potential utility effects of the Trent/Flowers Drive Station location in the NEPA Preferred Alternative when compared to Duke Eye Center Station Alternative.

ROMF

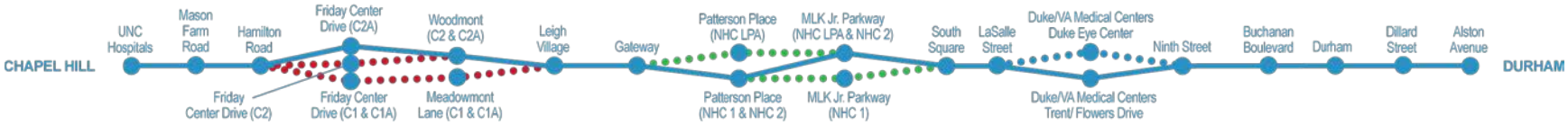
The only notable difference among the ROMF Alternatives is an existing cell tower that falls within both the Farrington Road ROMF site in the NEPA Preferred Alternative and the Leigh Village ROMF Alternative. To retain this cell tower, it would need to be accommodated in the ROMF design for either of these two ROMF locations. For all the ROMF Alternatives, existing utilities running through or around the perimeter of the site may need to be modified as part of the ROMF construction. As an example, there is an existing sanitary sewer at the Farrington Road and Leigh Village ROMF sites that will need to be relocated.

4.15.4 Mitigation Measures

The D-O LRT Project team has been coordinating with each utility owner to identify utility facilities that would potentially be affected by the NEPA Preferred and Project Element Alternatives and to develop conceptual plans and cost estimates for the anticipated relocation, replacement, or protection of those utilities.

Ongoing coordination will continue as the proposed project design progresses to identify additional impacts and minimize service disruptions, in coordination with respective utility owners and appropriate local agencies. Existing utilities will be surveyed during the Engineering phase and efforts will be made to avoid or limit impacts to existing utilities when practical. Where the D-O LRT Project may conflict with existing utilities, the utilities will be protected in place, relocated, replaced, or abandoned (if possible) in consultation with the utility owner.

Where relocation will be required, efforts will be made to consolidate existing utilities where practical to reduce the number of lines (e.g., replace two water mains with a single line) or combine facilities (e.g., use of a joint duct bank for underground telecommunication lines) as permitted by the utility owners.



Measures will be taken to minimize utility service outages and to schedule them with the utility owner and the customer such that they would present the least inconvenience. Special measures may be incorporated to ensure continuous service to life safety functions such as hospitals, fire protection, emergency response, detention centers, and other facilities providing critical support such as private medical offices/care facilities or university laboratories.

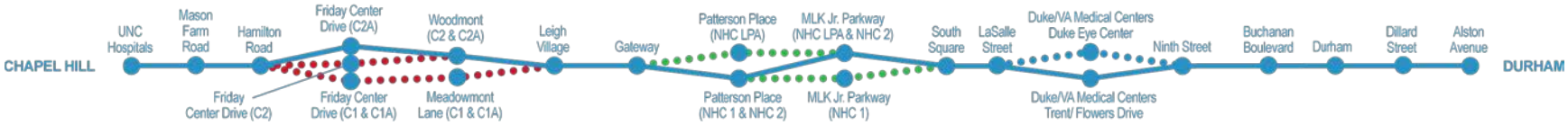


Table 4.15-1: Approximate Potential Utility Effects

Utility	No Build Alternative [a]	NEPA Preferred Alternative [b]	Change in Potential Approximate Effects from NEPA Preferred Alternative					
			Little Creek Alternatives[d]			New Hope Creek Alternatives[d]		Duke/VA Medical Centers[d]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Water Mains	✓	6	-0.5	-0.5	-0.5	-0.5	+0.5	0
Sewer Lines	✓	3	-0.25	-0.25	0	0	0	0
Overhead 244 kV Electric Transmission	✓	0	0	0	0	+4 towers	+10 towers	0
Underground 44 kV Electric Transmission	✓	1.25	0	0	0	0	0	0
Overhead Electric Distribution	✓	300 Poles [c]	-50 poles	-50 poles	0	+10 poles	+10 poles	0
Underground Electric Distribution	✓	22	-2	-2	-3	0	-1	0
Natural Gas	✓	4	-0.25	-0.25	-0.25	0	0	0
Copper Telecom	✓	18	-1	-1	0	+1	-4	0
Fiber Optic Telecom	✓	14	-3	-3	-1	+1	-2	0
Cable Television	✓	3	0	0	0	0	-1	0

Source: STV 2015.

Note: Based upon conceptual plans, preliminary discussions with utility owners, and limited field information.

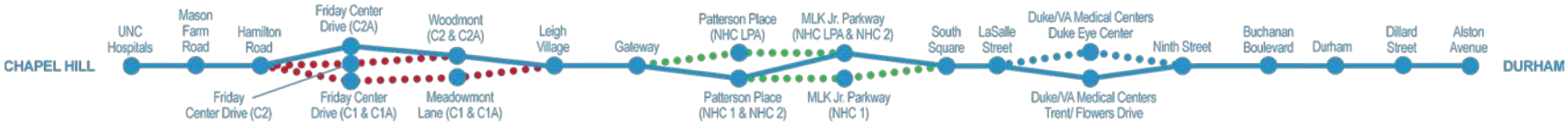
Note: Potential effects measured in miles, unless otherwise noted.

[a] Existing utilities will be affected under the No Build by utility expansion and maintenance projects, transportation projects, and governmental, institutional, and private development projects.

[b] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[c] Approximately 14 miles, assuming an average pole spacing of approximately 250 feet.

[d] In comparison to the NEPA Preferred Alternative



4.16 Construction

Construction consequences of the proposed D-O LRT would be temporary and limited to the footprint of construction for the duration of construction. This section discusses likely construction consequences related to the natural and built environment with regard to the proposed D-O LRT Project based on the current level of design. Identification of the specific construction limits would be refined during the Engineering phase and will provide better delineation of the physical scope and timeframe of any impacts. Temporary construction consequences would be refined as the design of the project proceeds. Construction work details such as phasing will also be developed during the Engineering Phase.

Typical short-term construction consequences include: dust; noise and vibration; traffic disruption, congestion and diversion, as well as limited or temporary loss of access for residences and businesses; and temporary loss of access to parking. If properly planned and coordinated, construction impacts to neighborhoods, businesses, and the natural environment can be minimized.

Construction-related consequences would result from demolition, grading and site preparation, as well as construction of the parking deck, park-and-ride lots, and the guideway's main structural components such as elevated guideway, bridges, walls, and stations. Construction of other system components, such as traction power substations and the ROMF would also have associated consequences, but to a lesser degree.

Large areas, such as the ROMF, park-and-ride lots, and stations could be used for construction staging areas. Additional areas would be identified by the contractor as needed. The contractor would be responsible for obtaining any necessary permits and approvals. The consequences of activities in staging areas known at this time are included in the discussion of construction consequences on the natural and built environments.

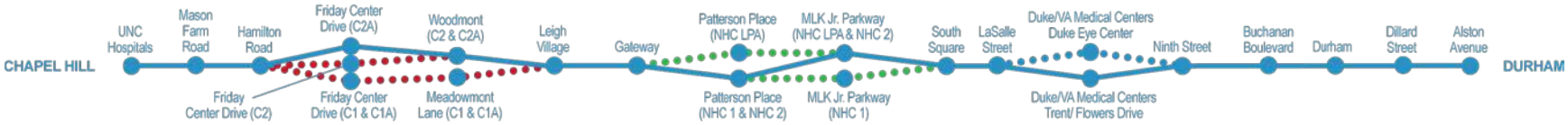
Construction would not have a substantial effect on some resources, as summarized in the introduction to DEIS chapter 4, including land use, public policy, zoning, air quality, greenhouse gases, safety and security, and energy. Consequences on other resources are discussed in the following sections.

4.16.1 Construction Scenario

The D-O LRT Project would involve a multi-year construction phase, which would be developed following completion of the FEIS, Record of Decision, and Engineering phase. Typical construction contract packaging involves multiple linear contracts for at-grade and aerial sections, including station infrastructure and utility work. A system-wide contract may be procured for construction of all the system elements (traction power supply and distribution, train control, and signaling and communications). System-wide procurements (owner-furnished materials) may be investigated for such elements as traction power substations, special trackwork, rail and concrete ties, and grade crossing panels given the volume of such items. The ROMF, station finishes, park-and-ride lots, and garage may also be separate construction contracts. Definitive contract packaging and procurement methodologies will be developed during the Engineering phase. Industry-wide outreach with national contractors, regional contractors, local contractors, Associated General Contractors (AGC), other transit agencies, and FTA regarding contract packaging will provide valuable input to the contracting plan, especially with how to package smaller contracts for the local contractors.

At any given time, there may be multiple line-section contractors and specialty contractors working along the alignment. However, the timing of these linear construction contracts would be arranged so that multiple contractors do not disproportionately overburden a single sub-area of the project at any one time.

A typical scenario for the order of construction phasing for a light rail project is presented in **Figure 4.16-1**. This assumes



that right-of-way acquisition and permitting precedes the construction.

4.16.1.1 Construction of the Guideway by Type

Construction methodologies would vary throughout the D-O Corridor due to differences in the guideway characteristics (e.g., dedicated transitway within an existing roadway; dedicated right-of-way off-street; and elevated on structure) and in some cases, the characteristics of adjacent streets along the route. A general discussion of the level and type of impacts follows.

Light Rail in a Dedicated Transitway within an Existing Roadway

Construction of a light rail system in a dedicated transitway within an existing roadway typically involves the creation of a new light rail track embedded in the median of a street. Embedded track construction involves constructing the transitway such that the rails are flush with the pavement. Construction of the transitway within existing roadways, such as University Drive, Erwin Road, and Pettigrew Street, would result in reconstruction of adjacent traffic lanes, sidewalks, and curbs. In addition to the guideway construction, other construction elements would include the following:

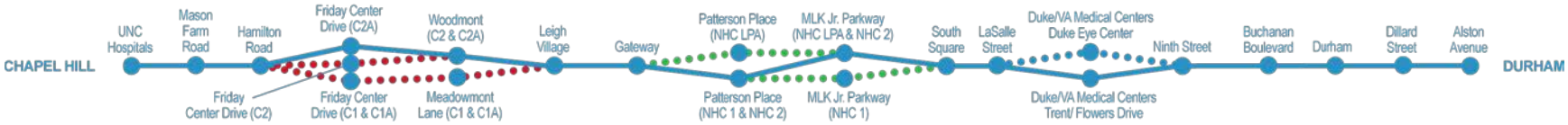
- Utility relocations/replacements
- Storm drainage system replacements/relocations
- Manhole structure repairs, cover adjustments, and relocations
- Roadway surface milling for smoother transitions
- Installation of overhead power supply (catenary) system and surface-level support systems (i.e., traction power substations) for the light rail system
- Pavement marking/signage installation
- Construction of in-street station platforms
- Construction of a median and the removal or addition of turn lanes.
- Installation of street lights
- Installation of traffic controls and signals for vehicular traffic and light rail trains

Example of Embedded Track

Example of Embedded Track Construction

Light Rail Guideway in a Dedicated Right-of-Way Off-street

Construction of light rail alignment in a dedicated right-of-way typically involves the creation of a new ballasted trackbed. Ballasted track construction involves constructing the guideway such that the rails



are laid on cross ties that are placed within a ballast material, which stabilizes the cross ties and is usually comprised of crushed stone. Disruption is typically limited to the immediate vicinity, and in some cases, to the properties through which the alignment runs.

In addition to the guideway construction, other construction elements would include the following:

- Utility relocation and/or reconstruction
- Curb and sidewalk reconstruction
- Construction of new or modified storm drain systems
- Installation of overhead power supply (catenary) system and surface-level support systems (i.e., traction power substations)
- Pavement marking/signage installation
- Landscape/streetscape installation

Example of Ballasted Trackbed

Light Rail Elevated on Structure

Construction of a light rail guideway elevated on structure typically involves first constructing foundations for the abutments and piers of the aerial guideway. This can include either drilled shafts or driven piles as deep foundations and is dependent on the subsurface materials and the sensitivity of the area in the vicinity of the construction. Pile driving results in substantial noise and vibration impacts, while drilled shafts have dust and excess excavated material disposal impacts. Large equipment is used for both types of foundations. Delivery and placement of reinforcing steel and concrete for abutments and piers can impact vehicular traffic.

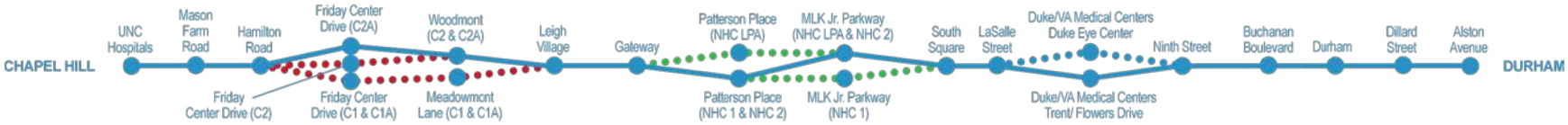
Example of Light Rail on Elevated Structure

The guideway superstructure will consist of pre-cast concrete or steel girders. Once the girders are installed, the top deck is then poured in place, connecting the girders and forming the top surface of the bridge. Delivery and placement of the pre-cast elements can impact vehicular traffic.

Another method is to use segmental precast box girder/deck combination, which are typically delivered in 10-foot long segments. This method is common for longer spans (above 130 feet and up to about 200 feet), and in extreme cases can be used for even longer spans with more specialized elements in the design. These units are usually cast to accommodate both tracks due to the nature of their erection. Thus, these 10-foot long units can be 30 to 35 feet wide to accommodate the double track cross section.

For superstructure installations, cranes are used to unload the pre-cast units and other guideway materials such as reinforcing steel, rail, and miscellaneous materials. The staging of construction is an important aspect for aerial structure construction.

Depending on site conditions, various methods and techniques could be used in the construction of elevated structures (bridges) to minimize construction impacts. In the typical construction method, “bottom up" construction, the foundation, columns, pier caps, and girders are placed using equipment resting on the ground surface. Construction materials are transported to the construction area from staging sites using public streets or temporary haul roads. The structure would be constructed from the



ground up using pile driving or drilling, cranes, loaders, and concrete trucks.

Example of Top Down Bridge Construction in Sensitive Natural Areas

The use of "top down" construction would be used to minimize disturbance of natural areas. Such areas would include the crossing of wetlands and floodplains associated with Little Creek, New Hope Creek, and Sandy Creek. When this construction method is used, a crane would reach out from an existing bridge segment and drive piles and place concrete for the adjoining support. Once the support is in place, the span girders would be lifted across and placed by crane or other heavy equipment. This newly-constructed span would become the platform from which the next span would be built.

In addition to the guideway construction, other construction elements would include the following:

- Utility relocation and/or reconstruction
- Storm drain replacements
- Manhole structure repairs, cover adjustments or relocations
- Roadway surface milling for smoother transitions
- Installation of overhead power supply (catenary) system and surface-level support systems (i.e., traction power substations)
- Retaining walls
- Track installation on the structure
- Systems elements for train control and communications

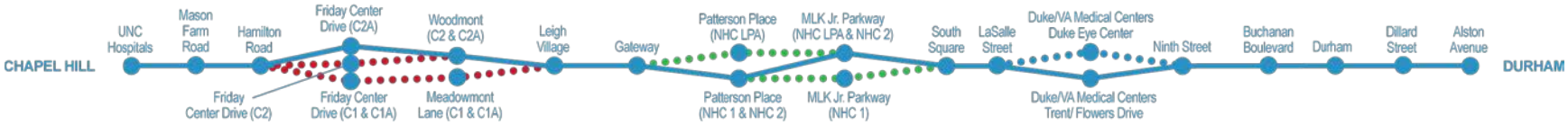
4.16.1.2 Construction of the ROMF

The ROMF will likely be one of the first project elements initiated during construction. Appropriate entrances and access roads into and through the job site would be built in compliance with environmental controls. Once site access is established, erosion and control measures within and around the perimeter of the site would be installed, a construction staging area would be set up, and clearing of vegetation and debris, and removal of any existing structures, would commence. At this point, grading, or leveling, of the entire site to a common ground elevation could start and then break into separate grading operations, one for the storage yard and the other for the maintenance facility. Subsurface utilities would be installed at the same time as the initial grading operations.

Grading in the storage yard would continue until the earthwork reaches the required ground elevation. At that time, soil underlayment for the trackbed could be placed. At the building site, any required deep pits such as those for hoist equipment and under-vehicle inspection would be excavated, formed, concrete poured, and the sides backfilled with soil. Throughout the remainder of the building site, column and wall foundations would be built in a similar manner.

As the grading and foundation work in the building nears completion, construction of the floor slabs with embedded utilities could begin along with the erection of the columns and beams. While erection of the steel building frame continues, the installation of the exterior walls could commence.

As construction of the exterior walls and roof continues, the building becomes enclosed and work on the interior can proceed without exposure to the elements. In addition to working on windows, doors, and interior walls, car maintenance, and electrical equipment could be installed and readied for testing. In conjunction with the installation of equipment, tracks within the shop could be installed.



While work on the maintenance facility continues, work on the yard area would progress. The perimeter fence and gates would be installed; the track ballast would be placed; yard tracks would be laid; and switch machines, yard lighting, and catenary system would be installed.

As work on the storage yard nears completion, so would the finish work on the building. Near the end of the project, parking lots would be paved and striped, concrete for the sidewalks would be poured, and planting areas would be landscaped.

4.16.2 Construction Consequences

The NEPA Preferred Alternative, Little Creek Alternatives, New Hope Creek Alternatives, as well as the ROMF and station alternatives would have similar construction consequences, as described below. Under the No Build Alternative, no construction consequences would result from the development of the D-O LRT Project.

Aerial view of light rail station construction

Resources that would be impacted during construction are listed below.

- Transportation
- Land use and zoning
- Business impacts
- Economic impacts
- Neighborhoods and community resources
- Visual and aesthetic considerations
- Cultural, historic, and archaeological resources
- Parkland and recreational areas
- Natural resources
- Water resources
- Air quality
- Noise and vibration
- Hazardous, contaminated, and regulated materials
- Safety and security
- Energy use
- Acquisitions, relocations, and displacements
- Utility impacts

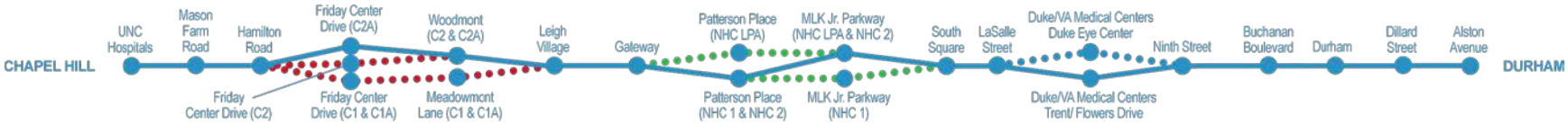
These impacts are discussed in the sections that follow.

4.16.2.1 Transportation

Construction of the NEPA Preferred and Project Element Alternatives would be expected to result in disruptions to traffic operations, including lane closures, short-term intersection and roadway closures, and detours that would cause localized increases in congestion. The details of construction staging would be developed during the construction phase of project. Additional information regarding impacts to the transportation system is presented in DEIS chapter 3.

Public Transportation

Construction of the NEPA Preferred and Project Element Alternatives could result in intermittent impacts to bus operations within the construction area. These may include temporary stop relocations or closures, route detours, or suspensions of service on segments of routes operating on streets where the light rail system is being constructed. As project planning and engineering advances, Triangle Transit will continue to work with CHT, DATA, and Duke Transit to evaluate transit routes. Additional discussion of impacts to the public transportation system is presented in DEIS section 3.1.



Roadways

Changes to the roadway network with the D-O LRT Project are described in DEIS section 3.2, Roadways. Typical impacts to the roadway network that are anticipated during construction of the D-O LRT project are described in section 4.16.3.1. These impacts are expected along University Drive, Erwin Road, and Pettigrew Street. Where the light rail tracks will be constructed in a dedicated transitway, disruption to normal traffic patterns is expected as the roadway is shifted to create the transitway.

Light rail station construction of roadway crossing

Other than in-street construction, the primary roadway impact from construction of the light rail system is the crossing of roadways. Three types of light rail crossings are proposed as part of the D-O LRT Project: at-grade crossings, crossings of the light rail alignment on a bridge over a roadway, and crossing of the light rail alignment under an existing roadway bridge. Approximately 30 to 35 at-grade crossings are proposed for the LRT alignment.

Any of the NEPA Preferred and Project Element Alternatives would include approximately 25-30 elevated light rail crossings over existing roadways, including crossings over US 15-501 (Fordham Boulevard), Business US 15-501 (Durham-Chapel Hill Boulevard), NC 54, I-40, Garrett Road (NHC 1 and NHC 2 only), NC 147, Erwin Road, Swift Avenue, and Campus Drive.

Pedestrian and Bicycle

During construction, temporary closures or detours are anticipated to affect existing facilities. Construction traffic and debris such as excess dirt could also pose obstacles or issues for pedestrians and bicyclists. Additional information on pedestrian and bicycle facilities is presented in DEIS section 3.6.

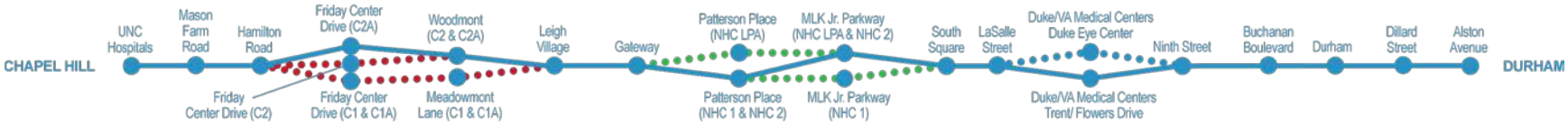
Construction impacts are generally expected to be similar for each alternative, with greater impacts where there are more existing pedestrian and bicycle facilities in or near the construction zone. In particular, UNC campus, University Drive, Erwin Road, and Pettigrew Street would experience greater pedestrian- and bicycle-related construction impact.

Freight and Passenger Rail

Minimal impact to freight and passenger rail service is anticipated during construction. This would typically occur during adjacent light rail excavation activities and coordination of traffic signal systems.

4.16.2.2 Business Impacts

Businesses could expect activities to be temporarily affected by changes in customer access, on-street parking availability, service access, traffic flow, business visibility, and congestion during construction activities. Depending on the intensity and duration of construction activities, businesses dependent on ease of customer access may experience a loss of revenue during this time. In general, retail businesses such as restaurants and shops that rely on walk-up and drive-up customers are most affected by traffic, parking, and access disruption. Businesses such as medical offices that operate by appointment only are usually less disrupted, although they still may be impacted if access and/or parking are removed. Businesses that typically do not have customers on the premises, call-centers for example, are least impacted by traffic and access disruption during construction. Businesses with outdoor activities such as outdoor dining or outdoor storage of products or materials could experience negative impacts due to noise, dust, or other nuisance conditions during



nearby construction activities. Businesses that rely on providing customers with a quiet atmosphere (e.g., restaurants, spa services, and libraries) may be affected during construction activities. Businesses may experience short-term disruptions of utility services during construction activities if utilities need to be moved or replaced.

Light rail construction in business center

4.16.2.3 Economic Impacts

The methodology for analyzing the economic impacts of construction follows guidelines contained in Environmental Impact and Related Procedures (23 C.F.R. 771) and Executive Order 12893, Principles for Federal Infrastructure Investments. The analysis utilized the project capital costs that were developed for each of the NEPA Preferred and Project Element Alternatives considered, as shown in DEIS chapter 7. Only those expenditures that are anticipated to take place within the Triangle region and affect the regional economy were included in the analysis. Some larger capital and specialized expenses such as systems or vehicles were not included, as it was assumed they would likely be imported into the regional economy based on federal procurement requirements. In addition, property acquisitions were excluded, as they are transfers of funds that would not affect the region. Property acquisitions do not create any specific construction impacts, but only transfer dollars to the property owners for the value of the existing asset.

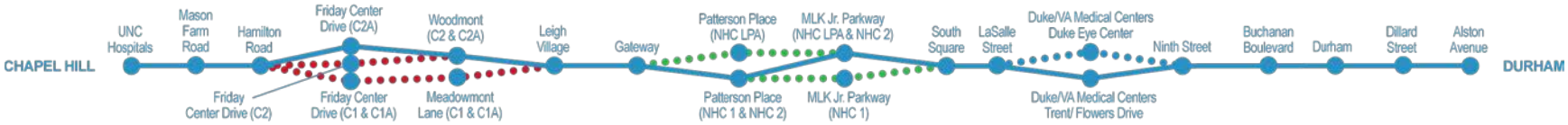
The analysis utilized available regional input-output modeling systems (RIMS II) and economic multipliers provided by the Bureau of Economic Analysis. The analysis measured the number of direct jobs created per million dollars of capital investment and the wages earned by the workers of those jobs as they relate to each alternative considered, and the indirect jobs and wages that result from project spending.

Table 4.16-1 presents the total number of jobs generated by the alternatives considered, including direct jobs, those working on the project (e.g., construction, survey, engineers, planners), and indirect jobs, which are jobs that exist because of the added investment in the community (e.g., waiters, doctors, teachers). Direct jobs represent those persons working on the actual construction of the proposed D-O LRT Project. Indirect jobs are created because of the added expenditures from the income received by persons involved directly in the construction of the project. The expenditures of the persons involved in providing goods and services to the direct employees creates an entire "cycle of impacts" throughout the economy as the initial round of indirect employees purchase goods and services resulting in further indirect job impacts. Earnings are the wages earned by the workers.

Table 4.16-1 compares the variance in jobs and wages generated under the various alternatives to the jobs and wages generated under the NEPA Preferred Alternative (Alternative C2A, NHC 2, Trent/Flowers Drive Station, and Farrington Road ROMF). The NEPA Preferred Alternative generates total/final demand effects from construction of 19,200 jobs and $1,694.6 million in earnings (constant 2015 dollars). The other alternatives generate from 1,100 fewer jobs to 200 more jobs and from $97.5 million less in earnings to $10.6 million more in earnings (constant $2015).

4.16.2.4 Neighborhoods and Community Resources

Although temporary in nature, construction phase impacts may affect neighborhoods and community facilities. Traffic detours may increase traffic through residential



neighborhoods or change access to community facilities. Similarly, sidewalk closures and detours may affect pedestrian traffic patterns. Construction impacts such as increased levels of noise and dust may temporarily affect neighborhood character, primarily in relatively quiet areas. The presence of large construction equipment may be perceived as visually disruptive and cause temporary effects to community character, particularly in residential settings. Residences and community resources may also experience short-term disruptions of utility services during construction activities, as utilities need to be moved or replaced. Additional information regarding neighborhoods and community resources is provided in section 4.3.

4.16.2.5 Visual and Aesthetic Considerations

During the construction of the proposed D-O LRT Project, there would be temporary visual impacts. These temporary impacts would include changes to views in and around the construction area. Construction activities would introduce heavy equipment such as cranes, bulldozers, backhoes, graders, scrapers, trucks, and light machinery into view. Due to their height, cranes would be a prominent visual element of construction that could be seen on the horizon from a distance. Cranes would be prevalent in areas where bridge construction would occur including crossings over US 15-501 (Fordham Boulevard), Business US 15-501 (Durham-Chapel Hill Boulevard), NC 54, I-40, Garrett Road (NHC 1 and NHC 2 only), NC 147, Erwin Road, Swift Avenue, and Campus Drive, as well as bridge construction in natural areas such as Little Creek and New Hope Creek. In addition, the proposed D-O LRT Project would use smaller-scale elements such as security fencing and sediment/erosion control devices such as silt fences and straw bales. These temporary construction activities may also include secured or fenced staging areas for materials and equipment.

The station areas, parking deck, elevated structures, and the ROMF would likely see construction activities for an extended period of time as the structures are built, but also due to road realignments, widening, and streetscape projects that would be occurring at the same time or prior to construction of stations and the ROMF. Additional information regarding visual and aesthetic consideration is provided in section 4.4.

4.16.2.6 Cultural, Historic, and Archaeological Resources

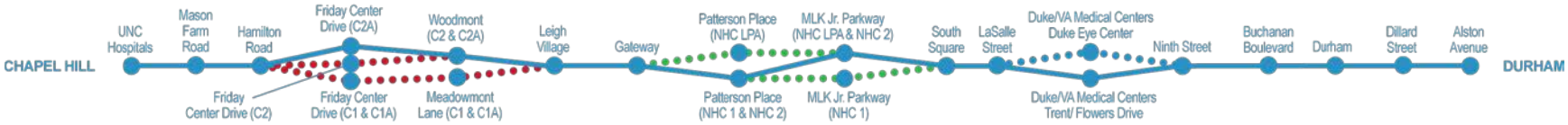
Noise, vibration, visual, and traffic impacts to cultural and historic resources would be experienced during construction. These impacts would be short-term and temporary. Noise and vibration impacts could produce a detrimental effect to the value of the resource, and the direct disturbance of unknown archaeological resources in the subsurface could occur during construction activities. The Section 106 process and additional information regarding potential impacts to cultural, historic, and archaeological resources is presented in DEIS section 4.5.

4.16.2.7 Parkland and Recreation Areas

Short-term construction impacts to parkland and recreation areas are expected. These impacts may cause temporary disruption to park users; however, any impacts would be temporary and limited to active construction areas. Access to these facilities would likely be maintained during most of construction, and temporary closures would be limited to the extent practicable. The Section 4(f) Evaluation details the temporary impacts to parks and coordination with the officials with jurisdiction to minimize or mitigate temporary impacts due to construction. Additional information regarding potential impacts to parkland and recreation areas and Section 4(f) resources is presented in section 4.6 and chapter 6.

4.16.2.8 Natural Resources

Construction activities, including use of heavy equipment, clearing of vegetation and



debris within the construction limits, use of silt fence/construction barriers, and construction noise, may cause short-term impacts to wildlife and wildlife habitat. As a majority of the D-O Corridor is already in an urban/disturbed environment, these impacts would be temporary and limited to active construction areas, and it is likely that wildlife would recover quickly. Furthermore, there is existing habitat adjacent to and near the study area to which wildlife could temporarily retreat or relocate to undisturbed areas while construction activities occur. Additional information regarding potential impacts to natural resources is presented in DEIS section 4.7.

4.16.2.9 Water Resources

Construction activities would disturb soils and could cause runoff that could potentially erode slopes and drainage ways, form gullies, and deposit sediment in adjacent water bodies. This could destabilize slopes and affect water quality if temporary Best Management Practices such as silt fencing, fiber matting, straw bales, sediment traps, desilting basins, and other methods required through the permitting process are not in place prior to a storm event. For those sections in the project area served by municipal storm sewer systems, construction activities could disturb soils and affect water quality by carrying sediment in runoff and discharging to storm drains. Additional information regarding potential impacts to water resources is presented in DEIS section 4.8.

Construction techniques were incorporated in the design to avoid and minimize impacts to wetlands and streams, such as using aerial structures on piers to cross larger wetland areas. The placement of the piers would be located outside of wetlands and streams to the greatest extent practicable. Moreover, top-down construction of the aerial structures would minimize disturbance to the wetland soils.

Light rail station construction BMPs to contain stormwater runoff

4.16.2.10 Air Quality

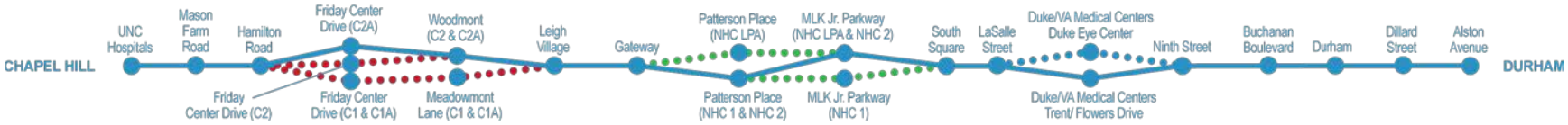
Construction would affect traffic volumes and operations along roadways in and around the project area. For temporary periods, some intersections may need to operate with reduced capacities or close. Under these conditions, traffic would be detoured to parallel roadway facilities near the project area. This temporary increase in traffic congestion may result in increased emissions and higher concentrations of air pollutants near those roadways.

In addition to increases in traffic-related emissions, construction activities can also result in higher concentrations of air pollutants. For the most part, air quality impacts would be minimal along the right-of-way; greater impacts would occur at station sites and at new bridge locations, but these would be localized in nature. Construction equipment powered by fossil fuels emits the same air pollutants as highway vehicles. Exposed earthen materials can also produce increased particulate matter when they are moved or disturbed by wind. BMPs will ensure that concentrations of air pollutants are kept at the lowest possible levels during the construction phase. Additional information regarding impacts to air quality is presented in DEIS section 4.9.

4.16.2.11 Noise and Vibration

Construction activities typically cause temporary, localized increases in noise and vibration. Construction noise varies greatly depending on the construction process, type, and condition of equipment used, and the layout of the construction site.

The construction process for the NEPA Preferred and Project Element alternatives



use equipment and vehicle operations that typically result in high noise levels adjacent to the construction sites. The use of especially noisy equipment, such as a rail saw, jack hammer, scrapers, and pneumatic tools, would be common throughout the alignment. Pile drivers, the noisiest type of equipment for light rail projects, may be used in areas where the track is on elevated structures, where bridges would be constructed, and at the ROMF and parking deck sites.

It is likely that noise impacts would occur in residential areas and commercial/industrial areas within 50 feet of the proposed light rail alignment because of the construction activities however, due to the linear nature of track construction, these impacts would be intermittent and temporary. Dictating working hours and limiting construction equipment noise and vibration levels near sensitive resources is a common practice. Hospitals, universities, and historic structures are examples of resources that are sensitive to noise and vibration that could be generated by construction activities.

Potential vibration impacts to properties within 50 feet of construction activities would result if vibratory pile drivers or drilling of shafts for the elevated track structures are utilized. Construction vibration levels would not result in structural damage to any properties, but may result in human annoyance during such activities. Additional information regarding noise and vibration impacts is presented in DEIS section 4.10.

4.16.2.12 Hazardous, Contaminated, and Regulated Materials

High and medium risk sites, if within or near an area of disturbance, would be further assessed during the Engineering phase to determine the presence, type, and magnitude of contaminated soil and/or groundwater. A high risk area or medium risk area has a greater known risk potential based on contamination type. Potential construction phase impacts would include the time and expense of identifying, testing, and removing the contaminated materials found within the potential area of disturbance.

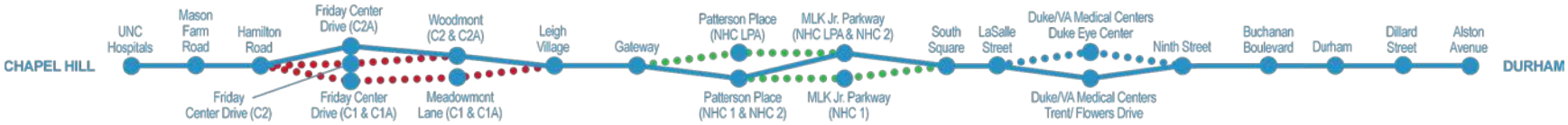
A Phase I ESA will be completed for disturbances in areas under the NEPA Preferred Alternative to identify the type of contaminated materials, prior to property acquisition. The results of the investigation would be used to determine whether contaminated materials could be minimized or avoided or whether additional investigation is needed to define the extent of contamination (Phase II ESA). The evaluation and identification of potential risk from hazardous, contaminated, and regulated materials is presented in DEIS section 4.11.

4.16.2.13 Safety and Security

Construction activity may pose a safety risk to both workers and the public. Construction workers may encounter hazards to personal safety by working adjacent to active lanes of vehicle traffic or in deep and confined spaces during utility relocations and construction. They also may face potential exposure to contaminants during soil excavation and drilling work. North Carolina and Occupational Safety and Health Administration (OSHA) standards for safety of construction site personnel would be maintained. Where practicable, construction site access would be limited by fencing and security gates to prevent inadvertent access by those without authorized clearance. Additional information regarding safety and security is presented in DEIS section 4.12.

4.16.2.14 Energy Use

The energy required for the construction of the proposed D-O LRT Project would be localized and temporary and would have an insubstantial impact on regional energy consumption. Additional information regarding energy use is presented in DEIS section 4.13.



4.16.2.15 Acquisitions, Relocations, and Displacements

Short-term consequences would involve temporary property easements to accommodate construction activities in certain areas outside the limit of the permanent right-of-way to be acquired.

4.16.2.16 Utility Impacts

Construction phase impacts to utilities are most likely to occur early in the Construction phase and in advance of other construction activities such as excavation and grading activities, placement of structural foundations, and work that requires large-scale equipment, which could impact subsurface and overhead utilities. Utility service disruptions could occur throughout construction to facilitate utility relocations. It is anticipated that these disruptions would be minimal, with temporary connections provided to customers prior to permanent relocation activities. Utility owners would ultimately decide when and if disruptions to service would be allowed.

Utility locations that are uncertain or misidentified can be unintentionally damaged during construction. The large number of utilities present within the project area increases the likelihood of encountering previously unidentified utilities. Coordination with utility providers was initiated during Project Development and will continue during the Engineering and Construction phases. A list of utilities and additional information regarding utility impacts is presented in DEIS section 4.15.

4.16.3 Mitigation Measures

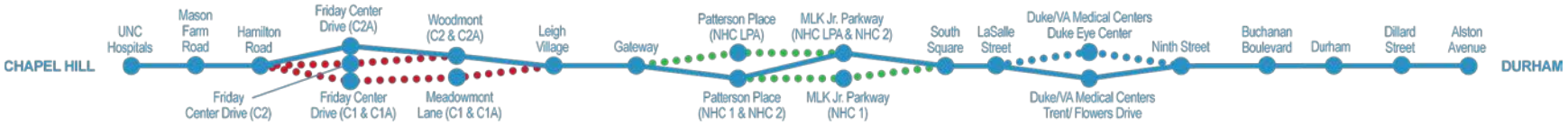
Triangle Transit would develop a project construction, education, and outreach plan during the Engineering phase of the proposed D-O LRT Project. This plan would identify how Triangle Transit will educate the public and stakeholders about ongoing and upcoming construction and construction impacts (e.g., detours, service interruptions). It would be expected to include both broad-based approaches to educate the public (e.g., media, web site, newsletters, public meetings) and targeted outreach to those who may be more directly affected by construction activities (e.g., direct mail, small group meetings, in-person communication).

Construction impacts discussed under the methods of construction will be minimized through selection and implementation of BMPs. The procurement documents will specify these methods along with restrictions on work hours, as appropriate.

Light rail station construction traffic control

4.16.3.1 Transportation, Traffic, and Parking

Local traffic may be inconvenienced by detours and temporary lane closures due to the construction of the LRT project, particularly where existing roads must be reconstructed on a shifted location. It is important that pedestrian and vehicular access to businesses, universities, medical facilities and residences be maintained with a priority placed on emergency facilities. Work zone traffic control plans will be prepared and approved by the appropriate agency during the Engineering and Construction phases. These plans will be coordinated with the City of Durham, Town of Chapel Hill, NCRR, universities, emergency services and the NCDOT. The plans will identify requirements for maintaining access to businesses,



university, medical and emergency facilities. Lane closures, required for construction will be limited to off-peak hours of traffic operation to the greatest extent possible. To construct at-grade crossings of existing roadways, full closures or staged closures could be used.

Full closures with detours are typically used to speed up construction on minor roadways where alternate access is available so that traffic can be rerouted. Staged construction, where half of a crossing is built while the other half of the road remains open is typically used on major roadways and/or where no detour route is available. Major aerial construction over highways includes the crossings of Fordham Boulevard, NC 54, I-40, US 15-501 (business), and NC-147. Construction of the structures will employ methods that minimize the impact to the roadway user. Lane closures on the major arterials must be approved by the NCDOT and coordinated with the Highway Patrol and local police authority. Restrictions to night and weekend lane closures will be used to minimize traffic inconvenience. Traffic detours will be restricted to maximum time durations via the contract and work zone traffic control plans. Triangle Transit is coordinating with NCDOT on the construction and detour plan for the extension of the existing Farrington Road bridge over I-40. The alignment construction would potentially require temporary closure or staged construction.

Construction will be planned to minimize disruption to the existing transit service to the greatest extent possible. Work zone traffic control plans will be developed during the Engineering and Construction phases, and submitted for approval to transit authorities.

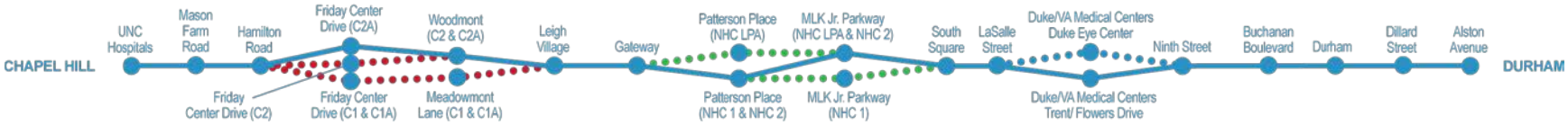
Advanced warning for lane closures, detours, and changes to utility service will be provided according to the work zone traffic control plans, which will be developed during the Engineering phase of the project and are described in DEIS section 4.16.2.1.

Construction mitigation for potential disruptions to bicycle and pedestrian facilities during construction will include appropriate access provisions in the Work Zone Traffic Control Plans, and BMPs to manage debris.

If crosswalks are temporarily closed, pedestrians will be directed to use alternate crossings nearby. Every effort will be made not to close adjacent crosswalks at the same time to allow for continued pedestrian movement across streets. Sidewalks and crosswalks will be required to meet minimum standards for accessibility and be free of slipping and tripping hazards. Temporary sidewalk closures will be discouraged but, if required, will be conducted in such a way as to minimize impacts. Depending on how construction activities will impact sidewalk areas, special facilities (such as handrails, fences, barriers, ramps, and walkways) may be required to maintain bicyclist and pedestrian safety. During the Engineering phase, it is expected that a plan will be developed to manage the closure of pedestrian crossings and other restrictions on non-motorized transportation facilities and crossings throughout the construction process.

The following techniques may be used to reduce construction-related transportation impacts:

- Scheduling construction activities during off-peak hours, where practical
- Developing plans for work zone traffic control
- Coordinating freight and passenger rail schedules and construction activities with NCRR, NS, and Amtrak to ensure there will be no disruption of freight and passenger rail service during construction of D-O LRT project elements within the North Carolina railroad right-of-way.
- Coordinating with appropriate traffic control authorities to maintain reasonable and safe traffic operations at affected roadway crossings



- Coordinating with hospitals, universities, and businesses in order to make reasonable efforts to mitigate concerns regarding reduction of parking through education of patrons and employees about parking alternatives, such as carpooling, park and rides, and transit options

The proposed alignment would pass under the existing Farrington Road bridge, which in turn passes over I-40. The Farrington Road bridge would be lengthened with a new span to provide sufficient clearance for the light rail to pass under the bridge on the west side of I-40. Temporary off-site detours of traffic and/or phased construction would be necessary during the construction period. Traffic on I-40 would be maintained during the construction period. Short periods of lane closure may be necessary to construct the pier adjacent to I-40 traffic and to erect the girders.

4.16.3.2 Business Impacts

Measures to avoid and/or minimize adverse impacts to residences and businesses during project construction will include efforts to maintain traffic, parking, and access during construction, modify business signage to maintain business visibility, use marketing campaigns to advise patrons of required construction in areas with multiple businesses, install temporary directional signage, and provide advance communication of construction activities. Temporary arrangements for safe pedestrian access will be addressed in the construction documents. Site specific business and access management plans will also be developed by the contractor.

4.16.3.3 Neighborhood and Community Resources

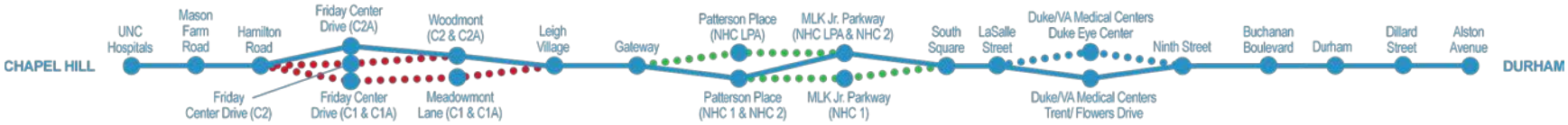
Local property owners will be informed of roadway disruptions and other construction-related activities and consequences by using construction education and outreach plans. The D-O LRT Project team will coordinate with emergency response personnel to maintain continuous access for emergency vehicles throughout the duration of construction. Prior to construction, coordination with Chapel Hill-Carrboro City Schools and Durham Public Schools will be implemented to identify potential impacts on school bus routes and appropriate temporary detour routes during construction.

Light rail construction near neighborhood

4.16.3.4 Visual and Aesthetic Considerations

The following steps will be taken as needed and feasible to reduce visual impacts associated with construction activities:

- Stabilizing embankments and planting of vegetation in construction areas as quickly as possible so that sediment and erosion control devices can be removed.
- Locating staging areas in the least visibly sensitive project areas. Whenever possible, locate these facilities out of view of residences, businesses, or any potential viewer.
- Implementing height limits for staged materials and excavated soil so that they are less visible.



- Directing lighting toward the interior of the construction areas or providing shielding to minimize light pollution into adjacent properties.
- Screening construction activities whenever possible.
- Clearing dirt and debris from areas adjacent to the construction sites in a timely manner.
- Keeping the construction sites well organized and clear of trash and debris.

4.16.3.5 Cultural, Historic, and Archaeological Resources

Mitigation measures and construction control will be addressed through consultation with the North Carolina State Historic Preservation Office as part of the process for compliance with Section 106 of the National Historic Preservation Act of 1966. This legislation requires federal agencies to take into account the consequences of their undertakings on historic properties, as well as through special contractor construction provisions identified in an Archaeological Recovery Plan developed during the Engineering phase. Avoidance and minimization measures will be determined through ongoing consultation with the North Carolina State Historic Preservation Office and FTA.

In the event of an inadvertent discovery of archaeological materials, construction within a 50 foot buffer around the material will cease. The construction manager will immediately contact the, SHPO, FTA and Triangle Transit. The SHPO and FTA will consult to determine appropriate actions to identify archaeological materials and mitigate adverse effects.

4.16.3.6 Parkland and Recreation Areas

Minimization measures associated with impacts to parklands are presented in DEIS section 4.6 and DEIS chapter 5. Triangle Transit will coordinate with relevant agencies and organizations to determine suitable ways to provide mitigation of unavoidable impacts.

4.16.3.7 Natural Resources

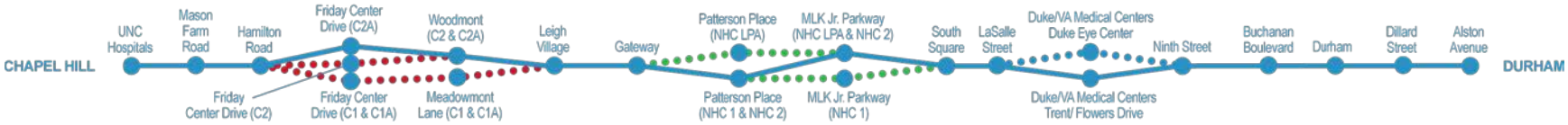
BMPs will be followed by the contractor during construction. BMPs could include the demarcation of the construction limits and staging areas prior to the initiation of construction to limit the disturbances to habitat and wildlife. Reasonable efforts will be made to create a plan that would minimize impacts and losses of vegetation.

Appropriate measures, including the following, will be taken to avoid adverse impacts on migratory birds. Between October 1 and February 15, the contractor would remove all old migratory bird nests from any structures that would be affected by the proposed project, and complete any necessary construction on existing bridges and/or vegetation clearing. In addition, the contractor would be prepared to prevent migratory birds from building nests between February 15 and October 1, per the Environmental Permits, Issues, and Commitments (EPIC) plan. In the event that migratory birds are encountered on-site during project construction, adverse impacts on protected birds, active nests, eggs, and/or young would be avoided.

4.16.3.8 Water Resources

Short-term, temporary impacts to surface waters could occur during the construction period due to storm water runoff from the site. To reduce potential impacts related to water quality, appropriate BMPs will be implemented during construction, such as installing fabric barriers at storm drain inlets.

Construction activities would be conducted in accordance with local, state, and federal regulations, as well as BMPs, including the NCDENR Stormwater Best Management Practices Manual (2007), the Erosion and Sediment Control Planning and Design Manual (NCDENR 2009), and the Design Standards in Sensitive Watersheds (15A N.C.A.C. § 04B.0124). Construction staging areas would be located away from wetlands, and preserved wetland areas would be



demarcated prior to construction. Wetlands anticipated to be temporarily affected by construction would be restored to their original condition as much as possible and would be planted with an appropriate native wetland seed mix.

A storm water pollution prevention plan (SWPPP) will be created during the Engineering phase of the project. The SWPPP will include provisions to control erosion and reduce sedimentation and other pollutants associated with construction activities. The SWPPP will outline how erosion and sedimentation will be controlled on the project site to minimize the discharge of sediment off-site. The SWPPP will address other pollutants that may be associated with construction activity, including for example, disposal of building materials and management of fueling operations. The SWPPP will address pollutants that may be associated with the post-construction land use.

Wetlands that are temporarily affected by impacts will be restored as close to their original condition as possible and planted with an appropriate native wetland seed mix.

Construction vehicles use hydraulic fluids and petroleum products that could cause negative impacts if improperly managed. Contractors will be required to have spill prevention, containment, and collection plans in place to address the risk.

4.16.3.9 Air Quality

Dust generated during construction will be minimized through standard dust control measures such as applying water to exposed soils and limiting the extent and duration of exposed soil conditions. After construction is complete, dust levels are anticipated to be minimal because soil surfaces exposed during construction will be permanently covered (e.g., paved or re-vegetated).

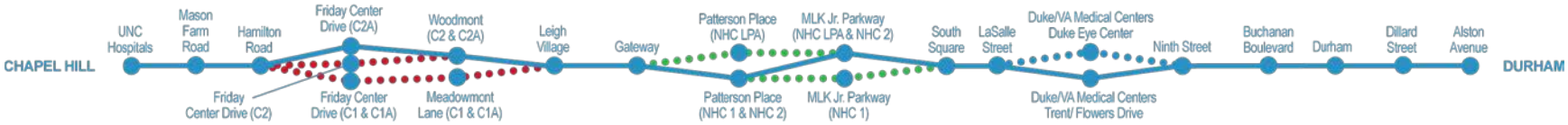
Light rail construction increased dust levels

Measures to mitigate fugitive dust kicked up into the air from earthmoving and other ground disturbance and emissions from construction equipment will include the following:

- Shutting off construction equipment not in direct use
- Watering areas of exposed soil
- Covering open body trucks transporting materials to and from construction sites
- Rerouting truck traffic away from schools and residential communities when possible
- Repaving and/or replanting exposed areas as soon as possible following construction
- Securing tarps, plastic, or other material over debris piles
- Prohibiting delivery trucks or other equipment from idling during periods of extended unloading or inactivity

4.16.3.10 Noise and Vibration

During the Engineering phase of the project when sufficient engineering detail is available, a detailed construction noise assessment will be completed which will provide property specific details to develop mitigation plans to keep the noise levels at or below acceptable levels during construction. Construction equipment will be required to be properly muffled and maintained. Construction activities will be conducted in accordance with applicable state and local requirements. Appendix K.24 outlines these restrictions and the contract specifications will be in accordance with such restrictions. Certain construction activities may be limited to weekday daytime



hours (typically from 7 a.m. to 6 p.m.). Noise will be monitored on a regular basis during construction near potentially affected sensitive receptors.

Vibration and noise monitoring would be conducted during construction depending on the sensitivity of the surrounding resources. Nighttime construction may be prohibited near residential neighborhoods, for example.

Other means for the control of noise impacts during construction would be considered including:

- Design considerations and project layout, such as: noise barriers, minimize distance of truck routing and route trucks away from residential streets, and relocating noise-generating equipment as far away from the sensitive noise areas as possible.
- Operations sequence, such as avoiding nighttime construction in residential areas.
- Alternative methods, such as: using drilled pile instead of impact pile driving, specifying quieted equipment in construction specifications, and alternative demolition or pavement breaking techniques.

Pile driving operations will be of limited duration resulting in short term levels of annoyance. Vibration levels will be monitored at sensitive building structures during construction.

In the event monitoring results in impacts beyond acceptable levels, additional site specific mitigation will be implemented. Where construction of deep foundations for elevated structures is required near sensitive receptors, drilled shaft footings will be employed to reduce noise and vibration.

4.16.3.11 Hazardous, Contaminated, and Regulated Materials

Measures to minimize construction-related impacts related to hazardous materials include the following:

- Complying with applicable federal and state regulations
- Following OSHA, state, and local standards in handling and storage of fuels and other materials
- Disposing of hazardous materials according to applicable federal, state, and local guidelines
- Cleaning construction vehicles to prevent off-site contamination
- Disposing of construction waste at approved sites

4.16.3.12 Safety and Security

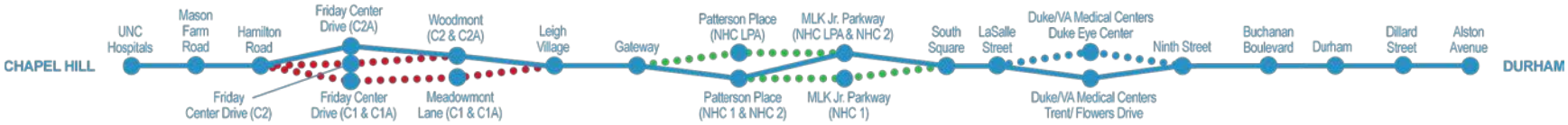
The safety of the public, particularly the passage of pedestrians, bicyclists, and other spectators near open excavations and other construction activity, will be addressed through the creation, proper timing, and placement of protective safety programs, public information efforts, and selected protective measures. The use of construction equipment, delivery of materials, and other construction site activity may have temporary negative safety impacts on adjacent roadways and pedestrian areas.

As described in DEIS section 4.12, applicable safety and security precautions will be specified in the SSMP and SEPP and will be overseen by Triangle Transit in cooperation with local law enforcement and emergency response personnel.

The D-O LRT Project team will provide construction barriers and fencing to secure construction sites and staging areas, and evaluate the need for additional security measures such as guards, if needed.

4.16.3.13 Energy Use

Measures to minimize energy consumption during construction will include limiting the idling of construction equipment and employee vehicles as well as locating staging areas and material processing facilities as close as practical to work sites.



4.16.3.14 Acquisitions and Displacements

Acquisitions and relocations associated with the D-O LRT Project will be performed in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (49 C.F.R. Part 24).

4.16.3.15 Utilities

Avoidance and minimization of utility disruptions will include coordinating utility construction with other construction activities and limiting construction around existing utility lines such as excavations, removal of fill, and grading. However, substantial excavations and grading adjacent to existing utilities may be unavoidable. Contractors will be required to adhere to the following items to mitigate utility impacts:

- Prior to construction, area utility companies and utility agencies will be contacted and requested to provide line location measures and approval of the proposed alteration of utility lines.
- Businesses such as restaurants, grocery stores, and food preparation/ manufacturing facilities will be accommodated in order to protect food preparation storage mechanisms.
- During construction, should utilities be identified that were not identified prior to construction, appropriate utility companies and agencies will be contacted to identify the line(s). The newly identified line(s) will not be disrupted until businesses and residences were notified and the utility owner/operator has approved the proposed alteration.

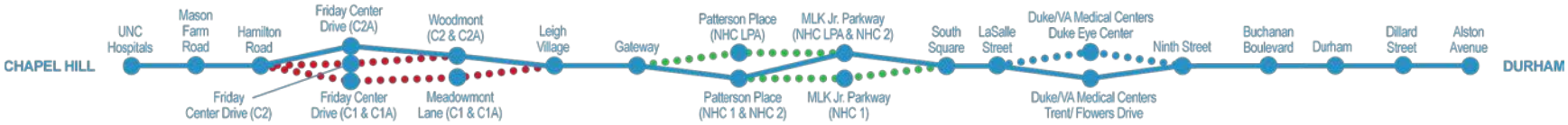


Table 4.16-1: Economic Impact During Construction of the NEPA Preferred and Project Element Alternatives

County	No Build Alternative	NEPA Preferred Alternative [a]	Little Creek Alternatives[c]			New Hope Creek Alternatives		Duke/VA Medical Centers [b,c]
			C1	C1A	C2	NHC LPA	NHC 1	Duke Eye Center
Jobs	0	19,200	-800	-600	0	200	-300	-
Wages [b]	$0	$1,694.6	-$71.7	-$49.4	-$3.0	$13.6	-$25.8	$-

Source: Vantage Point, AECOM 2015.

[a] The NEPA Preferred Alternative includes C2A, NHC 2, Trent/Flowers Drive Station, and the Farrington Road ROMF.

[b] Earnings 2015 Dollars in Millions.

[c] In comparison to the NEPA Preferred Alternative

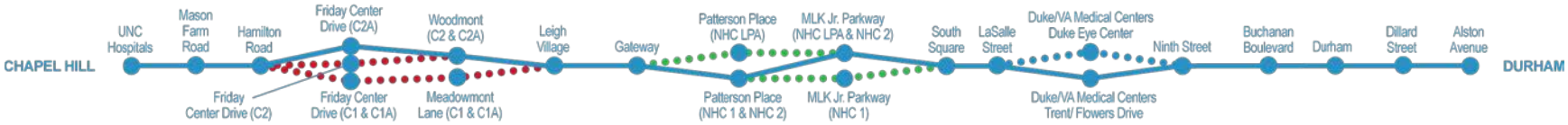
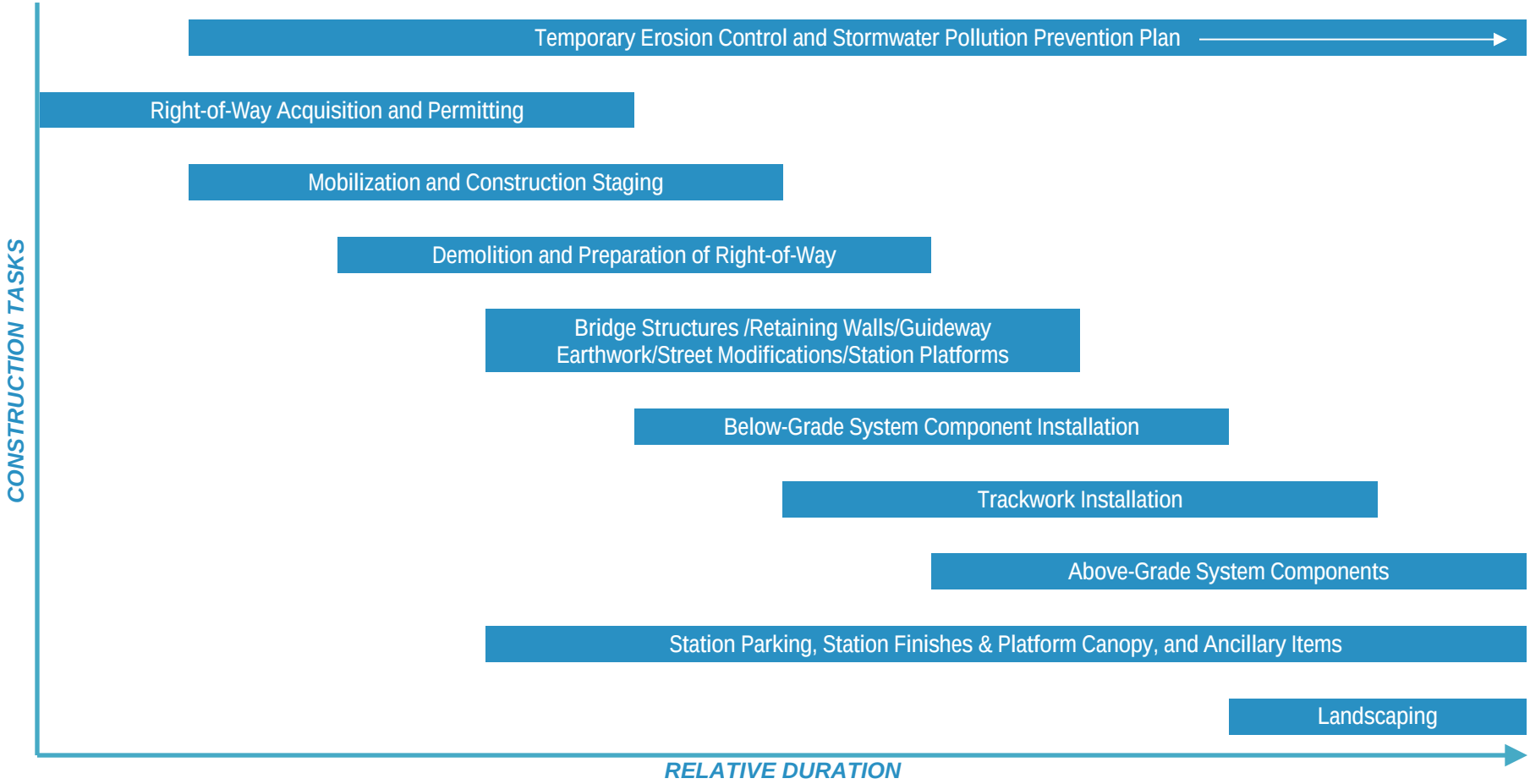
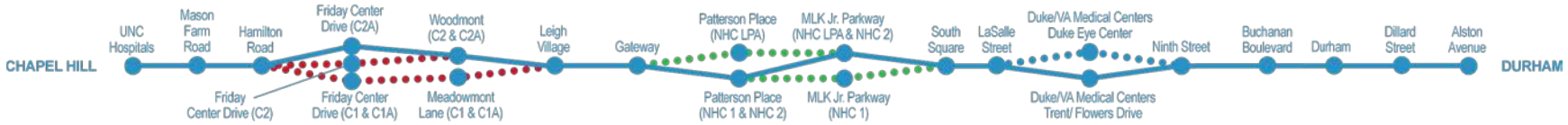


Figure 4.16-1: Typical Construction Phasing





4.17 Indirect and Cumulative Impacts

This section includes an assessment of indirect and cumulative impacts of the proposed D-O LRT Project alternatives. The section also includes a discussion of the potential mitigation measures.

The Council on Environmental Quality (CEQ) provides definitions for indirect effects and cumulative impacts in 40 C.F.R. § 1508.8. In general, indirect effects are induced by the proposed project, but occur later in time or outside of the project right-of-way. While there are uncertainties about the indirect effects of the proposed project, the DEIS identifies indirect effects that are known, and makes a good faith effort to explain the effects that are not known but are reasonably foreseeable (40 C.F.R. § 1508.8(b)). Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air, water, and other natural systems, including ecosystems.

A cumulative impact is an impact on the environment, which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The terms “effects” and “impacts” are used synonymously in the CEQ regulations and in this section.

Indirect Effects (Impacts): reasonably foreseeable effects that occur later in time or further in distance]

Cumulative Impact: an impact resulting from the incremental impact of an action when added to reasonably foreseeable past, present, and future actions

The NEPA legislation directs federal agencies to examine indirect and cumulative effects, but does not prescribe a specific methodology for analyzing these effects. The FTA also does not have a specific methodology for analyzing indirect and cumulative effects. Regulations included in the appendix to the Planning Assistance and Standards, Title 23 C.F.R. Part 450, indicate that the indirect and cumulative effects analysis should be sufficiently detailed such that consequences of different alternatives can be readily identified, based on current data and reasonable assumptions, and based on reliable and defensible analytical methods. Furthermore, courts have mandated that federal agencies take a reasonably “hard look” at their projects with regard to available information and analysis of appropriate issues (including indirect and cumulative effects).

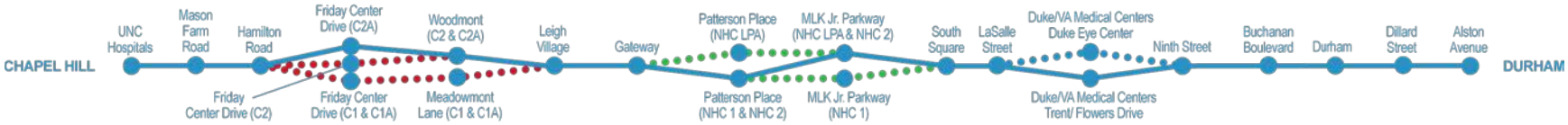
The CEQ requires an assessment of indirect and cumulative impacts per 40 C.F.R. §§ 1500–1508. CEQ guidance and other reference materials, including NCDOT and NCDENR’s *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina* (The Louis Berger Group, Inc. 2001) were used to inform the analysis of indirect and cumulative effects.

4.17.1 Indirect Impacts

The methodology, affected environment, environmental consequences, and potential mitigation measures related to the indirect impacts analysis are presented in the following sections.

4.17.1.1 Methodology

Transit projects have the potential to shape future land use and development within proximity to the proposed project. Where and how communities accommodate this development may affect the overall built and natural environments. Direct effects that would result from the NEPA Preferred Alternative and Project Element Alternatives are identified in DEIS chapters 3 and 4. Resources selected for analysis include those that would be affected by indirect development associated with the proposed station locations. Transportation is



presented in this analysis in terms of the role it plays in affecting other resources. The resources assessed in the indirect and cumulative effects analysis are the following:

- Land Use
- Economic Development
- Visual and Aesthetic
- Historic Resources
- Natural Resources
- Water Resources
- Hazardous and Regulated Materials
- Acquisitions, Relocations, and Displacements

The analysis of indirect effects of the NEPA Preferred and Project Element Alternatives as compared to the No Build Alternative took a four-pronged approach:

- Identification of the potential for increased accessibility, such as improvements in travel time, more direct access, and more transportation options, as these can have a catalytic effect on economic growth and development.
- Assessment of the potential for induced growth because of the potential for increased accessibility. Induced growth could include not only more growth, but also changes in the type, location, and pace of growth.
- Assessment of the potential for impacts on sensitive resources because of induced growth.
- Identification of potential minimization and mitigation strategies for induced growth effects.

Study Area

The study area for indirect effects is typically that area where there is potential for land use change because of the proposed project. The NCDOT and federal guidance indicates that indirect effects of a transportation project typically occur within ½ mile of stations, and this was used as the indirect effects study area for resources.

Timeframe for Analysis

The timeframe for indirect effects extends to 2040, which is the horizon year used in the TRM and applied in the development of the CAMPO and DCHC MPO 2040 MTP (2013). This timeframe extends slightly beyond the horizon years of most of the local land use plans.

4.17.1.2 Affected Environment

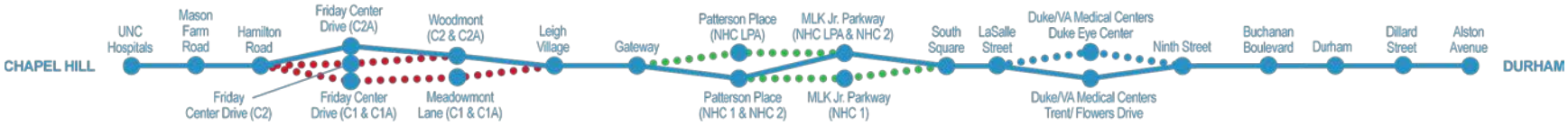
The proposed D-O LRT Project would be located in the Triangle, a region in the Piedmont of North Carolina anchored by the UNC, Duke University, and North Carolina State University, and the cities of Chapel Hill, Durham, and Raleigh (the state capital). The three-county area including Orange, Durham, and Wake counties has grown substantially in the last three decades and is expected to continue to grow through 2040. Despite recent economic downturns, dynamic growth continues because of the region's strong economic base. The Triangle's economy is driven by the presence of state and local government offices, renowned universities and colleges, nationally-ranked medical centers, and the research and development industries that they foster.

Such fast-paced growth burdens the existing transportation system. Growth is outpacing the region's ability to repair, replace, and expand its highways and bridges. As a result, citizens in the region are embracing alternative transportation options.

A description of land use by evaluation area, land use plans and local policies, and impact causing activities (like development activity/trends in the corridor) is included in DEIS section 4.1. Population, housing, and employment patterns are discussed in DEIS section 4.2.

4.17.1.3 Environmental Consequences

Transit-supportive growth and development is expected to continue throughout the corridor due largely to positive market



forces, supportive land use policies, capacity for growth, and supportive public investments. Over the past decade, Chapel Hill and Durham either have adopted, or are in the process of adopting, transit-supportive zoning districts that support TOD in the corridor.

The proposed project corridor is experiencing substantial redevelopment because of a growing local economy and supportive land use plans and policies. These projects are creating more density in the corridor and around station areas and will create new mobility needs.

Future development will be greatly influenced by factors outside the control of Triangle Transit. Regional and national economic trends can affect the economy of the Triangle region as well as how, when, and to what degree land is developed. The growth projections in the city and state plans are predicated on current information. Actual growth may be more or less than projected. Development that could occur around station areas was evaluated in the Durham-Orange County Corridor Alternatives Analysis Volume 4: TOD Assessment Report, May 2011. This evaluation provided detailed information on likely development levels based on market forces and expectations for improved access and mobility with the introduction of the D-O LRT Project. Regardless of whether the project is built, local plans direct future development to occur within the study corridor.

No Build Alternative

The No Build Alternative includes existing and planned transportation projects that are proposed to exist in 2040 and are included in the fiscally constrained Long Range Transportation Plan (or MTP) adopted by the DCHC MPO, with the exception of the proposed rail transit improvements and related bus transit modifications. The No Build Alternative is used to provide a comparison to the NEPA Preferred and Project Element Alternatives. The No Build Alternative is not consistent with local and regional long-range plans, which identify and support light rail in the D-O Corridor.

The No Build Alternative would provide less potential for increased accessibility and fewer transportation options as compared to the NEPA Preferred and Project Element Alternatives. A fixed guideway transit option would not be available in the D-O Corridor without the project.

In general, land use patterns under the No Build Alternative would be low density, dispersed, auto-oriented development with separation between types of uses. The potential for impacts on sensitive resources is greater with the low density, dispersed and more traditional development patterns.

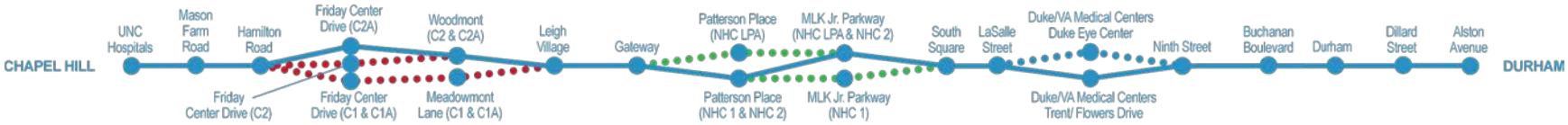
NEPA Preferred and Project Element Alternatives

The proposed D-O LRT Project would provide an additional and affordable option for travel in the D-O Corridor. It would provide greater access to destinations within the corridor as well as increased reliability. Other long-term benefits of the NEPA Preferred and Project Element Alternatives are documented in DEIS chapter 1.

The NEPA Preferred Alternative and Project Element Alternatives are not expected to materially differ in their impacts on regional growth forms, so their indirect impacts on the disciplines below are expected to be similar.

Land Use

As described in DEIS section 4.1, indirect impacts related to a transportation investment such as the proposed D-O LRT Project may result from land development that occurs in response to the transportation investment; however, specific development projects and their impacts cannot be accurately forecasted. In the case of the proposed D-O LRT Project, new growth that occurs in station areas in response to the transit investment is expected to be consistent with local comprehensive plans and zoning. A Transit Oriented Development (TOD) Assessment, included in the AA, depicted the following station areas as



having a high potential for TOD: Hamilton Road, Leigh Village, Gateway, Patterson Place, South Square, LaSalle Street, Ninth Street, Buchanan Boulevard, Durham, and Dillard Street.

The proposed D-O LRT Project and associated land use policies are expected to encourage more compact development, which has a smaller footprint than the auto-oriented development likely to occur without the transit investment. Extensive policies are in place in the D-O Corridor to guide development and ensure that it is sustainable. These policies encourage development that is higher density than the development that currently exists in most of the station areas listed above, which will result in more households and jobs within walking distance of the D-O LRT system. These policies also encourage a mix of land uses, and include design requirements for taller, street-oriented buildings; street grids with short block lengths; and narrower roadway cross-sections to allow more space for pedestrian, bicycle, and transit infrastructure. Therefore, the net indirect impacts of the proposed D-O LRT Project on land use are likely to be positive rather than negative. Orange County, Chapel Hill, and Durham City/County have incorporated (and support) the potential for transit in the D-O Corridor, and they have adopted, or are in the process of adopting, transit-supportive zoning districts in the corridor and at station areas. DEIS section 4.1 has more information about these plans and ordinances.

Economic Development

The project would create an opportunity for infill development on parcels in the station areas that are currently vacant or underutilized. Additional induced development from the project is anticipated based on existing plans. The induced development could result in future employment opportunities that would not occur with the No Build Alternative.

Visual and Aesthetic

The study area is already developed, and the overall visual change from the presence of the light rail or induced development would be tempered as it runs through an urban and/or suburban corridor. Indirect impacts on visual quality are not expected.

Historic Resources

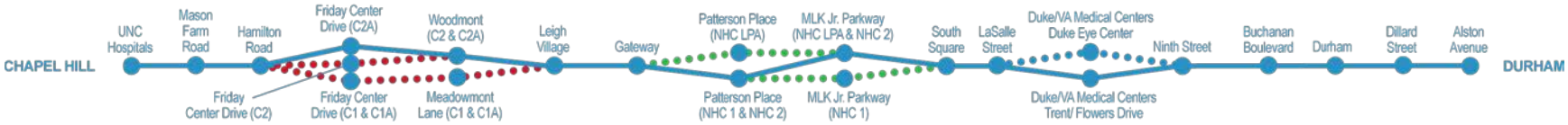
Development and redevelopment associated with the proposed transit stations could change the land use within the station areas (typically within ½-mile radius or less from the station). Such changes could have indirect effects on a historic property, such as changing the property's setting by adding a transportation facility or other new building or increasing the density of the area. It is also possible that the development induced by the project could directly affect historic properties though promoting unsympathetic renovations, demolition, change in property values, or other impacts.

Indirect impacts on historic properties caused by the project are subject to the protection and regulations of Section 106. FTA and Triangle Transit are consulting in accordance with Section 106, and the responsibility to protect historic resources affected by the project resides primarily with the State of North Carolina, Orange and Durham counties, cities, towns, and historic preservation groups.

Natural Resources

Induced development related to the project may result in general habitat impacts such as loss, fragmentation, and degradation of existing habitat and displacement or removal of native species from the geographic study areas. Habitat in both the aquatic and terrestrial geographic study areas was permanently changed by the 1983 damming of the Haw River near its confluence with the Deep River to create Jordan Lake. Mitigation, conservation, and restoration measures performed since that time have resulted in improvements to habitat quality in some locations.

Indirect effects on natural resources would be limited in part by local, state, and federal



efforts to project these resources. The City of Durham has plans to protect open space and natural heritage areas, like the New Hope Creek area, and the USACE and NCDENR are combining to work towards preservation of natural heritage areas adjacent to and connecting various properties such as riparian lands.

While natural resources may be indirectly impacted because of the proposed D-O LRT Project, the type of compact development likely to occur would be more beneficial to natural resources than the type of dispersed growth that typically occurs with auto-oriented development. Continued development is anticipated even in the No Build Alternative, and similar effects to natural resources may occur if the project is not constructed.

Water Resources

There is a potential for growth and land use change in the study area, and particularly within ½ mile of stations. Most of the study area is urban or suburban in nature, and the proposed project is not likely to cause a substantial change in the type of land use in the corridor; however, future development may occur in a more compact manner along the corridor and at stations, where utilities are in place, and development is already largely occurring. The station areas have been targeted for more compact development, resulting in less impervious surface and a reduction in stormwater runoff when compared to current development trends.

While water resources may be indirectly impacted because of the proposed D-O LRT Project, the type of compact development likely to occur would be more beneficial to water resources than the type of dispersed growth that typically occurs with auto-oriented development. Existing federal and state regulations (as described previously) would protect water resources from future indirect or development related impacts. These regulations include Section 404, with its avoidance, minimization, and mitigation hierarchy, FEMA regulations, Section 401 and the Jordan Lake buffer rules, as well as state approvals of sediment and erosion control plans.

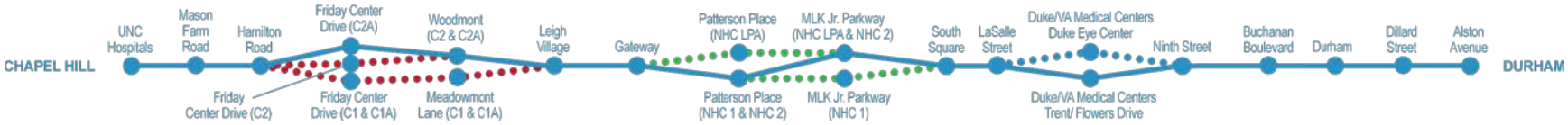
Stormwater runoff is a key concern when impervious surface is increasing, and the state's Section 401 water quality certification process includes stormwater management requirements once impervious percentage thresholds are exceeded. There may also be local programs that would further supplement the state and federal programs, especially in those instances where there is not a stream/wetland impact trigger. Water quality concerns would be minimized using these regulations.

Acquisitions, Relocations, and Displacements

Land use changes are anticipated as an indirect consequence of the D-O LRT Project. Changes to land use are likely to result in acquisitions, relocations, and displacements for existing property owners and potentially for residents and business owners. Land use changes would occur in accordance with local planning and development requirements and local zoning codes and would support the vision for the area as identified in local plans. Acquisitions, relocations, and displacements that could result as an indirect consequence of the D-O LRT Project are not anticipated to materially affect the availability of housing and business opportunities within the D-O Corridor.

Electromagnetic Fields (EMF)

The project would result in new sources of EMF generation and exposure of passengers and individuals working on the systems or passing in the vicinity. The main sources of EMF generation would include train power distribution systems; traction power substations with connecting lines to the major utility lines; passenger facilities, with their various electrical systems for lighting, communications, utilities, fare machines, among other systems, and their proximity to power distribution networks; and



electrically-powered rail passenger vehicles. Contributions from the project to the existing magnetic field levels would be negligible.

4.17.1.4 Mitigation

Although mitigation for indirect effects is not required by law, measures to minimize harm will be appropriately documented and involve coordination among FTA, Triangle Transit, and local officials. Suggestions for mitigation may be listed for the various disciplines in the relevant sections of DEIS chapters 3 and 4.

No specific mitigation measures are proposed to address the indirect effects identified for the D-O LRT Project. Development and operation of the proposed project in accordance with all applicable guidelines and regulations will reduce the indirect effects to levels that are less than substantial.

4.17.2 Cumulative Impacts

The methodology for analyzing cumulative impacts is presented below followed by the assessment of the potential for cumulative impacts and discussion of potential mitigation measures.

Indirect Effects (Impacts): reasonably foreseeable effects that occur later in time or further in distance]

Cumulative Impact: an impact resulting from the incremental impact of an action when added to reasonably foreseeable past, present, and future actions

4.17.2.1 Methodology

Resources selected for analysis include those that would be affected directly by the No Build or NEPA Preferred and Project Element Alternatives, those that are particularly susceptible to cumulative effects, and those that have the potential to experience individual impacts from the proposed D-O LRT Project as well as one or more other projects over time that, in aggregate, result in a cumulative effect. Transportation is presented in this analysis in terms of the role it plays in affecting other resources. The resources assessed in the cumulative effects analysis are the following:

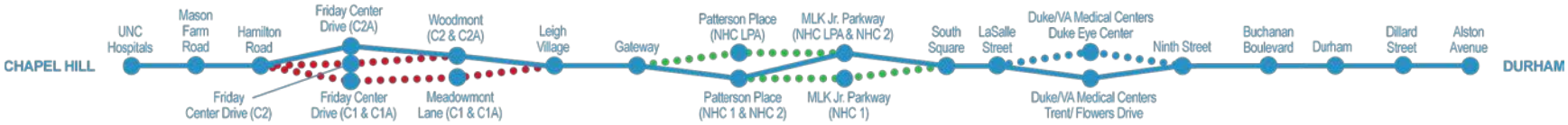
- Parking
- Freight and passenger railroads
- Pedestrian and bicycle conditions
- Land use (community character)
- Economic development
- Visual and Aesthetic
- Habitat
- Water quality
- Historic resources
- Environmental Justice

The cumulative impact analysis followed these steps:

- Identify the resources to consider in the analysis.
- Define the study area for each resource.
- Describe the current status/viability and historical context for each resource.
- Identify impacts of the project that might contribute to a cumulative impact.
- Identify other current and reasonably foreseeable actions.
- Identify and assess cumulative impacts.
- Document the results.
- Assess the need for mitigation.

Geographic and Temporal Study Areas

The geographic study areas differ by resource and are described in the subsections below. The temporal study area is from 1960 to 2040 to be consistent with the horizon year of this DEIS. Selection of 1960 was based on population trends and key events that affected transportation and land use in Orange and Durham counties. The region generally developed around the railroads associated with manufacturing of



tobacco and textiles. After a period of decline due to the closure of textile mills beginning in the 1930s, and a decline of the area's manufacturing fortunes in the mid-20th century, the area's growth began to rekindle with the establishment of Research Triangle Park just prior to 1960. In 1970, the Durham Freeway opened to traffic, which has influenced the land use and growth patterns of the area since that time. Population in Orange and Durham counties increased 211 and 139 percent, respectively, between 1960 and 2010. By comparison, North Carolina's population increased by 109 percent in the same time period. The year 2040 was selected as a future year boundary because socioeconomic data from the Triangle Regional Model version 5, developed for the 2040 MTP, was utilized to produce the travel demand forecasts in this DEIS. Population is expected to grow approximately 40 and 58 percent in Orange and Durham counties, respectively, between 2010 and 2040.

4.17.2.2 Affected Environment

The affected environment for the cumulative effects analysis includes conditions that would be present based on expectations related to the other past, present, and reasonably foreseeable future actions. These conditions are described by resource type below.

Transportation

Other actions include:

- All the transportation system improvements that are part of the No Build Alternative, as described in DEIS section 2.4. These include the existing roadway system; projects in the NCDOT State Transportation Improvement Program (STIP); projects in the CAMPO and DCHC MPO 2040 MTP; the existing transit system; planned transit improvements, as modified for the definition of the No Build Alternative; and the pedestrian and bicycle improvements in the plans listed in DEIS section 2.4.
- The D-O LRT Project would serve the Durham Transit Station, which is a multi-modal transportation facility served by local, regional, and intercity buses. Future actions include addition of bus services at this facility.

Land Use

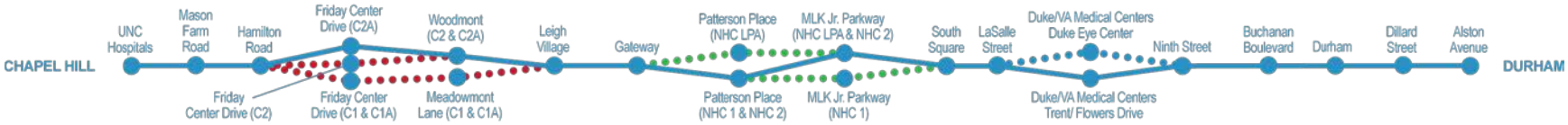
Past actions include adoption of the city and county comprehensive plans described in DEIS section 4.1.3.2 and future actions include implementation of these plans. The plans are the *Orange County, North Carolina 2030 Comprehensive Plan* (2008); the *Chapel Hill 2020 Comprehensive Plan* (2012); and the *Durham Comprehensive Plan* (2014). Implementation of the plans is expected to take a wide variety of forms, exemplified by actions to provide the infrastructure identified by the City of Durham's Station Area Strategic Infrastructure team, described in DEIS section 4.1.3.2. Development under the campus master plans of the UNC, Duke University, and North Carolina Central University, as described in DEIS section 4.1.3.2, will also implement the comprehensive plans. Actions affecting land use also include the real estate development projects already approved or that have been submitted for review and may be approved as identified in DEIS section 4.1.2.3.

Economic Development

Other actions comprise planned public investments other than the projects in the NCDOT STIP and DCHC MPO 2040 MTP, planned private investments in commercial and industrial activity, and the planned expansion of the major universities and medical facilities. These actions are reflected in the large forecasted increase in regional employment by 2040 on **Figure 4.2-6**, along with the associated forecasted increases in population and households in **Figure 4.2-4** and **Figure 4.2-5** in DEIS section 4.2.

Habitat

Past actions affecting habitat in the D-O Corridor include the following:



- Clean Water Act Section 404 and Executive Order 11990 (Protection of Wetlands) requiring federal agencies to avoid, to the extent possible, adverse impact to wetland habitat
- ESA federal listing of four endangered species in Orange and Durham counties (DEIS section 4.7.3.4)
- North Carolina ESA (N.C.G.S. § 113-331 et seq.) and Plant Protection and Conservation Act (N.C.G.S § 106-202.12 et seq.) listing of 17 threatened and 21 endangered wildlife species in Durham and Orange counties (DEIS section 4.7.3.4)
- NHP designation of select unique habitat areas as NHP Natural Areas (NHPNAs), formerly called Significant Natural Heritage Areas (DEIS section 4.7.3.2)
- Construction (beginning in 1963) and impoundment (1983) of Jordan Lake by the USACE and NCDOT and associated mitigation projects to compensate for the loss of floodplain habitat (NCDENR 2015)
- Adoption of the Jordan Lake Buffer Rules (15A N.C.A.C. 02B.0267) for perennial and intermittent streams and waters in the Jordan Lake Watershed, adopted by the North Carolina Environmental Management Commission on August 11, 2009
- The Sandy Creek wetland restoration project performed by Duke University beginning in 2004 to restore 2,000 feet of stream habitat and approximately 5 acres of bottomland hardwood wetland habitat near the confluence with New Hope Creek
- The Sandy Creek stream restoration program performed by the North Carolina Ecosystem Enhancement Program (NCEEP) in 2004 to enhance 2,700 linear feet of stream and restore 3.6 acres of wetland (NCEEP 2004) at a City of Durham park located near Sandy Creek Road

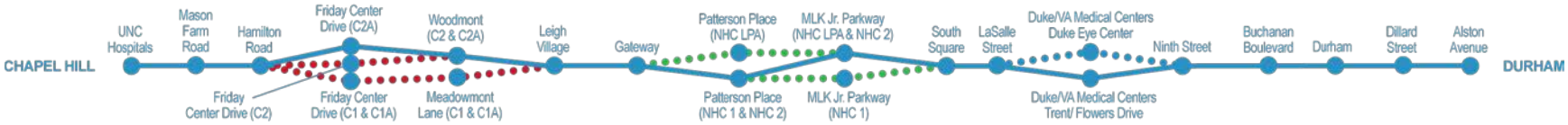
Reasonably foreseeable future actions include the following:

- Completion of targeted stream, wetland, and riparian buffer restoration projects described in the *Watershed Restoration Plan for the Cape Fear River Basin* (NCEEP 2001), including restoration of Sandy Creek stream banks and riparian areas and buffer restoration at New Hope Creek
- Completion of high priority projects, including protection, augmentation, and connection of NHPNAs, described in the *Neuse River Basin Restoration Priorities 2010* (NCEEP 2010)
- Implementation of the watershed objectives and potential strategies at Little Creek, including restoration and protection of streams and riparian buffers, as described in the *Morgan and Little Creeks Local Watershed Plan* (NCEEP 2004)
- Regional effects of climate change, including changes in temperature, precipitation, and severe events (State Climate Office of North Carolina 2015)

Historic Resources

Past, present, and future actions affecting historic resources include both urban development projects and plans or regulations to protect historic resources. Past development projects include the construction of interstate and state highways and 1960s-era urban renewal projects in downtown Durham and Chapel Hill. Past regulatory actions affecting historic resources include the passage of the National Historic Preservation Act of 1966, passage of the United States Department of Transportation Act of 1968, and establishment of the Durham Historic Preservation Commission.

Future development within existing historic districts is anticipated based on future market conditions and the demand for residential and commercial development. Future development would be anticipated to occur in accordance with local



comprehensive plans, zoning codes, and with adherence to restrictions based on historic designations.

Visual Resources

No additional actions beyond the actions described above for transportation and land use have been identified.

4.17.2.3 Environmental Consequences

Based on the methodology and conditions described in the sections above, cumulative effects are evaluated in the following sections.

Parking

The geographic study area for cumulative impacts on parking includes the same area defined for direct impacts, described in DEIS section 3.4. This includes an area within ¼ mile of proposed stations and within the anticipated construction limits of the proposed D-O LRT Project. The temporal study area is 1960 to 2040.

Because substantial growth within the study area has occurred since 1960, much of the area is characterized by auto-oriented land uses that have included substantial parking. As a result, the majority of existing residential and commercial development has adequate parking. As growth continues into the future, it is anticipated that new developments would continue to add adequate parking to accommodate demand.

No Build Alternative

The No Build Alternative would not alter the supply of parking in the study area.

NEPA Preferred and Project Element Alternatives

The number of existing parking spaces that would be displaced by the NEPA Preferred and Project Element Alternatives would be small in the context of the total existing parking spaces available within the study area. The compact, mixed-use development called for in the plans referenced in DEIS section 4.17.2.2 could reduce the supply of parking by redeveloping land now used for parking lots. Localized parking scarcity could occur; however, new developments would be expected to continue to include off-street parking to meet anticipated parking demand associated with those developments. At the same time, by reducing the percentage of trips made by automobile, such development would reduce the per capita demand for parking. In addition, parking scarcity encourages alternative travel modes, including transit, walking, and bicycling.

Freight and Passenger Railroads

The geographic study area is the same as the study area for the analysis of freight and passenger railroad impacts in DEIS section 3.5. The temporal study area is 1960 to 2040. The relevant railroad is owned by the NCRR with NS and CSX Transportation (CSXT) operating freight rail service, and Amtrak and NCDOT Rail Division operating passenger rail service.

No Build Alternative

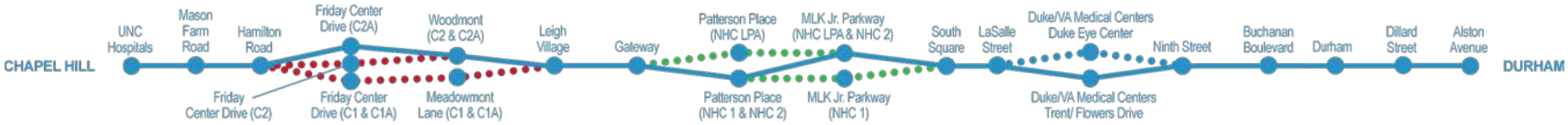
Freight and passenger service is expected to grow in the study area. There would be no change to this growth with the No Build Alternative.

NEPA Preferred and Project Element Alternatives

With the NEPA Preferred and Project Element Alternatives, frequent, all-day light rail service and additional feeder bus service would be introduced serving the Durham Transit Station, located adjacent to the Durham Amtrak station. This would increase the number of travel options for Amtrak passengers, increasing the overall attractiveness of public transit as a means to access Amtrak service in Durham. This would support plans for additional Amtrak trains serving the Piedmont region.

Pedestrian and Bicycle Conditions

The geographic study area for cumulative impacts on pedestrian and bicycle facilities is the same as the study area defined for the direct effects for pedestrian and bicycle facilities in DEIS section 3.7. The temporal study area is 1960 to 2040.



The historic land use pattern in the study area since 1960 has been primarily low-density and auto-oriented. As a result, the pedestrian and bicycle environment within this area is characterized by long distances between destinations, which tend not to be conducive to walking and bicycle riding, and poor or lacking facilities for walking and bicycling. Many of the roadways in the area are rural in character, with no sidewalks and narrow shoulders. There are many roadways with multiple lanes of traffic and high speeds, deterring pedestrian and bicycle crossing and causing an environment that is not attractive for walking or bicycling. The exceptions to this are at the campuses of UNC and Duke University and in downtown Durham, where densities are much higher and there are complete networks of sidewalks and generally well-connected networks of bicycle facilities.

No Build Alternative

With the No Build Alternative, the pedestrian and bicycle projects listed in **Table 3.7-4** in DEIS section 3.7 would be implemented. These projects would reduce the existing gaps in the pedestrian and bicycle networks and improve the overall pedestrian and bicycling environment. In some ways, the health of the pedestrian and bicycling environment would tend to worsen over time as traffic volumes continue to increase in locations that have poor pedestrian and bicycle infrastructure. However, in other ways the health of the pedestrian and bicycling environment would improve. This would result from implementation of the pedestrian and bicycle projects identified in DEIS section 3.7, which would reduce gaps in the sidewalk and bicycle route networks and increase density over time based on local comprehensive plans.

NEPA Preferred and Project Element Alternatives

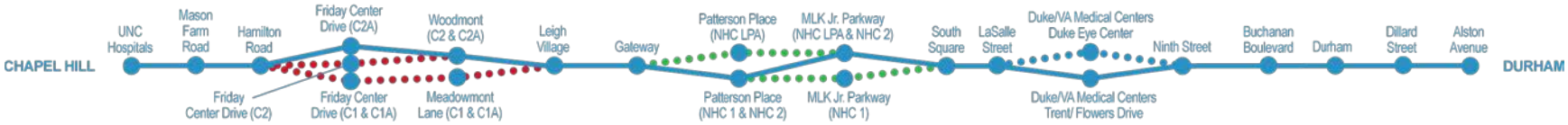
The NEPA Preferred and Project Element Alternatives would further improve overall conditions for pedestrians and cyclists because they would include connections to existing and planned pedestrian and bicycle facilities throughout the D-O Corridor. Where the project would reconstruct sidewalks, the new sidewalks may be wider and would include ADA ramps in locations where they may not exist currently. The project would include new bicycle parking at stations, helping to create a more complete transportation network by providing opportunities for combined bicycle and transit trips.

While the NEPA Preferred and Project Element Alternatives would introduce additional at-grade pedestrian and bicycle crossings, the cumulative impact of these light rail crossings, in addition to existing and planned at-grade roadway and highway crossings, would be small. The NEPA Preferred Alternative would preclude two planned on-street bicycle facilities, one on Erwin Road and one on Pettigrew Street. However, bike racks are planned at all D-O LRT Project Stations. Mitigation planned for roadway impacts could have an effect on existing and planned bicycle and pedestrian conditions; however, the cumulative effects of these conditions combined with other reasonably foreseeable projects is also anticipated to be small.

With one exception, the ROMF alternatives would not contribute to cumulative impacts on pedestrian and bicycle conditions. The exception is the Alston Avenue ROMF, which would introduce new light rail crossings at Plum Street and Bacon Street. As stated above, the CAMPO and DCHC MPO 2040 MTP calls for new bike lanes on Bacon Street and the City of Durham proposes a new street trail on Plum Street. The impact on the overall pedestrian and bicycle network of these additional train crossings would be small because this would be an access track for the ROMF, so the number of train crossings would be relatively few and the trains would not be in service and would be traveling at low speeds.

Land Use

The geographic study area for cumulative land use impacts is the area within the DCHC MPO, which includes Durham



County, the Towns of Chapel Hill, Carrboro, and Hillsborough in Orange County, and Northeast Chatham County. This is the area of development that would be most affected by the proposed D-O LRT Project. The temporal study area is from 1960 to 2040.

Land use in the study area is the legacy of past development practices, which have resulted in land use characterized by the following:

- Residential uses predominantly consisting of low-density single-family suburban subdivisions, very low-density single-family rural residential development, and scattered apartment and condominium complexes, some near shopping centers and others isolated
- Commercial uses concentrated in shopping centers along major roadways and where roadways cross
- The large campuses of UNC and Duke University

No Build Alternative

Without the proposed D-O LRT Project, the existing pattern of land use described above would continue, but with elements of the compact, mixed-use development called for by the Orange County, Chapel Hill, and City and County of Durham comprehensive plans. Implementation of the plans relies on construction of the proposed D-O LRT Project. Without the capital investment it represents and the alternative mode of transportation it would provide, less of the real estate development necessary to realize the plans' vision for compact, mixed-use development would occur and community character would stay largely the same as existing.

To the extent that forecasted growth in population and households occurs, more of the resulting housing needs would be met by low-density, single-family suburban subdivisions, very low-density, single-family rural residential development, and scattered apartment complexes such as what exists now. To the extent that the rural buffer around the Towns of Chapel Hill and Carrboro and other policies discouraging sprawl development patterns are effective, housing to meet forecasted needs could result even further from the urban areas. Similarly, some commercial development to meet the needs of forecasted growth would take the forms that typify existing commercial development.

NEPA Preferred and Project Element Alternatives

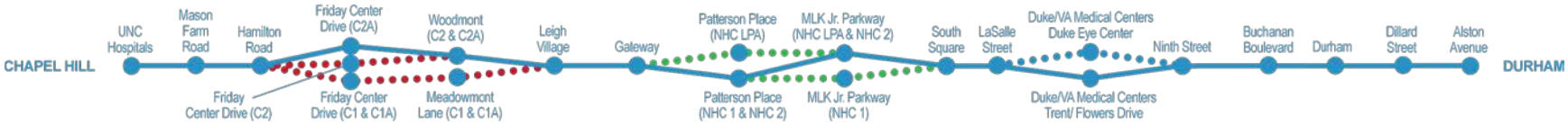
Compared to the No Build Alternative, the NEPA Preferred Alternative, in conjunction with the land use plans and implementing measures, would materially increase the amount of future land development that takes the compact, mixed-use, pedestrian-friendly form called for by the comprehensive plans. This change in community character is considered to be a desirable outcome. Experience elsewhere is that a light rail line, if combined with supportive plan policies and zoning, implementation strategies such as the City of Durham's, and market demand, can result in compact development at station areas. Within the study area, the scale of this impact under the Project Element Alternatives would be similar to the impact under the NEPA Preferred Alternative.

Economic Development

The geographic study area for cumulative impacts on economic development consists of Durham and Orange counties. The temporal study area is from 1960 to 2040. As indicated on **Figure 4.2-6** in DEIS section 4.2, existing employment in the two counties is more than 260,000.

No Build Alternative

The increase in traffic congestion under the No Build Alternative could reduce the region's appeal for the investments that result in economic development compared to other regions in the United States or elsewhere.



NEPA Preferred and Project Element Alternatives

The approximately 110 to 175 jobs needed to operate and maintain the project would be a small fraction of all jobs in the region, either alone or in combination with other forecasted employment growth in the region. However, with the reduced congestion and increased livability expected to result from the greater amount of compact, mixed-use, pedestrian-friendly improvements, the project could materially affect the region's ability to realize the high forecasted growth in employment.

Project construction is projected to create from 2,700 to 2,800 direct and indirect jobs per year over a 5-year construction period. These jobs would represent less than 1.5 percent of the employment in Durham and Orange counties. While this is a small percentage of total employment, combined with the construction of other transportation improvements and real estate development, project construction could result in episodic shortages of workers in specific labor categories.

As shown in **Table 4.2-10** in DEIS section 4.2, the ROMF would displace fewer than 25 jobs at the Farrington Road, Leigh Village, Patterson Place, or Cornwallis Road sites and from 150 to 250 jobs at the Alston Avenue site. Regardless of site, employment at the ROMF would be from 110 to 175 jobs. Therefore, at the Farrington Road, Leigh Village, Patterson Place, or Cornwallis Road sites, net additional employment at the site would be between 85 and 175 jobs. Locating the ROMF at the Alston Avenue site would reduce employment at the site by an estimated 40 to 140 jobs. Regardless of ROMF location, many of the displaced jobs would continue at the location to which the employer moves. In some cases, the employer may cease operations or relocate outside the region, in which case the jobs would be either lost to the region or replaced by jobs at other employers in the same industry. While the new and displaced jobs are important to those who hold them and their employers, the number of affected jobs represents a small fraction of all employment in Durham and Orange counties.

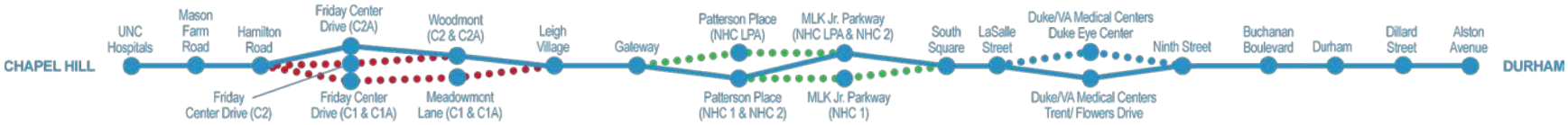
Visual and Aesthetic

The geographic study area is the area described in DEIS section 4.4.3, which is the area within view of the project or that would have a view from the project, as well as areas in the vicinity of proposed stations where redevelopment could occur as a result of the proposed project.

The temporal study area is 1960 to 2040. Past and present actions during this time period have contributed to changes in land development and building uses, which in turn have changed both the visual quality of the area and the viewers who experience the area. Views in the study area range from urban commercial/institutional development to rural wooded areas. Urban development includes intact, visually cohesive historic districts as well as areas that were developed over time and lack visual unity.

No Build Alternative

Under the No Build Alternative, development and redevelopment in the study area is expected to continue, resulting in an area that is more highly urbanized and that has fewer undeveloped parcels and less open space. Wooded areas that are protected from development would likely remain unchanged, but those zoned for development could be developed by 2040. This urbanization would result in changed views and new viewers. If new development results in a more visually cohesive and visually appealing area, the change would be beneficial; however, if new development is out of scale with the surroundings or visually unappealing, the change would be a negative impact. Land use planning and design reviews can encourage aesthetically appealing development, and tree preservation requirements and landscaping standards can ensure that there is sufficient vegetation, but there is no way to foresee whether the visual quality would be improved or degraded by future development.



NEPA Preferred and Project Element Alternatives

Under the NEPA Preferred Alternative and Project Element Alternatives, development in the study area would be similar to that described in the No Build Alternative, but with the addition of a light rail system and with greater development pressure in the vicinity of stations. Areas near stations would likely be developed or redeveloped sooner and to a greater density than under the No Build Alternative. As a result, those areas would experience visual changes from the project itself, but to a greater extent visual changes resulting from new development. As described in the No Build Alternative, future redevelopment could be beneficial if it enhanced visual unity and was aesthetically pleasing or it could be of poor design and low quality.

Use of the Leigh Village or Farrington Road ROMF sites would result in a change in visual quality. However, viewers from Farrington Road would generally not be sensitive to this visual change as described in DEIS section 4.4. Use of the Patterson Place site would substantially change the visual quality of the currently wooded site; however, the site is buffered from nearby viewers and would not contribute to cumulative visual impacts. Use of the Cornwallis Road site would result in minor to moderate visual changes that would include the potential removal of structures and vegetation, with the addition of new buildings and parking areas, and light rail infrastructure. Use of the Alston Avenue site would not alter the existing nature of the land use of the sites or of nearby land uses, and would not contribute to cumulative visual impacts.

Habitat

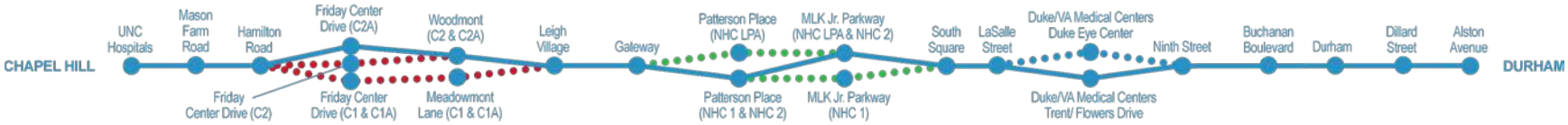
The geographic study area for cumulative impacts on aquatic habitat comprises lakes, streams, creeks, ponds, and wetlands located within portions of the Cape Fear River Basin, including the Haw Watershed (USGS Cataloging Unit 03030002) and the Upper Neuse Watershed (USGS Cataloging Unit 03020201). Information about the aquatic habitat resources located in the study area is provided in DEIS section 4.7.

The geographic study area for cumulative impacts on terrestrial habitat consists of the following contiguous biotic communities located within Durham and Orange counties: Maintained/Disturbed, Mesic Mixed Forest, Alluvial Hardwood Forest, and Bottomland Hardwood Forest. One sub-category of the Bottomland Hardwood Forest biotic community, the Little Creek Bottomlands, is designated as NHPNA by the North Carolina NHP. The terrestrial habitat study area has been altered by development and other disturbances. The majority of the D-O Corridor is designated maintained/disturbed land and typically contains a limited number of plant species, predominantly introduced, and weedy species. Because of this, wildlife species found in this area are typically opportunistic species that are adapted to disturbed habitat and will inhabit any of the biotic communities discussed in DEIS section 4.7.3.2. Information about the terrestrial habitat resources located in the study area is provided in DEIS section 4.7.

The temporal resource study area is 1960 to 2040. Past and present actions during this time period have contributed to the existing quality of habitat and species diversity. General habitat impacts include loss, fragmentation, and degradation of existing habitat and displacement or extirpation of native species from the geographic study areas. Habitat in both the aquatic and terrestrial geographic study areas was permanently changed by the 1983 damming of the Haw River near its confluence with the Deep River to create Jordan Lake. Mitigation, conservation, and restoration measures performed since that time have resulted in improvements to habitat quality in some locations.

No Build Alternative

Past, present, and future foreseeable actions within the study area have and will contribute to cumulative impacts on habitat. Development of currently undeveloped land would impact habitat, potentially causing loss, fragmentation, and degradation of



existing habitat and displacement or extirpation of native species from the geographic study areas.

NEPA Preferred and Project Element Alternatives

For use in the cumulative impacts analysis, residual impacts of the NEPA Preferred and Project Element Alternatives are summarized in the bulleted items below. Residual impacts on habitat are impacts remaining after mitigation measures have been implemented.

- Residual impacts of the NEPA Preferred and Project Element Alternatives on wetlands and aquatic habitat are summarized in **Table 4.8-4** and **Table 4.8-5** in DEIS section 4.8. As described in DEIS section 4.7.5.4, project impacts will be minimized or avoided to the extent reasonably feasible. Unavoidable impacts will be mitigated through on- or off-site habitat restoration. Project mitigation efforts may potentially result in improved habitat function and values relative to existing conditions (DEIS section 4.7.3) through improved water quality, increased connectivity, and increased prevalence of native species.
- Residual impacts of each NEPA Preferred and Project Element Alternative to terrestrial habitat vary and are summarized in **Table 4.7-3** in DEIS section 4.7. Impacts on Bottomland habitat, including designated NHPNA habitat, are considered more substantial than impacts on other types of terrestrial habitat as described in DEIS section 4.7.

In the context of prior land disturbance, loss and/or fragmentation of terrestrial and aquatic habitats in the project corridor, the project would have a small, incremental impact on remaining habitats. The project may have a beneficial effect on aquatic habitat, through improvements in habitat functions and values. Past and present restoration and watershed planning projects have resulted in improvements to habitat quality and availability.

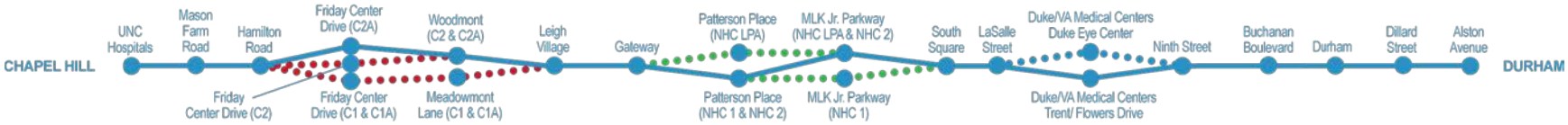
The project role in impacts to NHPNA habitat may be minimized through NEPA Preferred and Project Element Alternative route selection. Other reasonably foreseeable future actions, including the conservation and connection of NHPNA habitat, are expected to result in beneficial impacts on terrestrial habitat. Although the high density development included in comprehensive plans may result in additional habitat loss, it is unknown whether this is a net negative or positive impact relative to habitat loss associated with lower density development. Development projects constructed in the future are required to conform to applicable design standards to minimize habitat impacts, including standards aimed at improving the condition of habitat or species (e.g., habitat and rare species protection policies described in the *Durham Comprehensive Plan* [Durham City-County Planning Department 2014]).

Water Quality

The study area for cumulative impacts on water quality is the Jordan Lake watershed within the Cape Fear River Basin and the Upper Neuse watershed of the Neuse River Basin. Most of the project is within the Jordan Lake watershed, with streams draining into Jordan Lake. A small portion of the project near downtown Durham is within the Neuse River Basin. The temporal resource study area is 1960 to 2040.

The streams in the study area that cross through the project area include Morgan Creek, Chapel Creek, Little Creek, New Hope Creek, Sandy Creek, and several unnamed streams and tributaries. Little Creek is the only study area stream that is listed on the NCDENR DWR Section 303(d) list of impaired waters. Little Creek received a poor bioclassification for aquatic life.

The DWR has developed stormwater programs to protect waters of the state. The primary goal of these programs is to minimize impervious surface and treat runoff using BMPs. Durham and Orange counties and the cities of Durham and Chapel Hill have stormwater management plans and policies in place to regulate the amount of impervious surface added by development



and minimize pollutants from stormwater runoff. In addition, Orange and Durham counties are both classified by NCDENR as Phase II Tipped Counties (meaning urbanizing areas around larger municipalities with minimum standards and post-construction requirements). The North Carolina Division of Energy, Mineral and Land Resources must issue state stormwater permits for development in these areas.

The rapid growth in the study area since 1960 has contributed to increased impervious surface and stormwater runoff, contributing the degradation of water quality and aquatic habitat in the area.

No Build Alternative

Under the No Build Alternative, continued growth and development in the corridor would be expected to result in continued growth of impervious surface area and modification of stream channels and hydrology. These impacts would be lessened by DWR stormwater management BMPs and North Carolina Division of Energy, Mineral and Land Resources stormwater permits.

NEPA Preferred and Project Element Alternatives

With the NEPA Preferred and Project Element Alternatives, there would be additional impervious surface and modification of stream channels as a direct result of the project. These would combine with other new impervious surface area and modification of stream channels resulting from other urban development in the watersheds. This could contribute to further degradation of water quality in the Jordan Lake and Upper Neuse watersheds. However, the project would comply with stormwater management permitting requirements and include DWR stormwater management BMPs.

Historic Resources

The geographic study area for cumulative impacts on historic resources is the APE for direct and indirect impacts on historic resources as defined in DEIS section 4.5. The temporal resource study area is 1960 to 2040.

Past and present actions during this time period have contributed to changes in land development and building uses, which in turn have affected historic farms, buildings, and districts. The development and urbanization that has occurred since 1960, as well as changes to the area's economic bases, have resulted in building demolitions, changes in settings, and other adverse impacts on historic resources. Nevertheless, the area is still rich with history and many of its historic buildings and districts still remain in good condition.

As described in DEIS section 4.5, only one historic resource has the potential to be directly impacted by the project: the Leigh Village ROMF would displace the Walter Curtis Hudson Farm. The Alston Avenue ROMF and the Farrington Road ROMF are each close to historic resources (the east Durham Historic District and the Walter Curtis Hudson Farm).

No Build Alternative

Anticipated regional growth in population, households, and employment and implementation of comprehensive plans are likely to adversely impact historic resources in the region and reduce their numbers.

NEPA Preferred and Project Element Alternatives

As with the No Build Alternative, the regional growth in population, households, and employment and implementation of comprehensive plans are likely to adversely impact historic resources in the region and reduce their numbers. In addition to these impacts, the project has the potential to impact one resource if the Leigh Village ROMF Alternative is selected. If another ROMF alternative is selected, the project would have no impact on historic resources.